Enhancing elderly well-being through technology:

An integrating literature review

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Abstract

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According to World health organization (WHO) older people have been defined as a chronological age of 65 years, although this may differ in different societies. Generally, it refers to the age where an individual begins to receive pension (WHO 2014). Similarly, the Centre for Disease Control (CDC) 2007, defines elderly as greater than 65 years of age. Demographically, several categories ranging from young old, oldest old to frail elderly defines how the elderly´s cognitive and physical changes deteriorate as they grow older. It is therefore imperative to offer them support either from their families, agencies or health institutions

The purpose of this thesis was to investigate different technologies that enhance elderly well-being in order to make a conclusion for good care practice.

The aims of the study were; a) to explore the technologies that exist, b) to describe how these technologies are incorporated into elderly care, and c) to evaluate their importance in promoting communication and emotional support to the elderly. An integrating method of literation review was applied focusing on the use of technology in European, American, Asian and African societies that promote health among the elderly at home in their own settings or to designated health institutions. The literature and empirical evidence gathered demonstrate that technology can contribute heavily to the elderly well-being so long as the applications are geared towards independent living (Griffith 2013).

Key words: ageing, elderly, well-being technology, skype, integrating literature review

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1 Introduction

In this thesis ´ Enhancing elderly well-being through technology´, a focus on elderly care using different interventions in terms of technology have been highlighted and broadly illustrated through an integrating approach to literature review.

Although not very many studies have been carried out with elderly, it is true that as they age and their children move out, the gap once occupied by responsibilities suddenly is filled by the need to have friends. Through these friendships, a network is formed among them which leads to development of activities with similar interests and these keeps them psychological and physically healthy. This is due to the support they draw from each other.

Older adults prefer familiar and established relationships over new ones, meaning that friendship formation can continue in old age. As they age, elderly people prefer to stick with older routines, socialize with neighbours or those living within their community. Their choice is probably because of they relate to them or trust them the most or simply share the same interests. Unlike younger generation who have a variety of friends from all walks of life regardless of age, sex, or creed.

Older women, in particular, have more secondary friends people who are not intimates, but with whom they spend time occasionally, such as in groups that meet for lunch or bridge. For those that cannot meet frequently, the use of skype to communicate with each other will serve as a tool that will help improve their psychological well-being (McPherson, Smith-Lovin & Brashears 2006).

These technologies have been developed for use in long-term health care facilities, hospitals, and recreational facilities in the communities and in home settings. This has contributed to delivery of care in a faster and efficient way therefore saving costs; saving time in queues for prescriptions or appointments or having to drive for miles for a minor procedure. Some limitations may arise as well. For example; confidentiality issues when using skype or other video conferencing devices, breakdown of communication, difficult to operate equipment or to understand technology jargon. For successful results, the presence of personnel to assist them is always essential as opposed to leaving them entirely under the care of machines.

The purpose of this thesis is to find out how technology can enhance the well-being of the elderly people in order to make a conclusion for good care practice. The method of the thesis is an integrating literature review. The importance of these technologies enables independent living and cost effective care to the elderly population.

2 Elderly and wellbeing

2.1 Ageing population

According to the 2015 Revision of the World population prospects in New York (United nations 2015), as fertility declines and life expectancy rises, the proportion of the population above a certain age rises. This phenomenon, known as population ageing, is occurring throughout the world. In 2015, there are 901 million people aged 60 or over, comprising 12 per cent of the global population. The population aged 60 or above is growing at a rate of 3.26 per cent per year. Currently, Europe has the greatest percentage of its population aged 60 or over (24 per cent), but rapid ageing will occur in other parts of the world as well, so that, by 2050, all major areas of the world except Africa will have nearly a quarter or more of their populations aged 60 or over. The number of older persons in the world is projected to be 1.4 billion by 2030 and 2.1 billion by 2050, and could rise to 3.2 billion in 2100. In the short-to-medium term, higher numbers of older population are inevitable, given that the relevant cohorts are already alive.
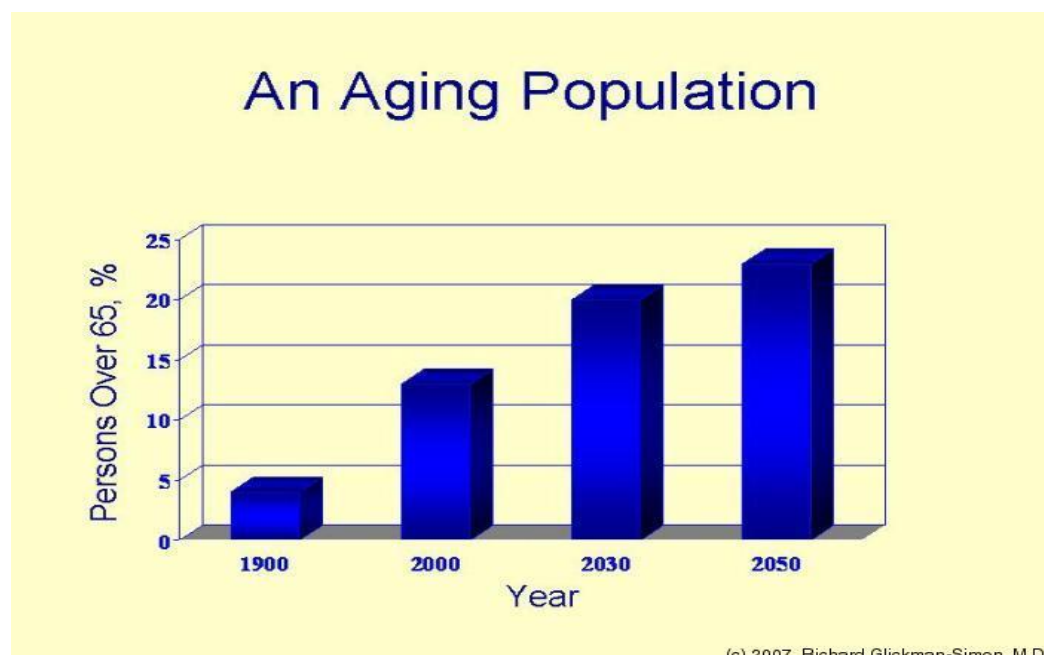

Figure 1   An aging population

2.2 Elderly well-being

Well-being has been defined as the balance point between an individual's resource pool and the challenges faced. In essence, stable wellbeing is when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge. When individuals have more challenges than resources, the see-saw dips, along with their wellbeing, and vice-versa (Dodge, Daly, Huyton & Sanders 2012).

It is evident that the number of elderly people is increasing every year. This rise would definitely affect how medical and non-medical caring measures are distributed. In the United Kingdom, these kinds of informal care have been put into consideration when developing new care policies (WRVS 2012).

This demographic shift coupled with changes in family-related behaviour such as divorce and having children outside marriage, has raised concerns about the availability of family support for older people (Tiomassini, Kalogirou, Grundy, Fokkena et al, 2004). It is evident that informal care is mainly provided by family members ranging from activities of daily living to counselling and emotional support. Due to their frailty, they require guidance on handling financial issues, accessing information regarding health or general matters of life, moving from one place to the other and finding a confidant. This support forms a give and take´ relationship in which elderly people not only receive but also give support e.g. financially to their adult children and their grandchildren, housing, baby-sitting services, emotional support and advice.

A recent research carried out through cooperation between WRVS, the Centre for Citizen Participation at Brunel University and the Centre for Social Action at De Montfort University, has shown that having fun with and being cared for, loved and valued by close family members are the most important aspects contributing to well-being for many older people (Hoban, James, Patrick, Beresford & Fleming, 2011: 21). Research on indicators of potential family support particularly how close adult children live and frequency of contact has therefore become an important topic in sociological and demographic research as well as in the broader socio-political debate.

The quantity as well as quality of social interactions has been identified as predictors of well-being (Cohen, 2004; Fiorillo & Sabatini, 2011). Regular contact with children may be

beneficial to health as it facilitates accessibility to social support and healthcare and help promote health messages, and this ensures that healthy behaviour is adopted (Fiorillo & Sabatini, 2011). Additionally, social contact has been proven to combat stress and anxiety through the provision of effective practical and emotional support and also by acting as a source of self-esteem and respect (Fiorillo & Sabatini, 2011). In the WRVS Shaping our Age study, older people mention that being with others focuses their minds on matters other than their own worries and puts any concerns into perspective (Hoban, James, Pattrick, Beresford & Fleming, 2011: 21).

On the contrary, a lack of social contact can lead to poor physical health outcomes (Cacioppo & Hawkley, 2003) and depression (Hawthorne, 2008). Contact with family becomes is considered important for elderly people who live alone and suffer from an ailment or simply those with poor health status because isolation can create the conditions for problems with older people's physical and mental health (WRVS, 2012). It is no doubt that those who live alone are significantly less likely to have visited a doctor as a result of a fall or what they consider a minor ailment. This lack of social interaction means that they are less likely to have people noticing deterioration in their condition (WRVS2012). Limited contact also leads to a loss of intimacy, which further exacerbates loneliness, isolation and depression (Allen, 2008).

2.3 Elderly well-being and technology

Technology has been broadly defined as the application of scientific knowledge resulting in artefacts that support the practical aims of human life. A living environment on the other hand is a generic term that is used to indicate place of residence. Routine life activities are a collection of activities of daily living that are needed for an individual to maintain functioning and quality of life (Horgas & Abowd 2004).

According to the Pew Internet & American Life on-going Project (2010), slightly more than one-half of American adults aged 65 and older use the internet or e-mail, and 70% of older adults online use the internet on a daily basis. Social networking also is increasing among this age group, as about one-third of older adult internet users visit sites such as Facebook and LinkedIn, up from 13% in 2009. Eleven percent of adults aged 65 and older own a smartphone.

With the increasing rise in technology, the traditional face to face contact is slowly fading away paving way to a more modern and sophisticated information and communication technologies. This are becoming popular among those who live far from each other and the increased potential for interaction over distance has also influenced the possibilities to receive help and support. These include communications devices such as telephones, mobile phones, emails and, webcam tools such as Skype and social networking sites such as Facebook, which make communication easier when children live far apart.

A conversation carried out through the telephone excludes the non-verbal content of a face-to-face visit unlike Skype or video-conferencing calls which provide the function of a 'social presence' although one which excludes physical contact such as hugs and kisses. 85 per cent of Skype users in a survey carried out by Horgas et al (2004) agree that it makes them feel more connected. A benefit of Skype or other similar internet based communication software is that users can make calls over the internet to another person who has the same software installed, for free anywhere in the world.

In the same study, the majority of respondents, 95 per cent, do not ever use Skype to communicate with their children. This non-use is because 42 per cent do not know how to use online technology such as Skype or email.

The same study by Horgas (2004) indicates that from overall Skype users, one quarter use Skype to contact their children weekly; however there is a big regional difference with the fewest users in England 21%,   in Wales 38% and the greatest number in Scotland 75% which may be indicative of geographical placements. 36 per cent of Skype users live over 200 miles away from their nearest child. Of these Skype users, 39 per cent are in contact with their children every day.

It is evident that rural and remote areas are more likely to make use of the internet (Howick & Walley, 2006; Ofcom, 2006). In a study conducted in Scotland, it was observed that older people aged 60 and over, living in a broadband pilot area, with little or no computer experience started using computers citing the attraction of using teleconferencing to communicate with distant relatives (Bernardi, Buneman & Marina, 2009).

Studies have also shown that increasingly older people use the internet to stay in touch with grandchildren as children who use email at school or to keep in touch with friends can easily send messages faster through email to their loved ones (Dickinson & Hill, 2007). The

advantages of email and online networking sites such as Facebook are that they may be used to send photos, documents or to appoint future online talks. Email and Facebook, like Skype and unlike telephone calls, are a relatively cheap way of keeping in contacting with relatives who live at a distance; however, there is the consideration of the cost of the internet connection (WRVS 2012). The results showed that 11 per cent of those questioned contacted their children via these online methods. It was no surprise that from internet users 6 per cent of 85 years old and over were connecting with their children online. Demo's research identified that older people were more likely to be 'hampered by fear and uncertainty' in using the internet (Berry, 2011: Hannon & Bradwell, 2007). Additionally, there was a variation on gender with men more likely to use email and skype to contact their children than women. This may be because email messages may be used to convey specific information and not general 'chat'.

Distance affects online contact similarly to Skype use, with the numbers of people using these methods increasing with distance apart from children. 13 per cent of those who use email and Skype to get in touch live over 100 miles away from their nearest child.

In recent years there has been an explosion in technological innovation in the field of elderly care. Due to an increase in elderly population, this has a great impact on workforce and hence a need to provide for the older people. The number of over-65s in Britain stood at 15 per cent in 1985. By 2010 this had risen to 17 per cent – an increase of 1.7 million. It is projected that by 2035 those over 65 will make up 23 per cent of the population. Such indicators calls for actions to be taken immediately to find technological solutions to elderly care, motivated by a need both to improve services and to save costs.

Much of the technology in development can be broadly broken down into two categories; monitoring and surveillance. Whereby electronic devices keep track of a person's medical condition and automatically alert health care staff when intervention is required; Sensors can also be fitted into the home that will alert staff members if, for example, someone is not in bed which may be an indication of a fall or other misfortunes.

An increasing use of assistive technologies is greatly in being utilised in the communities. These range from a simple device to help an arthritic hand turn on a tap, to a robotic machine that is able to spoon-feed an older person without the need for health care staff attention.

Much of this technology is designed to be fitted into the home to allow independent living for as long as possible.

Of course there are some issues of elderly abuse that may be associated with independent living. When providing care to the elderly people, it is important to consider the level of service versus the cost. The main contention of this issue being; as much as these inventions improve the quality of life of the elderly people, it is much more cost effective to provide care for them at home in their own settings surrounded by their loved ones whilst freeing the space occupied by them in the hospitals. But on the flipside, the enactment of this policy may have good intentions but for the wrong reasons.

On one hand, some may argue that in the future when technology would be much pronounced and utilised in health care facilities; most of health care workers´ tasks would be done allocated to technology leaving staff more quality time to spend with their patients. But on the other hand, as much as technology utilization makes work easier; it is important tom take charge and not be guide by machines but rather guide the technology (Griffith 2013).

In the field of robotics, experts warn of the potential of imprisoning the elderly in their own homes through heaping them with one technology after the other. This means that when there are surrounded and tended by machines in every corner of their home, they feel trapped and socially isolated. This may seem farfetched in this era but in the years to come, robots will be occupying every household; thanks to the rate at which inventions of technologies are growing (Griffith 2013).

Examples of technologies that are already being utilised in our communities include; a pressure sensitive underlay that can measure people's gait, a carpet fitted with a fibre-optic mid-layer which detects the pressure of each footstep and sends data to a computer where they can be analysed. These technologies are of great importance as they not only detect a fall (a common occurrence among the elderly), but also pick up changes in a person's gait over time, and so act as a predictor of a likelihood of falling, allowing a health care professional to be alerted if required. This is vital because by detecting a potential to fall and admission to hospitals to ultimate surgeries can be averted (Griffith 2013).

Statistically, an estimated 30 to 40 per cent of a community-dwelling old people fall each year, and that falls in the home account for 50 per cent of hospital admissions in the over-65 age group, by introducing and using this technology, there´s an ultimate reduction of costs in

the health care services. Both of these technologies can easily be fit in elderly persons´ own home to assist in independent living (Griffith 2013).

Independent living for older people enablers comprise of telehealth and telecare technologies. These two terms complement each other and are sometimes used interchangeably in reference to a collection of applications ranging from sensors placed in the home that can transmit information about the posture of the elderly either in bed, sitting in a chair or on the floor having fallen, to the monitoring of blood pressure and blood sugar levels. Whatever the readings, the information is gathered in the home prior to analysis at a central data centre, allowing health care staff to be alerted as appropriate.

Despite the advantages listed above, there has been some criticism aired towards the use of telehealth technologies. According to Professor Goodwin (Griffith 2013), these are a) validity and reliability, b) acceptance of the intrusion and loss of control by the elderly over the machines and, c) cost effectiveness in health institutions.

Other technologies include; blood sugar monitoring devices like Gore-Tex patch which is placed on the upper arm fitted with a chip, which transmits data back to a mobile phone and displays a warning similar to that on a traffic light system of red, amber or green meant for diabetes control. Regardless of age, it is not uncommon to forget to test one´s own blood sugar levels, and this is even worse particularly in the elderly because of cognitive changes. By installing this device in their homes, the level of compliance and adherence is certainly made easier in the elderly and encourage independent living.

An upcoming technology called pervasive computing, which means that a computer is always working in the background at home operates in such a way that a combination of sensors, trackers and software analysis 'learns' to identify a person performing simple tasks. This is specifically being developed to assist those diagnosed with an early-stage dementia. When the computer senses the task being performed, it then provides an audible prompt for the next stage.

Robotics also plays a great role in elderly care. Some have been developed in Japan for example for hygiene purposes such as washing hair or feeding patients completely independent of health care staff. Other robotics is responsive to movement and human voice, which is convenient to supply to nursing homes or residential homes particularly to those

living alone. They are designed to offer companionship to elderly people suffering from dementia sufferers and combat the loneliness that so often afflicts the elderly.

As quoted by Griffith (2013), Sharkey argued there could be some concerns that these technologies, designed to prolong independent living, may actually end up increasing the level of isolation experienced by older people. It is evident that older people prefer to remain in their own home surrounded by their loved ones but most often despite being in their own home, but with only assisted technologies for company is not ideal. But on the contrary, being in a nursing care home surrounded by people who are not family members or friends is indeed a perplexing matter

Older adults are the fastest growing population in the US and Europe, but are often over-looked in technology design. Online communication tool skype seem to have a particular appeal for older adults who want to stay in touch with family and friends but often have limited mobility or funds to travel and limited technical resources for setting up things like software and webcams.

With an increase in older people population, so has been an increase in their interest to access the internet. It is evident that older people over 60 years of age are visiting and different websites like Facebook, Google, Yahoo and YouTube. Using these media, elderly people are able to send messages through emails, chats and messages. The end result is that they are now able to communicate with friends and family or other significant others, keeping up with current news, community developments and managing their health issues.

Additionally, a recent study carried out by eMarketer has shown that the aging population has become especially become more receptive to social media. They reported that almost 36 percent of the aging population between the ages of 63 and 75 actively maintained a profile on the social web in 2009, which was an increase from the previous year. A similar research by Pew Research Center's Internet & American Life report also reported a profound increase of 50 year olds and older accessing the social media (Cohen 2010).

Technology designed for the elderly has tremendously grown in popularity not only in western world but also in Africa and Asia. These technologies are available in Zambia, Hong Kong and Ireland and are been utilized to access health information electronically from the comfort of their homes.

There are several factors that have contributed to this rise in technology mainly in developed countries; a tremendous increase in elderly population, a revolutionary development in the technology itself, an increase in knowledge about the elderly and their needs and, a general concern for their well-being.

Efforts have been put in place to provide these technologies while at the same time minimize costs. The aim of this venture is to develop assistive technologies that function within home settings under minimal or no supervision from health care staff. This way, the elderly can be cared for in their homes and their health monitored electronically. They can also seek help in case of emergencies using the same channel.

These technologies are made accessible within the communities either from nursing homes, hospitals, community centres or elderly homes. They are designed to be utilized in different applications in order to provide the best care possible to the elderly. For example, to support telehealth, leisure, obtain information, communications, and gaming. They also offer psychological supports in terms of game playing, radio installations, internet training programmes to cub loneliness, enhance their computer literacy and to improve their cognitive abilities.

The development of ICT (information and communication technology) has brought about the unification of different technologies or applications that are used in the community for various tasks. The development of a framework for technology enhances a community based informatics to partner with other applications to focus on the needs of its residence forming a symbiotic effect. This means that mutual connection is formed where the applications monitor the health of the elderly and transfer results to the data centre; while the elderly improves their computer literacy and services it independently.

This interaction between the technology and the community at large is geared towards developing and providing applications that are tailored towards an individual person. This means that when a device records information, the reactions to the results are only directed to that particular person in terms of intervention measures. In telehealth for example, sensor gathers information on the health status of an elderly person i.e. blood sugar levels; this data is conveyed through the internet to the respective health care staff through collaboration between the community and health care providers.

The convergence of different people within a community via the internet portrays a common interest and carrying out a gaming activity such as Wii enhances physiological and social development of the older person (Loeb 2012).

This community information focus is seen globally in the design and implementation of the applications as well. For example, residents in a village in Zambia, Africa worked together to get the radio and internet technology and maintain it, the use of an alarm system connecting a community in Hong Kong with health care givers and a group of elderly people taking computers classes from a fellow age mate in United States.

3 Purpose of the study

The purpose of this thesis is to find out how technology can enhance the well-being of the elderly people in order to make a conclusion for good care practice. The aims of the study were; a) to explore the technologies that exist, b) to describe how these technologies are incorporated into elderly care, and c) to evaluate their importance in promoting communication and emotional support to the elderly.

The study questions of the thesis are as follows:

1. What kind of technologies exists?
2. How are these technologies incorporated into elderly care?
3. What kind of importance in promoting communication and emotional support is described?

4 Methodology

4.1 Integrating literature review

According to Bensman (2007), literature reviews form an important part of academic writing just as much as they contribute to all areas of academics. The process of locating the right research material is often easier with the assistance of librarians who area equipped with knowledge to carry out their duties (McKibbon 2006). Literature reviews are usually a part of the main research paper but sometimes, they can be published as research publications on their own merit (Garfield 1997).

The integrative literature review is a distinctive form of research that generates new knowledge about the topic reviewed. A distinctive difference between an integrating review and a systematic one is that; the latter follows a structured approach with subsequent steps i.e. identification of a body of potentially relevant research publications, followed by an evaluation of the publication according to the defined criteria. Such a process is therefore potentially reproducible by other researchers (Greenhalgh 1997; Kitchenham & Charters 2007). However, it has been argued that the incorporation of systematic reviews in the field of medicine causes delays due to unnecessary studies and hence late treatments (Mulrow 1995).

Oxman (1995) suggests that in order to combat such problematic issues, other rigorous approaches are utilised in systematic. This means that the research question being investigated has to be fixed before the literature review starts. One of the main disadvantages of this approach is that; there is a restriction to accessing more data since the research question is already fixed. Additionally, a researcher cannot diverge into other areas or gather new information from other sources (MacLure 2005). For example in the field of social sciences and humanities, research questions are not clear cut and therefore evolve over the course of the research.

In this thesis however, an integrating literature review was used because, according to Rusell (2005), it has many benefits to the scholarly viewer. Through a collection of data from several sources, it identifies the central issue, generate a research question and identify a theoretical or conceptual framework. The process involves identification of the issue, collecting data, evaluation of data, data analysis and lastly, interpretation and presentation of results. It is

of vital importance to maintain scientific integrity and keeping awareness on threats to validity. When using an integrating review methodology, a combination of a detailed and thoughtful work is paramount to the outcome of the research work.
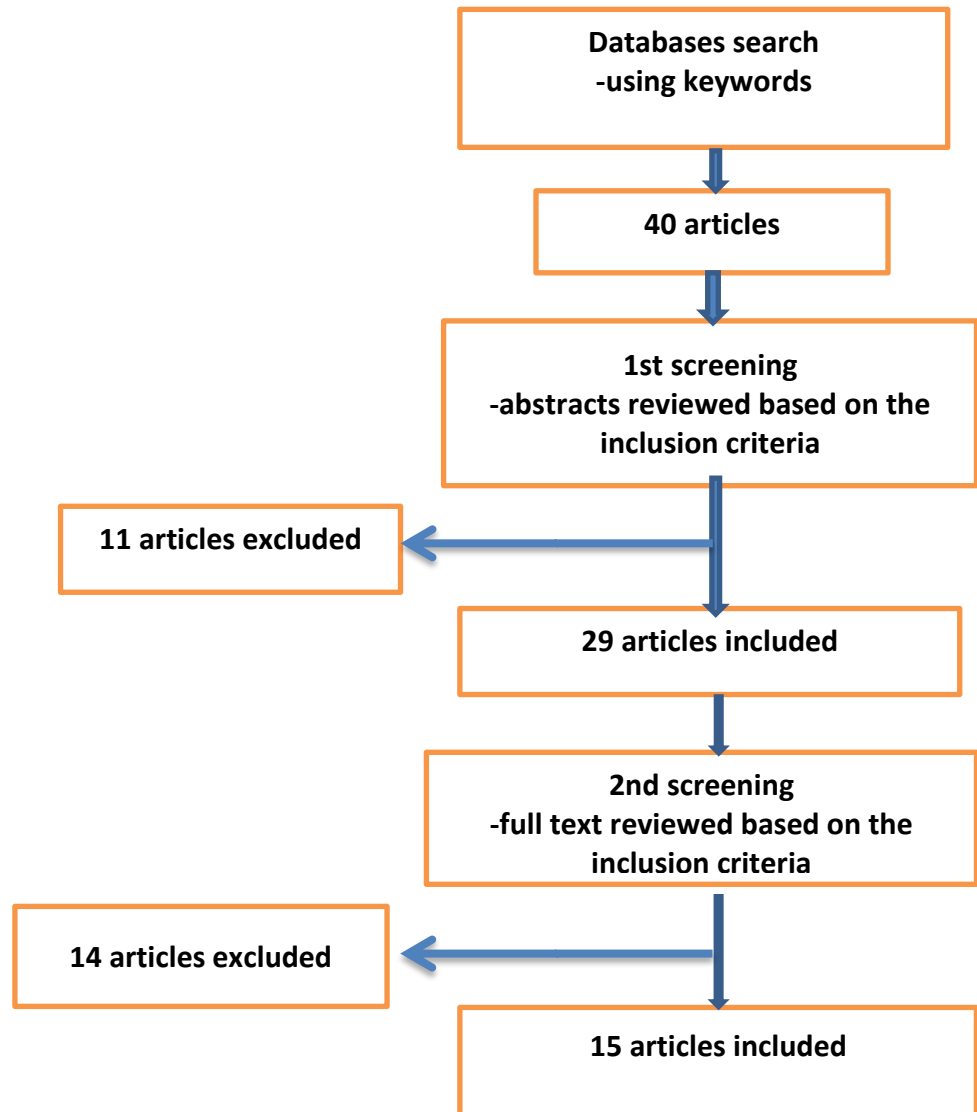
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Figure 2 Data collection process

4.2 Data collection

Research has extensively been carried out throughout the years regarding the elderly. A majority of these been published online without peer review ranging from magazines, newsletters, personal reviews; whilst others are found in nursing journals, editorials, case reports, research articles. In this case, all the above published articles from google scholar, articles from private sectors on the internet, PubMed (Medline) and nursing journals were reviewed. Search terms included "elderly and technology", "elderly and skype" and "elderly care" and well-being were included. This ranged from the year 2000 to 2015.

An extensive search was done on European and American societies using the terms indicated above from numerous articles and those considered relevant were included in this thesis.

Titles and abstracts were examined and when abstracts met the inclusion and exclusion criteria the full text of the article was obtained.

Inclusion criteria

The criteria for selecting articles were:

- articles focusing on the elderly
- articles describing the use of technology on elderly population
- articles on enhancement of elderly well-being using technology

Exclusion criteria

- articles which were not published in English language
- articles which addressed the elderly but have no relevancy to the thesis

Materials

In the preliminary search, several articles were identified in regards to elderly and technology, elderly, technology and well-being. This search yielded one article by Loe (2010) published online in 2012 that included all three search words.

The total number of articles selected was initially 40 published between the years 2000-2015. After reading the abstracts, more articles were included from the references found from these articles. Additional information was also gathered from newsletters online and research studies. All information was examined according to relevance and was included into the final analysis. The initial articles included are in described in table 1.

Table 1: Overview of included studies

AUTHORS	TITLE	TYPE	SAMPLE	TOOLS	REVIEWED
Baruah, T. D. (2012) in Journal of Scientific and Research Publications (Vol. 2 issue 5) ISSN 2250-3153	Effectiveness of social media as a tool of communication and its potential for technology enabled connections: A micro-level study. International	Micro-level study	Residents of Guwahati city	internet , magazines, books and journals	
Milliken, M. C., O`DonNell, S., Gibson, K. & Daniels, B. (2012). in The Journal of Community informatics. Vol. 8 no. 1	Older Citizens and Video Communications: A case study. National research council Canada.	Case study	16 citizens >55yrs	ICT	Study explored motivation for using video conferencing
Sawyer, R. (2011).In Senior honors ProjectS. Paper 242 http://digitalcommons.uri.edu/srhonorsprog/242	The Impact of new Social Media on Intercultural Adaptation	Investigative study	International students	social media	How student use social media
Nef, T., Ganea, R. L. & Murii, R.M.(2013). In International Psychogeriatrics Association. doi:10.1017/S1041610213000355	Social networking sites and older users-a systemic review.	Systematic review	Senior citizens	Computerized databases, inckludid 105 articles	18 articles were included in the literature review for proximity and geographical distance between older people and their children
WRVS (2012). Web based publication http://www.royalvoluntaryservice.org.uk/Uploads/Documents/How_we_help/loneliness-amongst-older-people-and-the-impact-of-family-connections.pdf	Loneliness amongst older people and the impact of family connections.	Research report	Older people		Study assessed

More articles were included as the writing continued to obtain more information to support the aim of the thesis.

4.3 Data analysis

Inductive content analysis was used to analyse these studies in order to ensure validity. Content analysis is a technique used in health sciences to analyse verbal and written material. This means that the text is classified into smaller content categories using a set of codes to reduce volumes of material into more manageable data (Krippendorf 2004; Elo & Kyngas 2007).

In this case, the table below illustrates the process of open coding, creating categories and abstraction by listing down narratives of elderly people using different technologies; and an illustration of documented different research outcomes on devices developed to enhance their well-being. This is done in order to demonstrate the answer to the research question. Data analysis is described in Appendix 1. An example of data analysis is in the following table 2.

Table 2   Example of data analysis concerning technologies

Authenticated	Reduced	Sub class
A small Gore-Tex patch with a subdermal probe that monitors blood sugar levels and a chip, which transmits data back to a mobile phone and displays a warning signal.	Blood sugar monitoring device	Blood sugar patch and a chip
Programmes on ICT developed in Ireland to provide computer literacy and adaptive devices for the aging, vision impaired community	Development of ICT projects for the aging population	ICT services
Tele-Physical Examination and Tele-Care Systems for Elderly People. It consists of graphs and diagnostic tools for self-examination. The results are transmitted to the medical community. This is a joint cooperation between the scientific developers, the medical community, and the elderly participants	Tele-Physical and tele-care systems for self-examination	Self-diagnostic tools

4.4 Ethical aspects and trustworthiness

According to Centres for Disease Control and Prevention (CDC 2007) one of the faster growing segments of the population are the elderly with over 70 million American citizens by 2030. The growth is attributed mainly to the advances in health care research which has a great impact on living longer. This rise in elderly population forms an integral part in population history which calls for more research work hence, a greater need to observe ethical principles when dealing with such a vulnerable group.

According to Whitbeck (1995), a research method in itself is never reliable or unreliable. Its trustworthiness is determined in relation to what is being examined. In this thesis, the evidence gathered from the review and from the findings; it's no doubt that integrating review was the ultimate and appropriate method to the study as it aligns with the purpose of the thesis.

In literature reviews, the main ethical issues include;

1. selection and ,or publication bias and literature accessibility
2. accurate and fair treatment of existing research (including issues of misrepresentation of results, plagiarism, and academic fraud)
3. respect of original study participants' consent and confidentiality
4. ethics of the research included in the review
5. permissions to use and reproduce materials
6. conflicts of interest

The articles reviewed ranged from the year 2000-2015, therefore making some over 10years old which may be considered redundant. However, those articles were relevant to accomplish the purpose of the thesis.

Documentation of the inclusion and exclusion criteria helps with the repeatability of the study and also brings additional quality to the study.

5 Results

From the findings gathered it is evident that technology does enhance the well-being of the elderly. The study has shown that the use of cell phones, computers, and the internet provide an insight on social participation and access to information, and, overall how to increase technology confidence and skills.

It is evident that cognitive and physical impairment form the process of aging and as a result; assistive technologies enhance their smooth transformation of life. Therefore, for these technologies to qualify, some factors ought to be considered as illustrated below;
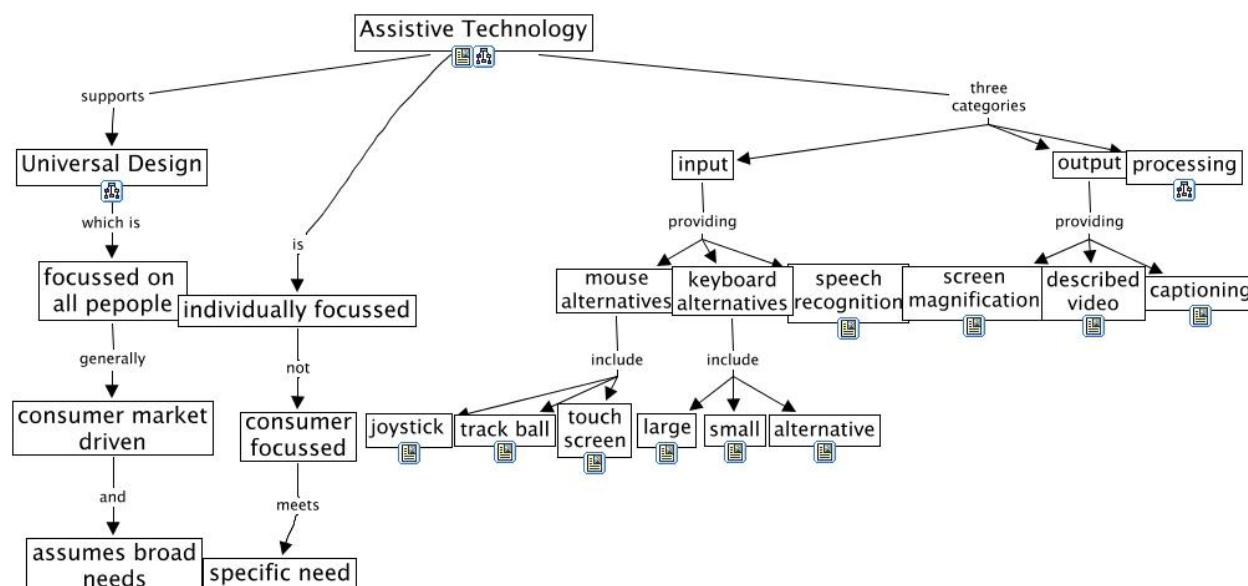

Figure 3 Assistive technologies (Cmap 2014).

The technologies mentioned in this study were universally developed to meet the needs of individual persons in different residential settings for the purposes of enhancing their well-being. The following sub-categories were written down during the reading process: Virtual storytelling, ICT, Games, Ci technology, Instant messenger, On-line communities, Skype, Visual tools.

The categories were then divided into three theme-categories in alignment with the aims of the thesis (Table 3)

Table 3   Types, use and support of different technologies

Types of technologies	How technologies are used	Support system
ICT	-through Ipads to surf the internet -as a personal locater -internet programs for vision impaired -Games, exercises, puzzles -online game-qq farm -computer training programme -distance learning programme entertainment and hobbies, accessing support and information about health topics, and managing daily activities e.g. banking and shopping	-cognitive improvement & communication -emergency services -to improve literacy & adaptation -to maintain mental health -the games build strong family bonds, getting in touch with their adult children and receiving caring and loving messages which were crucial for their health and well-being. -increased and continued use of computers , improved ability and development of confidence with computer and internet technology, leading to social connectivity, easy access to information, and social and civic participation -improve social, emotional life and promote independent living
Virtual story telling	-through the internet -Youtube	-emotional & social support discipline & unsupportive story telling
	-through the internet	-eradicate loneliness & increase social relationships

Ci technology	-email,facebook	-self-diagnostic tool -grand-parent grandchild communication
Instant messenger	from the computer, cell phones	communication
Skype	from computers , cell phones	social communication, healthcare services,
Visual tools	skype & video conferencing	communication purposes
Remote patient-operated remote monitoring technology	cooperative development between the patient, the medical community & instrument developers	encourage independent living
Nintendo Wii video game	used in a nursing home environment through Tv	social interaction
Community radio, phone & internet	the elderly transmit information on culture & intangible heritage to shape the future	signifying the culture through communication

6 Conclusion and discussion

The purpose of this thesis was to investigate different technologies that enhance elderly well-being in order to make a conclusion for good care practice.

From the study, the results demonstrated that the use of information and communication technologies have boosted social networking among the elderly, improved their knowledge and skills and access to information. This confirms that technology does enhance the well-being of the elderly which is a part of holistic care.

A good care practice is a technique or methodology that, through experience and research, has proven to reliably lead to a desired result. The results from this thesis were a collection of researched work by professionals who used their knowledge and tested different technologies at their disposal to ensure success in supporting the elderly and their caregivers. Through these technologies providing care has been easier with a resultant decrease in health care costs.

These technologies ranged from ICT, virtual tools, robotics, mats, games, to self-operated remote monitoring systems. Although all of them played a great role in enhancing the well-being of the elderly, virtual tools , games, and assistive devices stood out because they created a social network and communication portal e.g. skype where visual of both parties was possible. It also stimulated thought process and assistive devices encouraged independency.

The technologies were incorporated through computers in form of games, training sessions, stuffed animals or patches. The most important aspects of such technologies, was that the elderly could live normal lives without the hassle of having a nurse around the clock to cater for their every need. However, it was not easy for the elderly to accumulate so much knowledge on the technical aspects of these technologies and therefore difficult to put into use in some degree.

Through virtual tools; video conferences and YouTube have made it easier for the elderly to virtually communicate with their doctors, socially connect with friends and family and have a freedom to tell their stories without any inhibitions. All these have contributed to emotional support and confidence to communicate.

The study is based on literature review specifically, integrative literature review, which is a distinctive form of research that generates new knowledge about the topic reviewed. The study is based on data collected from different articles i.e. secondary data, therefore the reliability and validity cannot be fully attested as this requires both primary and secondary research data. The integrative review methodology involves detailed and thoughtful work, the outcome of which is a significant contribution to this study. However, it consumes a lot of time to collect data and more effort to integrate all information learned.

Confidentiality is a great concern too when exchanging personal and health information over the internet. The devices require constant care and sometimes personnel on sight in case of repairs.

While it is true that the use of technology makes a large difference in the lives of many elderly people, it is important to consider their state of health and the environment they live be considered in its development. For example, elderly people living alone require those technologies that eliminate loneliness while providing companionship (Leikas et al 2012). For a particular technology to carry out the tasks it has been designed for, it is important to consider the potential users as individuals who will easily access the product and benefit from it hence an improved well-being and their quality of life (Gitlin 2000, 2002).

It is evident that the use of technology is becoming more and more popular in our society. This does not only apply to the younger generation but also in older people who are fascinated by all the available gadgets and want to use them. Although older adults are not as quick a study as their younger counterparts, there has been an increasing use of social media as such Facebook and skype as a communication tool to connect with their families, friends and caregivers. According to Reardon (2010), there are some social workers who ignore the role of technology in older adults' and therefore jeopardize the opportunity to help older people maintain and improve their physical, mental, and emotional well-being.

The aims and purposes for the thesis were not duplicated from other writers. Otherwise it would have been un-ethical. According to research articles gathered, all the participants involved in previous studies have been quoted and maintained their integrity without misinterpretation of the results. There was no mention of forceful or coerced participation from the publications retrieved. However, those case reports and blogs found on the internet cannot be ascertained to be 100% accurate in terms of following the ethical guidelines.

Some of the limitations of this study were; a) technology may not be enough in itself and therefore requires personnel involvement for continuous feedback from the consumer to the manufacturer and vice versa, b) challenges of learning about new information and communication technologies by elderly members secondary to late-stage in life (Loeb 2012), c) Physical limitations for example video chats which require physical presence and the use complicated settings. Most of the elderly people are interested in using these technologies for the diverse benefits they offer but most importantly for fun. In order to increase participation and encourage the elderly to use available technologies, then a few adjustments should be made to accommodate their needs, for example structural design, and skill development. The study confirms that older people realize that their capabilities in terms of using technologies to certain extend. As much as they try, there are some technical barriers associated with age that prevent them from utilizing these technologies to the fullest, and that they may project that thinking on other people. They often perceive that technologies are meant for younger generations and these may lower their morale leading to frustrations attributed to ageism rather than other factors such as shortcomings in technological design (Broady et al 2010).

In the future, it is important to consider the elderly while designing these technologies since it is evident that older citizens are often using these tools to enable intergenerational communication in both the private and public spheres of their lives. It is vital to remember that elderly people have political, economic, social, and community rights and responsibilities to participate in the creation of ICT tools. Therefore, as Harley (2009) states; the sectors involved in the development and marketing of these products should recognize the elderly as a viable and valid group of technology users.

Many technologies are available in the market and even more are developed and improved every day. It is therefore imperative to involve the consumers in the development process to ensure the end product meets their needs. This will not only save time but costs in the manufacturing process.

Health care personnel need also to be proactive and educate themselves either individually or through continues education in health care institutions. Moreover, they should be encouraged to be innovators themselves as they understand the consumers` needs better. It is of utmost importance to remember that should not completely take charge of the roles that health care workers play in health promotion.

Although not very many studies have been carried out with elderly, it is true that once grown children have moved out, there is a vacuum left behind that most often times is filled with friends. Friendships become more important among the elderly because of that connection with the entire community. For older adults who have restrained moved due to illness, a visit from friends and families creates an environment of sharing health information or memories which is important for social connectedness. Example of social gatherings includes, knitting clubs, baby-sitting, wellness club especially walking, tea club and religious prayer meetings. It is evident that older adults who are active participants in their social lives show an improved psychological well-being.

Therefore, technology does play an essential role in enhancing elderly well-being. The results of the study have confirmed that through various technologies, the health and well-being of the elderly significantly improved. These technologies have played a role in connecting families together despite of their geographical location, improved their knowledge not only on recognition but also how to operate them and, enhanced their independency.

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Appendix

Appendix 1   Data analysis

Authenticated	Reduced	Sub class
A personal description by an invalid elderly person with hip and knee injuries on how modern technology is used to assist her to get up from the bed or the floor. The machine is activated by a switch button and an under mat slid under the seat.	Raising up is more easier	Invacare stand
The use of a panic button worn around the neck of an elderly person. It has been designed to sit well as a jewellery to avoid stigma. It is used to send alerts in case of danger i.e. a fall to relevant personnel. It is ideal for the elderly because of its simplicity and most importantly, enhances independent living.	A simple emergency portable button	button
A small Gore-Tex patch with a subdermal probe that monitors blood sugar levels and a chip, which transmits data back to a mobile phone and displays a warning signal. It is used for diabetic sufferers	Blood sugar monitoring device	Blood sugar patch and a chip
The use of Ipad to access the internet by visiting different sites.	Internet access through Ipad	Ipad
Programmes on ICT developed in Ireland to provide computer literacy and adaptive devices for the aging, vision impaired community	Development of ICT projects for the aging population	ICT services
Research work on the use of CIT technology for cognitive stimulation, exercise, puzzles, and games, to maintain mental health.	Research on technologies for cognitive stimulation	Cognitive stimulation
Tele-Physical examination and Tele-Care Systems for elderly diagnosis and treatment. It comprises of graphs and diagnostic tools which allow them self-examination. The results are then transmitted to medical community. This is a joint venture between the scientific developers, the medical community, and the elderly participants	Tele-Physical and tele-care systems that allow the elderly to examine themselves	self-diagnostic tools