
# UNIVERSITY OF NAIROBI

# SCHOOL OF COMPUTING AND INFORMATICS

## THE POTENTIAL OF SMS BASED AUTOMATED REMINDERS TOWARDS ENHANCING ADHERENCE TO CLINICAL INSTRUCTIONS FOR DEMENTIA PATIENTS: A CASE OF HEALTHCARE GIVERS

**BY**

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# Declaration

I**, Sheilah Mirenja,** declare that this project report is my own original work and where there's work or contributions of other individuals, it has been duly acknowledged and relevant citations given. To the best of my knowledge, this report has not been previously presented to any other education institution or forum for examination. No part of this project report may be reproduced without the prior permission of the author or University of Nairobi.

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# Dedication

To Almighty Jehovah God, the giver of life

&

To my family

# Acknowledgements

This work benefits from the input of many people. Time and space allows me to mention a few. I am profoundly grateful to my supervisor (Dr. Christopher Chepken) for believing in me, always being ready to listen and give direction and for your great gift of extra-ordinary patience. Under your guidance, I learnt a lot. Special thanks to the management of SCI. The SCI family provided great support and a conducive environment for studies and research. To my family; your unyielding support made a lot of difference and I am forever grateful. I am also grateful to all my friends for always your words of encouragement and prayers and may Almighty God bless you richly in all ways. Finally, to my family at PAC, your support has seen me come this far.

# List of Abbreviations

- **CAK –** Communications Authority of Kenya
- **PDA –** Personal Digital Assistant
- **ICT –** Information and Communication Technology
- **IT –** Information Technology
- **KNeS –** Kenya National eHealth Strategy
- **SMS –** Short Message Service
- **UN –** United Nations
- **WHO –** World Health Organization

# Glossary of Terms

- **Adherence**

  *The degree to which a person's behaviour corresponds with agreed recommendations from a health care provider (WHO, 2003)*

- **Caregiver**

  *An individual who is responsible for attending to the daily needs of another person. (Noonan and Tennstedt, 1997).*

- **Clinical Appointment**

  *An arrangement to meet a clinical expert at a particular time and place. (Oxford Dictionary)*

- **Dementia**

  *Clinical syndrome of progressive deterioration in memory, thinking, behaviour and the ability to perform everyday activity (WHO, 2017)*

- **Electronic health (e-Health)**

  *The use of information and communications technologies in support of health care services, health surveillance, health literature, health education, knowledge and research (WHO, 2012).*

- **Mobile Health (mHealth)**

  *Medical and public healthcare practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices (WHO Global Observatory for mHealth, 2011).*

- **Technology**

  *Purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities (Clara, Neo and Laukonova, 2014)*

# Abstract

Dementia condition presents a challenge with regard to the ability of a person with this condition to adhere to treatment regimes. Provision of healthcare service to persons with dementia remains a challenge because the condition negatively impact memory retention and thus, persons with this condition tends to easily forget even the most important things, including medication and clinical appointments. Traditionally, the care of a person with dementia will be delegated to a caregiver, who in most cases is a next of kin, guardian or neighbour. Caregivers face their own personal challenges and this may result in scenarios where they fail to remember the activities that need to be done by the person under their care, especially those relating to adherence to treatment regime. The potential of technology has been explored and evidence show that it can aid in the provision and support of healthcare services. The growth in the use and adoption of mobile technology is viewed as a potential tool that could aid in enhancing support for care givers. Existing studies has concentrated on evaluating outcome of technology use among persons with dementia. This study sought to evaluate the potential of an SMS-based automated reminder system towards enabling care givers to ensure adherence to clinical appointment, for persons with dementia. The study adopted exploratory approach; a mobile based prototype was designed to send SMS reminders to respondents at predefined periods, reminding them of the clinical appointments for person under their care, as the appointment date approached. The development of the prototype used agile methodology. A sample size of 30 caregivers, was used. Adherence data was collected from the caregivers covering 15 clinical appointments, spread over a period of four months. Outcome of the analysis of the data showed that the *gender* and *age* attributes did not influence the level of adherence; adherence increased consistently across the age groups by 19.7%, while for gender, a slight difference was observed where adherence among the females increased by 8.2% while in the males it increased by 10.98%. Overall, adherence increased by 9.79%, for the sample of 30 respondents in the study, an indication that SMS based reminders had potential improving adherence to clinical appointments for caregivers in dementia cases.

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# CHAPTER ONE

# INTRODUCTION

## 1.1 General Introduction

Challenges in healthcare across the world require innovative, well thought-out and timely solutions to address each of these challenges. The growth and successful application of Information and Communication Technology (ICT) solutions in various aspects of daily life has inspired hope in healthcare sector. This chapter is organized as follows; first, it gives a brief background highlighting global challenges in healthcare and with a bias towards challenges in the management of dementia and highlights the potential in ICT. This is followed by problem statement, research objectives, research questions, motivation and justification for the study and finally, the underlying assumptions are stated.

## 1.2 Background: Healthcare Challenges

The world continues to experience increased healthcare challenges with no matching strategies to counter the challenges. Studies have revealed that the health related challenges are a burden to the economy as well as to quality of the human life (Tariq & Akter, 2011). The World Health Organization (WHO), a body mandated by the United Nations to spearhead, oversee, formulate best healthcare practices and give directions on medical and healthcare practices across the world, identified developing countries and particularly the Sub-Sahara Africa as one of the most severely affected regions (WHO, 2013). In the effort to combat these challenges, WHO (2013) report recommended a strategy anchored on three foundational pillars; prevention, surveillance and strengthening existing healthcare systems.

The prevention pillar focuses on ensuring that measures that work towards lowering infection and re-infection as well as preventing outbreak and spread of diseases are put in place. The surveillance pillar recommends that effective and efficient mechanism be devised and utilized to monitored outbreak and spread of diseases in order to ensure appropriate and efficient responses that limit the negative impact of the disease. The third pillar advocates for strengthening existing systems by making processes more efficient and effective; having more healthcare personnel,

adequate medication, enhanced assistive technologies, support for caregivers and increased accessibility to healthcare facilities and services for all (WHO, 2013).

Dementia is a clinical syndrome of progressive deterioration or failure in memory, behaviour, thinking and ability to perform basic everyday activity. It has been marked (WHO, 2017), as a growing global challenge and it is estimated that there are approximately ten million new cases every year. The loss of memory caused by dementia has a profound effect on the person and renders them incapable of managing basic and critical life activities. Among the critical activities that can be negatively affected when a person develops dementia is the failure to adherence to treatment regime, including medication and clinical appointments.

Caring for persons with dementia is an energy and time consuming exercise. Studies indicate that there is a growing attempt to explore the use of technology, with the overall goal being to provide support for persons with dementia as well as their caregivers (Kindell et al, 2016; Astell et al., 2009; Landau et al., 2010; Living made easy, 2010; Sävenstedt et al., 2010; Mulvenna et al., 2007; Martin, Bengtsson and Dröes, 2010; Gagnon-Roy et al., 2017). The growth in adoption of Information and Communication Technologies (ICT) especially the mobile technologies, has revolutionized and positively impacted daily life activities in many spheres of life; financial, Agricultural and healthcare (ICT Update, 2012; WHO, 2013; WHO, 2011c; Vital Consulting, 2009). The growth of these technologies has led to digitization of financial services, which in turn has led to increased efficiency, accessibility and effectiveness of service delivery (ICT Update, 2012). In healthcare, the challenge of very low Doctor to patient ration means that many individuals do not get opportunity to access healthcare practitioners. Sema Doc application is a mobile based solution, available on 24 hours/7 days a week basis and enables individuals seeking healthcare to have a direct interaction with doctors; for quick consultation, diagnosed and treatment, no matter the time and location of the individual (Mediamax, 2015). The success of these innovations has led to the view that if creatively explored, mobile-based technology innovations have the potential to significantly improve access to and provision of healthcare services. Global surveys, reports and studies (Zurovac et al, 2011; WHO, 2011c; Vital Consulting, 2009) point to growing interests, efforts and attempts to explore the potential of this technology towards enhancing healthcare. The innovative solutions reported cover the three key pillar; prevention, surveillance and strengthening of existing systems.

## 1.3 Problem Statement

Adherence to treatment regime significantly contributes to the improvement of health status as well as the well-being of a patient. A treatment regime consists of two main components; adherence to medication and adherence to clinical appointment. Clinical appointments influence prescribed medication hence the need to adhere to appointments. Patients suffering from dementia have challenges remembering and this does negatively impact on their ability to honour clinical appointments as well adhere to treatment regimes. Caregivers who support persons with dementia are tasked with ensuring that the individual under their care performs all activities that they need to for their well-being. But dependency on care givers presents a challenge. There is a high probability that the caregiver may be overwhelmed or pre-occupied with other equally crucial life activities and therefore unable to render the necessary support and care. Such scenarios would have deadly consequences on the demented person. Previous studies (Landau et al., 2010; Living made easy, 2010; Sävenstedt et al., 2010; Astell et al., 2009; Mulvenna et al., 2007; Martin, Bengtsson and Dröes, 2010; Gagnon-Roy et al., 2017; Ashok, 2008) have mainly focused on evaluating the potential of mobile technology towards enhancing memory retention for the persons with dementia, but leaves out the care giver; a critical component in the well-being of the person with dementia.

## 1.4 Research Objectives

### 1.4.1 Main Objective

The main objective of this study was to design, implement and test the outcome of use of SMS based automated reminders for dementia care givers.

### 1.4.2 Specific Objectives

i. To find out the dementia care and ICT support services.
ii. Isolate unique dementia support services which can be supported by ICT.
iii. Design an SMS based automated reminder system
iv. To test the outcome of use of an SMS based automated reminder system

## 1.5 Research Questions

i. Which ICT support services are necessary in aiding healthcare for dementia?
ii. What approach can be used in the design of an SMS based automated reminder system?
iii. What is the outcome of use of automated SMS-Based automated reminder system?

## 1.6 Justification

Healthcare support services is fundamental ingredient in the strategy of ensuring improved quality of life those affected by dementia. Since adherence to treatment regime is critical for individuals affected by dementia and the probability that a caregiver may be overwhelmed, there is need to explore technologies that are flexible and cost effective, to aid the caregiver in the process of supporting persons with dementia to live up-to the requirements of a treatment regime.

## 1.7 Assumptions

- Information provided by stakeholders in process of designing and developing the application would represent the reality of the ground.
- The caregivers will have access to their mobile phones at all times and that the phones will be charged throughout.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

An in-depth review of relevant literature shows the evidence of growing disease burden globally. Dementia is on the rise globally and has been identified as a rapidly growing challenge in developing countries. This chapter reviews relevant literature covering global disease burden, status of dementia and management of the same in developed and developing countries, strategies for managing dementia cases, challenges in the use of caregivers in management of dementia, technology intervention in management of dementia, potential in the growing mobile technology and finally, an overview of Health landscape in Kenya.

## 2.2 Disease Burden and Healthcare Challenges

The United Nations (UN, 2000), a global community of Nations recognized the challenges of global disease burden and its profound negative effects on quality of life, global development agenda and economy. The UN has continuously made attempts to rally the community of nations towards a common focus, with regards to addressing the global disease challenge. In the year 2016, the global community of nations under the umbrella of United Nations launched Sustainable Development Goals (SDGs), a global initiative whose primary purpose was to rally the global community in an attempt of addressing the global development agenda (UN, 2016). The SDG initiative was designed as a successor to Millennium Development Goals (MDG), SDG is anchored on seven key goals, which outline various aspects of global development that must be realized by the year 2030. The third goal focuses on health related issues (Table 1.0)

*Table 1.0: The SDG Goal Number 3.*

| Goal 3.0 | Description of the targets |
|---|---|
| 3.1 | Lowering of the global maternal mortality |
| 3.2 | End preventable deaths of new-borns and children under 5 years of age |
| 3.3 | End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases |
| 3.4 | Reduce premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being |
| 3.5 | Strengthen the prevention and treatment of substance abuse (narcotic drug abuse and harmful use of alcohol) |
| 3.6 | Reduce by halve global deaths and injuries resulting from road traffic accidents |
| 3.7 | Ensure universal access to sexual and reproductive health-care services, including; family planning, information and education |
| 3.8 | Attain universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all |
| 3.9 | Substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination by the year 2030 |

(**Source**: UN, 2016)

## 2.3 Dementia: Status, Care, Intervention and Management

### 2.3.1 Dementia Status Globally

The World Health Organization (2017) report estimates that there are currently fifty million dementia cases globally and the trend is such that nearly ten million new cases are identified annually. In Africa, growth rate of aging population is the fastest in the world (WHO, 2017) and it is therefore projected that greatest economic burden will be due to dementia, because of increasing longevity. Dementia is clearly a growing global challenge. The gradual loss of memory implies that there is a high probability of a patient with dementia failing to adhere to important treatment regime; adherence to medication and clinical appointments

According to Kindell et al, (2016), there is a gradual and progressive interest in providing support for people with dementia and their family. In United Kingdom, the department of health set up a National Dementia Strategy (Department of Health, 2009), which offered specific recommendations to National Health Service (NHS) and local government, towards improving care for dementia cases. Hoof et al, (2009) pointed out that significant challenges exists in supporting adults with dementia to live active and healthy in places of their choice. There are strong suggestions to the effect that technology is a potential tool that may be used to effectively support adults living with dementia and as well as their care givers.

### 2.3.2 Dementia Management in Developed Countries

Developed countries have comprehensive programmes designed to aid in enhancing management and care given to persons with Dementia. Shaji (2009) argued that the dementia challenge in developed countries was made easier through early detected and that these countries have had more time to craft solution in the form of comprehensive legislation, stable and robust health and social care systems, innovative care strategies and services, effective treatment programmes for early cases, a range of available assistive technologies, resulting into a fairly streamlined and controlled environment for managing the challenge. In these countries, the strategies for managing and caring for demented persons have been positively impacted by three factors; strong economies, advanced experiences in research on the subject and advanced and readily available assistive technologies. Elaborate and effective dementia care and management strategies (Kindell et al, (2016) have been designed, developed, implemented, evaluated and improved over time. The adoption of technology and acceptance of Care-Homes strategies for the elderly, supported by effective legislation have worked well towards ensuing improving health care for dementia cases.

### 2.3.3 Dementia Management in Developing Countries

The management and care for persons with dementia condition is significantly different in developing countries compared to developed countries. In most cases, the care for demented person is left to the caregivers who in most cases are close relatives or neighbours. In most developing countries, traditional approach to dementia care has been adopted; use of caregivers. Since dementia management and care is resource intensive, the economic challenges make management of dementia a great challenge in low resource regions. Generally, caregivers take on

the care duties as one among their routine activities. According to Prince et al., (2007), attempts to deal with the dementia challenge is faced three major hurdles; weak economy that limit resources that can be channelled to healthcare, challenges in technology innovativeness towards dealing with dementia and lack of legislative strategies for dealing with the emerging dementia challenge. Prince et al (2007) further argued that governments in low resource regions, a typical description of the developing countries have the tendency to avoid involvement in the management of dementia challenges and do not invest in a comprehensive long term care or financing plans. Quintero-Osorio (2012) recommended a five-point strategy for dealing with the challenge of dementia in developing countries; investing in research, developing a mechanism for early detection and providing sufficient support for affected persons, providing quality care, and finally creating public awareness about prevention and caregiving.

### 2.3.4 Challenges of Using Caregivers Strategy

Provision of care for persons with dementia may negatively impact on the wellbeing of the caregiver, especially when the affected person has severe cognitive and memory impairment (Han et al., (2014). When the wellbeing of the caregiver is at its best, the quality of the care to the recipient has been found to improve. Dais et al., (2008) and Gavrilova (2008) pointed out that sustained support for the caregiver was an essential component in enhancing quality of care for affected individuals. Given the possible adverse negative outcome on the quality of care when the wellbeing of the caregiver is compromised, there is need to provide caregivers with tools that can aid in providing care, in order to lessen the burden associated with this nobble responsibility. Han et al., (2014) estimated that dementia population will grow to 140 million people by 2015, a scenario that would triple the burden of care for persons with dementia, which is a strong justification for research into possible innovative approaches that may enhance care for dementia. Research into the potential of eHealth solutions provides a possible opportunity to lessen the burden of dementia care.

## 2.4 Technology Intervention in Dementia

The use of technology in management of dementia has been explored. Lauriks et al, (2007), suggested that technology tools can lower limitations brought about by dementia condition; enhances patient’s confidence, leading to an overall positive impact on their lives. This is

evidently shown in an example where a hand held computer registers and keeps track of a patient's medication regime and emits a signal at the designated time, when a patient needs to take medication. Meiland et al, (2007) established that people with dementia have a general positive attitude about using technology devices to facilitate and enhance their independence and reduce family stress. In the United Kingdom, attempts to use mobile phone text message reminders for dementia patients with oral antipsychotic medication prescriptions have been reported. The technology has been found to work for affected persons, regardless demographic, diagnostic characteristics, attitudes towards medication or levels of past adherence to medication regime (Bogart et al, 2014). SMS-based reminder technology solution have been tested in treatment regimens associated with other diseases. Otieno et al, (2014) established that in cases of care for children with malaria in Western regions of Kenya, there was high willingness of caregivers to receive text message reminders to enhance adherence intervention requirements. According to Horvath et al, (2012), there was strong evidence to the effect that mobile phone text messaging, scheduled at weekly intervals was efficacious in enhancing adherence to antiretroviral as compared to standard care.

A significant number of studies (Landau et al., 2010; Living made easy, 2010; Sävenstedt et al., 2010; Mulvenna et al., 2007; Martin, Bengtsson and Dröes, 2010; Gagnon-Roy et al., 2017; Ashok, 2008) have focused on technologies of used by persons with dementia and therefore little has been done on assistive technologies for the care givers.

## 2.5 Growth and Utilization of Mobile Technology

Adoption of Information and Communication Technologies (ICTs) permeates many aspects of life, with positive impact the life of common man. Globally statistics (Table 2.0) show that the uptake and use of Mobile technology has been more rapid in developing countries. According to ITU (2017), 98.7% of global population has access to some form of mobile technology for communication purposes. This therefore means that an estimated 7.3 billion out of 7.4 billion global population, have access to a mobile phone. An estimated 5.7 billion of the total global subscriptions can be traced to developing countries.

*Table 2.0: Mobile Phone Global Statistics*

| Mobile Subscriptions Estimate (millions) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Region** | **YEARS (2005 – 2014)** | | | | | | | | | |
| | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014*** |
| **Developed** | 992.0 | 1,127.0 | 1,243.0 | 1,325.0 | 1,383.0 | 1,404.0 | 1,411.0 | 1,447.0 | 1,490.0 | 1,515.0 |
| **Developing** | 1,213.0 | 1,618.0 | 2,125.0 | 2,705.0 | 3,257.0 | 3,887.0 | 4,453.0 | 4,785.0 | 5,171.0 | 5,400.0 |
| **World** | 2,205.0 | 2,745.0 | 3,368.0 | 4,030.0 | 4,640.0 | 5,290.0 | 5,863.0 | 6,232.0 | 6,662.0 | 6,915.0 |

(**Source**: ITU, 2016)

In Kenya, growth in uptake of mobile telephone has been phenomenal. Communications Authority of Kenya (CAK) estimates that the current subscriptions stands at **38,596,928** subscribers, translating to a penetration of 87.3% as at September 2016.

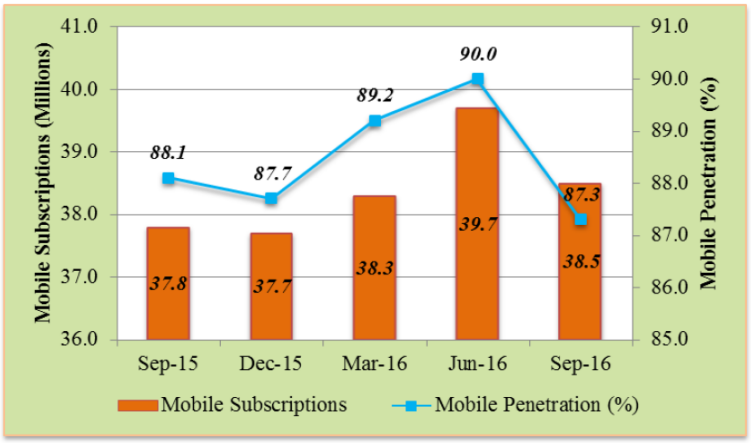



*Figure 1.0: Mobile Phone Growth and Penetration*

(**Source**: CAK, September 2016)

The growth in mobile technology in Kenya has led to numerous successful mobile based innovations. The Table 3.0 shows a summary of the successful initiatives.

*Table 3.0: Mobile Technology Innovations*

| Initiative | Sector | Brief Description |
|---|---|---|
| Sema Doc | Health Sector | A mobile based application available on 24 hours/7 days a week basis and enables individuals seeking healthcare to have a direct interaction with doctors; for quick consultation, diagnosed and treatment, no matter the time and location of the individual (Mediamax, 2015). Sema Doc solution was found to contribute significantly to |

| | | |
|---|---|---|
| | | improving access and quality of healthcare while at the same time lowering healthcare costs to patients. |
| mFarm | Agricultural Sector | A mobile based application designed to aid smallholder farmers in rural areas to access useful information on available markets for their produce as well as enhances communication between buyer and sellers. It was found to significantly improve access to information; easier, faster, cheaper, reliable and current (Mfarm, 2012). |
| Mpesa | Financial Sector | A mobile based application owned by Safaricom Limited, a telecommunications Company in Kenya, which is available to users who register. It primarily uses SMS codes to effect money transfer services. It provides a convenient and secure way to transfer money and it has been especially useful banked and unbanked individuals (Morawezynski, 2009). |
| ZiDi Application | Health Sector | An integrated enterprise management application, designed to primarily to track Utilities: services utilization, commodities consumption, expenditure, personnel and health indicators including tackling the quality of maternal and child healthcare, track procedures, drug inventory, lab tests, and facility revenues. The application aids in forecasting the demand as well as utilization. |
| Omnio and the Health eVillages App | Health Sector | Designed to assist medical professionals by availing current and up-to-date medical and healthcare information to clinicians to enhance service delivery: it enables clinicians to get drug information, research and recent development in medicine as well as disease diagnosis guide (HealthVillages.org). |
| "R U OK 2day?" | Healthcare | Designed to enable community health workers to make follow-up on patients via text messaging to establish whether they are getting well. Targeted patient responded with the text message “shida”, a Swahili word indicating that there is a problem, a response that alerts and prompts the health worker to visit the patient (Rukikaire, 2010). |

(**Source**: Literature)

## 2.6 Mobile Technology in Healthcare: Utilization and Outcomes

Outcomes of numerous studies on mHealth point to a gradual and steady growth in the confidence in the use of mobile based solutions to enhance efficiency, effectiveness and quality of healthcare services (Klasnja and Pratt, 2012). Mobile technologies and applications have been successfully applied in healthcare to accomplish various needs. The growth acceptance and use of mobile technology solutions is a positive step and adds to the pool of growing evidence that proves that mobile technologies have the potential to enhance preventive and curative strategies for tackling and managing the global disease challenge (Klasnja & Pratt, 2012; WHO, 2011b; Mechael et al. 2010).

The mHealth application areas that include:

- *Transmission of test results to patients via SMS messages*

  This mHealth innovation attempts to reduce the cost of travelling to and from a healthcare facility to collect test results (WHO, 2011c). The results are transmitted to the patient's cell phone via a text message. The patient can then embark on the next course of action in the nearest healthcare facility.

- *Remote Collection and submission of health-related data to a central repository*

  Disease surveillance data is more useful when made available in near real-time, for quick decision making. Traditionally, the data is collected throughout the month and once in a month, on an appointed day, the worker meets to tally the figures. To enhance the near real-time submission and lower the cost associated with data collection exercises, mobile applications have been developed and used to collect and submit health and disease occurrence data to a central repository (Kagiri et al., 2015).

- *Public health and lifestyle promotional messages*

  Public healthcare campaigns have traditionally been carried out in public gathering, an approach that is slow and expensive. An emerging new way of carrying out public promotional health campaigns is the use text messages, multimedia images or integrated voice recordings. These messages can be delivered to the mobile phones of the targeted population regardless of their physical geographical location (Mupela, Mustarde and Jones, 2011).

- *Appointment and Medication reminder*

  The appointment and medical reminder technology solutions are send to patients in form of text messages to enhance the rate of adherence to clinical appointments as well as medical treatment regimes. (Singh et al. 2012; Sidney et al. 2011).

- *Linking Community Health Workers(CHW) in remote areas with clinical expert*

  Community Health Workers in remote locations may encounter complicated medical cases and my need the advice of clinical expert. The mHealth solutions in this category link Community Health Worker in the field and clinical officers (Luk et al. 2009; Vital Wave Consulting, 2009a).

- *Automated Clinical advice*

  The solution is pre-programmed with clinical and diagnostic information. When a user sends a text message, the user is guided through a series of steps depending on the choices made. Automated clinical tips on specific health issues are given as responses depending on the user questions or request (WHO, 2011c; Vital Consulting, 2009).

## 2.7 Mapping mHealth initiatives in Kenya

The ministry of health has made efforts towards exploring the potential provided by the mHealth solutions. The development and publication of the Kenya eHealth Strategy (2011) by the Ministry of Health was an initial step aimed at ensuring that the design and implementation of mHealth solution followed a guided process. The Strategy is defined by five building blocks (Figure 2.0)


*Figure 2.0: Kenya eHealth Strategy*

(**Source**: KNeS, 2011)

The results of a study by Njoroge et al., (2017), in a survey to map out eHealth initiatives in Kenya indicated that there was a steady gradual growth in eHealth initiatives and that mHealth initiatives account for 69% of all electronic health initiatives (Figure, 3.0).

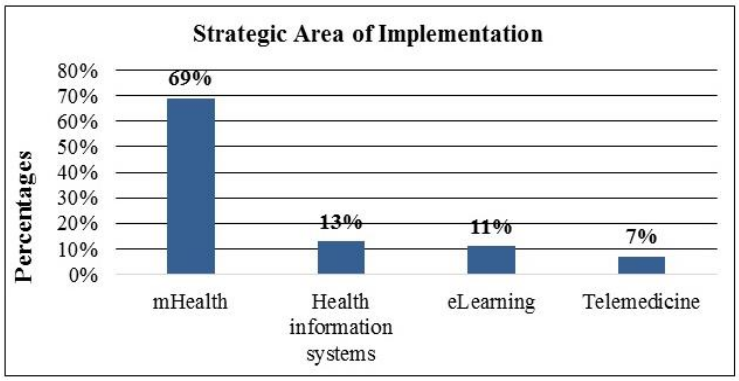



***Figure 3.0**: eHealth Solutions Distribution in Kenya*

(**Source**: Njoroge at al., 2017)

The mHealth initiatives are distributed as shown in figure

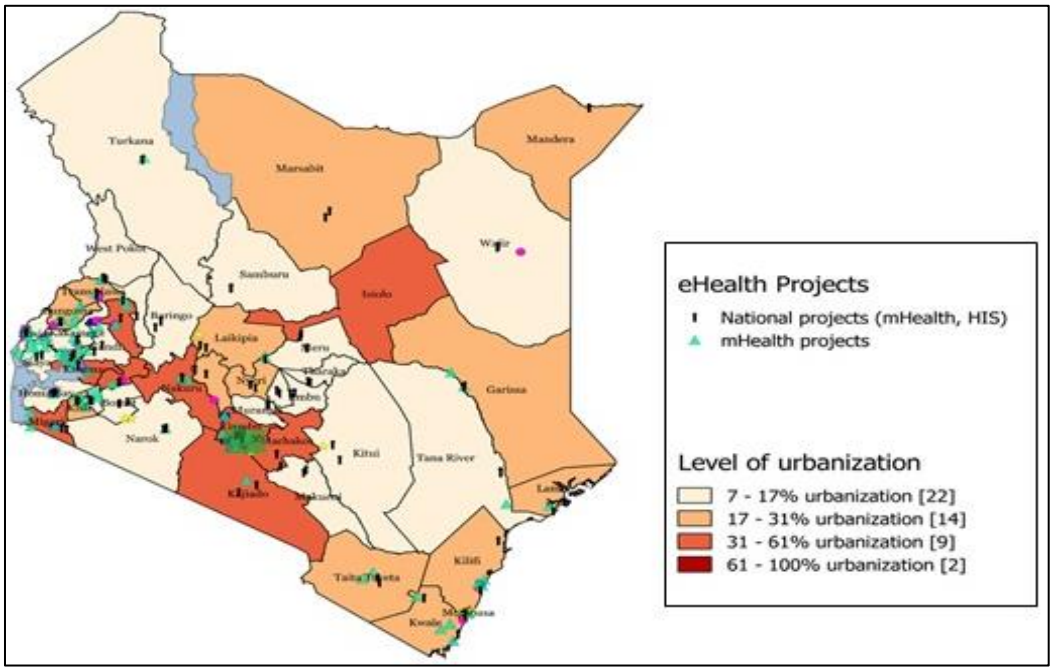



***Figure 4.0**: mHealth Project Landscape Map*

(**Source**: Njoroge et al., 2017)

## 2.8 Gap Analysis

Caring for person with dementia is labour intensive exercise. Whereas the potential of Mobile technology to enhance healthcare has been evaluated in many areas of health, literature does not

show evidence of the same being used for caregivers in cases dementia. Further, research in the developed countries revealed that, individuals with dementia are fairly excited about the use of technology to gain some level of independence when carrying out basic daily life activities (Meiland et al, 2007). Attempts to deal with the dementia challenge in developing countries is faced five major hurdles; weak economies that limit resources that can be channelled to healthcare, lack of comprehensive policies tailored to address the dementia healthcare challenge, little development in research to understand the identify the appropriate technology solutions for dementia cares in developing world, lack of affordable and tested technological solutions to addresses the challenge or to aid in managing the care. Finally, although caregivers strategy for case of person with dementia plays an important role in the management and care of persons with dementia, little research has explored to establish potential outcome of use of assistive technologies for caregivers.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

Kothari (2006) and Sivasubramaniyan (2012), agree that strategy and tools selected for use in research have an impact on the validity, reliability and quality of the outcome of a study. Research Methodology Appropriate strategy and tools are therefore a prerequisite if the outcome of the research is to be utilized to solve real problems. This chapter describes the steps, techniques and tools used to realize the research objectives and is organized as follows: Research Design, Research Process, Study Population, Sampling Technique and Sample size, prototype Requirements Gathering and Analysis Procedure, prototype Design, Development and Testing, prototype Deployment, Data Sources and Collection, Data Analysis and Fulfilment of Ethical requirements.

## 3.2 Research Design

The study adopted an exploratory research design. This was informed by the fact that there are few studies that have been done to evaluate the outcome of use of assistive technologies by caregivers in cases of patients with dementia. Studies relating to use of technology in cases of dementia have focused on enhancing memory retention for the patients.

## 3.3 Pre-study - Understanding the Dementia Condition in Kenya

A short exploratory qualitative pre-study, using interviews as a data collection tool was carried in Mathare Mental Hospital of Nairobi to help the researcher to gain an indepth understanding of the dementia status and key issues in Kenya. The pre-study involved ten respondents (*n=10*); six caregivers, two patients, two nurses, to gain a clinical understanding of the dementia condition. The study defined one criteria condition that was to be met by the Nurses and Caregivers selected to participate in the pre-study; the participant must have had experience of not less than five years in dealing with dementia patients. This duration was deemed sufficient for the participants to have accumulated enough experience and exposure that had allowed them to give facts and informative opinions relating to care and management of dementia. The participants involved in the pre-study were not included in main study. The aim of this step was to identify effects of dementia condition on a patient, challenges associated with managing affected persons, treatment or management regimes that affected persons are subjected to, assistance required by

the caregivers in their effort to manage the condition, possible assistive technologies that may be useful to caregivers and general attitude of demented person as well as care givers towards use of assistive technologies.

### 3.4 Population of Study

Mathare Mental hospital ; a healthcare facility that focuses on treatment and care of mental related healthcare challenges, has an estimated 3,550 persons suffering from Dementia who seek healthcare services in the hospital. On average, most of the individuals are above 50 years old and suffer from various ailments that require them to periodically and consistently attend clinical consultations. The study targeted care givers responsible for persons with dementia, who sought healthcare services in the hospital.

### 3.5 Sampling Technique

This study employed simple random sampling technique when identifying respondents. In this technique, participants were randomly selected from a previously prepared list of selected respondents. The Random sampling technique ensured that possible bias dealt with, a condition that has the potential to negatively impact on the outcome. Since the mild dementia condition has the same effects on affected persons, random sampling was deemed sufficient.

### 3.6 Sample Size

According to Kothari (2006) a study sample is necessary when it is not practically possible to research an entire population and an optimum sample is one that fulfils the requirement of representativeness and reliability. Mugenda and Mugenda (2003) argue that when the situations, resources and time permit, a researcher must ensure that the study sample is large enough to guarantee reliability of the outcome. Hair et al (2010) recommended a guideline on the selection of an optimal research sample size, for generalizability of the outcomes. Hair recommended that a sample should generally be larger than 30 and less than 500. The study utilized a sample size of 30 respondents from Mathari area of Nairobi City County, guided by the arguments and recommendations of Kothari (2006), Mugenda and Mugenda (2003) and Hair et al (2010).

The process of determining the sample size involved two steps;

- First, the study identified potential respondents (caregivers). Mathari Mental Hospital played a crucial role in identifying the first few care givers. The rest of the caregivers were

identified through a snowballing technique, where the first few caregivers identified, pointed out the other caregivers. In addition to identifying the caregivers, other pertinent information about the potential respondent that would be crucial to the quality of the study were confirmed. The information include the duration of time that the caregiver had been in the service, the challenges they had faced in the process of discharging their services and their willingness to voluntarily participate in the study as well as the willingness of the person under their care to voluntarily participate in the study. Additional information captured included; personal attributes of the respondent; age, ability to read and understand instruction - established through level of education, their access to and ability to operate mobile phones and any other challenge the were likely to face for example ensuring that their phone was charged and operational at all times. In total, fifty six caregivers who met the outlined criteria were identified.

- The second phase involved the selection of actual respondents from the list of potential respondents who had met the defined threshold. Out of the fifty six caregivers identified, thirty care givers were randomly selected. The cost of the rewarding instances of adherence limited the number to 30 respondents only. Each respondent was briefed on the study, their role in the study and the duration that they were expected to participate in the study. Finally, an informed consent note was presented to caregivers and they were given 7 days to carefully consider and make a decision on their willingness to voluntarily participate in the study.

## 3.7 Prototype Design and Development

### 3.7.1 User Requirements Gathering and Conceptualising the Prototype Design

The first step in the development of the application in this study, was gathering the user needs and requirements from the initial sample of respondents who participated in the pre-study. The requirements gathering and analysis process was carried using interviews with twelve (*n=10*) persons .An interview guide (**Appendix I: iii to v**) was used to systematically establish the basic functional requirements for designing an SMS based prototype.

### 3.7.2 Prototype Functional Requirements Specification

The functional requirements specification focused on establishing:

i. The most appropriate messages content and message formats that could be used in the reminders.
ii. The number of reminders that needed to be sent to the participants
iii. The time interval between the reminders and the frequency as patient approached the date of the clinical appointment.
iv. The most appropriate time of the day for receiving the reminder.
v. Establishing whether there were challenges accessing a mobile phone or charging of the mobile.

### 3.7.3 Prototype Architecture and Design

The prototype architecture (**Figure 5.0**) includes various components, each with defined functions

***Prototype Functional Components***

*i.* *Hospital Personnel Access Point*

This component of the prototype enables the hospital personnel to review the patient's records and doctors diagnosis verdicts and set the SMS based reminders for the next appointment.

*ii.* *Database Server*

This component enables the capturing records associated with all patients who are scheduled to receive reminder.

*iii.* *Application Server*

Server contains and runs the application that is used to program and schedule the appointment reminders. This application server is accessed by the hospital personnel who have the required privileges to modify and schedule reminders.

*iv.* *Patient Access Point*

This component enables the patient to receive reminder SMS about the next appointment that they need to honour.

***Prototype Components***

The design and the architecture of the prototype is shown in Figure 5.0. The architecture shows the components of the prototype, the role of the components and how the flow of the messages from the prototype to the targeted respondent.

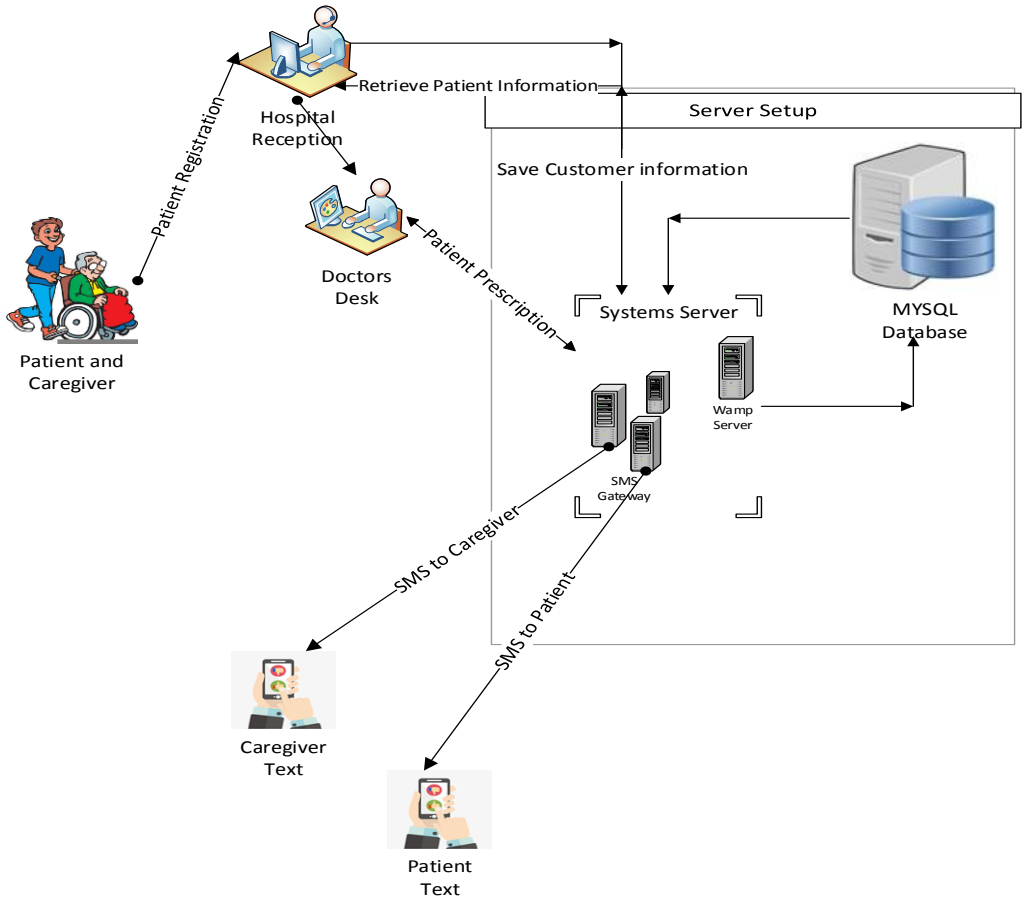



***Figure 5.0**: Prototype Architecture*
(**Source**: This study)

### *Prototype Organization and Process Flow*

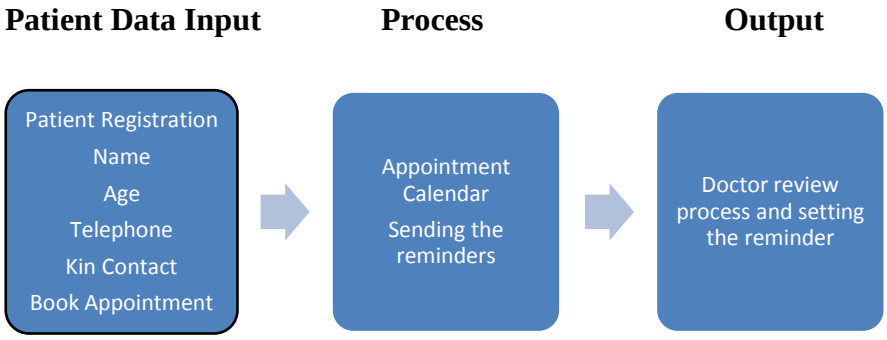


*Figure 6.0: Prototype Processes and Logic Flow*

**(Source**: This study)

***Message Content and Frequency***

The reminder text message was designed to be simple and short; content was limited to approximately 24 words. The reminders were sent in the mornings before 8:30 am. The message was designed to communicate a reward component and a consequence component in order to motivate both the caregiver and the patient to put in their best efforts towards compliance.

***i. SMS content***

The message was structured to address five important components:

i. Capture and attract the participants' attention
ii. Explain the reason for the message – Clinical Appointment.
iii. Specify the date of the appointment
iv. Encouragement to honour the appointment
v. Specified the clinician that would attend to them

**"*Hello John Doe your appointment is on 2018-03-15 with a cash reward of KES 500, failure to which you will forever loose their memory. You will be seen by: Dr. Mary*"**

***ii. Reminder SMS Scheduling and Frequency***

The reminder messages were sent to the participant at intervals defined in the table 4.0

*Table 4.0: Reminder SMS Frequency*

| Reminder SMS | Period Before Appointment Date and Time |
|---|---|
| First Reminder | 14 Days Before Appointment Date |
| Second Reminder | 7 Days Before Appointment Date |
| Third Reminder | 1 Day Before Appointment Date |
| Fourth Reminder | On the Appointment Time |

(**Source**: This study)

### 3.7.4 Prototype Development

***Prototype Development Environment and Resources***

The prototype was primarily developed in Java. The development environment included;

- MySQL Database.
- WAMP/LAMPP Webserver.
- PHP scripting language.
- NetBeans IDE - HTML editor for streamlining PHP development process.
- MySQL Workbench – Graphical User Interface for administration.
- Java development Language for Short Messaging Service development and execution.

***Prototype Development Approach: Agile Methodology***

The study adopted the agile system development methodology. The adoption of this methodology was informed by the fact that the agile methodology breaks tasks into small iterative incremental components that typically last between one to four weeks. The following principles were followed in the process of developing the prototype for the study.

i. Useful changes in requirements to the prototype, based on feedback from participating stakeholders were accommodated in all stages of development. The study identified ten stakeholders; six caregivers, two patients, two nurses (Section 3.3 and Section 3.7.1) who provided critical feedback. The stakeholders were constantly and actively involved in the design, development and testing processes through feedback and reflection that led to an enhanced and more improved prototype (Henderson-Sellers and Serour, 2005; Highsmith and Cockburn, 2001; Cockburn, 2007). Constant interaction with stakeholders at short intervals enabled manoeuvrability and effecting of quick changes in the development process.

ii. The Agile methodology defines version or subset of the following activities: Planning and Visualization of the entire project, User and functional requirement analysis, Software Modelling and logical design, Coding, Documentation, Testing for functional requirements, and Deployment of the prototype and Maintenance (Maheswari and Jain et al, 2012). The study modelled the user requirement, functional requirements and the logic and data flow in the prototype by constantly seeking feedback from the ten stakeholders. The feedback given was evaluated, its implementability evaluated and where

modifications were possible, they were incorporated in the development. This iterative process continued until a consensus was reached among all stakeholders.

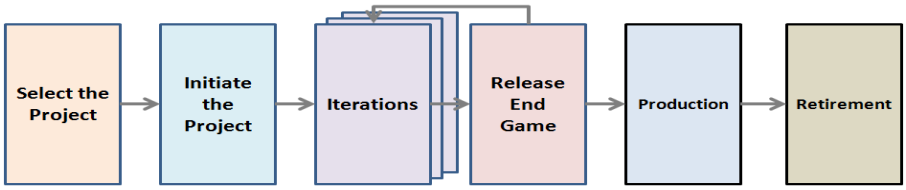



*Figure 7.0: Agile system development methodology*
(**Source**: Scott, 2014)

### *Prototype Coding*

**Web Portal Login**

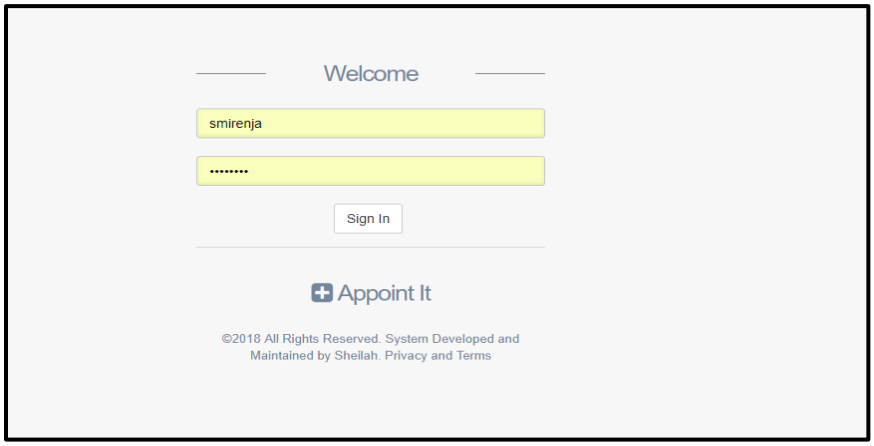



***Figure 8.0**: Web Portal Login*
(**Source**: This study)

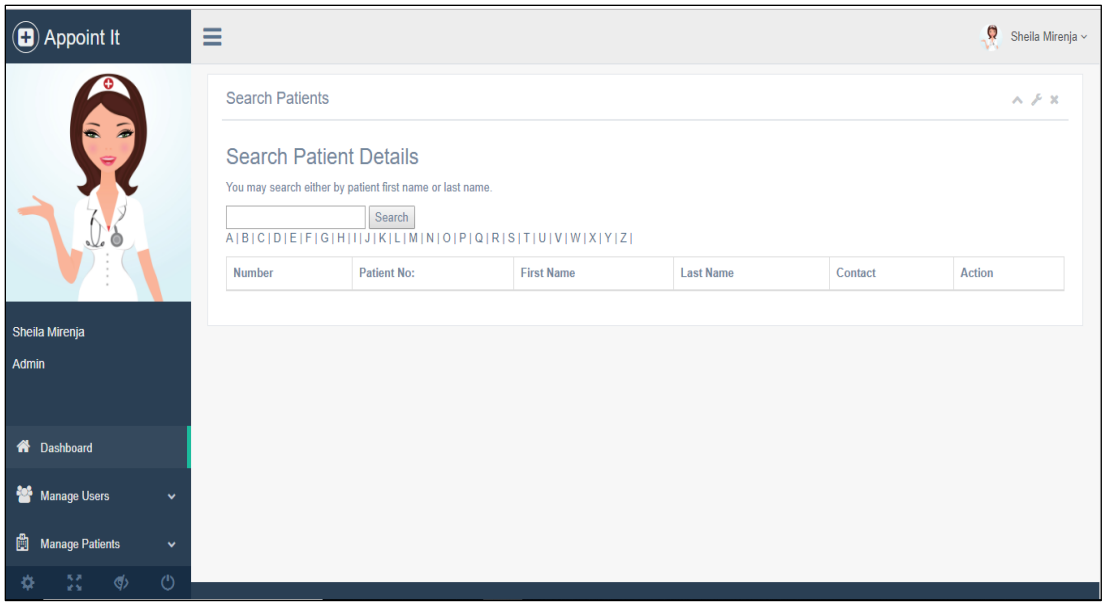



*Figure 9.0: Prototype Dashboard*
(**Source**: This study)

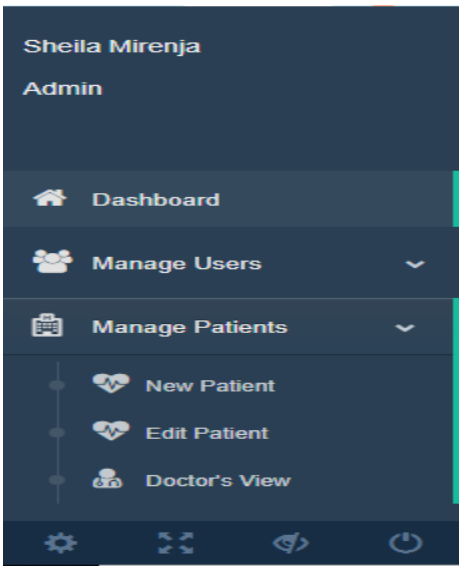



***Figure 10.0**: Prototype Menu*
(Source**: This study**)

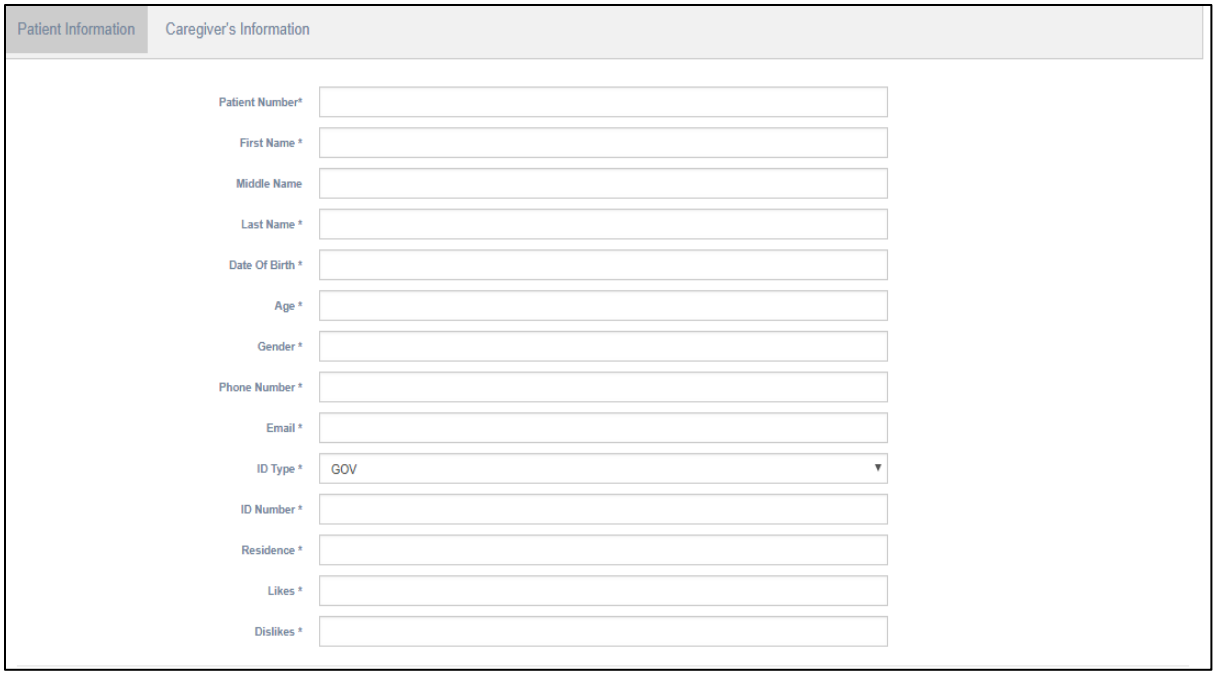



***Figure 11.0**: Patient Information Capture*
(**Source**: This study)

Enter the patient's information with the asterisk indicating that the fields are mandatory. To get a full patient profile you will have to enter the patient's Caregiver Information from the following tabs.

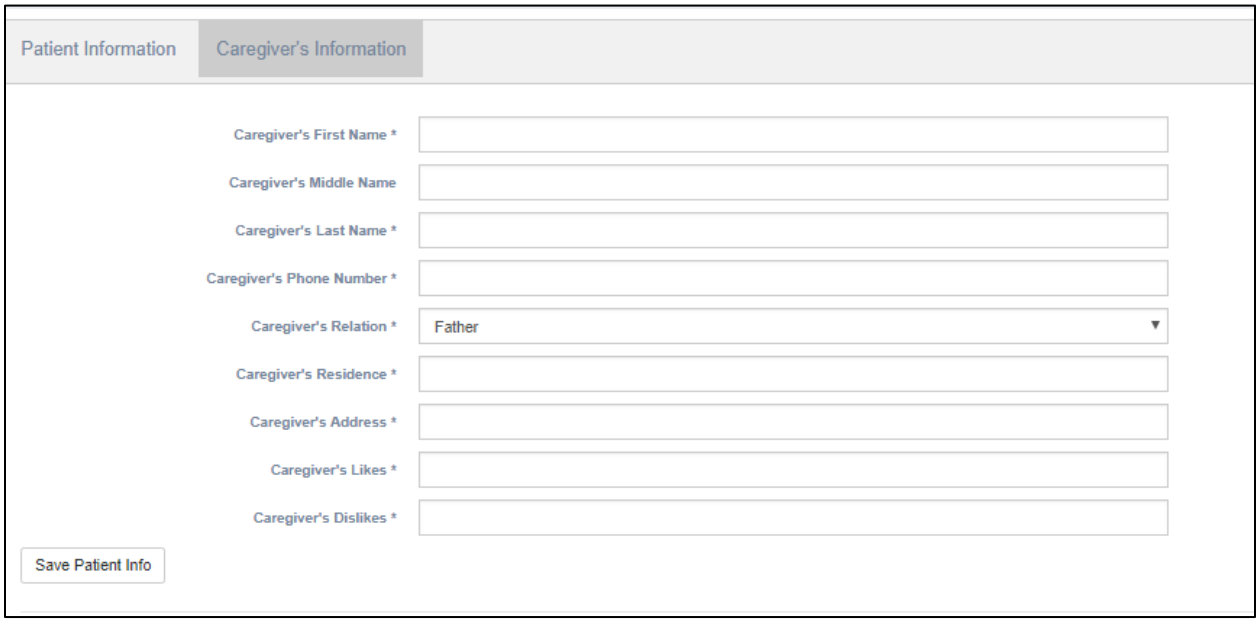



***Figure 12.0**: Caregiver Information Capture*
(**Source**: This study)

The doctor searches the patient using the name as shown


***Figure 13.0**: Booking New Patient Appointment*
(**Source**: This study)


***Figure 14.0**: Searching New Patient*
(**Source**: This study)

Then book appointment as shown in Figure 15.0

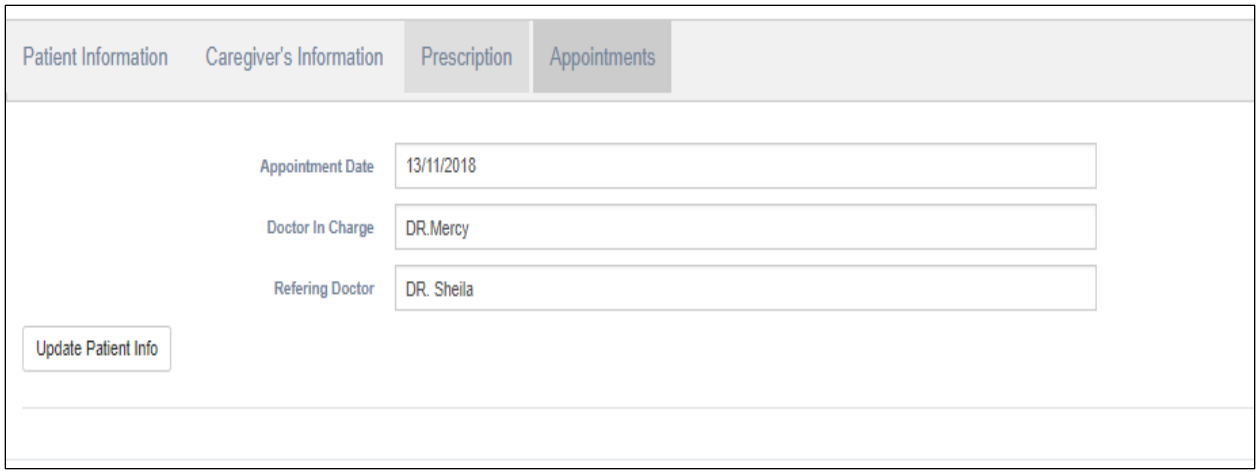



***Figure 15.0**: Booking New Patient Appointment*
(**Source**: This study)

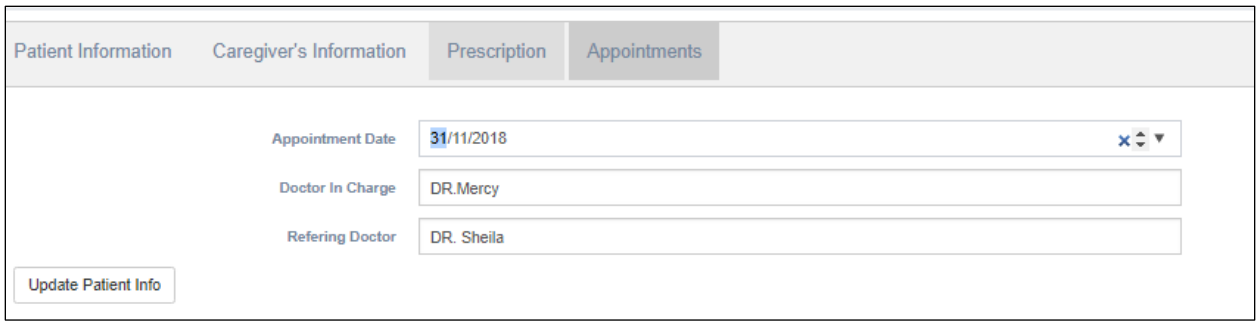



***Figure 16.0**: Editing Patient appointment*
(**Source**: This study)

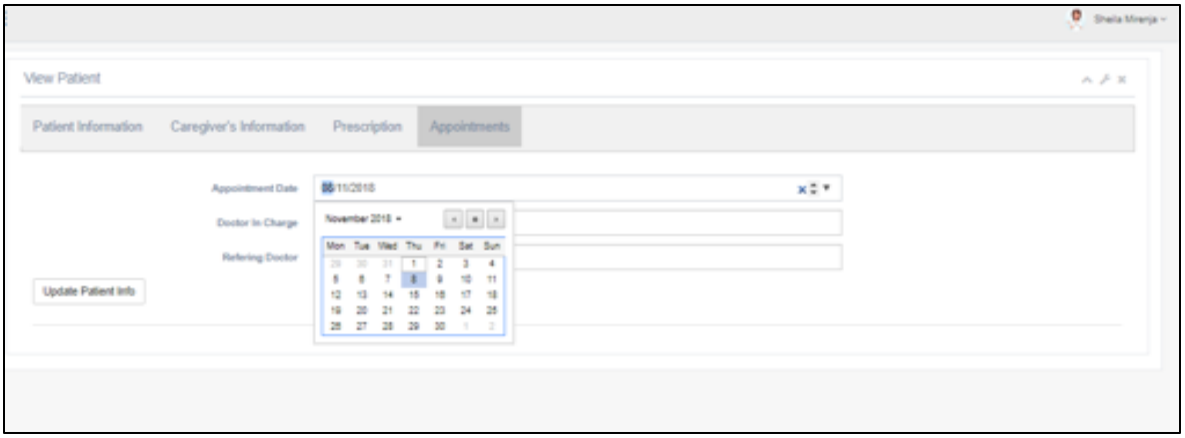



*Figure 15.0: Editing Patient Appointment*
(**Source**: This study)

A patient can be assigned a new appointment and a doctor to examine them.

### 3.7.5 Testing Functionality of the Prototype

The prototype functions were systematically tested at different levels to confirm functionality.

- **Level 1**: Individual unit codes were tested
- **Level 2**: Module Level were tested
- **Level 3**: Scheduling for appointment, Sending SMS and Database capture of reminder activities.

The testing of the functionality of the system included;

- Ensuring respondent could be registered into the system using assigned identification codes
- Confirming that the message triggers (Time) worked properly
- Ensuring that the SMS was sent at the required time based on the assigned date of clinical appointment.
- Capturing the send statistics

The deployment of the system was done after the prototype was functioning as required.

## 3.8 Data Collection

The study utilized both primary and secondary data. The primary data was collected form the system; patients were tracked for four months and within this period, reminders were sent for the 15 scheduled clinical visits. The data for the clinical appointments and actual visits were capture

in the database of the system. When a respondent visited the clinic and was assigned their next data of appointment, the date of appointment was automatically entered into the prototype and the prototype automatically scheduled four reminders SMS messages for every appointment given to a respondent (table 4.0). Entries were also made into the prototype whenever a respondent honoured the clinical appointment. In total, 15 clinical appointments for each respondent, covering a period of four months were tracked and recorded. The secondary data consisted of the participant's previous appointments, captured in the form of manual records and stored at the hospital.

### 3.9 Data Analysis

Clinical adherence for the 4 months (fifteen clinical appointments) was analysed and compared to their previous levels of adherence (fifteen clinical appointments before the introduction of the technology). Analysis of the data involved comparing the rate of failure to honour clinical appointments computed from the secondary data and that which was computed from the primary data, which involved the use of SMS based clinical reminders.

### 3.10 Fulfilment of Ethical requirements

In order to uphold privacy, confidentiality and the right of the participants in this study and conform to the research regulations governing research and research activities involving human subjects, two conditions were met:

- Presenting a research brief to the participants and obtaining an informed consent from them. This step was geared towards ensuring that participants were informed on why the research was being carried out.
- Clearance for the research was obtained from the health facility: the interview guide, accompanied by an introductory letter detailing the purpose of the study, assurance of anonymity and confidentiality were delivered to the health facility.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.1 Introduction

The chapter discusses the results obtained based on objectives defined in Section 1.4 and using the methodology outlines in chapter three of study.

## 4.2 Dementia Care and ICT Support Services

The dementia care has the primary goals of improving comfort and quality of life for persons with dementia condition. Services provided with the aid of technology include:

- Cultivating and developing routines among persons with dementia to improve adherence to healthcare treatment regime that include clinical appointments and medication. Mobile phone technology utilizing SMS have been used to aid overcoming this challenge.
- Easing anxiety and developing confidence; persons with dementia require periodic entertainment and engagement for example constantly being assured about the time of the day. Periodically, video clips or photos are sent to give assurance to the persons and build their confidence, which aids in preventing depression and anxiety.
- Constant engagement to enhance memory retention capacity; repetition of important issues: automated reminder on important events for example their date of birth, names of their children, names of their spouse or when to take a shower.
- Constantly monitoring and tracking of the persons to ensure their safety and respond to any arising emergency for a speedy evacuation. Sensors that sent alerts on the movement of the person are attached to the bodies to give a precise location where the person could be, to prevent them from wondering into danger.

## 4.3 Prototype Description

The SMS Reminder prototype consisted modules, with each modules designed to carry out a specified function.

### 4.3.1 Prototype Functional Modules

Five modules were defined in the prototype and these were:

i. **A web-based Registration module** that capture the patient and caregiver details and assigns them identification codes.

ii. **SMS scheduler: component that** automatically schedules the SMS based on the doctor's recommendation for the next appointment for the patient.

iii. **Database Server**: this component captures and tracks sent SMS messages as well as capturing the honoured clinical appointments.

iv. **Message Server**: this component is responsible for sending out the SMS messages at the scheduled times.

v. The **Cell phone Handsets** for the caregivers and the patients

When a patients is brought to the clinic by the caregiver, the nurses capture the details of the patient and the caregiver into the system and allows them to have consultation with the doctor. After consultation and treatment, the doctor recommends the next clinical appointment which is entered into the scheduler. The scheduler automatically schedules four reminder SMS for both the caregiver and the patient. The message server sends out the schedule SMS messages at the defined frequencies (table 4.0) to the patient and caregivers number specified in the database. SMS reminder statistics are capture and recorded in the database server. Honoured clinical appointments are also capture into the database.

### 4.3.2 Sample SMS Reminder Messages Sent

The sample SMS reminder messages sent to the caregivers and the patients are shown in Figures 16.0 and Figure 17.0.

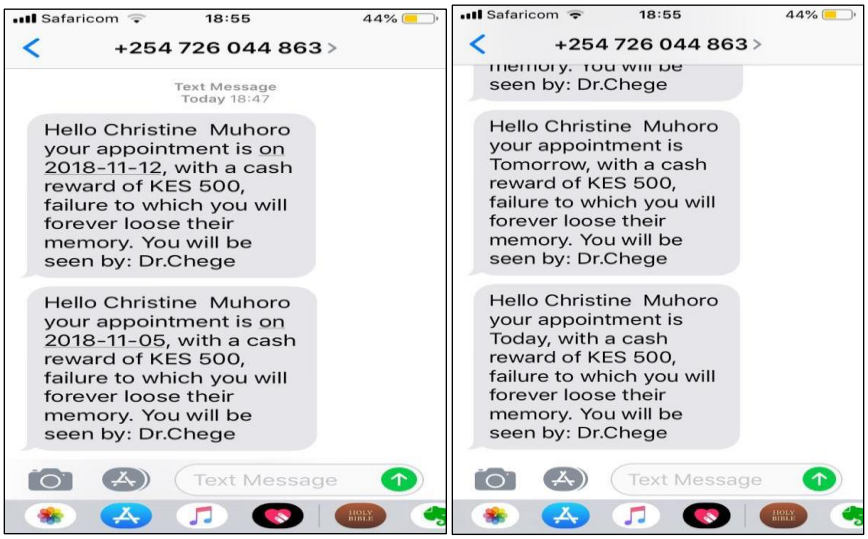



***Figure 16.0**: Sample SMS Reminder Messages to the Patients*
(**Source**: This study)

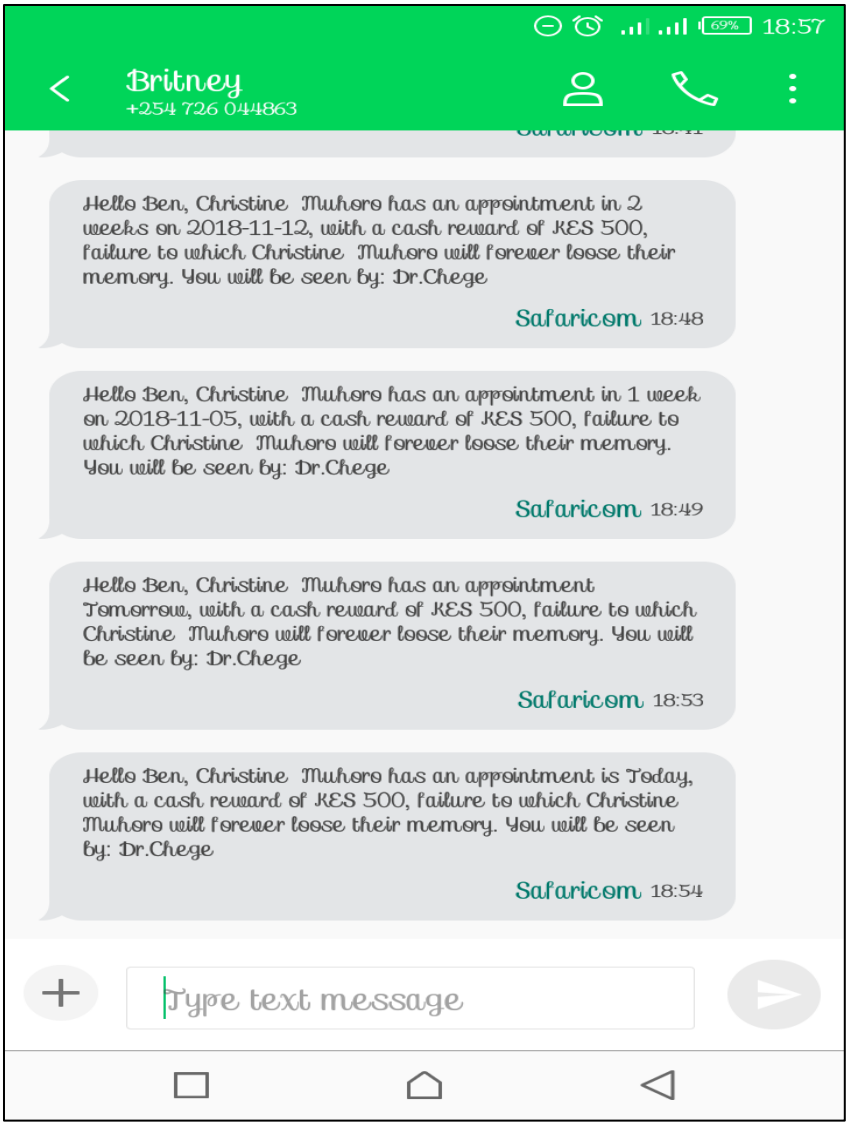



***Figure 17.0**: Sample SMS Reminder Messages to the Caregivers*
(**Source**: This study)

## 4.4 Participants Characteristics

### 4.4.1 Gender

The gender distribution for the study is a shown in table 5.0. This shows a fair variability of the gender distribution.

***Table 5.0**: Participants Gender Distribution*

| Male | Female | Total |
|---|---|---|
| 17 | 13 | 30 |

**(Source**: This study)

### 4.4.2 Level of Education

Analysis of the age brackets for the 30 participants in the study showed that all participants had attained Kenya Certificate of Secondary education. A further evaluation of the ability of the participants to read and write in the English showed that all participants had a fairly good grasp of the English language and in both written and verbal communication (Table 6.0).

***Table 6.0**: Participants Level of Education Statistics*

| GENDER | KCPE | KCSE (O Level) | Above O level |
|---|---|---|---|
| Male | 0 | 13 | 4 |
| Female | 0 | 8 | 5 |
| Total | 0 | 21 | 9 |

**(Source**: This study)

### 4.4.3 Age Bracket

The age distribution of the participants in the study had only three participants in the age bracket below the age of 50, an indication that 90% of the participant in the study were of the age of 50 years and above (Table 7.0).

***Table 7.0**: Participants Age Bracket Characteristics*

| Age Bracket (Years) | Male | Female | Total |
|---|---|---|---|
| Below 40 | 0 | 0 | 0 |
| 40 - 49 | 2 | 1 | 3 |
| 50 – 60 | 7 | 5 | 12 |
| Above 60 | 8 | 7 | 15 |
| Total | 17 | 13 | 30 |

**(Source**: This study)

#### *4.4.4 Mobile Handset Ownership, Operation of Handset and Utilization*

Analysis of the access to a mobile handset revealed the outcomes presented in Table 8.0:

***Table 8.0:** Access to Mobile Handset Analysis*

| Component | Status |
|---|---|
| 1) Handset Ownership and Access | Each of the participants had their own individual handsets and therefore had no challenge accessing a handset. Most of the participants had a string attached to the phone such that the phone would be with them throughout the day. |
| 2) Ability to operate Handset | Each participant was capable of operating their handset; to access and navigate to read messages. |
| 3) Access to Power | The participants did not have a challenge with charging the phone; they had access to power supply. |

(**Source**: This study)

## 4.5 Appointment Adherence: General Outcome

Table 9.0 and shows the records of appointment adherence as captured from the manual records before the introduction of technology and after the introduction of the SMS reminder system.

***Table 9.0**: Appointment Adherence: General Outcome*

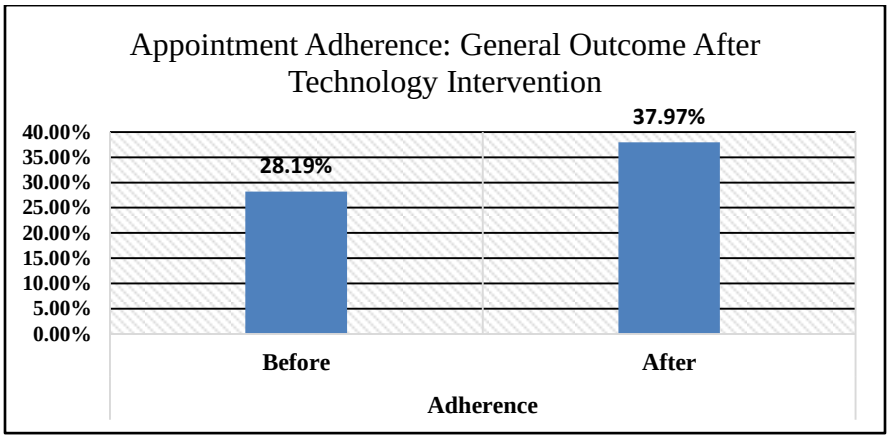
| Care giver Coded Identity | Clinical Appointment (4 Months) (15 Clinical Appointments: Number/Percentage Honoured) | | | | |
|---|---|---|---|---|---|
| | Before Introduction of Technology (Appointment Honoured) | | After Introduction of Technology (Appointments Honoured) | | Percentage Change |
| | Number | Percentage | Number | Percentage | Percentage |
| DP-AP-H-01 | 7 | 46.6% | 8 | 53.3% | 6.70% |
| DP-AP-H-02 | 3 | 20.0% | 6 | 40.0% | 20.0% |
| DP-AP-H-03 | 5 | 33.3% | 8 | 53.3% | 20.0% |
| DP-AP-H-04 | 5 | 33.3% | 5 | 33.3% | 0.0% |
| DP-AP-H-05 | 2 | 13.3% | 6 | 40.0% | 26.7% |
| DP-AP-H-06 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| DP-AP-H-07 | 4 | 26.6% | 3 | 20.0% | -6.6% |
| DP-AP-H-08 | 6 | 40.0% | 9 | 60.0% | 20.0% |
| DP-AP-H-09 | 5 | 33.3% | 6 | 40.0% | 13.3% |
| DP-AP-H-10 | 3 | 20.0% | 4 | 26.6% | 6.6% |
| DP-AP-H-11 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| DP-AP-H-12 | 3 | 20.0% | 8 | 53.3% | 33.3% |
| DP-AP-H-13 | 6 | 40.0% | 6 | 40.0% | 0.0% |
| DP-AP-H-14 | 7 | 46.6% | 5 | 33.3% | -13.3% |
| DP-AP-H-15 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| DP-AP-H-16 | 3 | 20.0% | 6 | 40.0% | 20.0% |
| DP-AP-H-17 | 6 | 40.0% | 7 | 46.6% | 6.60% |
| DP-AP-H-18 | 3 | 20.0% | 4 | 26.6% | 6.60% |
| DP-AP-H-19 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| DP-AP-H-20 | 5 | 33.3% | 3 | 20.0% | -13.3% |
| DP-AP-H-21 | 3 | 20.0% | 5 | 33.3% | 13.3% |
| DP-AP-H-22 | 3 | 20.0% | 7 | 46.6% | 26.6% |
| DP-AP-H-23 | 4 | 26.6% | 7 | 46.6% | 20.0% |
| DP-AP-H-24 | 5 | 33.3% | 7 | 46.6% | 13.3% |
| DP-AP-H-25 | 2 | 13.3% | 4 | 26.6% | 13.3% |
| DP-AP-H-26 | 5 | 33.3% | 5 | 33.3% | 0.0% |
| DP-AP-H-27 | 4 | 26.6% | 7 | 46.6% | 20.0% |
| DP-AP-H-28 | 5 | 33.3% | 6 | 40.0% | 6.70% |
| DP-AP-H-29 | 4 | 26.6% | 4 | 26.6% | 0.0% |
| DP-AP-H-30 | 3 | 20.0% | 5 | 33.3% | 13.3% |
| **AVERAGE** | **3.9/15** | **28.19%** | **5.7/15** | **37.97%** | **9.79%** |

(**Source**: This study)

Analysis of the adherence and comparison of the clinical appointment reminder statistics before and after technology was introduced is captured in Table 9.0 and Figure 18. Before introduction of the SMS based reminders, the average appointment adherence for the 30 participants was

28.19% but increased to 37.95%, indicating an improvement of 9.79%. The results tend to therefore suggest that the SMS based reminders had a positive effect.

***Figure 18.0:*** *General Outcome of Adherence Analysis for 30 respondents*




(**Source**: This study)

## 4.6 Appointment Reminder Outcome: Gender Analysis

Gender analysis of appointment adherence (Table 10.0 and Figure 19) show that for the group of female participants, the average appointment adherence was 28.17% before introduction of the SMS based reminder but improved to 36.37% on introduction of the technology component. This therefore means that on average, there was an improvement of 8.2%%. On the other hand, the average percentage adherence for the males was at 28.21% before the introduction of the technology but improved to 37.62% on the introduction of the technology, indicating an improvement of 10.98%.

***Table 10.0****: Appointment Reminder Outcome: Gender Analysis*

| Gender | Care giver Coded Identify | Clinical Appointment (4 Months) (15 Clinical Appointments: Number/Percentage Honoured) | | | | |
|---|---|---|---|---|---|---|
| | | Before Introduction of Technology(Honoured Appointments) | | After Introduction of Technology(Honoured Appointments) | | Percentage Change |
| | | Number | Percentage | Number | Percentage | Percentage |
| Female | DP-AP-H-03 | 5 | 33.3% | 8 | 53.3% | 20.0% |
| | DP-AP-H-06 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| | DP-AP-H-07 | 4 | 26.6% | 3 | 20.0% | -6.6% |
| | DP-AP-H-10 | 3 | 20.0% | 4 | 26.6% | 6.6% |
| | DP-AP-H-13 | 6 | 40.0% | 6 | 40.0% | 0.0% |
| | DP-AP-H-17 | 6 | 40.0% | 7 | 46.6% | 6.60% |
| | DP-AP-H-19 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| | DP-AP-H-20 | 5 | 33.3% | 3 | 20.0% | -13.3% |
| | DP-AP-H-22 | 3 | 20.0% | 7 | 46.6% | 26.6% |
| | DP-AP-H-23 | 4 | 26.6% | 7 | 46.6% | 20.0% |
| | DP-AP-H-25 | 2 | 13.3% | 4 | 26.6% | 13.3% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | DP-AP-H-27 | 5 | 33.3% | 5 | 33.3% | 0.0% |
| | DP-AP-H-28 | 4 | 26.6% | 7 | 46.6% | 20.0% |
| | **AVERAGE** | **4.2** | **28.17%** | **5.5** | **36.37%** | **8.2%** |
| | | | | | | |
| Male | DP-AP-H-01 | 7 | 46.6% | 8 | 53.3% | 6.70% |
| | DP-AP-H-02 | 3 | 20.0% | 6 | 40.0% | 20.0% |
| | DP-AP-H-04 | 5 | 33.3% | 5 | 33.3% | 0.0% |
| | DP-AP-H-05 | 2 | 13.3% | 6 | 40.0% | 26.7% |
| | DP-AP-H-08 | 6 | 40.0% | 9 | 60.0% | 20.0% |
| | DP-AP-H-09 | 5 | 33.3% | 6 | 40.0% | 13.3% |
| | DP-AP-H-11 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| | DP-AP-H-12 | 3 | 20.0% | 8 | 53.3% | 33.3% |
| | DP-AP-H-14 | 7 | 46.6% | 5 | 33.3% | -13.3% |
| | DP-AP-H-15 | 4 | 26.6% | 5 | 33.3% | 6.70% |
| | DP-AP-H-16 | 3 | 20.0% | 6 | 40.0% | 20.0% |
| | DP-AP-H-18 | 3 | 20.0% | 4 | 26.6% | 6.60% |
| | DP-AP-H-21 | 3 | 20.0% | 5 | 33.3% | 13.3% |
| | DP-AP-H-24 | 5 | 33.3% | 7 | 46.6% | 13.3% |
| | DP-AP-H-26 | 5 | 33.3% | 5 | 33.3% | 0.0% |
| | DP-AP-H-29 | 4 | 26.6% | 4 | 26.6% | 0.0% |
| | DP-AP-H-30 | 3 | 20.0% | 5 | 33.3% | 13.3% |
| | **AVERAGE** | **4.24** | **28.21%** | **5.82** | **37.62%** | **10.98%** |

(**Source**: This study)

A comparison of the female and male adherence improvement factor, it shows that on average, the improvement increased by almost the same factor; female 8.2% while the male was at 10.98%.

The results tend to suggest that on average, technology has the same effect on both males and females.

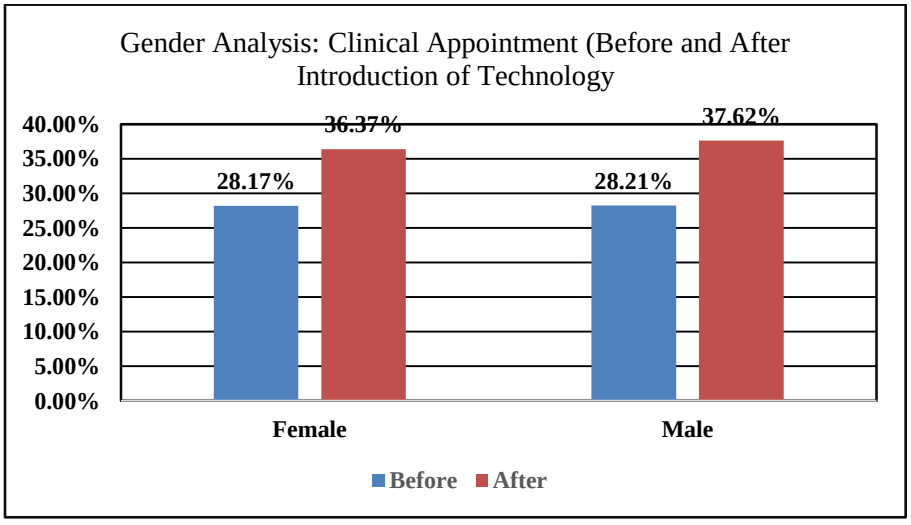



***Figure 19.0:*** *Gender Analysis of Adherence*
(**Source**: This study)

## 4.7 Appointment Reminder Outcome: Age Bracket Analysis

The outcome of on the appointment adherence is shown in Table 11.0 and Figure 20.0 Before introduction of the technology, the age bracket below 50 years had an adherence of 41.1% but this improved to 61.1% after the introduction of the technology, an improvement of 20.0%. On the other hand, the 50-60 age bracket achieved an adherence of 31.38%, which later improved by 19.44%, achieving 50.82%. Finally, for those above 60 years, adherence before introduction of technology was 28.88% but this rose to 48.43% after the introduction of technology, indicating an improvement of 19.55%.

***Table 11.0**: Appointment Reminder Outcome: Age Bracket Analysis*

| Age Bracket | Care giver Coded Identify | Clinical Appointment (3 Months) (10 Clinical Appointments: Number/Percentage Honoured) | | | | |
|---|---|---|---|---|---|---|
| | | Before Introduction of Technology | | After Introduction of Technology | | Percentage Improvement |
| | | Number | Percentage | Number | Percentage | Percentage |
| Below 50 Years | DP-AP-H-01 | 4 | 40.0% | 7 | 70.0% | 30.0% |
| | DP-AP-H-14 | 5 | 50.0% | 8 | 80.0% | 30.0% |
| | DP-AP-H-26 | 5 | 33.3% | 5 | 33.3% | 0.0% |
| | **AVERAGE** | **4.7** | **41.1%** | **6.7** | **61.1** | **20.0%** |
| | | | | | | |
| 50 – 60 Years | DP-AP-H-06 | 4 | 40.0% | 5 | 50.0% | 10.0% |
| | DP-AP-H-04 | 5 | 50.0% | 8 | 80.0% | 30.0% |
| | DP-AP-H-10 | 3 | 30.0% | 7 | 70.0% | 40.0% |
| | DP-AP-H-09 | 3 | 30.0% | 5 | 50.0% | 20.0% |
| | DP-AP-H-11 | 4 | 40.0% | 4 | 40.0% | 0.0% |
| | DP-AP-H-19 | 2 | 20.0% | 5 | 50.0% | 30.0% |
| | DP-AP-H-16 | 3 | 30.0% | 6 | 60.0% | 30.0% |
| | DP-AP-H-18 | 3 | 30.0% | 5 | 50.0% | 20.0% |
| | DP-AP-H-22 | 3 | 20.0% | 7 | 46.6% | 26.6% |
| | DP-AP-H-23 | 4 | 26.6% | 7 | 46.6% | 20.0% |
| | DP-AP-H-28 | 5 | 33.3% | 6 | 40.0% | 6.70% |
| | DP-AP-H-29 | 4 | 26.6% | 4 | 26.6% | 0.0% |
| | **AVERAGE** | **3.6** | **31.38%** | **5.8** | **50.82%** | **19.44%** |
| | | | | | | |
| Above 60 Years | DP-AP-H-03 | 4 | 40.0% | 6 | 60.0% | 20.0% |
| | DP-AP-H-02 | 2 | 20.0% | 5 | 50.0% | 30.0% |
| | DP-AP-H-13 | 2 | 20.0% | 5 | 50.0% | 30.0% |
| | DP-AP-H-05 | 2 | 20.0% | 5 | 50.0% | 30.0% |
| | DP-AP-H-08 | 5 | 50.0% | 8 | 80.0% | 30.0% |
| | DP-AP-H-17 | 3 | 30.0% | 5 | 50.0% | 20.0% |
| | DP-AP-H-20 | 3 | 30.0% | 4 | 40.0% | 10.0% |
| | DP-AP-H-12 | 3 | 30.0% | 5 | 50.0% | 20.0% |
| | DP-AP-H-07 | 4 | 40.0% | 6 | 60.0% | 20.0% |
| | DP-AP-H-15 | 4 | 40.0% | 5 | 50.0% | 10.0% |
| | DP-AP-H-21 | 3 | 20.0% | 5 | 33.3% | 13.3% |
| | DP-AP-H-24 | 5 | 33.3% | 7 | 46.6% | 13.3% |
| | DP-AP-H-25 | 2 | 13.3% | 4 | 26.6% | 13.3% |
| | DP-AP-H-27 | 4 | 26.6% | 7 | 46.6% | 20.0% |
| | DP-AP-H-30 | 3 | 20.0% | 5 | 33.3% | 13.3% |
| | **AVERAGE** | **3.3** | **28.88%** | **5.47%** | **48.43%** | **19.55%** |

(**Source**: This study)

The outcome shown in Table 11.0 and Figure 20 shows that the average improvement lies between 19.44% and 20.0%, and thus tends to suggest that the average improvement is the same regardless of the age bracket.

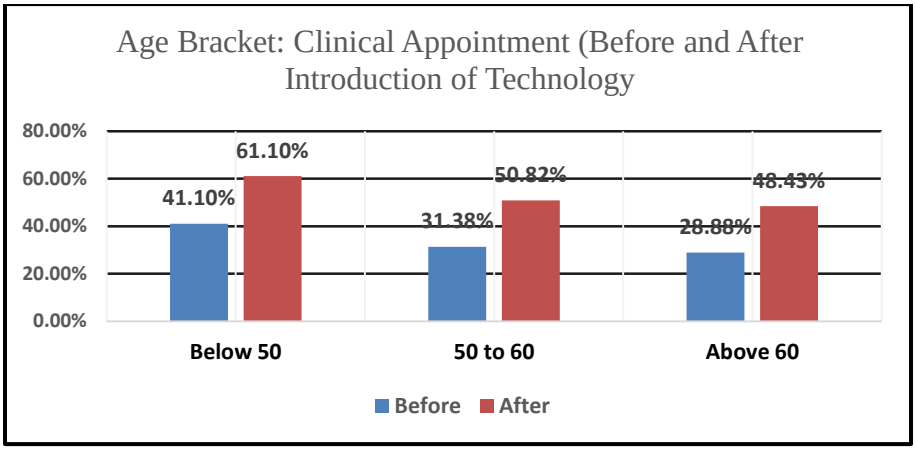



***Figure 20.0:*** *Age Adherence Analysis*
(**Source**: This study)

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATION

## 5.1 Introduction

This chapter analyses and evaluates the realization of the research objectives. The overall objective of the study was to "***Design, implement and test the outcome of use of SMS based automated reminders for dementia care givers"***. This was broken down into specific objectives as outlined in **Section 5.3**.

This chapter maps the results and discussions in chapter four to the research objectives and research questions, draws conclusion and makes recommendations for future studies.

## 5.2 Conclusion

The outcome of the study shows that introduction of technology resulted into a significant improvement in adherence to clinical instruction for caregivers in cases of dementia patients. The outcome suggests that age and gender attributes do not have an influence and therefore may not have an impact adherence to clinical appointment, where SMS based appointment reminders are used. This outcome points to the potential of mobile technology to enhance adherence to clinical appointment for care giver who support persons with dementia.

## 5.3 Review of the Specific objectives of the study

The study was primarily guided by four specific research objectives, derived from the statement of the problem. The four specific objectives were key in realizing the overall objective of the study.

### 5.3.1 Research Objective 1

The first research objective was "***To find out the dementia care and ICT support services***". This objective was achieved through two key steps:

i. Review of relevant literature on dementia care and management
ii. A qualitative pre-study was carried out in order to understand the practices in the care and management of dementia.

### 5.3.2 Research Objective 2

The second research objective was to **"*Isolate unique dementia support services which can be supported by ICT*".** This was achieved through review of relevant literature and the pre-study, where the key issues identified included;

i. ICT is a tool that could be used to assist caregiver in enabling patients achieve enhanced adherence to medical treatment and regime.
ii. ICT could also be used to help the caregiver to enforce adherence clinical appointment for the dementia patients.
iii. ICT related technologies were also used to improvement Memory retention; Technology that aids in repetitive practice, in an attempt to improve memory retention capabilities for the dementia patients).

### 5.3.3 Research Objective 3

The third objective of the study was to **"*Design an SMS based automated reminder prototype*".** This objective was achieved by prototype designed, developed and deployed. The first step towards realizing this objective involved selection of a suitable development methodology. The study adopted the agile system development methodology. The prototype was then designed & developed in continuous consultation with targeted users, in order to tailor it to the user's needs. Finally, the prototype functionality tested to ensure that it automatically send SMS reminders to targeted respondents as scheduled.

### 5.3.4 Research Objective 4

The final specific objective of the study was to **"*To test the outcome of use of an SMS based automated reminder prototype*".** In order to achieve this objective, there activities were carried out:

i. Data on clinical adherence for the caregivers covering a period of four months before and four after technology was introduced was captured, analysed and compared.
ii. Possible effects Age and Gender evaluated.
iii. Deduction made on the effect of the technology on adherence made based on the results obtained in (i) and (ii) above.

## 5.4 Recommendation for Future Research

Future research on the same should be extended to cover the following components:

- A larger sample that includes participants from both formal and informal settlement to ascertain whether the outcomes hold in both scenarios. A large sample size may provide a higher level of variability and hence a better gauge of the outcome of use of SMS reminder technology on the adherence. A larger sample size in the current study was not possible because of the resource constraints and challenges in the coordination of the many caregivers.
- Participants with different levels of educations to reveal the possible effects of the levels of education. The study was restricted to users who had a good grasp and understanding of the English language. Extending this technology to those whose level of education limited them to the use of Swahili language would provide informative insight.
- The research should cover longer durations exceeding four months. A longer duration would have allowed for deeper acceptance and adoption of technology after the initial excitement and the may have impacted on the outcome because of possible change of attitude in the cause of use of the assistive technology.

# REFERENCES

Ashok J. B., Vivek, A., Jodi, F., Mary, A. D., Charles, F. R., Scott, S., Howard, W., (2008). Intelligent Assistive Technology Applications to Dementia Care: Current Capabilities, Limitations, and Future Challenges. AJGP.

Astell et al. (2009), Developing technology to meet psychosocial needs. JDC, 17 (1), pp.36-39 Audit Commission.

Bogart, K., Wong, S. K., Lewis, C., Akenzua, A., Hayes, D., Prountzos, A., Okocha, C. I., Kravariti, E., (2014). Mobile phone text message reminders of antipsychotic medication: is it time and who should receive them? A cross-sectional trust-wide survey of psychiatric inpatients. BMC Psychiatry.

CAK (2016) Quarterly Sector Statistics Report Year 2016/17(Jan-Mar 2017)

Noonan E. A and Tennstedt L, S., (1997). Meaning in Caregiving and Its Contribution to Caregiver Weil-Being. The Cerontologist Vol. 37, No. 6, 785-794

Cockburn, A.,(2007). Agile Software Development: The Cooperative Game. Addison-Wesley Professional, 2nd Edition

Cockburn, *A. and* Highsmith, *J. (*2001*)* Agile *Software Development The People Factor. Computer, 34, 131-133.*

Dias, A., Dewey M. E., D'Souza J, Dhume, R., Motghare, D. D,, Shaji, K. S., et al. (2008). The Effectiveness of a Home Care Program for Supporting Caregivers of Persons with Dementia in Developing Countries: A Randomised Controlled Trial from Goa, India. PLoS ONE. PMC

Gagnon-Roy, M., Bourget, A., Stocco, S., Courchesne, A.-C.L., Kuhne, N., & Provencher, V. (2017). Assistive technology addressing safety issues in dementia: A scoping review. AJOT, 71.

Gavrilova, S. I., Ferri, C. P., Mikhaylova, N., Sokolova, O., Banerjee, S., Prince, M., (2008). Helping carers to care–The 10/66 dementia research group's randomized control trial of a caregiver intervention in Russia. IJG Psychiatry.

Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). Multivariate Data Analysis. Seventh Edition. Prentice Hall, Upper Saddle River, New Jersey.

Han, J. W., Jeong, H., Park, J. Y., Kim, T. H., Lee, D. Y., Lee, D. W., RYU, S.-H., Kim, S. -K., Yoon, J. C., Jhoo, J., (2014). Effect of Social Support on Burden in Caregivers of People with Dementia. Int. Psychogeriatr 26, 1639 - 1648

Henderson-Sellers, B., and Serour, M.K., (2005) Creating a Dual-Agility Method: The Value of Method Engineering. *Journal of DB Management*.

Hepburn KW, T. J. (2001) Dementia family caregiver training:affecting beliefs about caregivingand caregiver outcomes. PubMed, 450-7.

Hoof van, J., Aarts, M. P. J., Rense, C.G., & Schoutens, A. M. C., (2009). Ambient bright light in dementia: effects on behaviour and circadian rhythmicity. Building and Environment, 44(1), 146–155.

Icow ICT Update Issue, August 2012, issue 67)

IITU-T.,C(2016) http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx (Accessed June 2017)

Landau et al., (2010) Families and professional caregivers' views of using advanced technology to track people with dementia. *Qualitative Health Research.*

Living made easy (2010), Ethical issues with assistive technology. at: http://www.livingmadeeasy.org.uk/scenario.php?csid=43

Kagiri, M., Waiganjo, P., Orwa, D., and Ngechu, R., (2015). Enhancing Community Based Health Information System (CBHIS) Reporting Through Open-Source Short Message Service-Based Tool. *IJER.* Vol. 3 No. 4.

KeHS (2011). Kenya eHealth Strategy

Kindell, J., Keady, J., Sage, K., and Ray, W., (2016). Everyday conversation in dementia: a review of the literature to inform research and practice. Int J Lang Commun Disord. 2017 Jul-Aug; 52(4): 392–406.

Klasnja, P., & Pratt, W. (2012). "Healthcare in the pocket: Mapping the space of mobile-phone health interventions". *JBI, 45(1), 184-198.*

Lauriks, S., Reinersmann, A., Roest, H.v.d., Meiland, F.J.M., Davies, R.J., Moelaert, F., Mulvenna, M.D., C.D., N., Dröes, R.M., (2007). Review of ICT-based services for identified unmet needs in people with dementia. *Aging Research Reviews 6, 223246.*

Luk, R., Zaharia, M., Ho, M, Levine, B., & Aoki, P. M., (2009), 'ICTD for healthcare in Ghana: two parallel case studies', *Proceedings of the 3rd int conference on ICT and development, IEEE, pp. 118–28.*

MacCallum, R. C., Widaman, K. F., Zhang, S., (1999). Sample size in factor analysis Methods.

Maheshwari, S., & Jain, D. C. (2012). A Comparative Analysis of Different Types of Models in Software Development Life Cycle. *Int Jour of Advanced Research in Computer Science and Software Engineering*, 2(5), 285-290.

Martin, S., Bengtsson, J. E., and Dröes, R. M., (2010), Assistive technologies and issues relating to privacy, ethics and security. In supporting people with dementia using pervasive health technologies, Ed.

Mechael, P., Batavia, H., Kaonga, N., Searle, S., Kwan, A., Goldberger, A., Fu, L., & Ossman, J., (2010) 'Barriers and gaps affecting mHealth in low and middle income countries', Policy white paper, Columbia University Earth institute and mHealth Alliance.

Mediamax (2015)http://www.mediamaxnetwork.co.ke/peopledaily/160678/cba-safaricom-launch-sema-doc/, Accessed December 2017

Meiland, F.J., Reinersmann, A., Bergvall-Kareborn, B., Craig, D., Moelaert, F., Mulvenna, M., Nugent, C., Scully, A., Bengtsson, J., Droes, R.M., (2007). COGKNOW: Development of an ICT device to support people with dementia. *JITH 5, 324-334.*

Mfarm(2012)http://techfortrade.org/wpcontent/uploads/2012/07/10-13-MFarm-fundingrelease_FINAL.pdf

Morawczynski, O., (2009). Exploring the usage and impact of "transformational" mobile financial services: the case of M-PESA in Kenya. Journal of Eastern African Studies Volume 3, Issue 3.

Mugenda, O. M., and Mugenda, A. G., (2008) Research Methods, Quantitative & Qualitative Approaches, Acts Press, Nairobi.

Mulvenna, M. D., and Nugent, C. D., Martin, S., Nugent, C., Wallace, J., Kernohan, G., McCreight, B., and Mulvenna, M., (2007), Using context awareness within the "Smart home" environment to support social care for adults with dementia. Technology & Disability, 19, 143-152

Mupela, E. N., Mustarde, P., Jones, H. L. C., (2011) Telemedicine in primary health: the virtual doctor project Zambia. *Philosophy, ethics, and humanities in medicine* 6 (1), 9.

Njoroge, M., Zurovac1, D., Ogara, A. A. E., Jane, C., and Kirigia, D., (2017). Assessing the feasibility of eHealth and mHealth: a systematic review and analysis of initiatives implemented in Kenya. BMC Res Notes.

Otieno, G., Githinji, S., Jones, C., Snow, R. W., Talisuna, A., Zurovac, D., (2014). The feasibility, patterns of use and acceptability of using mobile phone text-messaging to improve treatment adherence and post-treatment review of children with uncomplicated malaria in western Kenya. *Malar J. 2014 Feb 3;13:44.*

Prince, M., Ferri, C. P., Acosta, D., et al. (2007). The protocols for the 10/66 Dementia Research Group population-based research programme. BMC Public Health.

Quintero-Osorio, M., Falque-Madrid, L., Sega, O., Chavez, C., Amaya, G., Lee, J., Maestre, G. (2012). Capacity building for dealing with dementia in developing countries: Lessons from the Maracaibo Aging Study. Alzheimer's & Dementia, 8(4), P430.

Rukikaire, K., (2010). "R U OK 2day?" Weltel Project.
http://www.irinnews.org/report/88653/kenya-r-u-ok-2day-sms-check-takes
Accessed 7th June 2018

Sävenstedt, S., Meiland, F., Dröes, R, M., and Moelaert, F., (2010), Evaluation of cognitive prosthetics In Supporting people with dementia using pervasive health technologies, Ed. Mulvenna, MD and Nugent. Springer Publications

Shaji, K. S., (2009). Dementia care in developing countries: The road ahead. Indian J Psychiatry. 2009 Jan; 51(Suppl1): S5–S7.

Sidney, K., Antony, J., Rodrigues, R.. Arumugam, K., Krishnamurthy, S., D'souza, G., De Costa, A., and Shet, A., (2011), 'Supporting patient adherence to antiretrovirals using mobile phone reminders: patient responses from South India', AIDS Care, vol. 24, no. 5, pp. :612–17.

Scott and Associates. (2014). Software Development at Scale: Results from the Spring 2014 DDJ State of the IT Union Survey.

Singh, P., Singh, A., Lal, S., & Naik, V., (2012), 'CVDMagic: A Mobile Based Research for CVD Risk Detection in Rural India', Proceedings of the fifth international conference on Information and Communication Technologies and Development, pp. 359–66, ACM, NY.

Sivasubramaniyan, P., (2012). Research Methodology: An Introduction. Available at http://www.newagepublishers.com/samplechapter/000896.pdf.

Tariq, A., & Akter, S., (2011) An assessment of m-Health in developing countries using task technology fit model. Research Online: *University of Wollongong*

UN (2000) Resolution adopted by the General Assembly-United Nations Millennium Declaration. http://www.un.org/millennium/declaration/ares552e.pdf.

UN. (2016) Sustainable Development Goals Report 2016. UN, New York, 2016

Vital Wave Consulting, (2009). Health Information Systems in Developing Countries: A Landscape Analysis

Vital Wave Consulting (2009a), mHealth for development: the opportunity of mobile technology for healthcare in the developing world, UN Foundation-Vodafone Foundation Partnership.

WHO (2011b) mHealth: New horizons for health through mobile technologies, Global Observatory for eHealth series - Volume 3.

WHO (2011c), mHealth: New horizons for health through mobile technologies.

WHO (2013) Call for innovative health technologies. http://www.who.int/ehealth/en/.

WHO (2017)www.who.int/dementia (December 2017) Accessed June 2018)

Zurovac, D., Raymond, K. S., Willis, S. A., Moses, N., Davidson, H. H, Alexander, K. R., Robert, W. S., (2011) Kenyan health workers' adherence to malaria treatment guidelines: a cluster randomised trial. The lancet.

# APPENDIX I

# INTERVIEW GUIDE

**i. Introduction**

- *Research introduces herself and breaks the ice*
- *Asks the prospective participant their name*
- *Explain the purpose of the study; give a research brief or overview*
- *Requests the prospective participant if they would like to be part of the study*

**ii. Challenges with Honouring Appointments**

- *What challenges do you encounter when trying to honour clinical appointments?*
- *Do you think you would need help?*
- *What form of help?*
- *Do you use mobile phones?*
- *Do you think Text SMS based reminder would help?*
- *Would you like to receive them on a trial basis?*

**iii. Message and Message Format**

- *What should be the content of the SMS messages that would be appropriate in helping you remember to hour the clinical appointments?*
- *The number of reminders that needed to be sent to the participants?*

**iv. Reminder Intervals and Time**

- *What should be the intervals of sending the reminders?*

**v. The most appropriate time of the day for receiving the reminder.**

- *What would be the most appropriate time to send you the appointment reminder?*

**vi. Challenges of Accessing SMS reminder**

- *Do you own a phone?*
- *What challenges would prevent you from accessing reminder SMS?*

**END OF INTERVIEW**

# APPENDIX II

# INFORMED CONSENT BRIEF

My Names are **Sheila Mirenja** a student Masters undertaking a Masters of Science Degree in Applied Computing, in the School of Computing and Informatics of the University of Nairobi. The research aims at evaluating the potential of Mobile phone based SMS message towards enhancing clinical appointment adherence.

The research requires that I interact with participants and healthcare practitioners. Data will be gathered from respondents through sending of text based SMS reminders to their phones at specified times, to remind them of the approaching date of appointment. The data would then be analysed in order to understand the possible effects of SMS reminder in enhancing adherence to appointments.

Information obtained through this study will remain confidential. All information captured will have no respondent's Identifier (ID No, Names, Passport Number, Birth Certificate Numbers, Next of Kin etc).