THE UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS

Mobile Personal Health information System (MSHAURI)

BY

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P51/65045/2013

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2016

A Project Submitted In Partial Fulfillment of the Requirement for the Award of the Degree of Masters in Applied Computing

DECLARATION

I Simon Mwai, declare that this research proposal is my original work and has not been submitted or presented for a degree in any other university.

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The proposal has been submitted for examination with my approval as the University Supervisor.

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UNIVERSITY OF NAIROBI

DEDICATION

I dedicate this work to my family and my fiancée. This work took a lot of time that would have been spent with them. They all understood and wished me well without reservation.

To my employer, Sybrin Kenya Limited, They gave me enough time which could have been used in implementing of company Projects.

To my classmates and colleagues at work especially Brian of Future Group ltd Thanks very the sacrifice provided to me and also for introducing me to so many CCCs. This work most of the time called for their attention and sacrifice God bless you all for the assistance provided.

ABSTRACT

HIV and Aids has been identified worldwide as one of the main causes of reduced economic growth in most of the developing countries. This is because a lot of resources are diverted in health care provision to patient living with HIV and AIDS which also reduces personal output. Due to the devastating effect of HIV/AIDS, the government in 1999, declared HIV/AIDS a national disaster and established National AIDS Control Council (NACC) to coordinate a multisectoral fight against the pandemic (World bank, 2005). This enabled the government to avail enough resources and manpower in the fight against the spread of this disease.

Kenya has achieved much in the areas of ARV dispensation, educating people on HIV and AIDS prevention and care. However one of the biggest problem affecting HIV and AIDS treatment is funding. Most of the organisations dealing with HIV and AIDS including the government still relying on donor funding to meet medication needs for their patients; due to this Most of the CCC'S are unable to provide patient medication requirement for the required duration of three months.

Kenya is a transit country for Eastern and Central Africa, Hence there are a lot of migratory HIV and AIDS patient moving from one country to another especially truck drivers when delivering goods from Mombasa main port to the other parts of Eastern and central Africa. Due to this most of them spend more than three month on transit. This is more than medication provided. Usually ARV are provided for three months some of which it's not possible due to their cost. This is one of the hindrance to reducing diseases caused by HIV and AIDS such as TB. To reduce this issue there are several CCC cares across the countries but due to lack of CCCs interoperability patients are not able to obtain medication when on transit due to lack of their treatment historical data which is very important for any medication to be provided.

With the growth of mobile technology in world, this issue can be eliminated by ensuring that patient information which is normally captured and transmitted to NASSCOP is stored centrally. If a patient visit any CCC no need for providing any hardcopies document, use of guess or information stored as draft messages on their mobile phones. Using our personal health information mobile system, the patient system provides their patient identification number which is sent as a sms and a response is sent back to the clinician with the previous crucial services provided to the patient and the patient is provided with the required services.

The issue of patient visiting their origin CCC of registration in order to get all services is eradication because as long as their information maintained centrally they can obtain information from any CCCs.

From our system testing if patient information has been stored correctly and also clinician information maintained in the system, security of patient data is maintained, nobody is able to obtain patient data and also patient cannot request for His/her information.

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List of Abbreviations

AIDS	-	Acquired Immunodeficiency Syndrome
ART	-	Antiretroviral Therapy
ARV	-	Antiretroviral
CARE	-	Cooperative Assistance and Relief Everywhere
CCC	-	Comprehensive Care Centre
CD4	-	Cluster of differentiation 4 (cells that fight infection)
DHIS	-	District Health Information System
FHI	-	Family Health International
GOK	-	Government of Kenya
GSM	-	Global System for Mobile
ICT	-	Information Communication and Technology
IJARAI	-	International Journal of Advanced Research in Artificial Intelligence
IMPACT	-	US aid implementing AIDS prevention and care
ITU	-	International Telecommunication Union
HIV	-	Human Immunodeficiency Virus
HAART	-	Highly Active Antiretroviral Therapy
KDHS	-	Kenya Demographic and Health Survey
mHealth	-	Mobile Health
MOH	-	Ministry of Health
NACC	-	National AIDS Control Council
NASCOP	-	National AIDS and STDS Control Programme
PEPFAR	-	President's Emergency Plan for AIDS Relief
PHI	-	Personal health information
SMSC	-	short message service centre
USAID	-	United States Agency for International Development
UNDP	-	United Nations Development Program
UNAIDS	-	United Nations Program on HIV/AIDS
VCT	-	Voluntary counselling and testing
WHO	-	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

PHI also referred to as protected health information, generally refers to demographic information, medical history, test and laboratory results, insurance information and other data that is collected by a health care professional to identify an individual and determine what type of care that individual should receive (Margaret Rouse, September 2010). Personal health information is also defined as individually identifiable health information that is transmitted or maintained in any form or medium (electronic, oral, or paper) by a covered entity or its business associates, excluding certain educational and employment records (HIPPA,2009).

Health systems and facilities development and improvements in many countries in the world have improved tremendously. In most of the developed countries health alone takes most of the countries budgets. For example in USA medical health takes the second largest share of the total country's budget. In most of the industrialized countries the government provide free health care for all (Stephanie Kelton, 2007).

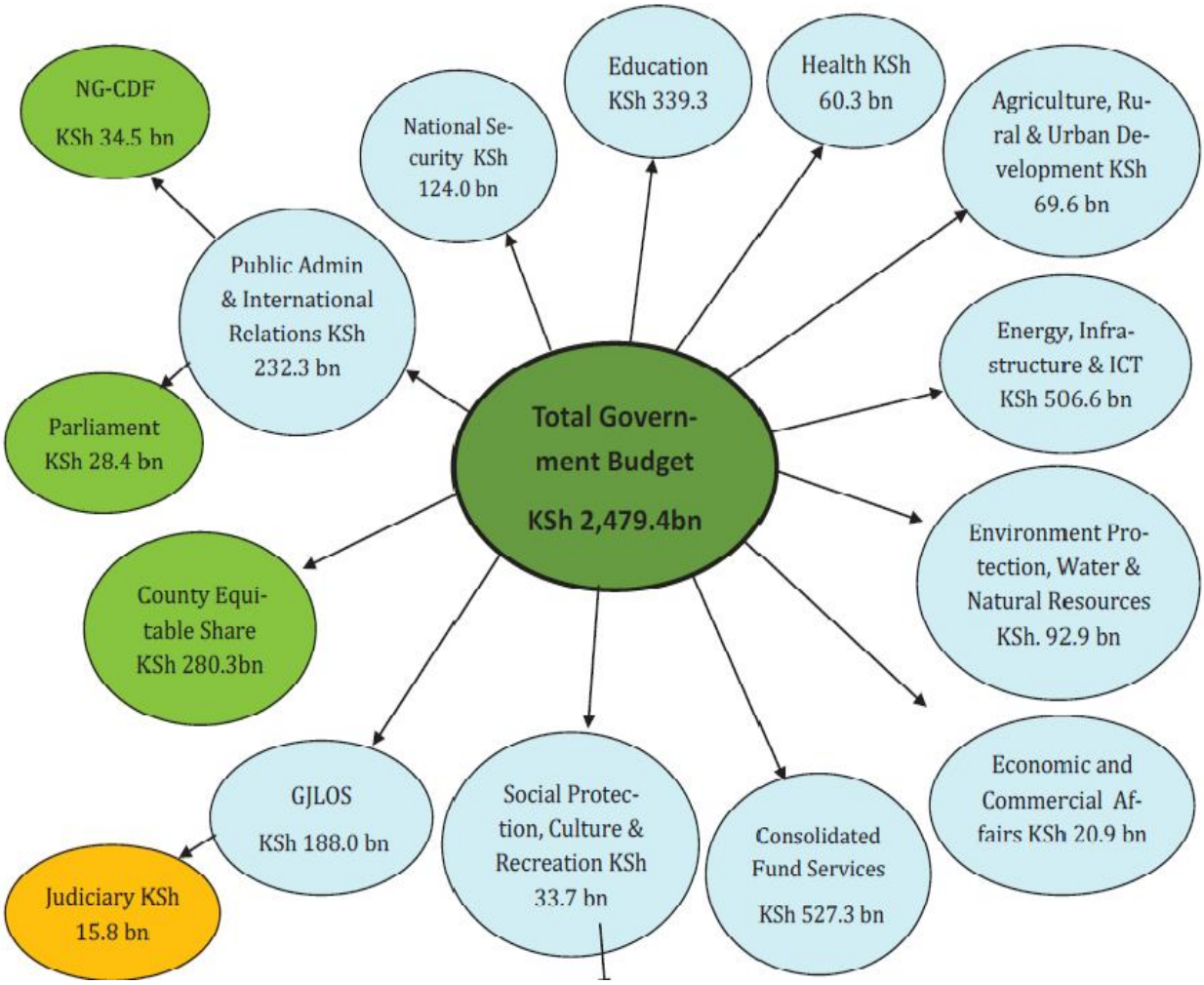
Economic development contributes to better health and vice versa. Some of the advantages for good health system in a country include; improved productivity, Healthy workers increases the productivity of an organisation through reduced off day's etc. (DSAED, 2010)

Improved learning; Improved nutrition and reduced disease, particularly in early childhood, leads to improved cognitive development, enhancing the ability to learn. Healthy children will also gain more from school, having fewer days absent due to ill health DSAED, 2010.

Reduced treatment burden (DSAED, 2010).

Most of the developing countries like Kenya do not take health serious compared to the budget allocated to health and other sectors such as military and education.

Figure 1: Budget allocation for Kenya (2016/17 Programme Based Budget).



From *Figure 1* which is the budget allocation, developed countries do not allocate enough funds to take care of the health needs of their population, hence the problem of meeting the MDG goals which have been setup by the year 2015.

Kenya is among the signatory of MDG goals which includes:

i. Reduce child mortality rate between 1990 and 2015,
ii. Improve maternal health
iii. Combat HIV/AIDS, malaria and other diseases etc. (Achim Steiner, 2006).

HIV/AIDS is the name of the fatal clinical condition that results from infection with the human immunodeficiency virus (HIV), which progressively damages the body's ability to protect itself from disease organisms. Thus, many AIDS deaths result from pneumonia, tuberculosis or diarrhoea; death is not caused by HIV itself but by one or more of these infections (FAO, 1997).

Africa with 12% of the total world population has the highest percentage of AIDS prevalence which accounts for 70% of all people living with AIDS (MDG Report 2012). African countries carry an HIV/AIDS burden 100 times heavier than that of industrialised countries. UNAIDS further asserts that Sub-Saharan Africa is more heavily affected by HIV and AIDS than any other region of the world (UNAIDS). Africa also accounted for 70% of all new HIV new cases in the world in 2010 (MDG Report 2012). Whereas some parts of Africa like West Africa have managed to reduce this epidemic, others such as Southern Africa and east Africa the epidemic still remains severe.

Table 1: Regional estimates for people with HIV and AIDS statistics (UNAIDS, 2014)

Region	People living with HIV 2013		**New HIV infections 2013**		**AIDS-related deaths 2013 (total)**
	Total	Children	**Total**	**Children**	
Sub-Saharan Africa	24.7 million	2.9 million	1.5 million	210,000	1.1 million
Asia and the Pacific	4.8 million	210,000	350,000	22,000	250,000
Latin America	1.6 million	35,000	94,000	1,800	47,000
Western and Central Europe and North America	2.3 million	2,800	8,8000	500	27,000
Eastern Europe and Central Asia	1.1 million	14,000	110,000	1,000	11,000
Caribbean	250,000	17,000	12,000	1,000	11,000
Middle East and North Africa	230,000	16,000	25,000	2,300	15,000
Global	35 million	3.2 million	240,000	1.5 million	

Since the first case of HIV and AIDS was disorganized in Kenya, it has become one of the country's biggest hindrances in social and economic development. Kenya Demographic and Health Survey (KDHS 2008) showed that 7% of adults aged between 15- 49 years in Kenya were infected with HIV. HIV/AIDS has no cure, but it's managed through ART which is a principle component of Comprehensive Care for HIV/AIDS infected persons. The goal of ART programme is to progressively deliver effective Antiretroviral Therapy, reaching 50% of eligible individuals by 2005 and 75% by 2008, so as to increase quality of life and survival (NASCOP, 2008). In a Declaration of Commitment, heads of state from 189 countries affirmed that "prevention, care, support and treatment for those infected and affected by

HIV/AIDS are mutually reinforcing elements of an effective response and must be integrated in a comprehensive approach to combat the epidemic" (Ritzenthaler, 2005).

Response and openness talk about the disease have evolved as people continue to experience their relatives die because of the disease as well due to political will from the government. The government also introduce HIV care which main goal was to provide continuous treatment to HIV and AIDS medication, social, psychological, emotional and spiritual care which in turn reduces the stigma of an illness perceived to be a death sentence. Information and communication plays a major thread running throughout the process of HIV and AIDS management by providing both form and content to prevention, treatment, and vulnerability reduction (AIDS in Kenya, 7th edition, 2005).

One of the biggest problems in most developing countries is providing HIV and AIDS medication to migrants such as truck drivers, pastoralist's communities, and IDP's in Kenya. Despite the increasing awareness of the link between mobility and the spread of HIV/AIDS, there are very few methods and systems which have been provided to ensure that HIV prevention and care programmes among long-distance truck drivers in East, Central and Southern Africa is maintained (GLIA, 2006).

Kenyatta CCC Health staff says,

"The medication most of the time is not enough for the whole journey before coming to their CCC of registration. This is brought about by lack of funding as most of the CCCs are funded by NGO'S. The patients are provided with a yellow card which contains information about their treatment.

Other patient just memorizes their medication which they normally say when requiring the medication. Others save their medication details on their phones as sms draft messages which they normally produce when requiring medications."

Using yellow card patients are able to visit any Comprehensive Care Centres (CCC) and get the required medication for a maximum of two times and if visit exceeds this number a register has to be opened for the patient. One of the main disadvantage of this process of carrying yellow card is; the card might get lost hence the access to medication is lost. Other problems including forgetfulness or providing the wrong information from the migrant

patient, there is also wear and tear hence obtaining the required information from the yellow card might not be accurate thus leading to a misdiagnosis. When patient information is not available the patient has to call CCC centre of origin to obtain the required information which brings another problem of cost. Sometimes they do not have the telephone number or enough credit of their CCC centres hence obtaining information is a tall order.

One of the best ways in reducing HIV prevalence is by ensuring that there is timely access to patient information which will ensure that right medication is provided and access to antiretroviral therapy (UNAIDS, 2012a). In a region often characterised by diverse resource limitations and fragmented infrastructures, information and communication are two of the most critical and abundant resources available in the fight against HIV/AIDS (Ojuondo and Kwanya, 2014).

Much coverage of ART has also improved in most parts of Africa with a 20 per cent increase from 2009 to 2010 alone (UNAIDS 2011b). According to UNAIDS easier access to ART has also prevented more than 2.5 million deaths from occurring in Africa.

1.2 Problem Statement

For many years HIV and AIDS has become a major threat to the socio-economic development for poor countries economy. There are more than 35.2 million people living with HIV and AIDS in the world IN THE YEAR 2012. Two-thirds of them are from Sub-Saharan Africa (WHO, 2013). Over 6 million people are accessing antiretroviral medications. Adherence to drug is paramount for them to maximize on treatment effect (WHO, UNAID & UNICEF 2011).

Since the invention of ICT, developed countries have shown that ICT can be able to integrate ICT in the health sector in order to improve health services delivery. However the same benefits have not been passed over to developed countries (UNAIDS 2011). Remarkable achievements have been made in adopting ICT in several areas e.g. Education and Banking, however little has been realized in the Health Sector and more so in HIV and AIDS programmes in Kenya (Makau, 2010). Muathe (2010), highlight that adoption and integration of ICT in our HIV and AIDS Programmes will enhance uptake of services and help reverse the negative impact the pandemic has had in our national economy and social fabric.

Data access for patient living with HIV and AIDS is always a problem. Patients are provided with cards which they carry around. Whenever a patient wants to visit a CCC, they have to carry the card and also they have to visit the specific CCC centre where they were registered

but in case they are on transit they must have the referral letter. This is due to accessing the patients' files to ensure that all test done such as allegers and any other side effects are adhered to before medication.

Some of the disadvantages of this process are; if a patient loses the card, this may lead to a new registration. Data for medication for the patient is not synchronized when a patient visits several CCC centres. This sometimes reduces the patient productivity since travelling to long distance is limited due to services provision.

1.3 Research Objectives

i) To evaluate the challenges experienced by health staff employees when storing HIV and AIDS patient data.

ii) To evaluate challenges experienced by CCC staff and HIV and AIDS patients accessing their medical information.

iii) To access how patient on transit obtain their information on visiting a different CCC centers in order to obtain services.

iv) Minimum patient data required in order to provide patient with services.

v) To design, develop and deploy a prototype mobile system for accessing vital patient data from any CCC centres for services provision.

vi) To test the prototype on acquiring information, updating and accessing the information.

1.4 Research Questions

i) How is HIV patient information stored?

ii) What are the challenges encountered when accessing this?

iii) How do health staff provide patient on transit with the required services?

iv) How can ICT empower CCC health staff and people living with HIV and AIDS?

v) What is the minimum patient dataset required in order to provide services?

1.5 Motivation for the study

HIV and AIDS is one of the biggest health problem affecting sub-Saharan countries accounting for more than 70% of the total world population suffering from the disease.

The government of Kenya is among the signatory of the united national and has an obligation to implement millennium development goal of combating HIV and AIDS. This include;

Ensure that there is timely access, and availability of medication for all patient by the year end 2015. Most of the developing countries including Kenya have achieved much in terms of availability of ARVs, however the issue of access is through the centres where the patient was registered thus reducing patients independence, productivity and privacy as the patient has to carry around the card and/or referral letter whenever they visit the CCC.

Kenya has an obligation to ensure that that millennium development goal of combating HIV and AIDS is achieved. By Adopting and integrating ICT in CCCs programmes will improve service quality and also ensure that these services uptake by client is scaled-up; thus enabling service providers to be more efficient and effective.

CHAPTER TWO

LITERATURE REVIEW

2.1 HIV and AIDS

HIV was discovered in 1983 (WHO, UNAIDS & UNICEF 2003), which is responsible for the development of the acquired immunodeficiency syndrome. HIV attacks immune system cells, weakening the immune system making the body vulnerable to opportunistic infections leading to AIDS. WHO reported that by the end of year 2010 more than 34 million people globally were suffering from HIV and AIDS; Two thirds of this number were in sub-Saharan Africa (WHO, 2010), an estimated 2.9 million people were newly infected with the disease worldwide. A presidential decree resulted in the formation of the National AIDS Control Council (NACC) as corporate body to deal with HIV/AIDS issues (GOK, 2000).According to NACC (2009). Number of people receiving ARV was more than 6.65million.

HIV and AIDS is not curative but lifelong treatment with ART reduces mortality and improves quality of life among patient with HIV/AIDS. The antiretroviral drugs normally suppress the replication of the virus in the body, and are used to treat and prevent HIV infection.

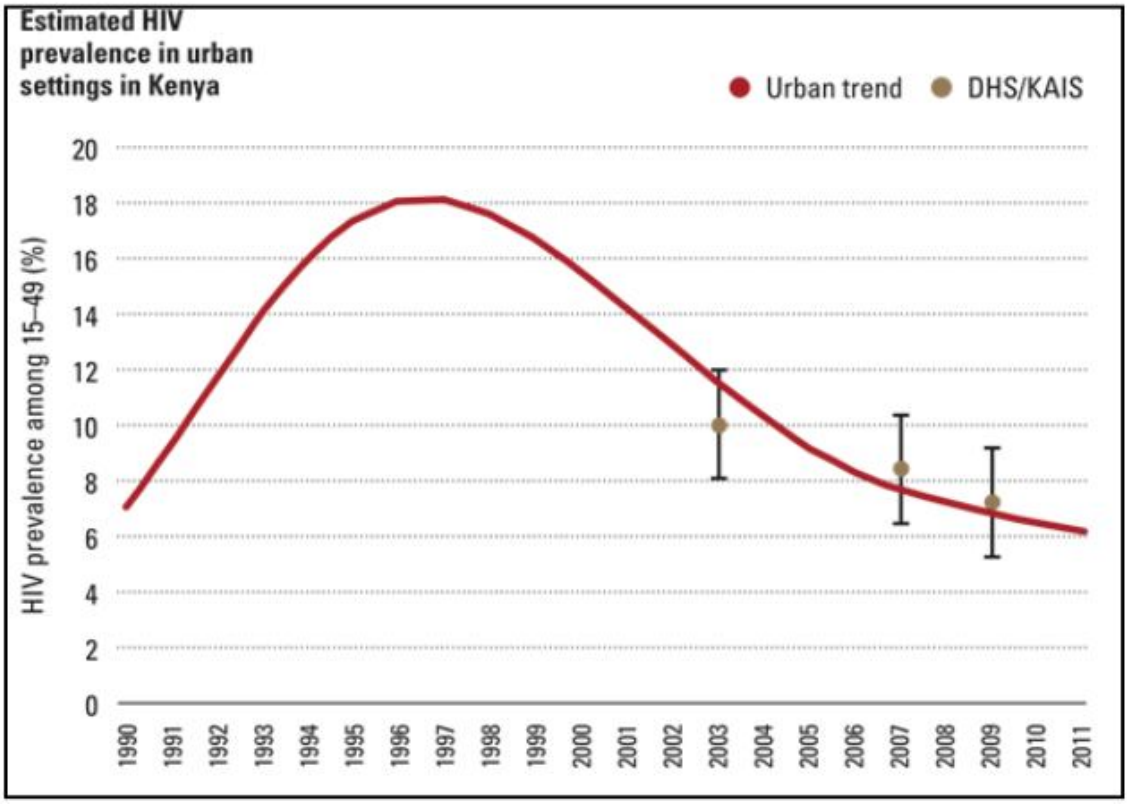
Taking of ARV is a lifelong commitment which requires patients' adherence and frequent clinic visits to CCC ARV refill. Patients who fail to adhere well or discontinue treatment are at death risk due to AIDS related diseases such as Tuberculosis (TB) as the probability of non –adherent is 3.87 times more likely lead to death (Garcia de Olalla et al., 2002). Some of the issues affecting adherence include; financial constraints such as drugs cost, lack of transport to CCC centres, medication side effects, disclosure and stigma, distance from patient home and the health facility etc.

HIV and AIDS is a big problem in Kenya. In 1999 Kenya declared HIV and AIDS a national disaster and a public health disaster (WHO, 2005). In June 2011 the president of Kenya joined other presidents at a HIV and AIDS conference where several resolutions were passed (2011 UN General Assembly High Level Meeting on AIDS from 8 –10 June 2011 in New York). These resolutions were contained in a strategy paper known as e UNAIDS Strategy - Getting to Zero 2011-2015. Among the commitment include; universal access to HIV prevention, treatment, care and support are critical step towards ending the global HIV epidemic, with a view to achieving Millennium Development Goal 6, and in particular to halt and begin to reverse the spread of HIV by 2015.

HIV and AIDS prevalence in Kenya is estimated based on the Demographic and Health Survey (2003 and 2008/9). Prevalence rate reached a peak of 10% in 1996 before dropping downwards. This was due to access to anti-retroviral therapy (ART) and reduction in the number of new infections. High level of adherence to antiretroviral medication is essential to minimize treatment failure and disease progression. The aim of antiretroviral therapy is to keep the HIV viral load at undetectable levels for as long as possible and to maintain the functionality of the immune system (Yeni et al., 2004).

Poor adherence and treatment interruptions are the main reasons for failure of ART suppressing HIV viral load leading to drug resistance. ART adherence levels of 95 Percent are necessary to achieve and sustain suppression of viral load (Paterson et al., 2000). Some of the factors that contribute to lack of ARV's adherence include; fear of disclosure, depression, side effects, disruption of daily routine, social isolation, financial constraints, travel cost to get access to treatment, lack of patient information and dependent of patient treatment centres. Facilitators of adherence include; faith in how well the drugs work, using reminder tools and trusting relations with health-care providers (Mills et al., 2006).

Figure 2: below shows some trends in HIV and AIDs trend in Kenya urban areas (NACC, 2014)



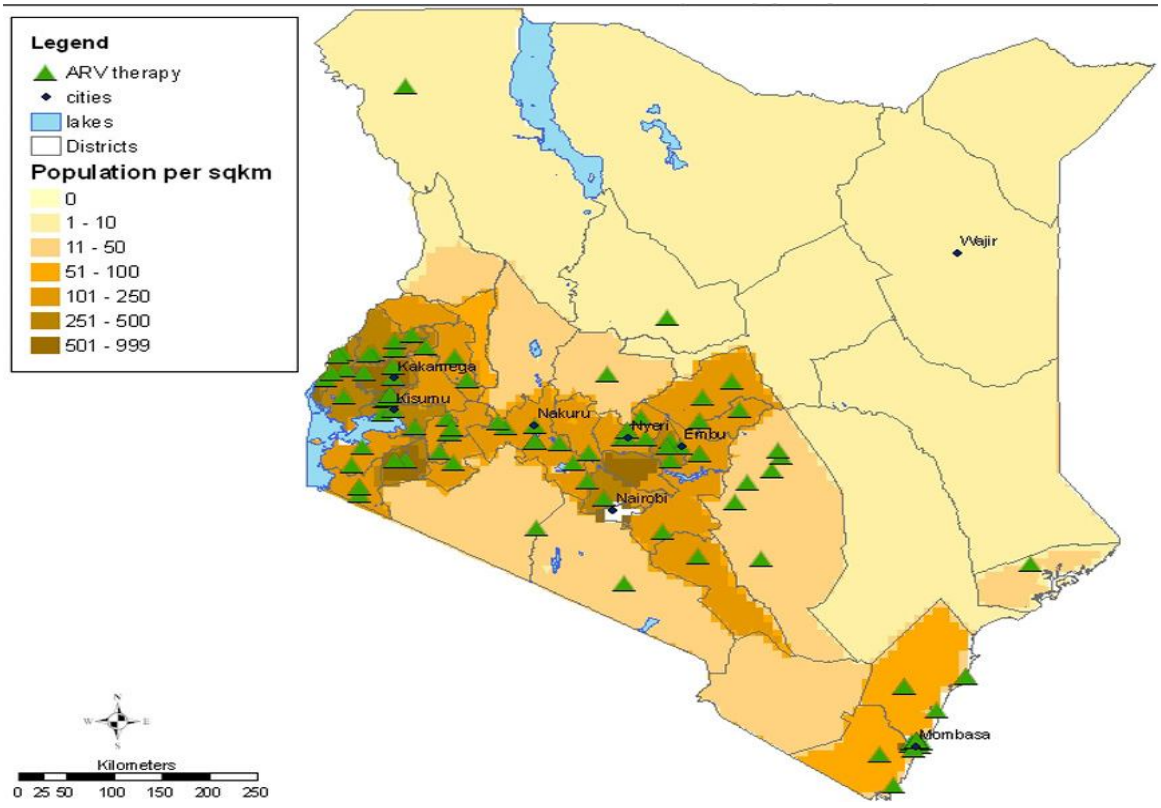
Currently, Kenya has been devolved into 47 counties. In 2013 HIV and AIDS prevalence in counties ranged from a high 27.1% in Homa Bay County to below 0.2% in Wajir County. Ten counties have an estimated prevalence higher than the national average, while 7 counties have prevalence of less than 2%(Kenya AIDS Response Progress Report, 2014).

Table 2: HIV and AIDS distribution in Kenya, 2013(NACC, 2014).

County	Adult Prevalence (%)	County	Adult Prevalence (%)	County	Adult Prevalence (%)	County	Adult Prevalence (%)
Homa Bay	25.7	Bomet	5.8	Uasin Gishu	4.3	Bungoma	3.2
Siaya	23.7	Kwale	5.7	Kitui	4.3	Baringo	3
Kisumu	19.3	Makueni	5.6	Nyeri	4.3	Meru	3
Migori	14.7	Nakuru	5.3	Isiolo	4.2	West Pokot	2.8
Kisii	8	Muranga	5.2	Vihiga	3.8	Elgeyo	2.5
Turkana	7.6	Trans Nzoia	5.1	Kiambu	3.8	Lamu	2.3
Mombasa	7.4	Samburu	5	Nyandarua	3.8	Garissa	2.1
Nairobi	6.8	Narok	5	Nandi	3.7	Mandera	1.7
Busia	6.8	Machakos	5	Laikipia	3.7	Marsabit	1.2
Nyamira	6.4	Kajiado	4.4	Embu	3.7	Tana River	1
Taita-Taveta	6.1	Kilifi	4.4	Kericho	3.4	Wajir	0.2
Kakamega	5.9	Tharaka-Nithi	4.3	Kirinyaga	3.3		

The government of Kenya established National AIDS Control Council in November 1999 to lead multisectrol response to HIV/AIDS. A HIV/AIDS strategic plan for 2000-2005 was developed for ensuring that all policies on HIV\AIDS are integrated with the core government-wide processes, including the implementation of the Poverty Reduction Strategy Paper. The strategy included; prevention of new infections; treatment, care and support for those infected and affected by HIV/AIDS; mitigation of the impact of the epidemic on social and economic development efforts; monitoring and evaluation, management, coordination and setting up of ARV centers in the country.

Figure 3: The distribution of ARV centres in Kenya



By the year 2013, the target for the government of Kenya was to reach at least 1million people with lifesaving anti-retroviral treatment. NASCOP was to assist in ensuring that there is institutionalizing care and treatment. To ensure this is achieved the concept of comprehensive care was introduced. So far a total of 288 CCC, of which 167 are in government facilities, including all provincial hospitals, all district hospitals, most sub-district hospitals and some health centres (WHO, 2005).

2.2 Mobile Phone Development

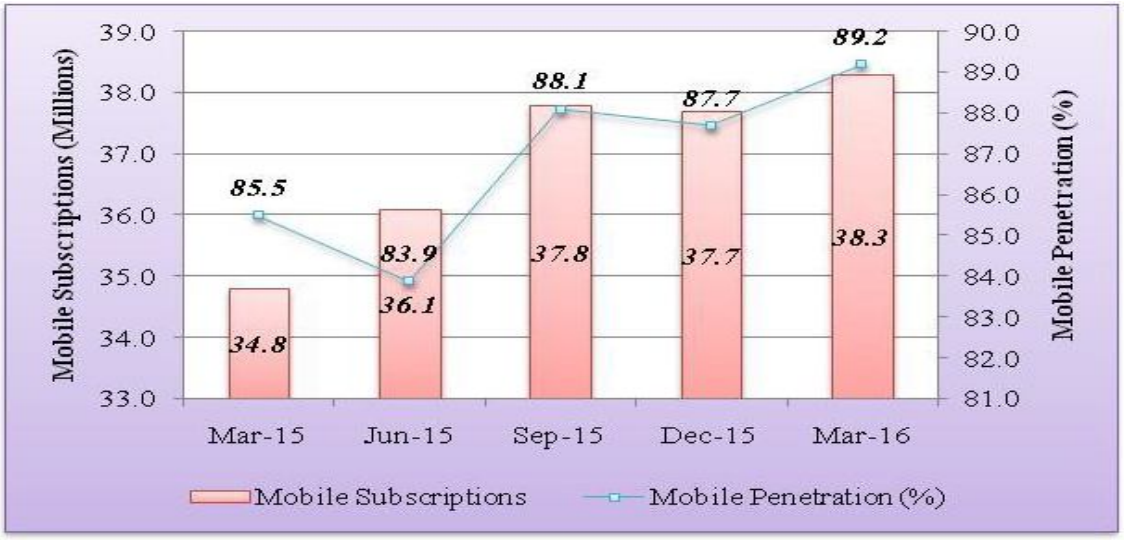
With the introduction of mobile phones; most of the developing countries have experienced a very high growth of mobile phones penetration as which is expected to reach 90% in developing countries compared to 121% in developed countries in 2014 (ITU, 2014). Such a

rapid growth in mobile phone networks has been made possible by the proliferation of GSM the standard for mobile communications across the world. GSM networks currently cover 219 countries and territories, serving more than 3 billion people (GSM Association). All mobile phones today offer voice and data communication. The most commonly used data application is the short message service (SMS), also called person-to-person "text messaging''. Advanced mobile phones called smart phones have additional features, such as Internet e-mail; built-in camera; speakerphone; voice recorder; GPS receiver; Bluetooth; Wi-Fi connectivity capacity to download, view, and store music, videos, or games and operate a variety of software applications (Apunyu, 2011). According to Dr. Howard Zucker, Assistant Director-General of the World Health Organization (WHO), asserts that the explosive spread of mobile phone networks across the developing world has created a unique opportunity to significantly transform how countries can tackle global health challenges.

Kenya experienced a very high mobile acquisition in 2009, which was brought about by government exempted VAT on mobile handsets (GSMA 2011). What was considered a luxury is now available to everybody including teenagers. Mobile phone today is one of the sophisticated and modern way of interactive networking, has offered global access to all kinds of information generation and sharing across the world, thus reducing the world to a global village. Through the mobile phone, one can record, access, search and retrieve information anywhere in the world in minutes (Thembu 2000).

Kenya has experienced very big growth and uptake of mobile phone technologies such as Mpesa etc. From the beginning of year 2000, there was rapid increase in use of ICT services with developing countries experiencing there highest growth; these services grew faster than even the main stream media with young people being among the main users (David J. McKenzie). During the second quarter of 2015, Communication Authority of Kenya (CAK) report indicates that the number of mobile subscriptions increased to 33.6 million both prepaid and post-paid with an 82.6% penetration rate in the country (CAK, 2015)

Figure 4: below shows mobile phone growth in Kenya in 2014(CAK, 2015)



Mobile technology has improved so much for the last few years Cisco Visual Networking Index estimate global mobile data traffic will increase 18-fold between 2011 and 2016. With this growth technology is expected to change the way health is delivered to patient in terms of cost, quality and patient experience. In Kenya 50% of all phones sold are smartphones (Bruce Howe, Nokia East Africa General Manager, July 4, 2015); However in rural areas where access to internet is not available, the most common phones are the normal feature phone.

Kenya has one of the best mobile phone network coverage. With the zero rating of tax on mobile phones penetration rate has grown tremendously covering most of the country as show in the map below.

Figure 5: The distribution of mobile phone coverage centres in Kenya (IJARAI, 2015)

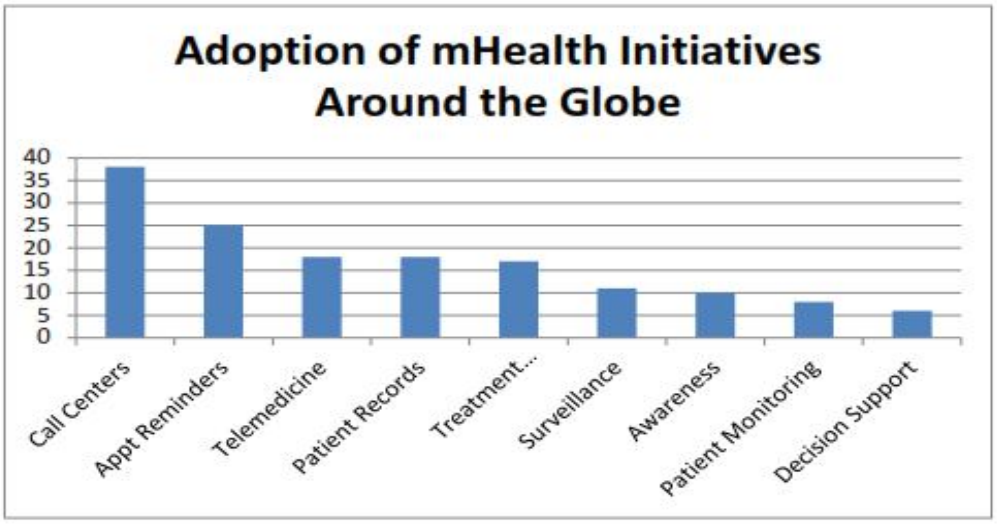
2.3 MHealth

mHealth is a field in health which is supported by mobile technology used in various sector such as observing blood pressure for patient with diabetes, tracking drugs and supplies, training healthcare workers, supporting patients ,educating the public, chronic disease management, empowering the elderly and expectant mothers, reminding people to take medication at the proper time, extending service to underserved areas, and improving health outcomes and medical system efficiency (Darrell West, 2012).

Several initiatives have been done to encourage in adoption of mHealth in the world from 2011. Several systems have been built such as tell centres where patients make calls such as pregnant mothers and they are provided with any information where necessary, reminders systems for reminding patient on when to take their medications, accessing patient information, decision support systems etc.

The major achievement in mobile phone is a feature which enables low-end mobile devices support SMS service as a mode of interaction. This has made SMS predominate in Africa (Danis et al., 2010). Whereas not acting as a replacement for a functioning system, the use of low-cost mobile health tools have potential opportunities in supporting treatment compliance, data management, health information systems, health promotion and disease prevention, emergency medical response (Earth Institute at Columbia University, 2012).

Figure 6: below shows adoption of mHealth for various services (Darrell West (May, 2012)



Main challenges affecting mHealth implementation include Financing, staffing, competing priorities (Darrell West, 2012). Etc. One of the biggest achievement that can be obtained by mHealth implementation is monitoring and treating of chronicle diseases such as cancer where the patients are able to monitor themselves and pass over the information to the disease care centre. Most of the developed nation's mHealth has taken a very big achievement such as systems to monitor sugar levels, for patient with diabetes implemented in 2011 in Mexico, iHeal for substance abusers developed by University of Massachusetts Medical School. China has also developed a system for monitoring heart and transmitting the information to a centralised registry for analysis. Adoption and integration of ICT in CCCs can chart a new course towards UNAIDS vision of zero discrimination, zero new HIV infections and zero aids related deaths through universal access to effective HIV prevention, treatment, care and support (UNAIDS, 2011).

Several MHealth systems have been developed such as training of health staff, pharmaceutical management systems for ART. A research done in Kawangware Nairobi, role of ICT use in HIV and AIDS included; the benefits derived from adoption of ICTs in the fight against HIV/AIDS in Kenyan slums were determined as being Social change; empowerment and reduction of vulnerability; advocacy, mobilization, networking and capacity building; Remote consultations and diagnosis; Information sharing; Remote mentoring; Facilitation of Distance learning teaching; and Online Counselling (Afande and Ofunya, 2000).

Scripps Company limited in USA last year September launched a mobile system which is able to access most of the monitoring and patient health data system on real-time base and transmit the data to a physician mobile device on a pilot base. One of the advantage of this system is interoperability; the system is able to integrate with any hospital management systems; however the system runs on mobile devices running on iOS, Android and Windows operating systems.

In developing systems for electronic health information exchange (HIE) networks especially those to manage chronic diseases such as AIDs cancer etc. Individual Choice principle is especially applicable when an individual is being treated for a condition the individual deems especially sensitive whether because of fear of social stigma attached to having the condition, or because of fear of potential discrimination if having the condition becomes known to others (Gray, 2013). In some countries like USA federal government has provided laws such

as law protects patients from disclosure of their medical records that contain information about testing for, diagnosis of or treatment for HIV, AIDS or sexually transmitted diseases**.**

One of the areas which have been taken into consideration is ARVS dispensing systems. The main reason behind this argument is that ARVS are costly; secondly it's important to monitor patient, for their adherence to the medicines, any adverse drug reactions, and how well they respond to their particular treatment. Initially the process of patient data keeping was being done manually; hence it was hard to monitor and check drug uptake adherence for the patient. Procurement of the drugs which is donor funded was also a hard task due to the process of obtaining the reports; but with the implementation of the system report generation was easy to obtain. One of the disadvantages of RPM Plus Program is that it's an access based system based at the location of ARVS dispensing which means that if a patient is not registered in that location; it's not possible for them to obtain the medication. The system also maintained basic patient information, historical data of patient medication and pharmaceutical needs. That means the system is not patient centred but the CCC centred.

Cell_life, an NGO based in Cape Town South Africa, has introduced several projects for managing, treating and preventing HIV and AIDS Some of these system include:

Cellphones4HIV project concern with preventing, treating and supporting patients with HIV and AIDS. Based on the high mobile phones rate penetration in South Africa, mobile phones have been classified as mass media which can be used to communicate any important information in the country. Cellphone4HIV has embraced this to communicate HIV and AIDS prevention methods, causes and counter any myths provided to communities about HIV and AIDS (Tolly and Alexander, 2009*)*.

Other project under Cell_life is SMS ARV reminders. This is an sms based system where members enrolled are reminded on daily basis when to take their medications, any side effects of the medications and information on other diseases related to HIV and AIDS. One of the biggest issue with these systems is confidentiality especially to people who share mobile phones; how does one ensure that if a another user access his/her phone they have no access to their confidential information about their HIV status?

This is the major hindrances to implementation of this system. Other problems include language barriers, number of characters per sms limiting the information to be given to the patient and sustainability of the project. Currently the project is being sponsored by the donor funds; what happens when the donor stop their funding (Tolly and Alexander, 2009*)*.

The government through the ministry of Health introduced DHIS system which is a tool for collection, validation, analysis, and presentation of aggregate statistical data, tailored (but not limited) to integrated health information management activities (Bloemfontein, South Africa http://www.hisp.org/events/index.html 10 - 24 April 2015). The main reason for introduction of this system was due to the presence of Multiplicity of Health Information /M&E systems which functioned on their own without any integration (Manya, 2011). In Kenya DHIS system was introduce to help assist the government in several ways such as data analysis, determining intra-district reporting rates, downward feedback to reporting facilities and districts which was not being done initially.

Some of the shortcomings and challenges of DHIS includes;

- Mostly used as a reporting system for assisting the government when making and implementing polices.
- Capital; much of the funding was done by donors hence sustainability of the project is a project
- The system rely on network connectivity which is a problem in some parts of the country.
- DHIS lacks modules for managing patient records; most of the system for managing patient treatments and record management has been left to the private sector, NGO's and well-wisher funding.

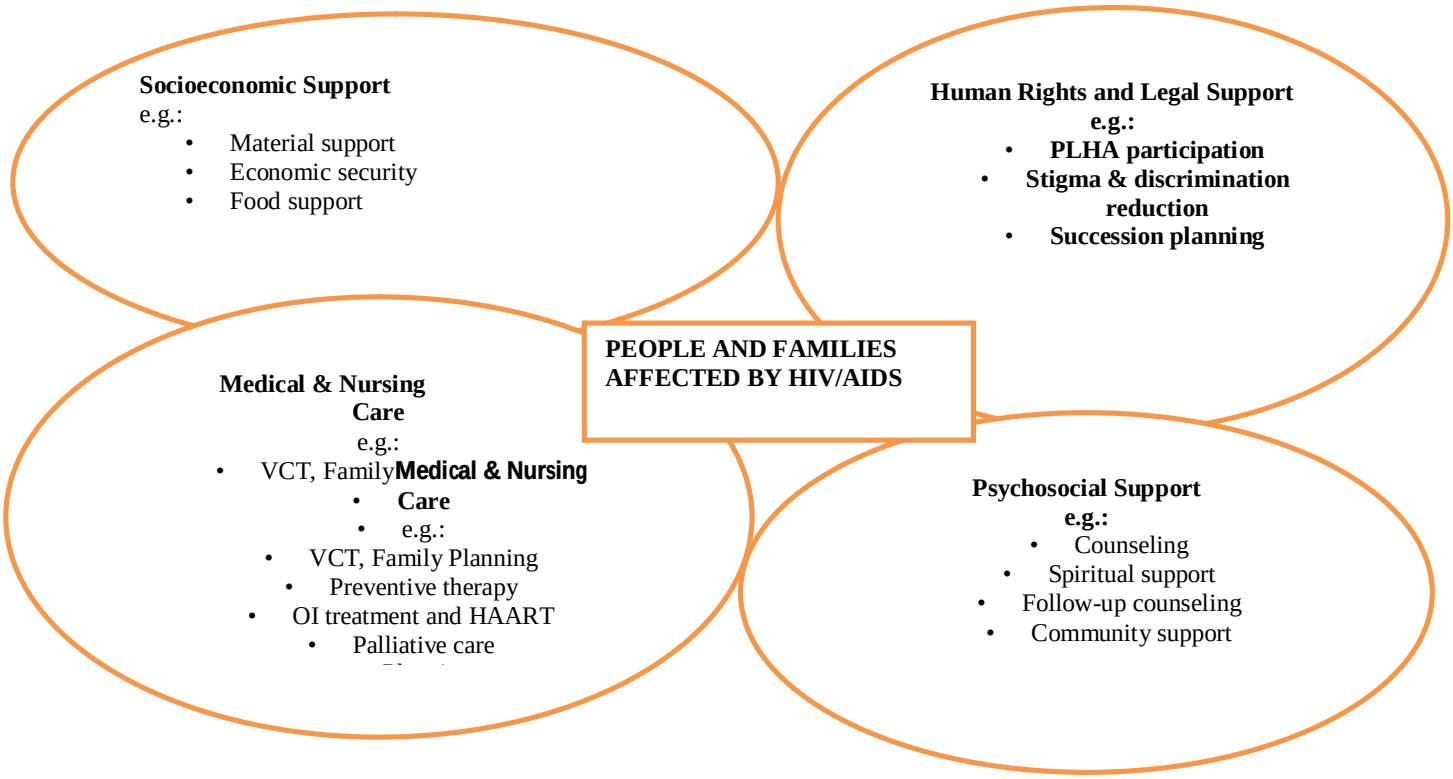
2.4 Comprehensive care centers

Due to the problem encountered by patients with HIV and AIDS; Family Health International (FHI), U.S Agency for International Development (USAID) among other partners developed ART learning sites in Ghana, Kenya and Rwanda. These countries were identified because of their strong government commitment to provide and sustain HIV treatment. This coupled with their well-established national AIDS programs and the presence of ongoing impact prevention and care interventions made the countries more suitable as pilot projects for the idea of comprehensive Care Centres in Africa. This marked the conception of the comprehensive care approach in managing HIV/AIDS (UNAIDS, 2002). Whereas ART centres concentrate much on patient treatment; CCC centres were developed from this to offer more than just the treatments. Each CCC features a set of common core services, including: a care-based counselling and testing service to establish an HIV diagnosis; a clinical ability to diagnose, treat and manage opportunistic infections; counselling for treatment adherence and nutrition; and delivery of ART (Taravella, 2005).

Following this development, the first CCC Center was opened at the Coast General hospital in Mombasa in the year 2002 in which ART was introduced as an integral component of comprehensive care and support for HIV-infected patients and their families. In 2004, additional sites were opened in hospitals and health centres throughout the country. By the end of April 2005, more than 5,800 new patients had started ART through this treatment and care initiative (Amenyah, 2005).

Comprehensive care focuses on the patient and provides the patient with not only physical, but also social, psychological, emotional and spiritual care (Manyeti, 2012).Currently there are 9,886 Health Facilities in Kenya sponsored by government, faith based and private organizations MFL (2014). Out of these 921 offers ART services; CCC centers account for 600 centres.

Figure 7: Some of the services provided in a CCC centreSource (Adungosi, 2005)



Many CCC centers have managed to as implement systems such as ARV drugs management systems to ensure maximum utilization of the drugs. In Kenya, KEMSA has implemented an oracle based system for managing all donated drugs including ARV's. Uganda has managed to customize, Supply Chain Manager (SCM) to manage laboratory tests and ARV distribution

in the country. Other systems include; ministry of Health Information Systems (HIS). But the system is only for data collection and management. Only CCCs in referral, Provincial and District Hospitals have partially adopted and integrated ICT in their operations. This translates to less than 2% of total facilities (GOK, 2011).

One of the biggest problem facing CCC centers in Kenya is patient data exchange between various CCC centers. Whereas several of the CC centers have systems to manage patient data; each one of them uses a different system depending on the donors supporting them hence when it comes to system integration there is none at all resulting into patient depending on their CCC of registration or moving with transfer letter when migrating to another location or on transit. In some places a patient on transit can only be provided with medication only twice more than that; they have to be registered in that CCC centre "Clinician Kenyatta CCC centre" This is due to data update of patient with their CCC centre of registration. whereas in other places they do not provide services to them at all " Coptic CCC centers clinician" due to previous patient data access. For patient on transit they do not require all that complication at the end they will go back to their original CCC centers what they require while on transit is to be provided with the same services they normally get from their CCC centers while on transit.

2.2 Summary of literature review

From the literature review, to reduce and intensify HIV prevention we need to improve on the following:

i. Adapt and scale up effective evidence-based combination prevention,
ii. Maximise efficiency in service delivery through integration,
iii. Leverage opportunities through creation of synergies with other sectors,
iv. Increase coverage of care and treatment and reduce loss in the cascade of care. Quality of care, limited use of electronic medical records, evidence informed interventions at facility level and viral load monitoring need improvement,
v. Establish standardised national patient unique identifier and tracking mechanisms that can be originated at HTC service point. (Kenya Aids Strategic Framework 2014/2015 - 2018/2019).
vi. Patient data exchange between various CCC centers does not occur at all. No single unified system is established in the country to help in achieving this.

vii. Improve on ICT usage in all parts of the country. There are many advantages that ICT offers in provision of quality services in prevention, PMCTC, VCT, Psychosocial, data collection and management of HIV and AIDS pandemic (RUCHA KENNETH KIBAARA APRIL, 2015)

Several countries have managed to implement mHealth to manage HIV and AIDS with developed countries leading. Most of the developing countries have also managed to implement the same; however most of these systems are not patient centred; most of them deal with ARV distribution and dispensing.

One of the major achievements of this is at least patients are able to get their medications on time, report generation is possible and government organisations are able to procure medication on time; however one of the issues which has not been solved by existing system is patient and CCC independent. Currently the patients have to visit their CCC of registration for them to obtain any medication. This is due to availability of the patient medical information.

Sustainability of mHealth project. Most of the systems are managed by NGO and donor funding. In South Africa most of the systems provide sms for free; the cost is taken care of by the donor funding. On average it costs R13.20 (US$1.32) per person per month to send the SMSs that mean these programs should be able to generate revenue to sustain. This is always a hard to sell idea to patient.

Most of the CCC centres are donor and NGO funded e.g. Mater CCC is funded by PEPFAR; whereas in Mombasa most are managed by IMPACT; this result in most of them having their own system to manage patient. Storage of data does not follow HL7 data exchange standards for health systems hence interoperability between various systems is a problem.

2.3 Conceptual Framework

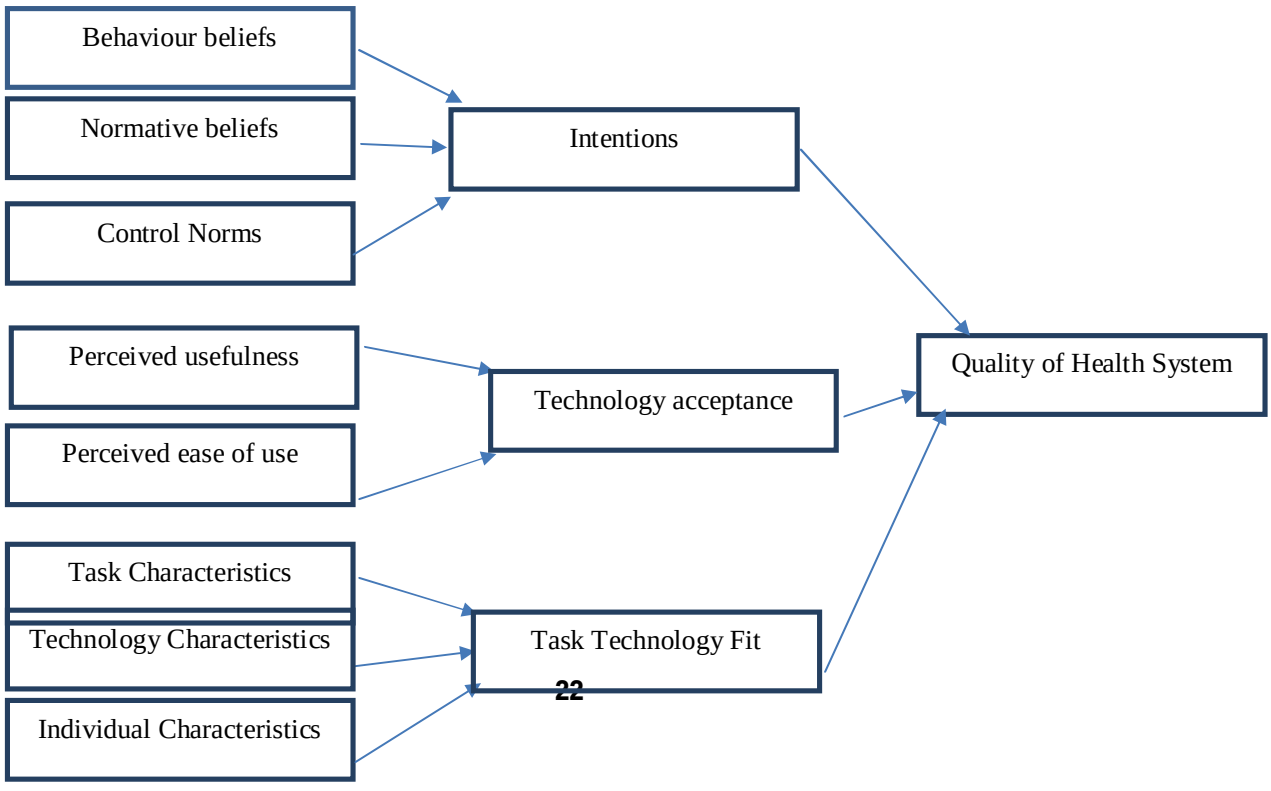
This research was guided by the ICT adoption Model which is adopted from Mburu (2013). The Conceptual framework identifies factors affecting patients' lack of adherence to drugs. The model consists of a two dimension framework consisting of three models Theory of Planned Behaviour (TPB) also known as reasoned action (TRA), Task-Technology Fit (TTF) and Technology Acceptance Model (TAM). Technology Acceptance Model (Davis, 1989) was developed based upon the TRA specifically for understanding user acceptance of information technology. TAM has been applied to understand healthcare professionals' acceptance of ICT (Huet al., 1999; rote au et al., 2002).

This will assist us in determining the benefits to be incurred by implementing the system in the fight against HIV and AIDS. TPB helps us to understand how we can change the behaviour of other people for example when advertisers are advertising their merchandise they want users to change their perception on a given product. Based on TPB we will be able to analyse the planned behaviours of migratory patient in terms of getting medication and the actual process of medication on their transit routes.

TAM suggests that the acceptability of an information system is determined by two main factors: perceived usefulness and perceived ease of use (Davis, 1989). Perceived usefulness is defined as being the degree to which a person believes that the use of a system will improve his performance. Perceived ease of use refers to the degree to which a person believes that the use of a system will be effortless. Several factorial analyses demonstrated that perceived usefulness and perceived ease of use can be considered as two different dimensions (Hauser et Shugan, 1980; Larcker et Lessig, 1980; Swanson, 1987) will help us to understand the system usage among health staff and patients by checking whether it's easy to use and useful.

TTF is the degree to which a technology assists an individual in performing his or her tasks. Specifically, it is the fit among task requirements, individual abilities, and the functionality and interface of the technology (Goodhue, 1997). MHealth system is considered important if it has been utilized and good fit with the tasks the technology supports (Goodhue & Thompson, 1995).

Figure 8: Conceptual Framework: Adopted and modified from Stephen Mburu (2013)



2.4 Hypotheses

- Mobile health system will improve patient health by ensuring that patient information integrity is maintained and available for treatment when required to ensure that timely and correct medication is provided when required.
- Most of the CCC canters have health management information systems where they store patient data thus accessing patient data for centralised data storage will not be a big problem.

CHAPTER THREE

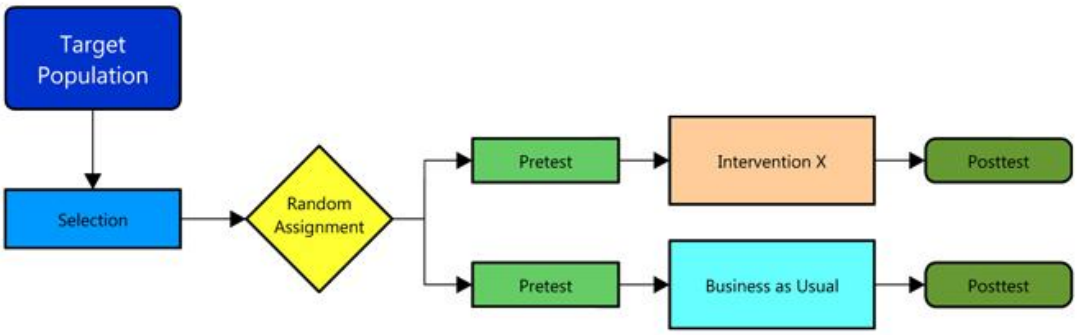
METHODOLOGY

3.1 Research Design

This study used intervention research which involves knowledge development, knowledge utilization, and design and development (Thomas & Rothman, 1994). It defined as the empirical study of professional intervention behaviour in the human services. It may involve acquiring knowledge about the process and context of intervention, or it may focus on creating or enhancing the fundamental methods and tools of intervention. It is an emergent area of research that is not as highly developed as more-established methodologies (Rothman and Thomas, 1994). One of the main advantages of Intervention research is acquiring knowledge that is practical, instrumental and closely related to the problems of intervention. In this process research was carried out to help us understand how HIV and AIDS data stored, data mobility, how skilled health workers obtain patient information, does the government has any database of all HIV and AIDS patient to assist in decision making and where is this information obtained from? Is there any technological availed to HIV and AIDS patient and how are they able to interact with their main CCCs when on transit. Here five processes were involved. The data was obtained by visit CCC centres in Kenyatta CCC centre, Kibra CCCs, Machakos level five CCCs, Mater Hospital CCC centre, Coptic hospital CCC centre and Meru level five comprehensive care centre and Homabay District Hospital CCC. How is the diagnosis done, treatment and drugs dispensation done; do they use same system or different systems for each function or the whole process is manual.

i) Development of the problem and theory about the problem
ii) Specifying research program and structure
iii) Refining of program components and doing Efficacy Tests (testing of product intended use to ensure that accurate information is obtained).
iv) Testing practical settings effectiveness.
v) Publishing the findings.

Figure 9: The process of Intervention research



3.2 Sample Size

The research concentrated on health staff in CCC centres clinicians, pharmacist, nutrionist and counsellor. Random sampling was used to determine sample size. Clayton (1997) proposes 15 to 30 people for homogeneous groups. Ziglo (1996) stated that 10 to15 people produce good results in a homogeneous panel. On the other hand, for heterogeneous groups, that is, people with expertise on a topic but from different social or professional groups, Clayton (1997) reported that only 5 to10 experts are needed. It was concluded that the larger the group, the more reliable their aggregate judgment will tend to be. However, groups beyond sizes of 20 to 25, showed only minimal improvements in reliability. It appeared that panels of experts who also had a diversity of perspectives produced more accurate judgments than experts who were more homogeneous. To have more reliable data the study used several clinicians, two pharmacist, two nutrionist and two counsellors from several CCCs countrywide. The reason behind this was the initial CCCs were not able to fill several questionnaire because all the staff perform almost the same functions. The study was carried out in the following CCCs: Kenyatta CCCs, Kibra CCCs, Machakos level five CCCs, Mater Hospital, Coptic hospital CCCs, Meru level five comprehensive care centre and
Homabay District Hospital CCCs.

3.3 Data collection

Data collection was based in all these CCCs. Cross sectional data collection was used. These include; use of focused group discussion involving some local translators, this assisted in obtaining direct feedback on the subject from the participants and also obtain more

information. This allowed for detailed exploration of participants. Participant were grouped into small groups of equal number of people from the area.

3.3.1 Structured questionnaires

Used in quantitative data analysis. This is done with assistance from translators. An advantage of using questionnaires is that; a lot of data/information was obtained from a large group of people within a short period and this was also being cost effective. The questions were both open-ended and closed. This was to ensure that as much information was obtained from the respondent. Attached is a copy of the Questionnaire.

3.3.2 Interviews

Interviews were carried out to help us investigate issues in an in depth way and also discover how individuals think and feel about a topic and why they hold certain opinions. That is "what is their opinion on having their health information on a mobile phone similar to the way customers carry their financial details of their accounts on a mobile phone". The study was divided into the following groups, HIV status, age, level of education, for Health staff on how they are able to organize patient data.

3.3.3 Focus Group Discussion

This where people from similar background and experience gather together to discuss a given topic which is normally guided by a moderator. One of the major advantage of using FGD is that the participants are allowed to agree and disagree which result in help the researcher to obtain a deep insight of the research topic.

Other sources of data were journals, research papers, newspaper, media and NGOs operating in these areas.

3.4 Limitations

Some of the limitations for these type of data collection were; Customer data privacy. One of the biggest problems is how to store HIV and AIDS data without leaking it out. HIV and

AIDS still remains as an outcast disease among so many communities in our society hence patient prefer their information to remain secret.

HIPAA Privacy Rule recommends that patient medical information is not shared more widely than is necessary under applicable federal and State laws (HIPAA Privacy August 14, 2002)

Gaining trust from HIV and AIDS patient. This is also one of the biggest predicaments for this study. For patient to use the system where they know their personal information is being stored somewhere is a major problem.

Most of the CCC centres required us to provide a written document to show that we are around to carry out any research work from those facilities; However permission was allowed when we explained that we are not going to go with any patient data our main research work was to have an overview of the operations of CCC centres and patient data storage.

3.5 Data Analysis

Data from qualitative research was analysed using content data analysis process procedure for the categorisation of verbal or behavioural data, for purposes of classification, summarisation and tabulation. This assisted us in making sense of the data which was collected. Data collected from the focus group discussion was analysed qualitatively in order to obtain direct feedback from the users and determine the level and type of interviews and questionnaires to be done.

Data from the questionnaires was analysed using quantitative data analyses method using SPSS software. This assisted us in making decision of the outcome and understand whether the solution provided was of any great importance to the community.

3.6 Ethical issues

Written permit was required in order to carry out the research, Access to patient data requires permit especially patients suffering from chronicle diseases. Due to the process required to obtain this permit; we opted for doing a research on the operations of the CCC centres and having general overview of the patient data without dealing with patient data in-depth.

CHAPTER FOUR

FINDINGS

4.1 Introduction

This chapter describes findings of the research on how health staff obtains patient information in order for them to provide medication or offer them counselling or nutrion information.

4.2 Current process

The current process is more complicated depending on the CCC. Currently implementation of IT system by government for managing HIV and AIDs patient in the country is divided into two region Western region using OpenMRS being implemented by I-TECH Kenya and Eastern region using IQCare which is being implemented by Future Group. In CCCs where these systems have already been implemented these systems are not integrated at all hence each CCCs manages their own system. This is most due to funding issues.

Some CCC centres are still using manual files such as Coptic centre. The patient is normally provided with a blue card upon visiting a CCC centres, tests done and confirmed to be HIV and AIDS positive which they normally produce on the next visit. Once medication is provided the health staff responsible update the patient manual file and also the patient blue card and return the card to the patient for next visits. Other CCC centres have standalone systems where they are able to retrieve patient information only if a patient is registered in that CCC centres but they also carry a yellow card which they normally produce on every visit. Some of the CCC centres have different system in each department's hence even sharing patient data in these departments is also a problem. If a patient visit a different CCC centre from the one of registration and they are on medication, they have to produce a card containing the medication information or any other document for medication confirmation. If they are relocating; they have to carry a transfer letter to their new CCC centres.

4.3 Discussion on responses

Several questions were administered to health staff so that we can understand the process of storing, retrieving of patient data and what happens if a patient under medication visit the CCC centre.

The questions asked are discussed below:

- First question was on the services provided in a CCC centre. Most of the respondent said HIV and AIDS services such as testing ARV dispensation, nutrition advice, counselling services and TB services. Retrieving of previous information is always a problem.
- One of the biggest issue facing CCCs in Kenya is data exchange between various CCC in different part of the country. In Kenya currently there are no standards on how health systems are developed to enable easy exchange of information in CCC centres. Hence each CCCs use a system based on what donors have proposed to them, no data exchange between them thus it's always hard to have a good follow-up of patient medicals and services provided to them from any CCCs in Kenya when a patient is on transit.
- The new system assist health staff by ensuring that all these services provided, information provided is stored and retrieved from any CCCs.
- Other question was if a patient visit a CCCs is there way provided to health staff to check whether patient is already in medication. All the respondent said if they do not have any manual document to prove that hence a patient can be registered in several CCC centres. The new system removes this inefficiency by ensuring that once health staff confirm that a patient is HIV and AIDs positive information is provided to system's administrator to upload to the main system and a patient unique number provided. Anytime a patient visit any CCC they provide their patient ID, using their mobile number a sms is forwarded in a specific format to determine whether this patient has been registered.
- Another question was minimum information required by health staff in order to provide services to a HIV and AIDS patient. The responses were varying as shown on the annex question response table. The system has taken care of this. No need for health staff to ask the patient this information. They will send a sms with a given format using the patient phone indicating the person to

receive the information and a response is provided with the required information.

- Issue of patient data privacy and confidentiality. In most of the CCCs the patient they get is not from their locality. This is due to the stigma associated with HIV and AIDs patient. To ensure that patient can visit any CCC centre without any worry about their data privacy and confidentiality the system checks for the phone number of the sim card requesting patient information to ensure that only registered patient phone number is able to query and receives the required information.
- The system also removes the issue of providing patients with wrong medication and worry of losing their information card or carrying of transfers letter since all their information is stored in one location. When they visit any CCC centre they are able to receive the same services as to when they visit their CCC of registration.

4.4 System Design

Currently the patient must have a yellow card or any other document which shows the medication to be given. The new system will only require a patient to have a sim card only in order to access his\her information. For patient initial registration in future we will integrate with existing system in order to obtain patient information. Any patient medication update on the system will be done in a central location to maintain data integrity.

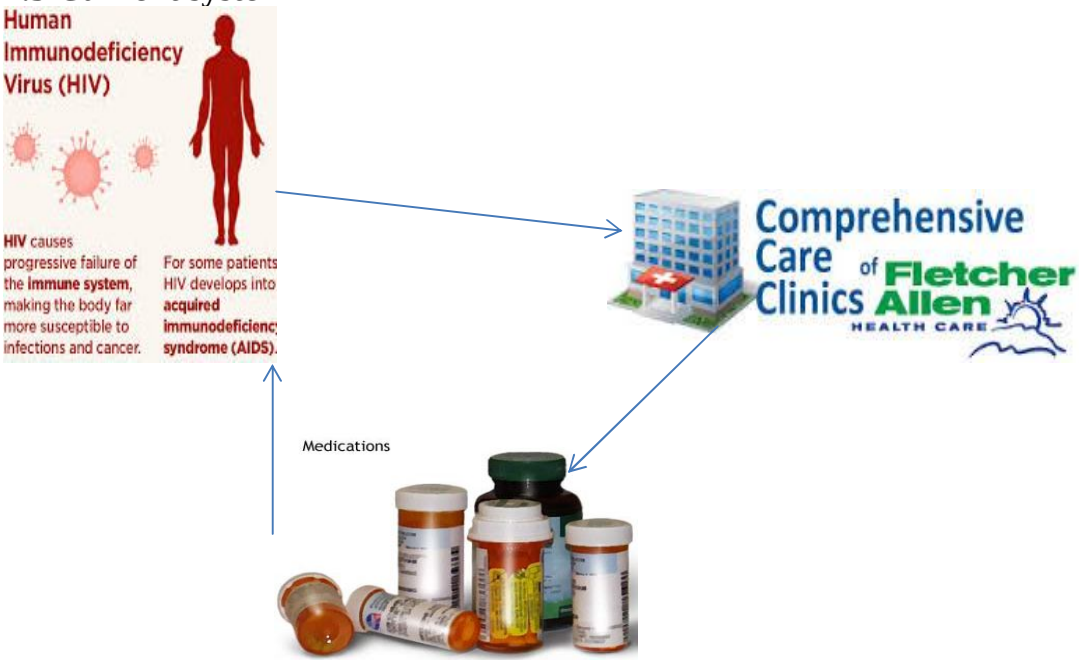
Based on the research done any system which has to interact with users should be acceptable i.e. Effectiveness and usefulness. In this perceptiveness and based on our research we borrowed similar ideas of Mpesa where Mpesa users are able to carry their financial information on their phone similarly on our side the users sees as if they are carrying their Health information on the phone. Most of the HIV and AIDS patient on transit have very little time to spend in CCC centres hence the system has to be efficient enough and very easy to use. This will enable them to obtain all the services they require very fast without wasting much time.

HIV and AIDS patient face a very big challenge in the society due to discrimination hence most of them have to ensure that their manual document which they normally use when visiting CCC centres are left in those facilities to ensure that nobody from their society have access to that information. Most of patient on transit even discard those cards hence the problem of obtaining their previous medical information. In our system design this has been

taken care of by ensuring that the system is fit for use by providing security features such as no other person is able to request for patient information apart from patient himself and they have the authority to determine who receives the information in order for them to obtain any service from CCC centres.

Figure 10: The current system design

4.5 Current system



In the current scenario, Patient visit a CCC centre where tests are done, a file is opened for the patient. Some of the information contained in the file includes:

- Patient profile
- Patient source (PMTCT, VCT, TB clinic, MCH-Child etc.)
- ART history (Purpose, list of drugs names, date last used, date conformed HIV positive and where etc.)

    i. HIV status of family members.
    ii. Patient CD4 Count
    iii. Date enrolled into the CCC centre
    iv. Date started on 1st line regimen
    v. Date switched to 2nd line regimen and reason
    vi. Date of transfer out and death

vii. ART treatment interruptions (date, reason of interruption and date restarted)

viii. Current CCC centre

ix. Patient address

x. Current Regimen

xi. Any known allergies

The patient is then provided with a small card which they normally carry along when visiting their CC centre. This assists the health workers with locating the patient files. Some of the disadvantages for using this process include;

- In case of loss of the card; it's not possible to locate patient files from CCC.
- Leaves a loophole for a patient to register twice in different location
- Patient are not independent of CCC they can visit. Restricted to only the location they have been registered in due to lack of data mobility.
- Wrong diagnosis may occur whenever the card is not available from the patient.

4.6 New System Design Methodology

In the system development methodology we applied "Rapid Application Development (RAD)". This is a development Lifecycle designed to give much faster development and higher-quality results than those achieved with the traditional lifecycle. This methodology is designed to take the maximum advantage of powerful software development tools that have evolved recently (James Martin, 1990).Main goals of RAD include; system should be of high quality, low cost and fast development and delivery. According to James Martin 1991, quality means "meeting the true business (or user) requirements as effectively as possible at the time the system comes into operation".

The reason for using this development methodology is; the system should be of high quality that is users are able to obtain all required information with minimum failures. Due to the target population and funding issues the system should be of low cost.

The system consists of centralised server for storage of patient data (back-end). The data consist of the most vital information which assist the health staff in treating the patients based on the research outcome. This information include:

i. Patient CD4 Count

ii. Date enrolled into the CCC centre

iii. Current CCC centre

iv. Patient address
v. Current Regimen
vi. Any known allergies
vii. Date started on 1st line regimen
viii. Date switched to 2nd line regimen and reason
ix. Current Regimen
x. Date of transfer out and death

Once a patient has been diagnosed; this information will be fed to the system using the national ID as the unique key using a mobile system and transmitted to a central server where the information will be stored. The next time a patient visit a CCC Center, He/she will just be required to provide His/her national identification number which will be keyed on the system to retrieve necessary information before treatment is provided.

Patient will also have access to the information but will only be allowed to update public information such as; mobile number, physical contact etc. other information will only be updated by a health worker.

One of the biggest benefit of using MPHIS is patient mobility is not controlled. A patient can access any CCC centres and get all services required similar to when they are visiting their CCC of registration. Similarly if a patient loses their yellow card, there is no need to worry. Similarly there is no need to remember their medication. Clinicians are able to obtain the patient information using their mobile phones.

4.7 Requirement

1. **DBMS Server** – Test Server with Patient Details @SCI – Patient accounts accessible via unique Patient ID stored here. Authentication required for any Read/Write Request
2. **SMS Gateway Server** – Centralized Server @ SCI connected to the DBMS Server
3. **Gateway Server Software** – the SMS Gateway Server is installed with SMS Gateway software to enable receipts and sending of SMSs
4. **UPS and with backup Generator** - Both DBMS and SMS Gateway server connected to UPS to ensure 24 Hr. availability everyday
5. **GSM Modem**: it is a specialized type of modem that accepts the SIM card. You can connect it to the PC with a data cable for sending/receiving SMS messages. The GSM

modem ensures that the system is accessible from anywhere for as long as the users know the GSM SIM card number.

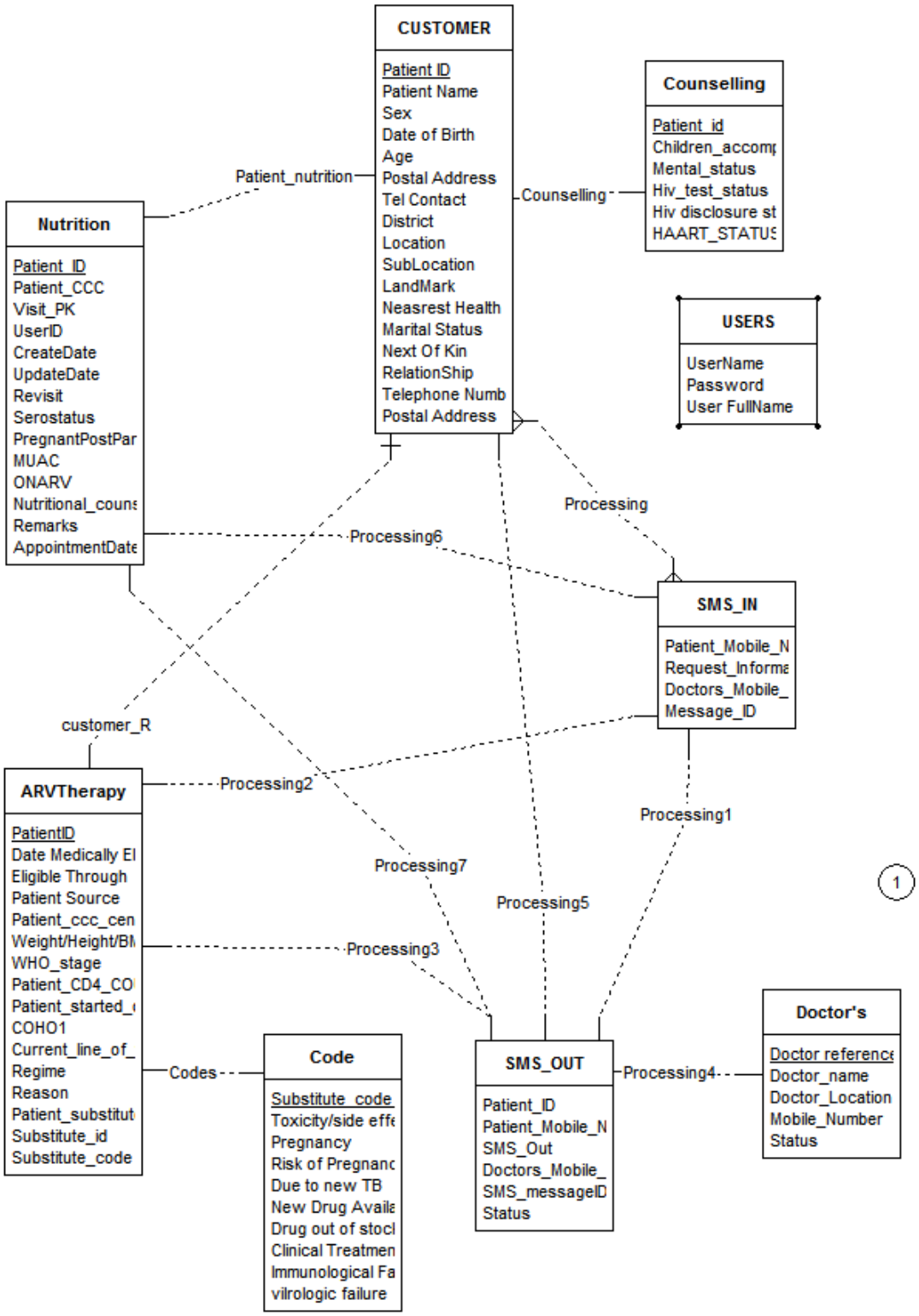
4.8 System Architecture

Mshauri consist of three layers;

- Interface layer, which is the graphical User Interfacing for system administrator to interact with the system (web and mobile application).
- Input processing layer – Used stored procedures for fast processing
- Database layer which is where patient data is stored

4.9 Database Design

Figure 11: Design of Database system



The system consist of two main modules,

I. The administration side (web based)

II. Users side (mobile based)

4.10 System Administration

a. System contains the following processes for administration

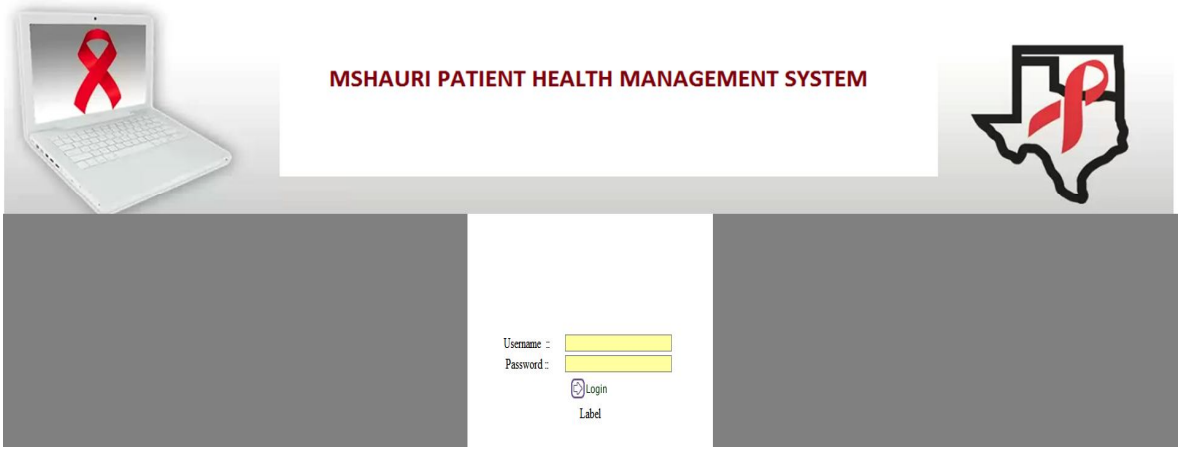
b. Creation and editing of patients

c. Creation and editing patient medical information

d. Creation of new patient counselling and nutrion information and also edit of the details

e. Creation and editing of health staff information

Figure 12: Logging page



This is the login screen for the administrator. Once the correct username and password is keyed in the system will display the following screen.

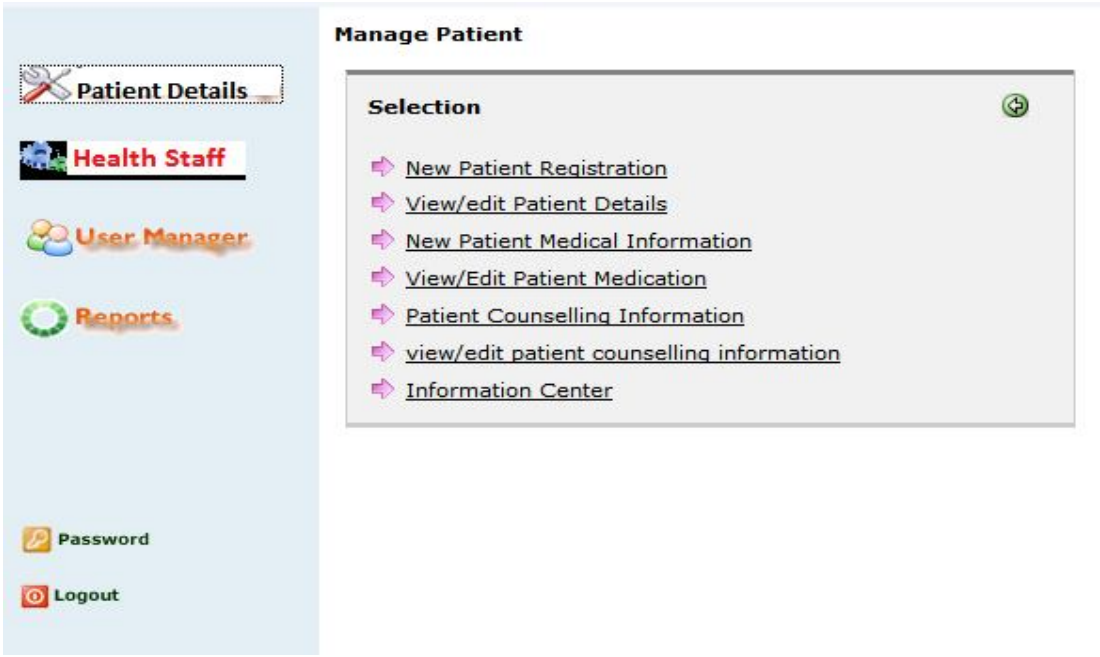
Figure13: Main Page

Following menus are available

- Patient Details: Deals with all processing regarding patient
- Health Staff: deals with all information regarding health staff

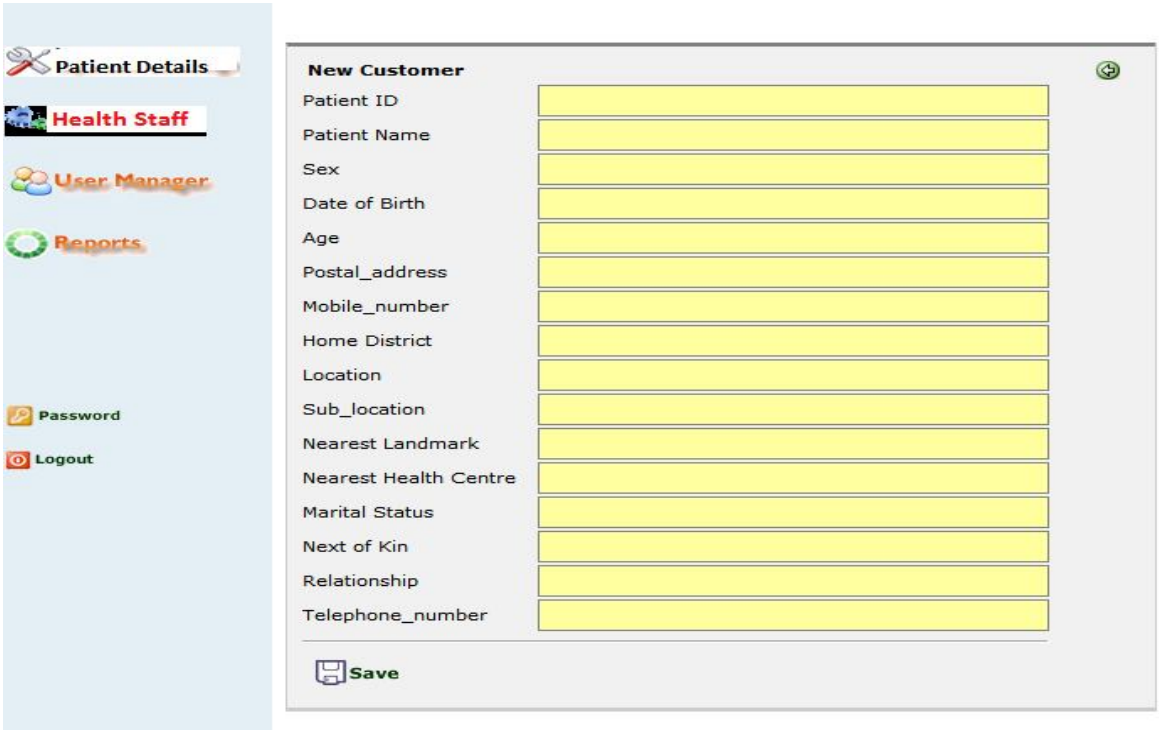
When a user clicks on patient details the following menus are displayed:

Figure 14: Patient management page



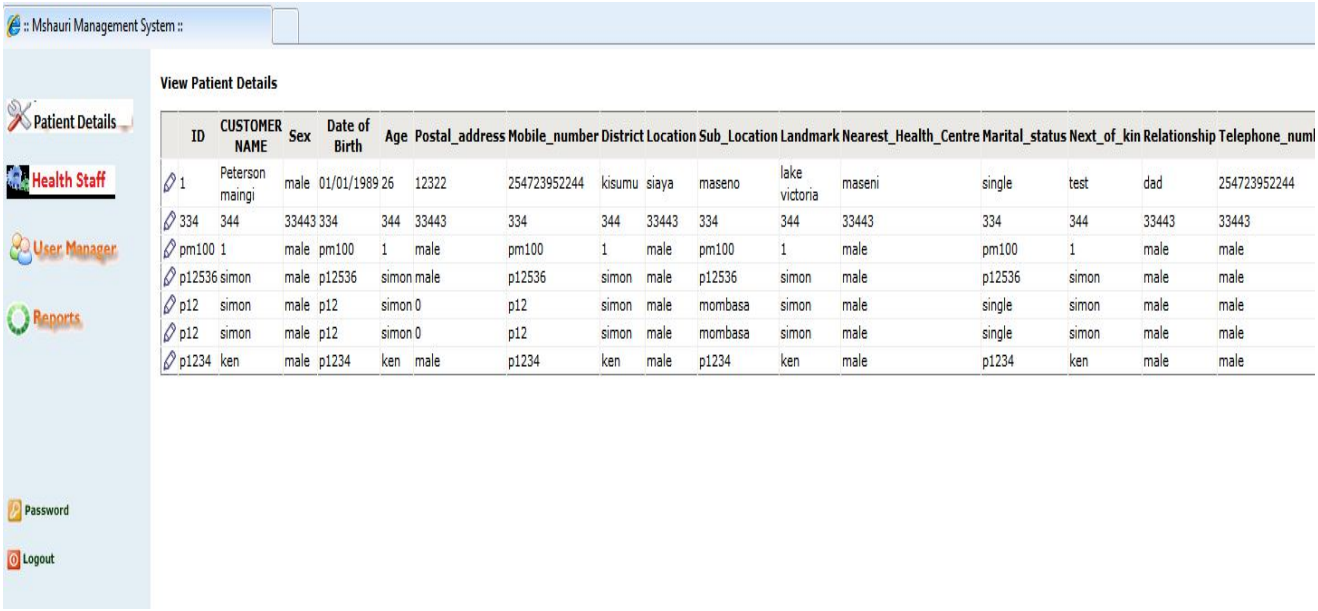
For registering of a new patient choose new patient registration

Figure 15: Patient registration page



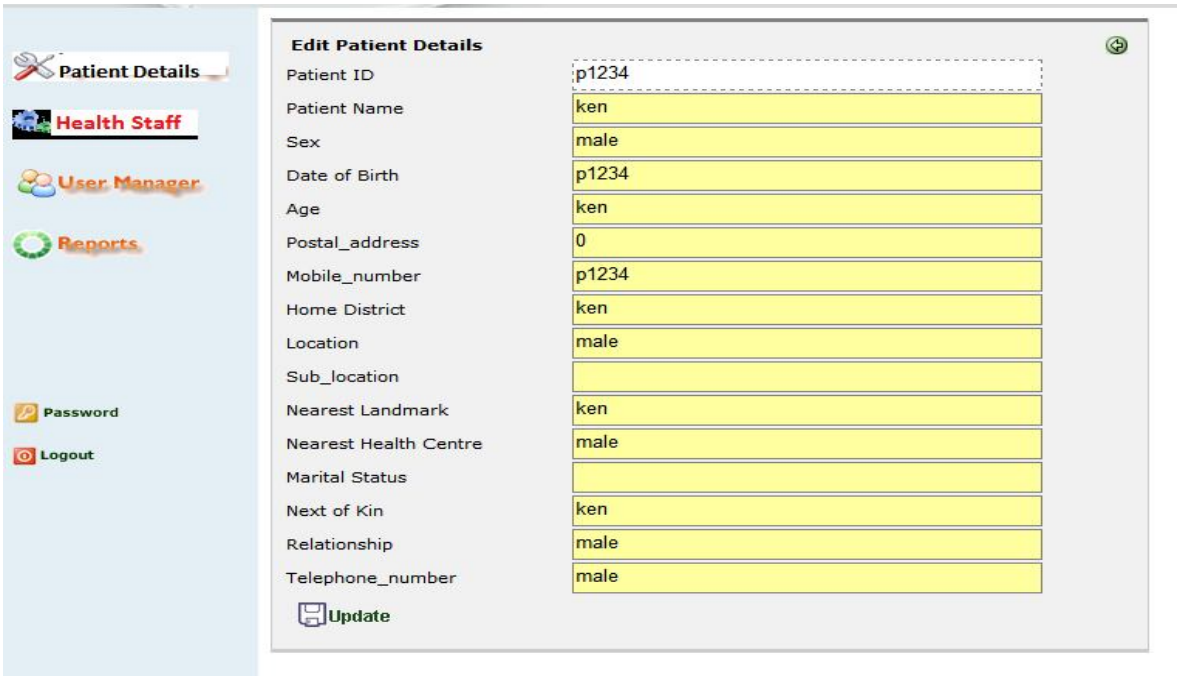
Input all the required patient details and click okay to save. If a patient already exist the system will notify the user. To edit a patient details click on view, edit patient details

Figure 16: Patient view/edit page



To edit click on the mark on the first column of the table.

Figure 17: Patient view/edit page



Change the details required for edit and click update to save the new details.
Figure 68: Patient new medication details

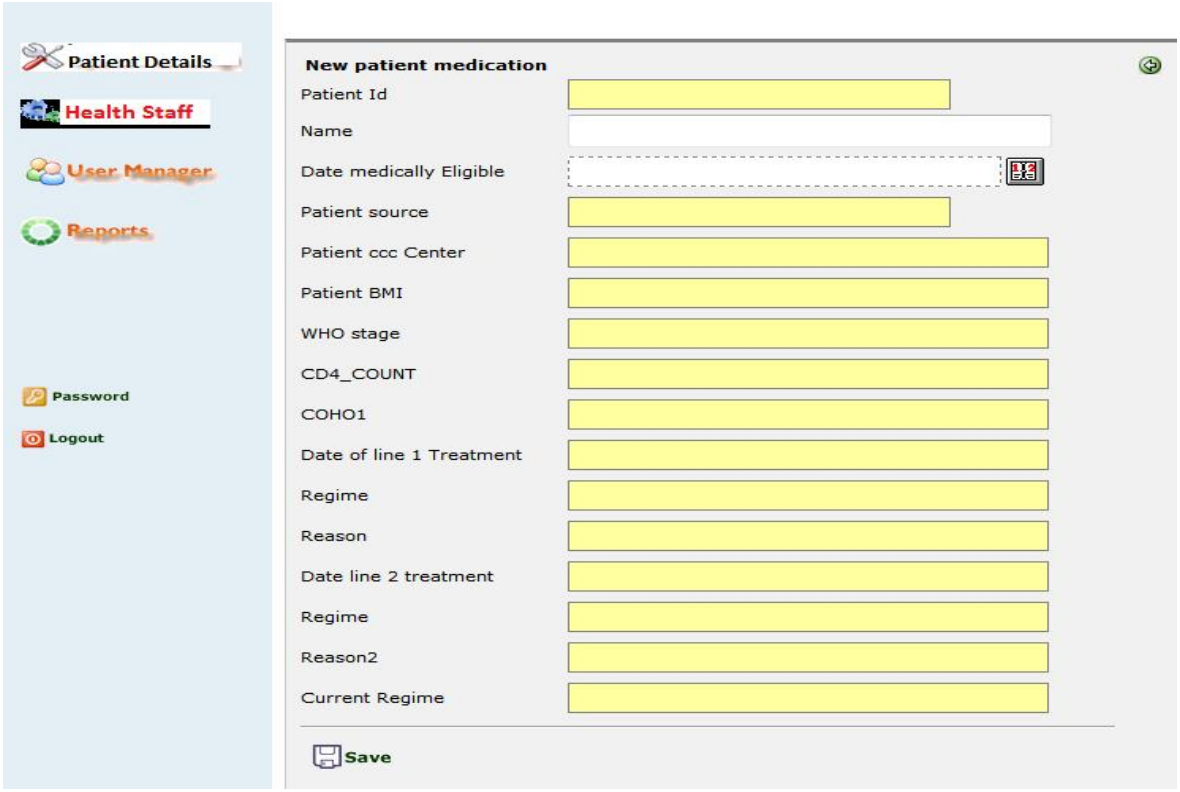
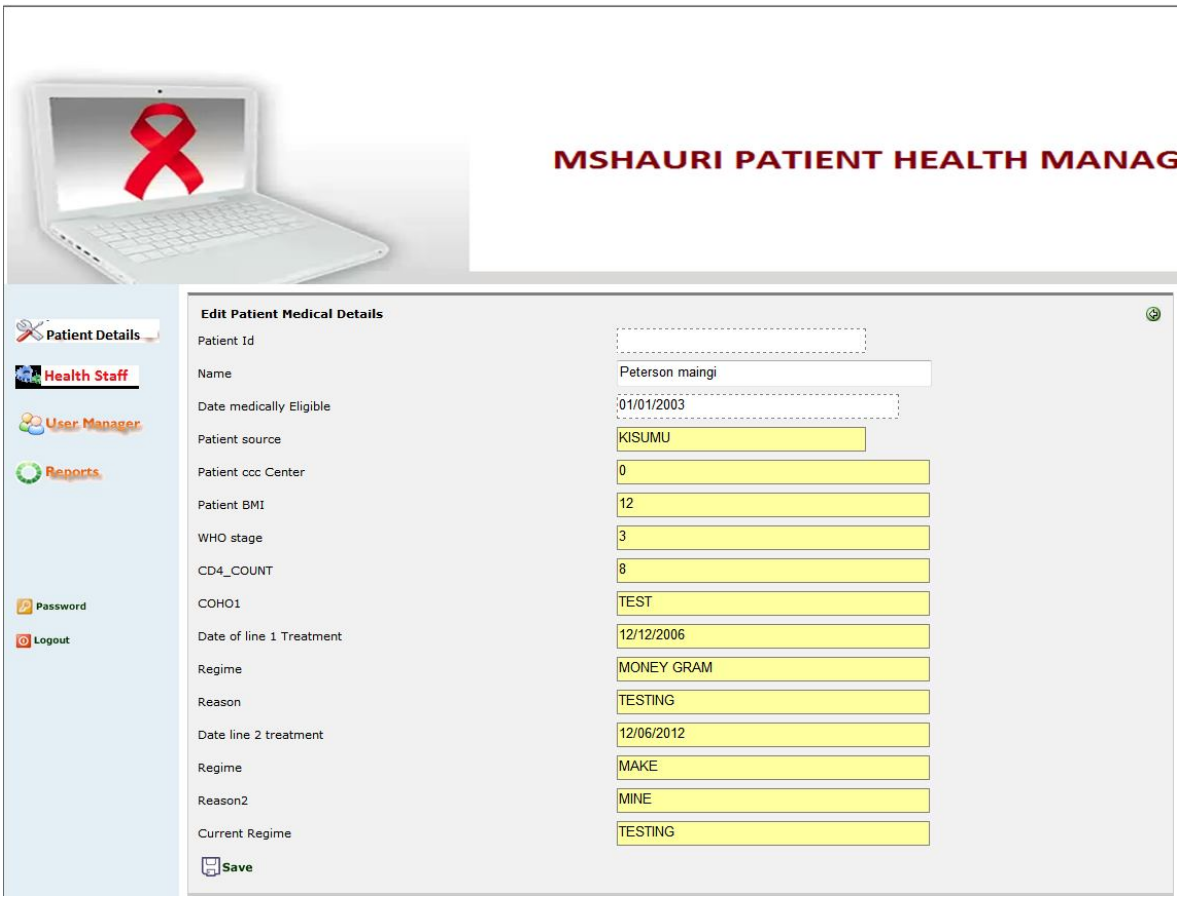
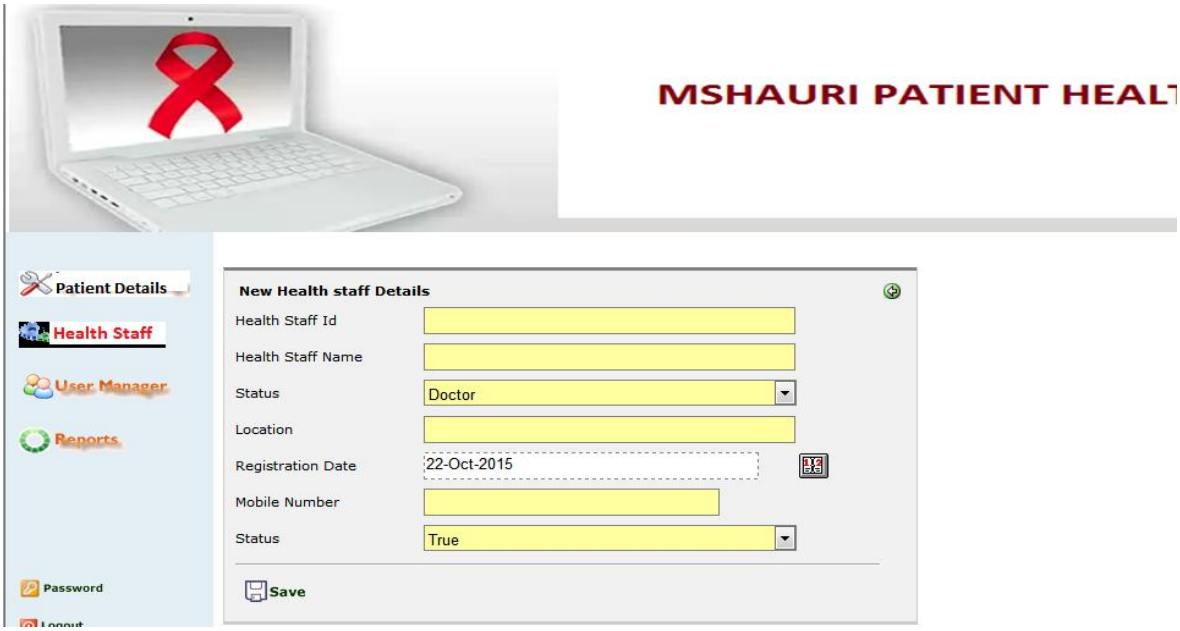


Figure 79: Edit patient details



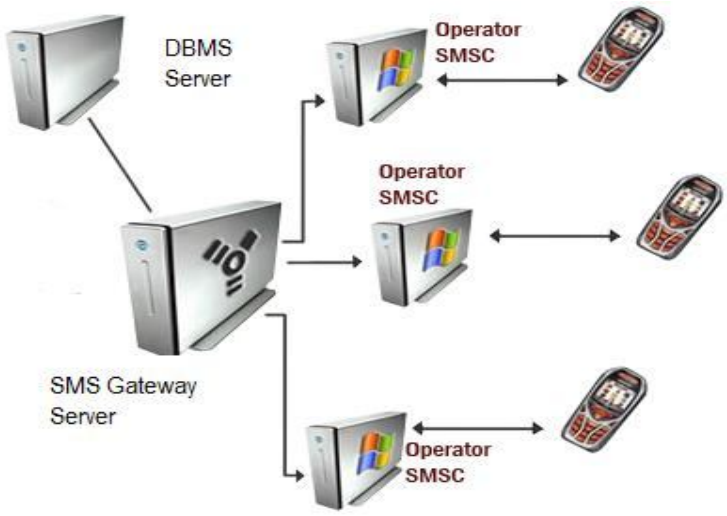
Creating of health staff and editing the details.

Figure 20: Edit staff details



4.11 Mobile Phone Application Design

Figure 21: The design of the front end mobile system



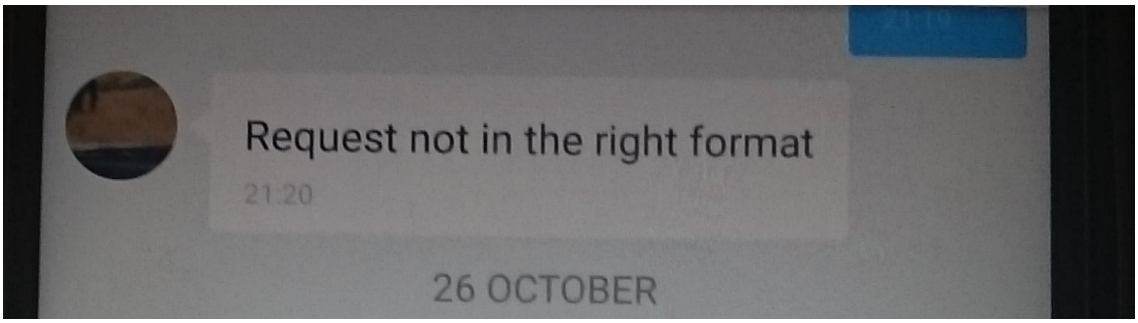
The user sends a sms message with the following details separated by hash (#)

- Patient id
- Request e.g. (cd4_count, revisit etc)
- Person to receive the information (nutritionist, counsellor, doctor)

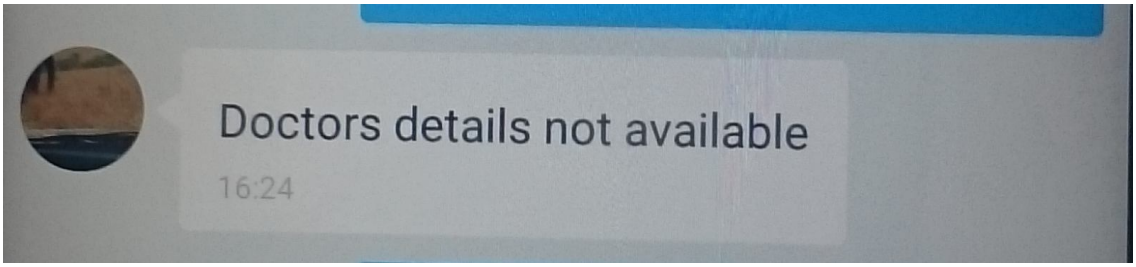
Message example

1#CD4_COUNT,#254722952244

If the message is in the wrong format, the sender receives the following message

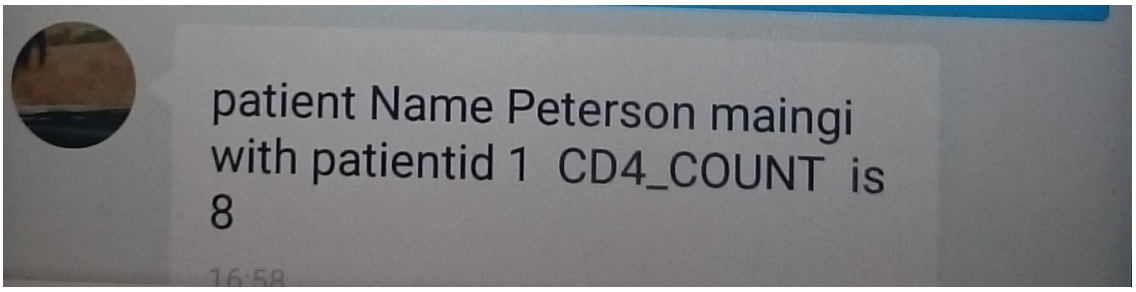


System first check whether the recipient exist and job description. If they do not exist a response is returned as a sms to the sender informing them the recipient number is not registered.



If the person requesting for information based on the mobile number used exist, the system query the information requested based on the recipient job deception.
The system will check whether patient exist first based on mobile used.
If the patient does not exist a sms is returned back to sender with message does not exist.

If the recipient does not exist the sender receives a sms showing the sender does not exist. Once all these are met the recipient receives a sms notifying the information requested as shown below. The information provided has basic information such as CD4_COUNT, WHO_STAGE and BMI. And current regime. This has to be included in all request submitted back. For example if a user request for last day of medication, the date will be provided back together with this information.



4.12 System Limitations

One of the biggest problems for this system is accessing multiple patient information in one sms request. The reason behind this is the limitation of sms number of characters. Sms currently only allows 160 numbers of characters. This problem can be solved by using USSD (Unstructured Supplementary Service Data); however the cost of USSD code for the telecommunication authority is very high and also takes time to be provided.

System Testing and Result

Test ID	Test Description	Expected Result	Observed Result	Comments For cases where there is difference between observed result and expected result
One	Patient Sending an sms where patient is not registered in the system	Patient receives an sms indicating that they do not exist in the system	The sms sent and received by the system processed and a feedback provided no patient with that mobile number exist	
Two	Patient request for previous treatment but that information does not exist in the system	Patient receive a feedback sms informing them that information has not been updated.	Feedback received is correct showing patient treatment information has not been updated.	
Three	Patient request for previous treatment but health staff to receive information not registered	Patient to receive sms informing them that health staff does not exist	Patient received the sms informing that the health staff has not been registered in the system	
Four	Patient request for basic previous treatment.	Feedback sms forwarded to health staff whose patient number provided when requesting for the information	Information provided to the health staff based on the request.	
Five	Patient request for basic previous treatment.	Feedback sms forwarded to health staff whose patient number provided when requesting for the information	Information provided to the health staff based on the request. However information was older than previous visit.	Previous Patient visit to CCC not updated back to the system.
Six	Patient request for previous counselling information.	Information to be provided to the counsellor on previous visit records	Information about the patient provided not complete.	Not all information required captured during system development
Seven	Patient request for previous nutrition advice provided by nutrionist.	System to send a sms containing all previous nutrition information provided.	Not all information provided as required.	All information could not be provided due to sms size.

NB: Currently updating patient information is being done using a web application which can also be used to view patient previous record without using phone.

CHAPTER FIVE:

CONCLUSION AND RECOMENDATIONS

5.1 Introduction

This chapter describes the objectives achievement, conclusion and recommendation to further enhance of use of ICT in providing patient with HIV and AIDS on transit with services in any CCC centres. The project conclusion has been made in line with the objectives established at the beginning of the study. Further the chapter has offered possible recommendation and a suggestion for further development.

a) Challenges experienced by health staff when storing and accessing patient information. From the research done some of the challenges experienced in CCC's is data storage. In some of the CCC's visited already automated systems exist however they are not in full use hence patient data is still being stored in files. When accessing this information, patients are only identified by producing the yellow or green card which they normally carry along. Health staff normally use this to search for patient file on the shelves.

b) Patients on transit accessing their medication services in different CCCs. Different CCC's treat this request in different ways. Currently there is no centralised database where health staff can access historical patient data. In some CCC's patient have to produce their medical card where they historical data is stored, services provided and health staff update back the information on that card. In some CCC's no services are provided to patients who are not registered in that CCC. If a patient visit a CCC for more than three times no services are provided unless they are registered there.

c) Minimum datasets required for patient to obtain data from any CCC. For any patient to obtain any medication there is minimum previous data required. This information include; CD4_COUNT, current regime given to the patient and others as shown on the system design and development.

d) Design, development and test a prototype. Based on the information obtained from the research work, design and development of the system was done. Due to procedure required for any system to be tested with patient data. Testing was done with my colleagues to check whether the required feedback is provided through sms.

5.2 Conclusions

Form the observations observed, in the current process which is normally manual takes a lot of time, Patient has to provide the card provided, retrieval of files also takes a lot of time, if a patient is on transit, the clinicians have to call the patient's CCC of registration to confirm information on the card. One of the main causes of lack of funds from these CCC is lack of good reporting which is required by donor for funding to be provided. Use of papers all the time also takes a lot of funds which can be used for services.

Currently there is no standard system for use in all CCCs in the country, each CCC uses its own system based on the donors hence there is no centralised database on patient with Hiv and AIDS for this system to be used well such a database is required; NASSCOP is in the process of creating such a database. The National government together with county governments should work together with the private hospitals and donors to ensure that systems used in all CCC centres follows health systems standards to ensure that integration and data exchange between them is done without any problems.

Patient information is stored and transmitted electronically, Patient confidentiality is maintained this is because information is transmitted electronically no need for patient to carry the card which currently they carry when going for services from CCC centres.

When this system is used it will improve efficiency of the CCCs because CCC will not be required to store any information as such they will be able to access information from centralised database in order to provide medication. Patient on transit will not have any worry on where to get any CCC services such as medication, counselling nutrion etc. This is because as long as they have any phone whether feature based phone or smart phone they will be able to access that information in any CCCs on their way.

5.3 Recommendation

The Personal health management system will only work well if CCC centres in the country implement Health management system and they are able to exchange data. The Ministry of health should also have a centralised database which will be accessed by all CCC centres and updated once services have been provided.

To improve userability of the system; a USSD system should be developed to ensure users are able to access the required information without sending a sms.

Second option is to develop a mobile app. Problem with mobile apps is they can only be used with high end phone hence for this option to work each CCC is provided with a tablet for accessing patient information.

Data confidentiality should be maintained by ensuring that data encryption should also be used in the database to ensure that only systems with the correct encryption that is authorised only are able to access this information.

Currently patient data update back once services have been provided can only be done by using a web portal which is currently in use. To maximize speed of data up to date, a mobile application need to develop to ensure that health staff is able to update information back using their mobile phone.

One of the biggest problems in the implementation of health information systems management is resistance from health staff. In some of the CCCs we visited when doing research we found out that a system already exist but health staff are very reluctant to use the system hence they are still using manual document to maintain patient information. Awareness should be done to ensure that patient is captured on all systems available to enable easier exchange of information.

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Appendices

HIV and AIDS Questionnaire

We are currently doing a research on HIV and AIDS patient obtaining ARV medication while on transit (e.g. truck drivers, pastoralist when on their migration path). This questionnaire is intended for health staff workers based in CCCs (comprehensive care centres) to provide information on the process of providing medication/ARV'S these patient.

INSTRUCTIONS: Please respond by placing a cross or a tick in the relevant box and explain briefly where required. Kindly answer as truthful as possible.

Appendix A: Sample Questionnaire

1) What are the services provided in a CCC centres?	
2) What is the process of registering a new patient in a CCC centres?	
3) Is there a process to check whether a patient is already on ARV therapy in a different CCC centres?	**Yes** **No**
If yes kindly specify the process?	
If no is there possibily of a patient having several treatments in different CCC centers?	**Yes** **No**
4) Is there minimum information required to provide treatment to a new HIV and aids patient?	**Yes** **No**
If yes what information is required?	

5) Once treatment is provided is there place where this information is maintained?	Manually Electronically Both
If electronically which system is in the use on the site?	
6) Does the CCC centre use one whole system for all its function or they are different for each unit?	• One system • different systems • No system at all
If different system; how is patient information shared among different departments?	
If no system at all how is the information stored and accessed by various departments?	
7) If a patient is already in medication and visit CCC centre how do health staff employees access the current medication of the patient?	
8) When a HIV and AIDS patient visit a new CCC centre, how do health staff obtain Health information of the patient?	• Manually • Electronically
if manually how does the patient provide the information?	
If electronically which system is used to obtain the information remotely?	
9) When a patient is from a different CCC centres visit a new CCC how to health staff access information from the patient's CCC centre?	
10) In case of medication changes or any information change how is the	

information updated back to patient's CCC centre?	

Appendix B: Filled Questionnaire

Figure below is a table of the questionnaire used with a sample of 34 respondent from various CCC centres.

Question	Respondent	Response	Percentage
Q1: What are the services provided in a CCC centres?	34	HIV Testing & Counselling	82%
		Care & treatment	47%
		PMTCT	41%
		Cancer screening	35%
		ART	24%
		Nutritional care	18%
		Inition of ARV	18%
		TB screening	18%
		HIV Testing	12%
		lab tested	12%
		Family planning	12%
		Aru dispensation,	6%
		Data collection and monitoring	6%
		PCR Testing	6%
		Supportive counselling	6%
		Reproductive health services	6%
		Provision of preventive commodities like condoms	6%
Q2: What is the process of registering a new patient in a CCC centres?	34	Registering Hiv positive with unique number and monitoring them in facility	47%
		Counselling and advising	24%

		Open new file or enrol	18%
		filling Bio-date information in system and manual	18%
		Confirming HIV status	12%
		HIV testing,	6%
		CD4 testing,	6%
		Monitoring HIV Positive in the facility	6%
Q3: Is there a process to check whether a patient is already on ARV therapy in a different CCC centres?		Yes	59%
		No	41
Q3b: If no is there possibly of a patient having several treatments in different CCC centres?	12	Yes	100%
Q4: Is there information required to provide treatment to a new HIV and aids patient?	34	Yes	100%
Q4a: If yes what is the most important information required to provide treatment?	34	ADHERANCE	18%
		CD4 Count	12%
		WHO staging	6%
		Any drug allergies	12%
		Previous treatment (ART, TB)	24%
		Counselling	6%
		Name of Patient	29%
		Age of Patient	41%

		Gender of Patient	29%
		Location of Patient	29%
		Viral load	18%
		clinical test done	6%
Q5: Once treatment is provided is there place where this information is maintained?		Manually	24%
		Electronically	24%
		Both	65%
Q6a: If electronically which system is in the use on the site?		MSH ART pharmacy management system	7%
		Open data kit	7%
		ARU database	7%
		ENR	14%
		IQ Care	36%
		C-PAD	50%
Q6b: Does the CCC centre use one whole system for all its function or they are different for each unit?		One system	88%
		Different systems	12%
Q6c: If deferent system; how is patient information shared among different departments?	4	Hard copy documents patients files	50%
		CPAD & ADT tool	50%
Q6b: If no system at all how is the information stored and accessed by various departments?	0		0

Q7: if a patient is already in medication and visit CCC centre how do health staff employees access the current medication of the patient?	34	Checking patient files	6%
		Verbal report from patient	12%
		Referral forms	12%
		Previous prescription	6%
		Check on patient appointment card	47%
		IQ care system stores this information	18%
Q8: When a HIV and AIDS patient visit a new CCC centre, how do health staff obtain Health information of the patient?	34	Manually	100%
Q8a: If manually how does the patient provide the information?		Transfer Letter from previous centre	59%
		Verbal	6%
		Questionnaires	6%
		Patient appointment card	29%
Q9: When a patient is from a different CCC centres visit a new CCC how to health staff access information from the patient's CCC centre?	34	Transfer letter from previous centre	59%
		Phone call	18%
		Referral forms	6%
		Use patient appointment card	18%
Q10: In case of medication changes or any information change how is the information updated back to patient's CCC centre?	34	Manual register	12%
		Regimen cannot be charged on transit	6%
		Referral forms/ Transfer letter	24%
		Its indicated on patient blue card	53%
		Through letter	6%

Appendix C: System code.

Receiving and processing sms

```
  public void ProcessMessages()
        {

            Cursor.Current = Cursors.WaitCursor;

            string storage = GetMessageStorage();

            try
            {
                int Comm_Port =
Int32.Parse(System.Configuration.ConfigurationManager.AppSettings["com_port"]);
                int Comm_BaudRate =
Int32.Parse(System.Configuration.ConfigurationManager.AppSettings["Comm_BaudRate"]);
                int Comm_Timeout =
Int32.Parse(System.Configuration.ConfigurationManager.AppSettings["Comm_Timeout"]);

                dataGridView2.ColumnCount = 6;
                dataGridView2.Columns[0].Name = "Sender";
                dataGridView2.Columns[1].Name = "Message";
                dataGridView2.Columns[2].Name = "Date";
                dataGridView2.Columns[3].Name = "Doctor";
                dataGridView2.Columns[4].Name = "Patient_ID";
                dataGridView2.Columns[5].Name = "Status";
                dataGridView2.AutoSizeColumnsMode =
DataGridViewAutoSizeColumnsMode.Fill;


                comm = new GsmCommMain(Comm_Port, Comm_BaudRate);
                comm.Open();

                DecodedShortMessage[] messages =
comm.ReadMessages(PhoneMessageStatus.All, storage);

                foreach (DecodedShortMessage message in messages)
                {
              Output(string.Format("Message status = {0}, Location = {1}/{2}",
               StatusToString(message.Status), message.Storage, message.Index));
                    ShowMessage(message.Data);


                    Output("");
                }
                Output(string.Format("{0,9} messages read.",
messages.Length.ToString()));
                Output("");



            }
            catch (Exception ex)
            {

System.IO.File.AppendAllText("C:\\MOBILE\\Logs\\bprocessmessageserror.txt", ex.Message
+ DateTime.Now.ToShortDateString() + " at " + DateTime.Now.ToLongTimeString() +
Environment.NewLine);

            }
            finally
            {
```

```
                Cursor.Current = Cursors.Default;
                btnSave.Enabled = true;
                comm.Close();
                savesms();
            }
        }

        public class CommSetting
        {
            public static int Comm_Port = 0;
            public static Int64 Comm_BaudRate = 0;
            public static Int64 Comm_TimeOut = 0;
            public static GsmCommMain comm;

            public CommSetting()
            {
                //
            }
        }
```

Onces sms has been saved processing occurs based on the request and response stored in smsout.

Code for sending out sms.

```
public void sendsms()
        {
            string MSMS_Number, MMessage;
            string PATIENT_ID;


            int i;

            SmsSubmitPdu pdu3;
            try
            {
                Comm_Port =
Int16.Parse(System.Configuration.ConfigurationManager.AppSettings["com_portSender"]);
                Comm_BaudRate =
Int32.Parse(System.Configuration.ConfigurationManager.AppSettings["Comm_BaudRateSender
"]);
                Comm_TimeOut =
Int32.Parse(System.Configuration.ConfigurationManager.AppSettings["Comm_TimeoutSender"
]);


                  comm = new GsmCommMain(Comm_Port, Comm_BaudRate, Comm_TimeOut);


                    comm.Open();

                if (comm.IsConnected() == true)
                {

                    try
                    {
                        Cursor.Current = Cursors.WaitCursor;

                        for (i = 0; i < dataGridView1.RowCount; i++)
                        {

                            PATIENT_ID
=dataGridView1.Rows[i].Cells[0].Value.ToString();
                            MSMS_Number =
dataGridView1.Rows[i].Cells[1].Value.ToString();
```

```
                            MMessage =
dataGridView1.Rows[i].Cells[2].Value.ToString();


                            pdu3 = new SmsSubmitPdu(MMessage, MSMS_Number, "");

                            comm.SendMessage(pdu3);



                            System.Threading.Thread.Sleep(1000);

                            SqlConnection connectionString = new
SqlConnection(connSQLString);

                            string query = "update SMS_OUT_Message set status='DONE'
where ID=" + PATIENT_ID + " and status='Ready'";
                            SqlCommand sqlcommand1 = new SqlCommand(query,
connectionString);
                            try
                            {
                                connectionString.Open();
                                sqlcommand1.ExecuteNonQuery();
                            }
                            catch (Exception ex)
                            {
                                MessageBox.Show(ex.Message);
                            }
                            finally
                            {
                                connectionString.Close();
                            }


                        }

                        Cursor.Current = Cursors.Default;


System.IO.File.AppendAllText("C:\\MOBILE\\Logs\\TOTALSMS.txt", "T O T A L - M E S S A
G E - S E N T = " + i + DateTime.Now.ToShortDateString() + " at " +
DateTime.Now.ToLongTimeString() + Environment.NewLine);

                    }

                    catch (Exception E23)
                    {

System.IO.File.AppendAllText("C:\\MOBILE\\Logs\\ERRORSENDINGTODEST.txt", "Error
Sending SMS To Destination Address\r\n\n Connection Has Been Terminated !!!\r\n\n" +
DateTime.Now.ToShortDateString() + " at " + DateTime.Now.ToLongTimeString() +
Environment.NewLine);

                        comm.Close();
                        pictureBox3.Image = imageList1.Images[0];
                        button9.Enabled = true;
                        button10.Enabled = false;
                        dataGridView3.Rows.Clear();
                        dataSet.Clear();
                        dataGridView1.Refresh();
                        button4.Enabled = false;
                        button7.Enabled = false;
```

```
                        Single_SMS.Enabled = false;
                        Phone_Model.Text = ".....";
                        Phone_Name.Text = ".....";
                        Revision_Num.Text = ".....";
                        Serial_Num.Text = ".....";

                    }
                }
                else
                {
                    System.IO.File.AppendAllText("C:\\MOBILE\\Logs\\NOGSMERROR.txt",
"No GSM Phone / Modem Connected" + DateTime.Now.ToShortDateString() + " at " +
DateTime.Now.ToLongTimeString() + Environment.NewLine);

                    button4.Enabled = false;
                    button7.Enabled = false;
                    return;
                }


            }
            catch (Exception E7)
            {

                label25.Text = "M U L T I P L E  -  S M S  -  I N F O";
                dataSet.Clear();
                dataGridView1.Refresh();
                button4.Enabled = false;
                button7.Enabled = false;

System.IO.File.AppendAllText("C:\\MOBILE\\Logs\\ERRORSENDING.txt", "Error Sending SMS
Messages\r\n\nKindly Check Connection\n\nNetwork Error Occurred" +
DateTime.Now.ToShortDateString() + " at " + DateTime.Now.ToLongTimeString() +
Environment.NewLine);

                Application.Exit();
            }


        }
```

Appendix D: System documentation

MSHAURI SYSTEM DOCUMENTATION

The system consist of two main modules,

I. The administration side (web based)

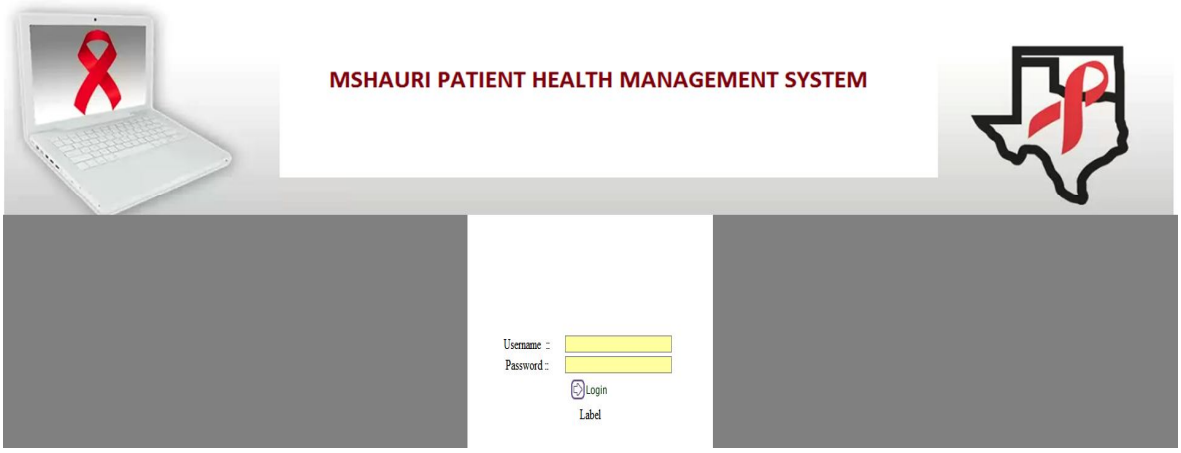
II. Users side (mobile based)

SYSTEM ADMINISTRATION

System contains the following processes for administration

- Creation and editing of patients
- Creation and editing patient medical information
- Creation of new patient counselling and nutrion information and also edit of the details
- Creation and editing of health staff information

UserManual Figure 1: Log In Screen



This is the login screen for the administrator. Once the correct username and password is keyed in the system will display the following screen.

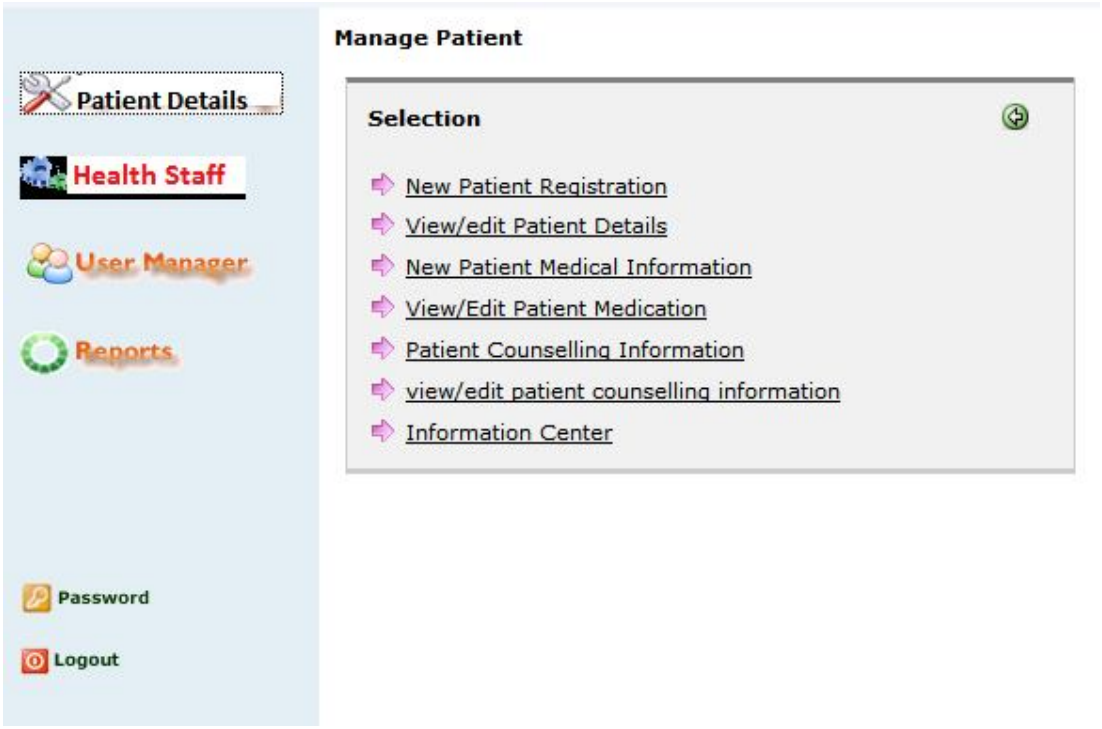
UserManual Figure 2: Menu Interface

Following menus are available

- Patient Details: Deals with all processing regarding patient
- Health Staff: deals with all information regarding health staff

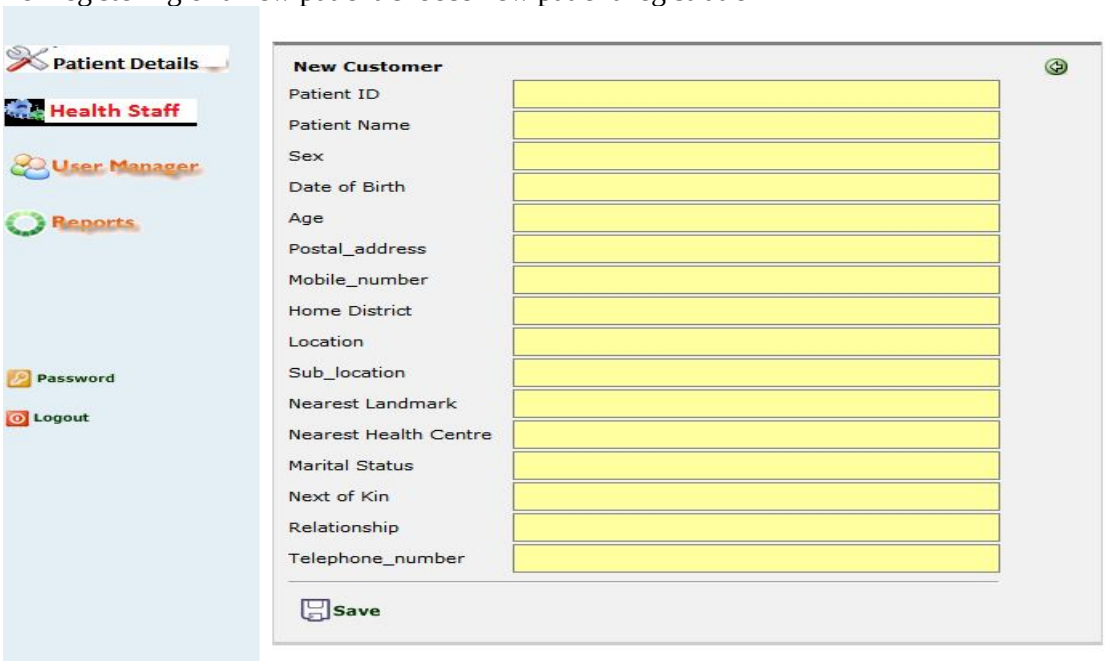
UserManual Figure 3: Patients Details

When a user clicks on patient details the following menus are displayed:

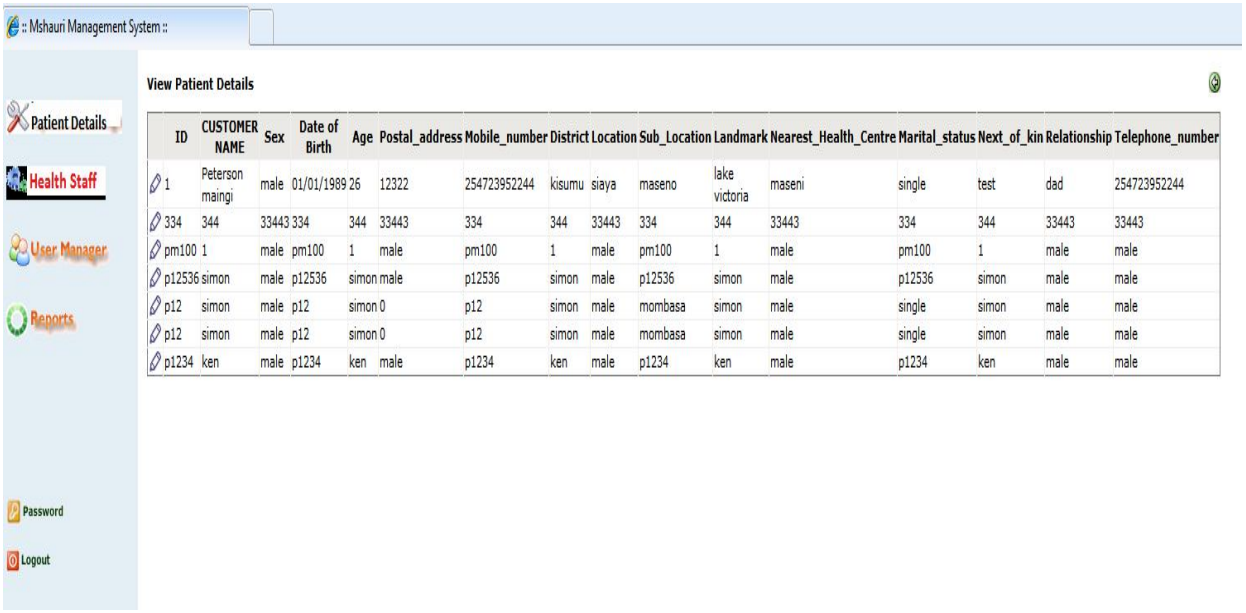


UserManual Figure 4: Registration of new Patient

For registering of a new patient choose new patient registration



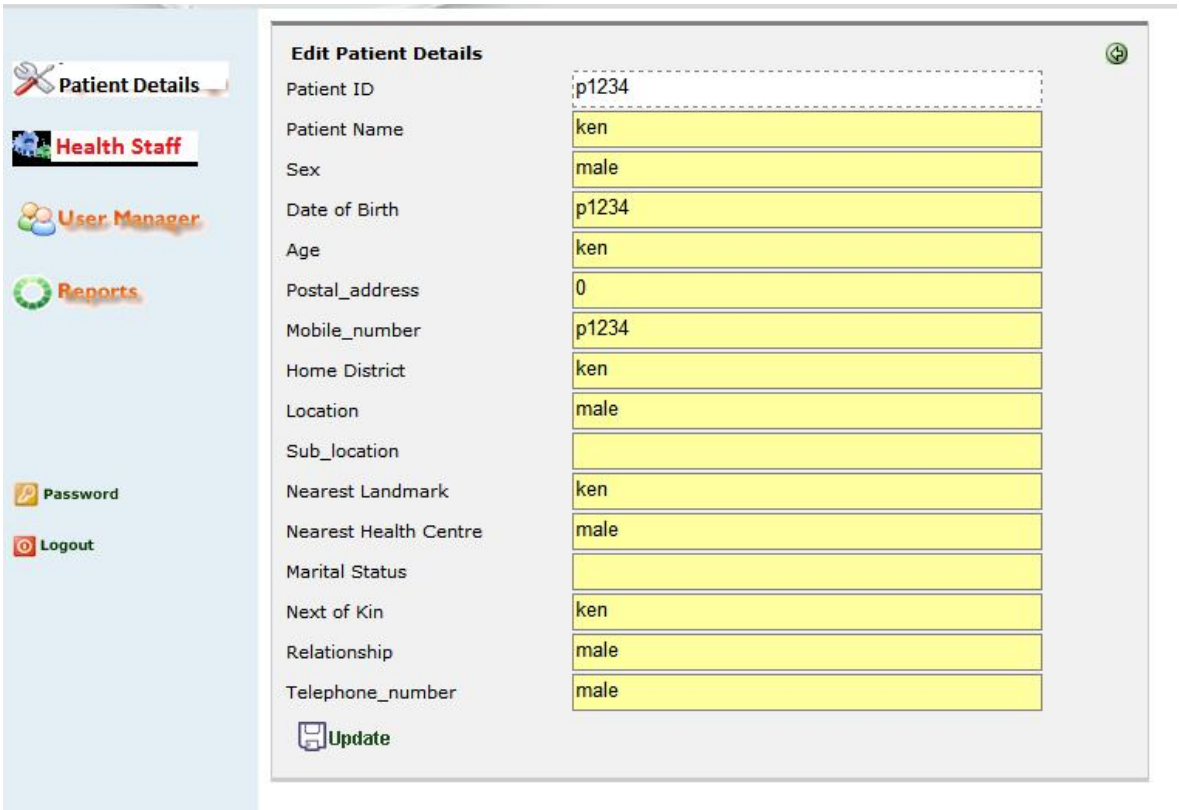
Input all the required patient details and click okay to save. If a patient already exists the system will notify the user. To edit a patient details click on view, edit patient details



ID	CUSTOMER NAME	Sex	Date of Birth	Age	Postal_address	Mobile_number	District	Location	Sub_Location	Landmark	Nearest_Health_Centre	Marital_status	Next_of_kin	Relationship	Telephone_number
1	Peterson maingi	male	01/01/1989	26	12322	254723952244	kisumu	siaya	maseno	lake victoria	maseni	single	test	dad	254723952244
334	344	33443	334	344	33443	334	344	33443	334	344	33443	334	344	33443	33443
pm100	1	male	pm100	1	male	pm100	1	male	pm100	1	male	pm100	1	male	male
p12536	simon	male	p12536	simon	male	p12536	simon	male	p12536	simon	male	p12536	simon	male	male
p12	simon	male	p12	simon	0	p12	simon	male	mombasa	simon	male	single	simon	male	male
p12	simon	male	p12	simon	0	p12	simon	male	mombasa	simon	male	single	simon	male	male
p1234	ken	male	p1234	ken	male	p1234	ken	male	p1234	ken	male	p1234	ken	male	male

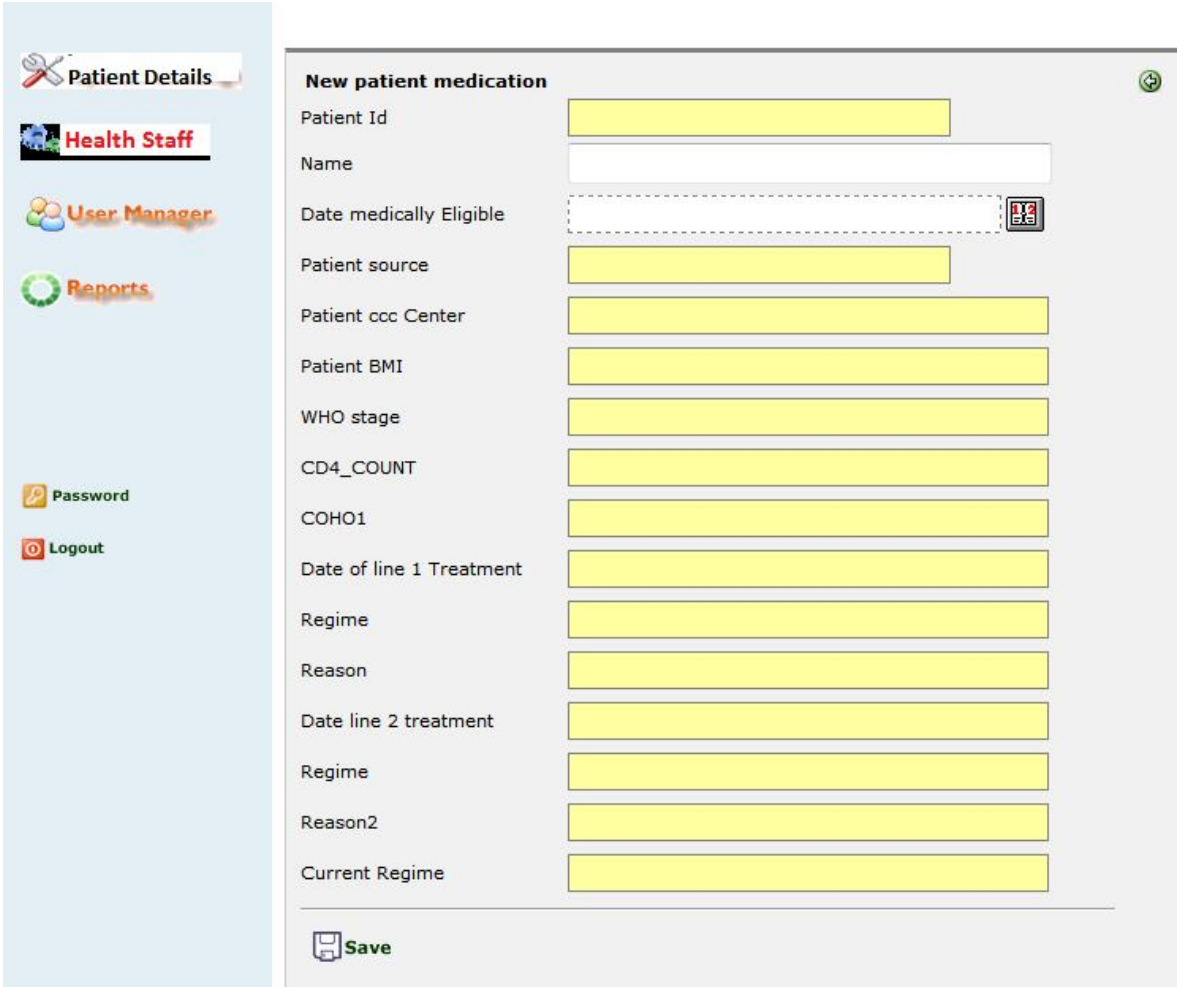
UserManual Figure 5: Edit Patient Details

To edit click on the mark on the first column of the table.

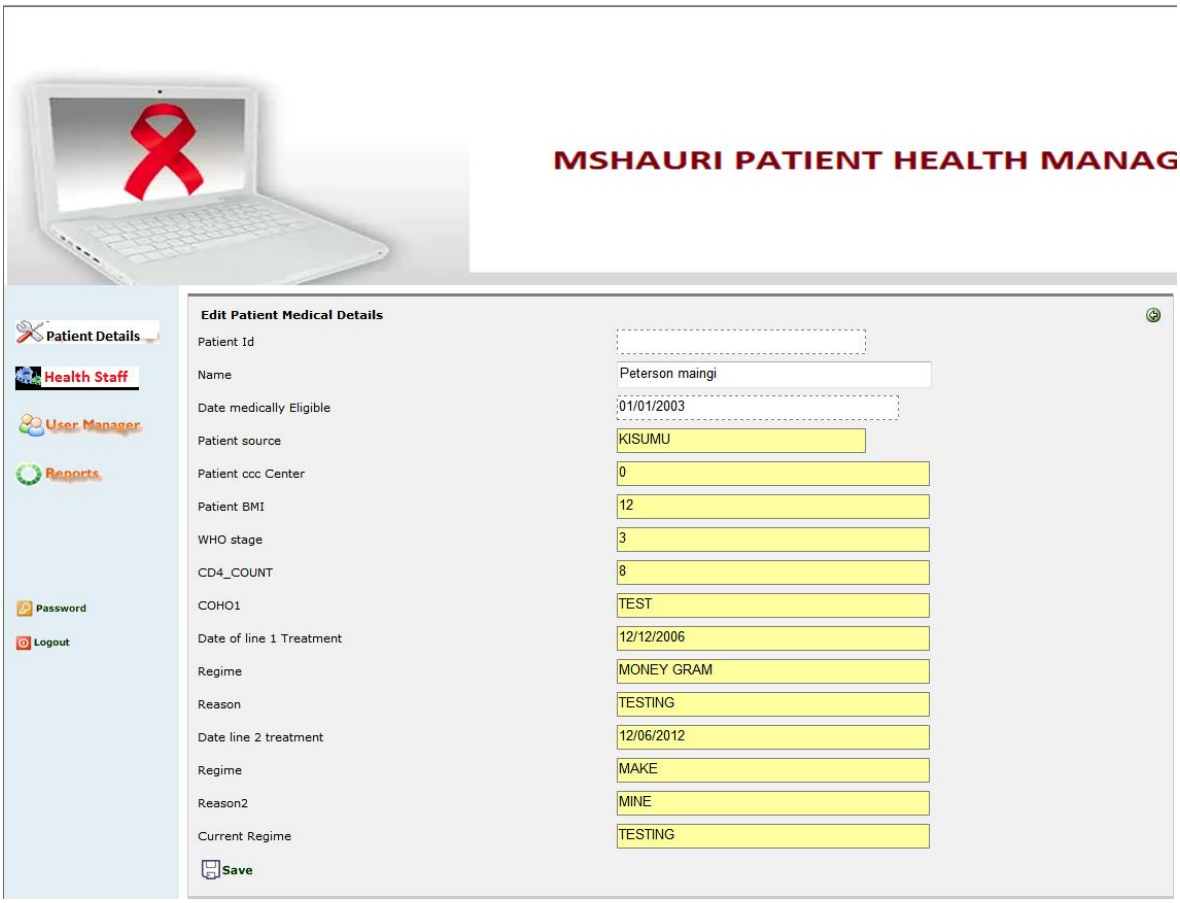


- Change the details required for edits and clicks update to save the new details.

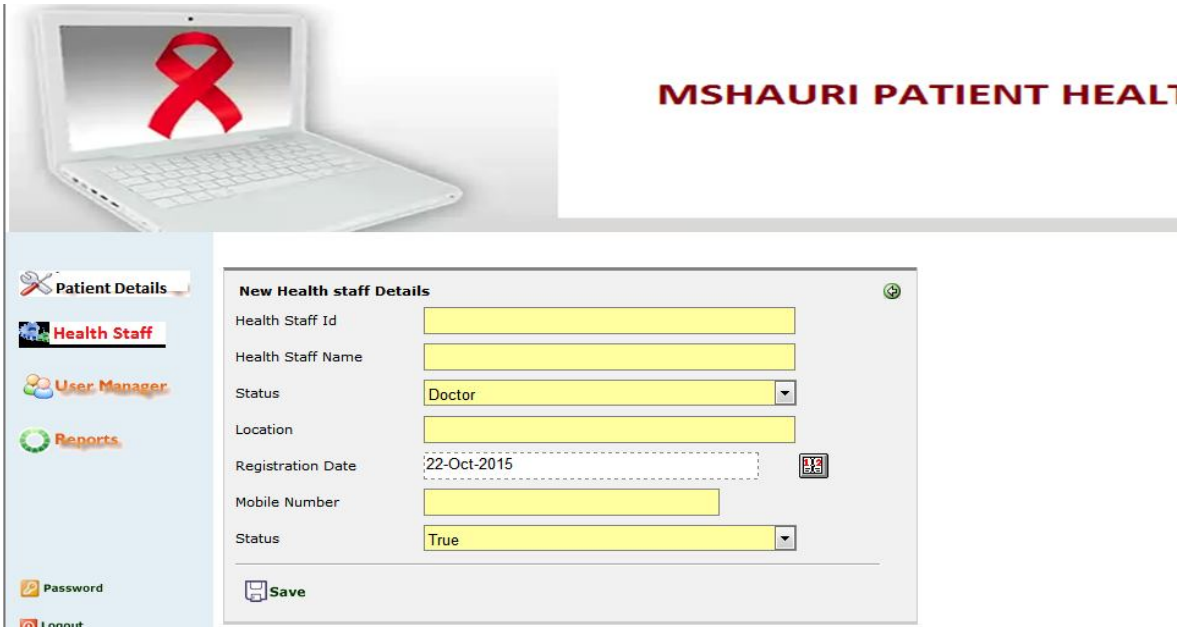
UserManual Figure 6: Creating of new patient medical information



UserManual Figure 7: Edit of patient medical details



UserManual Figure 8: Creating of health staff and editing the details.



Appendix E: Mobile Application

Send message with the following details separated by hash (#)

- Patient id
- Request e.g. (cd4_count, revisit etc)
- Person to receive the information (nutritionist, counsellor, doctor)

Message example

1#CD4_COUNT#254722952244

The system will check whether patient exist first. If the patient does not exist a sms is returned back to sender with message does not exist. Second step is to check the recipient type if doctor, nutrionist etc.

Determines the type of information requested.

If the recipient does not exist the sender receives a sms showing the sender does not exist.

Once all these are met the recipient receives a sms notifying the information requested.

Appendix F: Database Design

Login table for administrator

Users

Patient Personal details

Personal Information

Patient Medical information

Patient_Medical_Information

Counselling Information

Patient_Counselling_Data

Nutrion information

Nutrition_and_HIVAIDS_Register

Health Staff information

Health_staff_information

Sms message in (for receiving all sms with the requested information)

SMS_IN_Messages

Sms message out (for sending all sms with the information)

SMS_out_Messages