GERONTECHNOLOGY: REMOTE PATIENT MONITORING

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ABSTRACT
Gerontechnology is coined from two words; Gerontology which means the study of old age as well as Technology. Research in the field aims at identifying the needs of the people in their old age as well as encouraging and promoting technological innovations in products and services that address older peoples' needs; in order to enhance personal independence, maintain health, prevent diseases and enhance leisure. Improvement in diet, health care as well as environment factors has seen an increase in the life expectancy of people. But as people become older challenges among them frail health arises. Traditionally families lived together such that it was expected as one grows old there will be his/her children who will take care of them. But in recent times there has been an upsurge in rural urban migration where the young move to urban areas in search of employment leaving their old parents behind. These are people who may not know when to take prescribed medications or monitor other vital signals. Left on their own health deteriorates very fast and at times results with preventable death. The importance for gerontechnology is increasing because of the high ageing population. This paper attempts to awareness on technological responses to monitoring health of old people. The use of remote monitoring tools to address health issues of the aged is considered.
Keywords: *Technology, Gerontechnology, Health, Remote Monitoring*

INTRODUCTION
Gerontechnology is coined from two words: Gerontology and Technology. Gerontology itself is defined by two Latin words: "Gero" meaning "elders" and "ology" which means "the study of". Gerontology therefore seeks to understand the aged as well as the process of aging. Information Technology as a technology is the application of computers and the computer networks including the Internet in the manipulation and management of data and information. IT enables the creation, processing, storage and securing of all manner of electronic data. Gerontechnology therefore refers to the use of technological interventions to fulfill the needs, ambitions and opportunities of the old people. Bronswijk et al, (2009) refers to gerontechnonolgy as an interdisplinary field that links existing and new technologies in order to meet the needs of the aged.

The writers also note that gerontechnology is key in improving the quality of life expecially of the aged. The aim of gerontechnology is to pursue good health, enable full social participation and encourage independent living up to a high age. This is made possible through research, development or design of

products and services that are geared towards improving the quality of life. Fozald (2001) reported that gerontechnology is that which has the potential to help older adults maintain physical fitness, cognitive function and social activity, as well as provide opportunities for increasing independence and productivity. It potentially brings together professionals both in interdisplinary academic discplines and research environments from various fields in order contribute towards meeting all these needs.

Need for Gerontechnology

The importance and need for gerontechnology is increasing as a result of the increase in numbers of the ageing population. Notably, there are more chances of survival due to improved diet, proper health care and good environment surrounding the old. As population increases, the number of old people in the society also increases. Micera et al, (2008) observes that improvements in education, health status as well as economic resources in the last century have improved life expectancy moreso for women. They note that the population is both quantatively aging and on the other hand qualitatively getting younger. Though naturally aging, the population is now more aware of their potential and willing to contribute in the social order of things rather than decline to weakness and self pity. More older people now know how to access and use technology including basic mobile phones, more advanced smart phones, the internet, social networks as well as other internet technologies. Through technology the aged are able to connect to the world they are now no longer able to actively interact with physically due to age and age related sicknesses. Technology enables the aged contribute economically by partaking on online related activities which not only improves the financial welfare of the person but also maintains the self worth as the aged person feel he is needed in society. Gerontechnology in the same trend can therefore be applied to enhance our ability to provide care, and also influence research which incorporates technology in the lives of the elderly. Gerontechnology is used effectively in prevention of age-related diseases and of age-associated losses in strength, endurance, and other physical or cognitive abilities. These include design of equipment to facilitate interventions and the design of monitoring equipment that allows feedback about compliance with interventions and their effectiveness e.g. strength training equipment. It can enhance the performance and opportunities of older citizens in new roles that fit their new ambitions e.g. changed work, leisure, living, and modified social situations. It provides technology to compensate for declining capacities e.g. eyesight, the challenge of aging. It also aids older persons indirectly by improving research on aging e.g. technology allowing signal processing of neurological events and making other non-invasive measurements, thereby revolutionizing the scientific study of the processes within the aging body. According to Johanna et al, (2009), Gerontechnology ulitimately aims at implementing successful aging. Gerontechnology has the potential to help older adults to maintain physical fitness, cognitive function and social activity, as well as providing opportunities for increasing in dependence and productivity Fozard (2001)

Aging and Health in Kenya

The aging scenario in Kenya is not different from the rest of the world. As the economy of the country continues to improve, the middleclass are seen to live actually longer into old age creating problems which were previously not of much concern. In past times the aged were revered in Kenya, seen as rocks of wisdom. The nature of the society then was that the extended community used to live together or at least close together and it was expected that as one grows older then care will be provided by the children. But rural-urban migration has seen majority of the younger generation migrating from the rural and remote areas to towns or the urban areas in search of better opportunities. Physical care for the old from their children is no longer assured. Paid help is also not assured as the combined aspects of free primary school, affordable high school and growth of Universities and middle level colleges encouraged by devolution has opened ways for education for those previously not able to, who then used to serve the role of paid help. In rare cases children will take their old parents to retirement and care homes. But in majority cases the old are left to themselves. But as Spokus (2005) reported, using technology can greatly benefit old people living in rural areas as technology use provides them with access to quality healthcare.

Challenges Facing the Old

The mandatory retirement age of civil servants in Kenya was set at sixty years a raise from the previous fifty years of age in the year 2009. Those in the private sector have different retirements according to

contractual agreement. Aging comes with loss of ability to work. At best a person is let go with a specified benefit or a monthly pension. Yet this is not equivalent to what one earned when in active employment. Reduced income means reduced purchase power. A retired old person faces a situation where the quality of life lived before has to be reviewed in most cases downwards.

Non-communicable diseases (NCDs) are the leading cause of death globally. Among them are high blood pressure and diabetes. Diabetes mellitus is the 4th main contributor of death among the NCDs globally (WHO, 2010). There is an increase of high blood presseure together with diabetes among the older generation. Another common age related diseases which is starting to be widely visible in Kenya is Alzeimer and Dementia. Alzeimer disease is presented as mental deterioration gradually leading to dementia which is defined as memory loss coupled with difficulties in thinking, problem solving and language skills. According to Devenand et al*,* (1996), depression moderately increased the risk of suffering from dementia, primarily Alzheimer's disease. Loss of strength and other age related challenges facing the old can contribute to Alzheimer's disease and dementia. Of concern is that reduced income is one factor contributing to these diseases. Tiffany (2013) notes a connection between poverty and diseases such as diabetes. The old in the society are very important due to their words of wisdom and guidance. They preserve the culture of any society and passing it on to the newer generations. There is a great need in coming up with ways of ensuring they enjoy quality of life and cope with the challenges easily by providing necessary conducive environment through technological innovations. To address the challenge of health, remote patient monitoring is suggested.

Nursing and Care Homes in Kenya

In Kenya, there are only a few nursing and care homes for the old which are majorly run by non-governmental and faith-based organizations. The Fairseat Retirement home in Rosslyn is such an example. The home can only accommodate 35 residents who are 70 years and above. Coupled with the high costs charged, only few can afford to stay there. Kilulu, a retirement home in Mombasa is developed on three acres and has catered for the elderly for 16 years.The home has seen an increasing number of elderly men and women who come into the home in search of companionship, care and a healthy atmosphere. The average cost is between KSh90, 000 and KSh120, 000 per month depending on the circumstances and need for each residents. The population is also limited to the space available (Mwakilishi, 2013). The Nyumba ya Wazee, or house of the old people, based in Nairobi, is run by the Little Sisters of the Poor, a Catholic organization that survives on donations. It has a capacity of only 65 residents. (Brown, 2009). According to the Kenyan government figures, the ageing population above 60 years stood at 1.4 million in 2015. This number is expected to double in the next 10 years.

This calls for us to channel our resources and attention to the care of the old and how to improve their quality of life through the use of technology. A study of relationship between retirement preparation in the psychological, financial and health domains and quality of life of retirees shows that more than half of the 10% of the retirees sampled do not enjoy quality life in old age(Pauline et al, 2015).

Remote Patient Monitoring

It might be difficult to get and accommodate all the elderly into care homes across the country but it is possible to offer specialized care and attention to majority of them in urban and rural setups by utilizing remote patient monitoring technology. Remote patient monitoring, including home telehealth, uses devices to remotely collect and send data to a home health agency or a remote diagnostic testing facility (RDTF) for interpretation. Such applications might include a specific vital sign, such as blood glucose or heart ECG or a variety of indicators for homebound patients. Such services can be used to supplement the use of visiting nurses.Such technology could be an answer to help the thousands aged who are at our homes in enjoying life including good health and social integration. This will ensure independent living of the old and reduce the burden to families e.g. cut hospital costs, counselling and travelling costs to medical centers and such other costs.

Calcagnini et al, (2008) proposed a short messaging service (sms) as a tool for monitoring of home-care therapeutic or rehabilitative programs in elderly. Another remote monitoring system is proposed by Heyoung et al*,* (2008). This implementation 'smart house' is a 24-hour continuous health monitoring

system in a house with the intention of aiding independent living of the elderly and / or people with disabilities. Wu et al,*.(2014)* have proposed a portable prototype system for the automatic monitoring and correction of elderly patients with the Obstructive Sleep Apnea Syndrome (OSAS). The system monitors for sleep related breathing which then causes the stimulus module to change the patient sleeping posture improving the respiratory pattern. iRxReminder is an iPhone system developed by Sterns et al, (2010). *The application stroke patients* including reminding, to present multi-media educational materials, and to present tailored surveys for capturing information about daily activities. A suite of apps that addresses the issues affecting the aged has been developed by Sposaro and Tyson(2009).These include (iFall) Sposaro and Tyson(2009) to monitor falling, iWander to monitor an old person who may have lost the way as well as other monitoring tools all for the Android platform. If an emergency occurs, the phone can automatically call several contacts using Google Voice technology.

Other Existing Remote Patient Monitoring and Care Initiatives Include:

Care coordination / home telehealth (CCHT)
Broderick (2013) describes the VHA's CCHT. The Veteran Health Administration is an institution in the United States of America that implements the medical assistance program of veterans. Care Cordination / Home Telehealth is one of the programs in VHA. CCHT provides non institutional care and case management to the veterans. Among health conditions monitored are diabetes, hypertension, congestive heart failure, post-traumatic stress disorders among other conditions. All this is done by using remote monitoring devices which are installed in veterans homes. The devices can capture and transmit biometric data and communicate health status of the veteran. These remote devices are remotely monitored by health care cordinators

Partners healthcare network (Boston)
Partners HealthCare network offers remote monitoring programs patients to track their health and securely share their health data with their provider through a secure patient portal. Among diseases remotely monitored are diabetes, hypertension, heart failure and weight management among other conditions. An example of how this system works is in the case of heart failure patients who have been treated and discharged, yet need close monitoring. For these patients, each morning, patients take their blood pressure, pulse, oxygen levels and weight. In addition, patients answer symptom questions on a small touch-screen computer, and transmit the data to Partners HealthCare at Home. A nurse reviews the data and when readings are outside established parameters, appropriate intervention is taken. This includes a call to the patient to check on their condition and, when necessary, coordination with the patient's physicians. Diabetes patients upload readings from their glucometer via a wireless communications device which gives the care giver idea on the sugar readings of the patient for monitoring and further action. Same applies for hypertension and other conditions remotely managed (Patners-Healthcare, 2016).

Remote home care (Australia)
Older Australians just like other aged elsewhere wish to remain in their homes for as long as possible with the support of medical technologies that can delay or stop the transition into hospital or residential care. In April 2012, the Federal Government of Austrarlia announced the living longer living better intiative under the Aged Care reform plan. This is aimed at encouraging home based care with the government planning to provide $3.7 billion in the next five years to support the older Australians' and their families. Aging and Aged Care, 2014.

Telestra health
An online platform for care and management of patients that seeks to empower them with effective home and mobile monitoring solutions. Among the provisions are platforms to collect data, manage diseases and give care to its clients right from their home remotely. MyCareManager is one example of these platforms. MyCareManager has a portal, telemonitoring, videoconferencing and integration engine through which data collection and remote monitoring is effected.Another one is MyHealthPoint, a chronic condition management platform that gives carers access to patient health information in real time via the web or mobile app, and helps patients manage their condition at home.

Telemedicine Africa (South Africa)
Telemedicine Africa is a South African medical platform that provides remote diagnosis and treatment of patients. It has Patnered with the Industrial Development Corporation (IDC) and Dimension Data technology company to establish a virtual telemedicine consultation center. General practioners and medical specialists deliver medical services to remote patients connected to the virtual telehealth center.

The non-invasive blood glucose project
Implemented in Kelvin, a suburb of Sandton, Gauteng, S. Africa. The system uses visible light spectrometry. The main function is to accurately measure blood glucose. A means of calibration is provided to account for component variations and maintain accuracy. The measurement results are stored in a data log that, upon request, can be uploaded to a PC via a USB serial cable. The data log is implemented on a non-volatile memory (EEPROM) that keeps the data in the event of battery removal or power loss. Diabetes Development NIBGM (Non-Invasive Blood Glucose Monitor Project, 2009)

CONCLUSIONS
The mounting challenges of population growth and demographic ageing will place a considerable strain on healthcare systems across the globe, leading to increased healthcare costs and a risk of lowering the standards, not only for older people, but across all population demographics. To address these challenges, governments will need an increased focus on the research and design, commercialization and deployment of smart technology to enable older people to remain in their homes longer and provide cost-effective solutions to meet the needs of an ageing population.

Remote patient monitoring uses digital technologies to collect medical and other forms of health data from individuals in one location and electronically transmit that information securely to health care providers in a different location for assessment and recommendations. Monitoring programs can collect a wide range of health data from the point of care, such as vital signs, weight, blood pressure, blood sugar, blood oxygen levels, heart rate, and electrocardiograms.This data is then transmitted to health professionals in facilities such as monitoring centers in primary care settings, hospitals and intensive care units, skilled nursing facilities, and centralized off-site case management programs. Health professionals monitor these patients remotely and act on the information received as part of the treatment plan. Monitoring programs can also help keep people healthy, allow older and disabled individuals to live at home longer and avoid having to move into skilled nursing facilities. It can also serve to reduce the number of hospitalizations, readmissions, and lengths of stay in hospitals—all of which help improve quality of life and contain costs.

Remote Patient Monitoring integrated with home telehealth is an important technology that should be embraced in Kenya, Africa and the globe at large. Its benefits are way much great and its effectiveness is of great help both to the governments and its citizens (older citizens). In taking care of the old in the society, we need to think of better ways to simplify their care yet maintain the quality of service. Technology can be used to achieve this through various ways, this being one of them. There are many success stories around the world and I believe as a nation we can also make it to be counted among the leading countries. Adopting this idea will bring greater joy to the ageing population and also affected citizens of Kenya. Provision of care that enables individuals to be treated in the home environment is far more cost effective than all other alternatives. It should therefore be embraced and implemented as a priority for improved health care.There only few homes for elderly currently which are expensive for low income citizens. There is therefore need to use technology to help the thousands who are at our homes in enjoying life including good health and social integration.

Some of the devices used in data collection and doctor interaction include: alarms/alerts, pulse oximeter, sphygmomanometer, peak flow meter, continuous glucose monitoring, drug delivery/infusion pump, smart incontinence management system, heart rate monitor, spirometer, electrocardiogram (ECG), and home hemodialysis among others.

There have been very poor condition and implementation of gerontechnology in Kenya and Africa at large. However, there is great research that is going on in this area. Adoption of remote patient monitoring and home telehealth in Kenya would see the nation achieve a great milestone in dealing with the ageing population. Most of these are investments that the government has to be ready to undertake for the benefit of its citizens. These technologies as seen above have many benefits and will reduce on costs by the families affected and improve the quality of life of the older citizens. This will also contribute much in the growing economy of the Kenyan government. This project would go a long way in reaching the many underserved areas in Kenya. With the advances in technology and telecommunication, then it will be an easy task to implement these systems in almost every county.

Remote patient monitoring and home telehealth however requires patient data to be stored electronically. We are living in a digital world where every activity and service is digitalized. With digitalization of health management systems in our hospitals, then we should be able to achieve these technologies easily and within a very short time. Setting up of monitor centers, which could be situated in the local hospitals, will ensure the government reaches most of the target population easily and be able to manage their needs easily. Educational training can be available in these centers to ensure the patient or carers get to know how to use the monitoring devices. The specialists can also communicate with the patients directly in case of recommendations and consultations as depicted by the data transmitted.This will also help in reducing admissions in hospitals and the problem of shortage of specialists and doctors in our country. Fewer practitioners will be able to handle a bigger number of patients at a go compared to physical service delivery. Chronic disease can be detected early and diagnostic measures undertaken on time. In cases of emergency, then deployment of medicare services is faster and this will prevent extreme conditions, including death, during travel of patients to medical centers.

Nursing homes are currently very few compared to the large population in Kenya. They are also quite costly to majority of the older citizens and have limited capacity of accommodation. This technology can be used to provide same care as nursing homes but in the individual's homes and comfort zone without change of environment.

Other benefits of using remote patient monitoring system include the following:

i. Improved Access – it has been used to bring healthcare services to patients in distant locations. It helps to improve access to patients and also allows physicians and health facilities to expand their reach, beyond their own offices. Given the provider shortages throughout the world, in both rural and urban areas, it has a unique capacity to increase service to millions of new patients especially the increasing ageing population.
ii. Cost Efficiencies – Reducing or containing the cost of healthcare is one of the most important reasons for funding and adopting remote patient monitoring technologies. To reduce the cost of healthcare and increase efficiency through better management of chronic diseases, shared health professional staffing, reduced travel times, and fewer or shorter hospital stays.
iii. Improved Quality – Studies have consistently shown that the quality of healthcare services delivered are as good those given in traditional in-person consultations.
iv. Patient Demand – Consumers want home based care. The greatest impact is on the patient, their family and their community. Using remote patient monitoring technologies reduces travel time and related stresses for the patient. Over the past 15 years, study after study has documented patient satisfaction and support for the services. Such services offer patients the access to providers that might not be available otherwise, as well as medical services without the need to travel long distances.

However some challenges come with remote monitoring technology including:

i. Level of technology – low level of technology that may not meet the required standards for implementation of the system in some parts of the country. However, the rate of telecommunication and technology advancement in the country is promising to reach out to all parts of the country.

ii. Illiteracy - especially on use of technological devices is a challenge to deal with. Many older citizens are not oriented to usage of such devices and may proof difficult to use. However, some can be trained whereas in other cases the carers can be trained on how to use the technology.

iii. Government participation – the government must be ready to embrace this project and fund it accordingly for it to be realized. Several stakeholders involved must be ready to work together in achieving this milestone in gerontechnology.

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