

**USE OF MOBILE PHONE SHORT TEXT MESSAGE SERVICE TO
ENHANCE CERVICAL CANCER SCREENING AT THE THIKA LEVEL
5 HOSPITAL, KIAMBU COUNTY, KENYA.**

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**A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
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KENYATTA UNIVERSITY.**

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University or any Institution of Higher Education.

Sign.....

Date:

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We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

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DEDICATION

This thesis is dedicated to my wife Faith and sons Wesley and Fabian for their love and encouragement.

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First I would like to give thanks to God for giving me good health during the study period. Special thanks go to my supervisors, Professors Ephantus Kabiru and Elizabeth Bukusi for their encouragement and guidance. Appreciation goes to the management of Kenyatta University for offering me a chance to conduct the study. I would also want to pass my appreciation to the members of the Department of Obstetrics and Gynecology for being there and supporting me throughout the study. Special acknowledgment goes to the nurses, my data collector and my two cytologists for facilitating the smooth running of the project. To Benson for offering IT support. My appreciation goes to all the study participants for consenting to participate in the study.

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ACRONYMS

ACOG	American College of Obstetricians and Gynecologists
ARV	Anti Retro Viral agents
ASCUS	Abnormal Squamous cell of undetermined significance.
ASIR	Age Standardized Incidence Rate
ASMR	Age Standardized Mortality Rate
CDC	Centre for Disease Control and Prevention
CIN	Cervical Intra-epithelial Neoplasia
DNA	Deoxyribonucleic acid
ENT	Ear Nose and Throat
E-Health	Electronic based health systems
GIS	Geographic Information Systems
GSM	Global System for mobile communication
HIV	Human Immunodeficiency Virus
HPV	Human papillomavirus
HSIL	High Grade Squamous Intraepithelial Lesion
IARC	International Agency for Research on Cancer
KDHS	Kenya Demographic and Health Survey
LGSIL	Low Grade Squamous Intraepithelial Lesion
LSTMH	London School of Tropical Medicine and Hygiene
NaCoSTI	National Council of Science Technology and Innovation
NCI	National Cancer Institute
Pap test	Papanicolaou test
RCT	Randomized Controlled Trial

SMS	Short Message Service
SPSS	Statistical Package for the Social Sciences
TB	Tuberculosis
VIA	Visual Inspection using Acetic acid
VILI	Visual inspection using Lugo's iodine
W.H.O	World Health Organization

DEFINITION OF OPERATION TERMS

Adherence to screening	Attendance to cervical cancer screening during a set period of time, being screened within two weeks of scheduled repeat screening
Call recall system	A system based upon a cyclical pattern of call and recall notifications designed to ensure that the maximum number of women deemed to be at risk of cervical cancer receive cervical screening (WHO, 2002).
Cancer	Class of diseases in which a group of cells display uncontrolled growth, with invasion and destruction of adjacent tissues and sometimes spread to other locations (Striker <i>et al.</i> , 2010)
Invasive cancer	Cancer that has spread beyond the layer of tissue in which it developed and is growing into surrounding, healthy tissues (Cochran, 1983)
Bethesda system	A comprehensive system for reporting findings on cervical Papanicolaou smears; includes observations on the adequacy of the specimen, benign cellular changes (inflammation, infection), changes in squamous or glandular epithelial cells reflecting atypia or malignancy, and hormonal status (Solomon <i>et al.</i> , 2002)
High grade cervical Lesion	Used in the Bethesda system for reporting cervical-vaginal cytological diagnosis to describe a spectrum of noninvasive cervical epithelial abnormalities, including moderate and severe dysplasia and carcinoma in situ
Low grade cervical lesion	Term used in the Bethesda system for reporting cervical/vaginal cytological diagnosis to describe a spectrum of noninvasive cervical epithelial abnormalities; these lesions include the cellular changes associated with human papillomavirus Cyto-pathologic effect and mild dysplasia
Adherence to scheduled screening	Women who attends to repeat cervical cancer screening within a period of two weeks at end line of the study.

Screening	Testing of an apparently normal population in order to detect the cases of a target condition
Screening for cervical cancer	Testing of an apparently normal woman at risk to detected precancerous lesions of the cervix
Perceived Barriers to cervical cancer screening	One's belief and opinion of the tangible and psychological factors that impairs screening for cervical cancer (Taylor <i>et al.</i> , 2007)
Perceived Severity of cervical cancer	One's belief and opinion in the benefits of being screened to reduce risk or seriousness of the impact of cervical cancer
Perceived Benefits of cervical cancer screening	One's belief and opinion of how serious cervical cancer is and its consequences
Perceived Susceptibility towards cervical cancer	One's belief and opinion of chances of getting or developing cervical cancer
Precancerous cervical lesion	An abnormality in the cells of your cervix that could eventually develop into cervical cancer
Cervical intraepithelial neoplasia	Also known as cervical dysplasia and cervical interstitial neoplasia, is the potentially premalignant transformation and abnormal growth (dysplasia) of squamous cells on the surface of the cervix.
Cervix	A small, cylinder-shaped organ that forms the lower part and neck of the uterus.
Uterus	Hollow organ in a female's body where the egg is implanted and the fetus develops.
Screening interval	The period of time between each episode of screening (12 months for normal tests and 6 months for low grade lesions)

ABSTRACT

Cervical cancer is a major public health problem among adult women especially in developing countries and its control is of paramount importance. Organized screening programmes have led to a large decline in cervical cancer incidence and mortality in developed countries. In Kenya very few women at risk have regular repeat cervical cancer screening and there exists no effective recall mechanism to enhance scheduled screening. The Short Message Service (SMS) Text may be used as a recall tool to enhancing cervical cancer screening in developing countries such as Kenya where other communication means may not be easily available. This blinded randomized controlled trial where participants were recruited from among eligible women attending the general female outpatient clinic at Thika Level 5 hospital; randomly allocated to an intervention (SMS text reminders) arm and a control (no SMS) study aimed to determine the influence of using SMS text reminders in enhancing adherence to scheduled repeat screening for cervical cancer. Data was collected using interview guide and analyzed using STATA version 11. Categorical variables were summarized by frequencies and proportions while continuous variables were summarized by means, medians and standard deviations. Chi square test was used to establish the relationship between categorical variables while logistical regression analysis was conducted to evaluate the influence of the independent variables on adherence to scheduled screening while using the SMS reminders. The mean age of the participants was 38.8 ± 10.8 , most were married and of low socio- economic status. Only 20% of the eligible women attending the general outpatient's clinic had ever been screened with only 8.8% having had regular screening. A total of 7.4% of the study population had abnormal cytological smears of which 3.2% were invasive cancer. It was found that 67.1% of participants in the intervention arm and 20.3% in the control arm re-attended to rescreening at end line as scheduled. The participants who received SMS text reminders were 8 times more likely to adhere to scheduled rescreening than those who did not (OR 8.02; CI 95% 4.69-13.73; $p < 0.001$). The age group 30-34 years, participants those whose spouses were employed and those who used public transport to access the hospital were significantly associated with return to scheduled screening after sending SMS text reminders (OR 2.24 $P < 0.005$); (OR 2.2 $P < 0.05$); (OR 3.29 $P < 0.005$) respectively. On multiple logistical analyses having owned a mobile phone for more than two years was found to be more important in influencing re-attendance if one was educated above secondary school level. It was concluded that many women attending the general outpatient's clinic were not screened and almost 10% of such women had abnormal cervical lesions including cervical cancer. Screening such women and reminding them of the next screening dates increases their chances of adherence to scheduled screening by up to 8 times when compared to those not reminded. The study recommended that the Short Text Message Service (SMS) reminders should be integrated into the cervical cancer screening programmes and cervical cancer screening services should be integrated in the female general outpatient clinic.

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Cervical cancer is a malignant condition of the cervix which is the lowermost part of the uterus. Most of it arises from the transformation zone and the commonest histological types are squamous cell carcinomas (Sellors *et al.*, 2003). It is the second most common cancer among women worldwide, with an estimated incidence of over 500,000 and an annual mortality of over 250,000 (Ferlay *et al.*, 2010). Cervical cancer deaths rank fifth among all cancer deaths in women worldwide (WHO 2006) with almost 90% of the deaths occurring in developing countries (Parkin *et al.*, 1997; Kitchener *et al.*, 1999, Ferlay *et al.*, 2014)

A close relationship has been observed between the incidence and mortality of cervical cancer in various geographical locations with Africa and especially Eastern African region carrying the highest burden of the disease (Ferlay *et al.*, 2005, Parkin *et al.*, 2003). Kenya's cumulative risk for cervical cancer is 2.2 per 100 women while Tanzania's cumulative risk reaches 5.2 per 100 women (Ferlay *et al.*, 2005) and that for Uganda has been estimated to be as high as high as 40.8 per 100 in 1997 (Wabinga *et al.*, 1997). As far back as the 1990s medical records from various hospitals in Nairobi, Kenya showed that cervical cancer accounted for 70–80% of all cancers arising from the female reproductive tract with 10-15 new cases of cervical cancer being diagnosed weekly (Rogo *et al.*, 1990, Korir *et al.*, 2015). This situation of high national incidence has been confirmed by data

from the world health organization which has shown that cancer of cervix is still common in the country (WHO, 2010). Unless innovative ways are developed to address barriers to screening and early diagnosis of cervical cancer among women at risk, the World Health Organization has projected an increase of 50% by the year 2020 (Stewart *et al.*, 2003).

Introduction of cervical cancer screening to those women who has never undergone cervical cancer screening before has been shown to drastically reduce cervical cancer incidence and mortality within less than three years of starting such services (Agency for Health Research and Quality, 2002). Globally, cytological screening tests using the Papanicolou test (Pap test) have been shown to be one of the most successful cancer screening procedures. With a well organized and timely screening of women at risk, deaths as a result of cervical cancer have been shown to be avoidable (Stewart *et al.*, 2003). Availability of resources for cervical cancer screening and ensuring women at risk are regularly screened and remain in the cervical screening programs reduces the burden of cervical cancer significantly (Provost, 1996). Kenya, like most Sub Saharan African countries, lacks effective well organized cervical cancer screening programs and hence the high rates of the disease.

According to the World Health Organization (WHO) recommendations, an organized system of calling women for screening and reminding them of scheduled screening when due (call recall system) is key to make cervical cancer screening programmes effective (WHO, 2002). In the developed countries where

screening programs are very effective, women due for cervical pre-cancer screening are informed of the next screening date through the mail, email or telephone calls (United Kingdom National Health Service 2010). In the developing countries where the morbidity and mortality related to cervical cancer is very high, sending mail is difficult and most of the population has no access to computers or the fixed telephones. Recent introduction of the mobile phone has dramatically improved communication in many developing countries like Kenya. Kenya has wide network coverage of the mobile phone where these mobile phones are in wide use in small businesses and money transfers in many areas. The mobile phone subscriptions has continued to grow steadily with the quarterly report released by the Communication Commission of Kenya (CCK) for the fourth quarter of 2013/2014 financial year showing that subscriptions had risen from 30.5 million from beginning of the year to 32.2 million. This translated to a growth of subscriptions of 6.5% and translated to a mobile penetration of 79.2% up from 60% which had been found in the Kenya Demographic Health and Survey (KDHS) of 2010 (Communication Commission of Kenya Quarterly Sector Report April-June 2014, Kenya Government Demographic Health Survey, KNBS and ICF Macro, 2010). The studies that have been conducted on mobile health have proved that this platform is affordable and acceptable in resource constrained regions for health promotion and enhancing care. In this study the use of the Short Text Message Service (SMS) reminders was assessed as a tool for improving regular cervical cancer screening for women at risk. Other factors that may hamper

regular screening like time taken from the home location to the screening site, transport costs and distance were also assessed to determine their influence on scheduled screening.

1.2 Problem statement

Cancer is a devastating disease affecting people of all social status and age, which if not diagnosed early will eventually cause death. Cervical cancer is rated second among all malignancies that affect women worldwide with most of its burden being found in developing countries (Parkin *et al.*, 1997; WHO, 2010). This has been attributed to among other factors lack of organized regular screening of population at risk. Screening at Thika Level Five Hospital, located in Kiambu County, Kenya, is mainly opportunistic. It follows the guidelines set up in the National Cervical Cancer Screening strategy where most screening is concentrated on women attending the HIV care and reproductive health clinics. This leaves out cervical cancer screening a significant number of women attending the general outpatient's clinic. From hospital records, many of the cases of advanced cancer of cervix are admitted from the outpatient clinic which shows that these women are at a significant risk for the disease. This is a missed opportunity to screen women who attend the outpatient clinic for other problems not related to reproductive health or HIV services, put them into the regular screening cycle and also treat those with abnormal cervical lesions.

For an integrated program of cervical cancer screening to be effective, at least 70% of the population at risk needs to be put in the cervical cancer screening cycle with a strong inbuilt mechanism of recalling women at risk for scheduled repeat screening (United Kingdom NHS 2010; WHO, 2002). This mechanism has not been incorporated into Cervical Screening Strategic Program in Kenya which has been rolled out in hospitals like Thika Level Five (Republic of Kenya NCCPP, DRH/ MOPH/GOK, 2012). The mobile phone based Short Text Message Service (SMS) has been successfully used in other health care services such as Tuberculosis (TB) as well as for Antiretroviral (ARV) treatment compliance for HIV management where there is proof that use of mobile phone technology is feasible and acceptable in improving adherence to treatment (Michael *et al* 2010; Lester *et al* 2010). However this service has not been tried as a way of reminding women on their next scheduled screening to improve adherence to scheduled cervical cancer screening.

1.3 Study justification

The World Health Organization recommends that for a Cervical Cancer Screening Programme to be successful, it is important to integrate a system of calling women to screening and also reminding them when they are next due for screening (WHO, 2002). Such a system of pre-appointment reminders has shown efficacy in the west, but has not been researched in Sub-Saharan Africa. Due to lack of a such system for recalling women for cervical cancer screening (call recall systems) in

the Kenya Cervical Cancer Screening Strategy which has been rolled out in hospitals like Thika Level 5 Hospital, there was need to develop and research on an innovative, effective and inexpensive way of using new technology of the mobile phone Short Text Message Service (SMS) as a recall tool for its possible integration into the screening programme. At the same time due to the lack of information on uptake of cervical screening services of women attending the general outpatient's clinics, research was needed to establish the screening status of such women as well as to determine the cervical lesions present in women who had never been screened before. The purpose of this study was therefore to assess whether using the mobile phone SMS as a call recall system can improve the adherence to scheduled repeat cervical cancer screening among women attending the general outpatient clinic. At the same time the study set out to determine the screening status of women attending the general outpatient's clinic at Thika Level 5 Hospital. The prevalence of abnormal lesions in women who have never been screened before was also assessed. The results obtained in this study will inform policy makers at the County and National level on the feasibility of integration of the mobile phone SMS into the Republic of Kenya Cervical Cancer Screening Programme as a tool for information dissemination as well as for reminders on next scheduled screening in order to enhance scheduled repeat screening. It will also provide information on the screening status of women attending the general outpatient's clinics and the prevalence and types of cervical lesions in those who have never had cervical cancer screening.

1.4 Research questions

- i. What is the current level of uptake of cervical cancer screening among women attending the general outpatient's clinic at Thika Level 5 hospital?
- ii. What is the prevalence of abnormal cervical lesions among women who have never been screened for cervical cancer at Thika Level 5 hospital?
- iii. What is the influence of sending SMS reminders on next scheduled cervical cancer screening on adherence to the scheduled screening?
- iv. What is the influence of socio-demographic factors on adherence to the repeat scheduled cervical cancer screening after sending SMS reminders?
- v. What is the influence of health beliefs towards cervical cancer screening on adherence to the repeat scheduled cervical cancer screening after sending SMS reminders?

1.5 Null hypotheses

H₀. Using the mobile phone SMS reminders as a recall tool for repeat cervical cancer screening does not influence adherence to scheduled cervical cancer screening in women with previous normal smears.

H₁. Using the mobile phone SMS reminders as a recall tool for repeat cervical cancer screening does influence adherence to scheduled cervical cancer screening in women with previous normal smears.

H₀. There are no socio-demographic factors that influence adherence to rescreening after using the mobile phone SMS text reminders as a recall tool for repeat cervical cancer in women with previous normal smears.

H₁. There are some socio-demographic factors that influence adherence to rescreening after using the mobile phone SMS text reminders as a recall tool for repeat cervical cancer in women with previous normal smears.

1.6 The Study objectives

1.6.1 General objective

The overall objective of the study was to evaluate the use of a mobile phone based Short Message Service (SMS) text communication system to enhance repeat scheduled cervical cancer screening at Thika Level 5 Hospital in Kiambu County, Kenya.

1.6.2 Specific objectives

The specific objectives of the study included:

- i. To establish the current level of uptake of cervical cancer screening in women attending the general outpatient clinic at Thika Level 5 Hospital.
- ii. To determine the prevalence of abnormal cervical lesions among patients who have never had cervical cancer screening.

- iii. To determine the influence of use of mobile phone based SMS reminders on next scheduled cervical cancer screening on adherence to scheduled repeat cervical cancer screening.
- iv. To establish how socio-demographic factors influence adherence to scheduled repeat cervical cancer screening after using SMS reminders.
- v. To establish how perceived health beliefs influence adherence to scheduled repeat cervical cancer screening after using SMS reminders

1.7 Significance of study

This study will help the government in integrating the mobile phone platform of SMS into cervical cancer screening programme as a recall tool as well as for disseminating information on cancer of cervix to the population at risk. It will also provide information on the uptake of cervical cancer screening services among women attending the general outpatient's clinics and determine the prevalence of abnormal cervical lesions among patients who have never been screened before. The County and the National Government will use the information gathered to establish programs for integrating cervical cancer screening in the general outpatient's clinics and thus reduce missed opportunities to diagnose cervical lesions when women at risk attend the general out patient's clinics for services other than HIV and Family planning. To the Kenyan women, adherence to repeat scheduled screening will enable early detection and management of pre-cancerous and cancerous lesions. This will eventually reduce the burden of cancer of cervix

in Kenya. The study also has potential for integrating the mobile platform of SMS into primary health care for most cancer prevention, regular follow-up, monitoring patients on treatment for adherence.

1.8 Limitations and assumptions

The study will assume that the study women will be available and will consent for the study and will be willing to return for repeat screening after one year. Women attending as emergency after normal working hours or during the weekend will not be recruited for the study. The study will need follow-up for the subject up to one year after the baseline test with the potential of drop out. Patients may refuse to come back after initial screening due to the inherent fear of cancer diagnosis while some may misplace their mobile phones during the follow-up period. Financial constraints of performing cytological smear as well as setting up a computer based system for sending group SMS may be encountered. Screening will only be conducted among patients seen in the clinic during the day time.

1.9 Conceptual framework

Clinic appointment reminders are a source of important policy recommendation for enhancement of cervical cancer screening uptake but such reminders remains unclear with conflicting and limited evidence in countries with high burden of cervical cancer such as Kenya. The main focus of this randomized controlled trail was to determine the efficacy of Short Message Service (SMS) text platform reminders on adherence to cervical cancer screening on women attending the

general outpatient clinic at Thika Level 5 Hospital. It also aimed at determining how socio- demographic factors such as age of the women, marital status, and parity and socio-economic status such as employment status, personal income and spouses employment status as well as health beliefs such as beliefs of susceptibility to cervical cancer, risks to and benefits of cervical cancer screening influenced adherence to scheduled screening after using SMS reminders for the next scheduled screening.

Independent variables

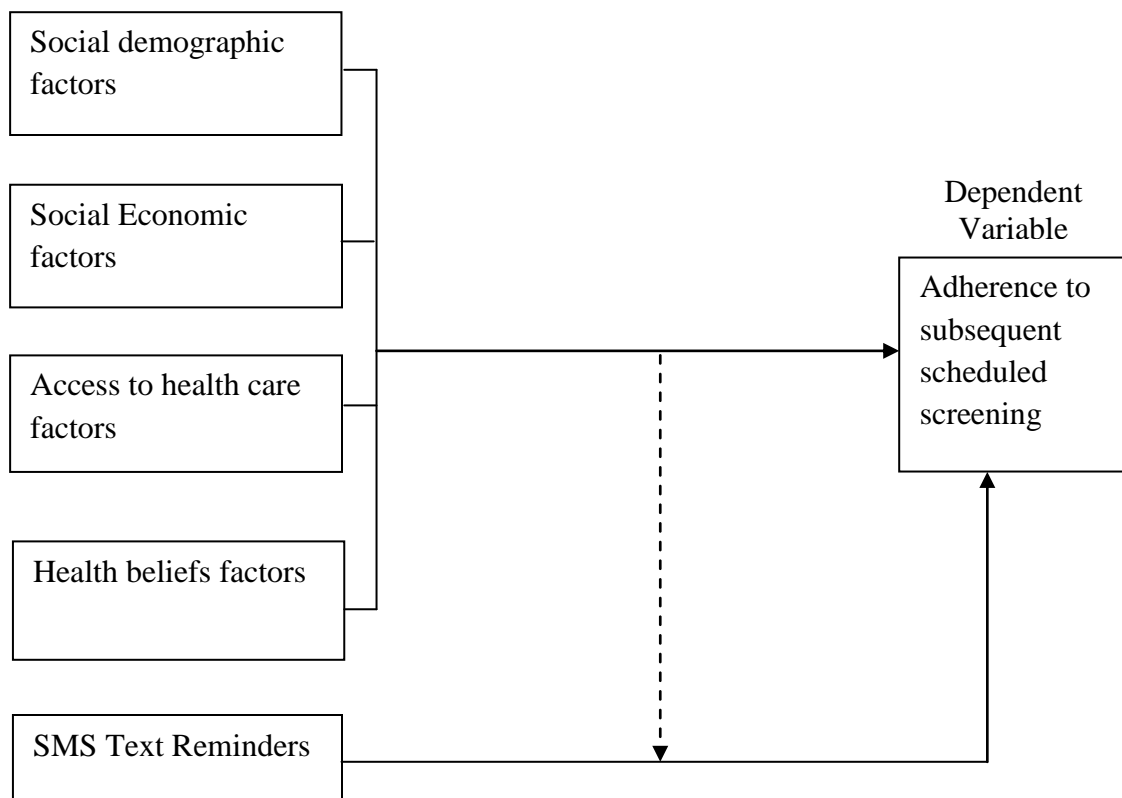


Figure 1.1 Conceptual framework: Constructed from literature review.

CHAPTER TWO: LITERATURE REVIEW

2.1 General background on cancer

Cancer is a disease that arises when genetic changes occur in a cell leading to failure of the cell cycle control mechanisms with subsequent loss of control of cell growth and death. The affected cell stops to act normally, stops to obey signals from adjacent cells, don't stick together and remains immature due to lack of specialization and also do not die when they move to other areas of the body (Striker *et al.*, 2010). These changes lead to abnormal proliferation, invasion and destruction of adjacent tissues. The abnormal cells spread locally as well as to distance parts of the body where instead of dying like normal cells would do, they start growing forming secondary tumors; a process known as metastasis which is unique to cancer cells (Cochran, 1983).

Cancer can arise from any part of the body. In the human beings more than 300 cancers have been described which includes cervical, breast and lung cancer among others (Peedell, 2005). Although the actual causes of cancer are unknown, multiple risk factors have been identified. These risk factors include physical carcinogens like ionizing radiation, biological factors like some viruses and parasites as well as chemical carcinogens like tobacco and aflotoxins. Other factors that may initiate carcinogenesis include inherited genetic mutations, hormonal imbalances and metabolic disorders (Mohan, 2005; WHO, 2009). All this causative factors act singly or together by interacting with the genetic makeup

of a cell to trigger abnormal cellular maturation therefore making cancer a cellular disease (Cochran, 1983; Striker *et al.*, 2010).

Cancer has been recognized as one of the leading causes of deaths globally. The incidence of cancer varies from one country to the other. The global cancer incidence is estimated to be 10 million cases annually. In developing countries the incidence is estimated to be 5.3 million and is the third common cause of death after infectious diseases and cardiovascular diseases. Cancer incidence and mortality is expected to rise due to various demographic factors such as increase in the elderly population and change in lifestyle (Pisani *et al.*, 1999; WHO, 2011). For example in 2008, more than 12.5 million cases of the diseases were diagnosed while projections predict that by 2030, new cases will increase to about 22.2 million with most of these increase projected to be seen in low income countries (Bray *et al.*, 2012). Deaths due to cancer in 2008 were estimated at 7.6 million (Boyle *et al.*, 2008) with projections that this deaths will increase to 12 million by 2030 (Mathers *et al.*, 2006). The current annual cancer deaths in the world are mainly due to lung, stomach and colorectal, liver, breast, cervical and esophageal cancers. Among men lung, stomach, liver, colorectal, esophageal and prostate are commonest causes of deaths while in women the commonest cancers deaths arise from breast, lung, stomach , colorectal and cervix (WHO, 2011; Bray *et al.*, 2012).

2.2 Global incidence of cervical cancer

Cervical cancer is one of the commonest malignancies of women being only second to cancer of breast (Ferlay *et al.*, 2010). Out of all the new cases of the disease diagnosed each year, it is estimated that approximately 86% are found in developing countries. Worse still 80-90% of deaths resulting from cervical cancer occur in these countries (Parkin *et al.*, 2005). Since most women are affected at their most productive ages (35-45 years), the disease has the potential to disrupt the family and social well being and also lead to economic difficulties. Global estimates have shown that Asia has the highest burden of cervical cancer of which India alone accounts for more than a quarter of all the cervical cancers worldwide closely followed by Africa which contributes 10% of the global cervical cancer burden (Ferlay *et al.*, 2014).

2.3 Cervical cancer in sub-Saharan Africa

Cervical cancer remains one of the most common gynecological malignancies in Sub-Saharan African countries in general and Eastern Africa in particular (Ferlay *et al.*, 2010). The crude incidence rate for East Africa is 20.1 per 100,000 compared to 15.8 for the whole world. The cumulative risk for age 0-74 years is also high in East Africa (3.8%) compared to a worldwide cumulative risk of 1.6 %. The annual incidence of cancer of cervix in East Africa is 31,516 cases (WHO, 2010).

2.4 Cervical cancer in Kenya

Cervical cancer is estimated to be the second commonest among cancer in women causing a lot of morbidity and mortality in the country. Every year, almost 2,500 of Kenyan women are diagnosed to have cervical cancer with almost 1,700 deaths being attributed to the disease annually. This picture is projected to become worse if nothing is done to curb this menace with the incidence rising to more than 4,000 new cases by 2030 (Government of Kenya Division of Reproductive Health (DRH), 2012; WHO, 2010). The annual incidence rate has been estimated at 12.7 per 100000 with an age standardized incidence rate of 23.4 per 100 (Ferlay *et al.*, 2010; WHO, 2010). However more recent data has shown an age standardized incidence of 46.1 per 100,000 (Korir *et al.*, 2015). The crude mortality rate attributed to cancer of cervix in Kenya is 8.6 per 100000 with an age standardized mortality rate of 17.3 per 100,000 (WHO, 2010). With these high figures, control of cervical cancer in Kenya will be of great public health benefit.

2.5 Risk factors for cervical cancer

Many epidemiologic studies have shown a significant relationship between cancer of cervix and multiple interdependent social factors. For example a higher incidence has been noted among black and Mexican Americans compared to the whites and this has been attributed to lower socio-economic status of the former (Disaia *et al.*, 2002). Other factors such as the age of sexual debut, use and duration of use of combined oral contraceptives, number of lifetime sexual

partners, multi-parity and infection with HPV have been shown to increase the risk of cervical cancer (Berrington *et al.*, 2004; Disaia *et al.*, 2002).

2.5.1 The Human Pappiloma Virus

In the 1970s, zur Hausen (1974) suggested that Human Pappiloma Virus (HPV) was a possible candidate for causing genital hyperplasia and since then there have been a lot of studies on HPV which have given clear evidence that HPV infection is strongly associated with cancer of cervix (zur Hausen 1974). Infection with the high risk subtypes of this sexually transmitted virus is the main risk factor to cervical cancer. High risk HPV types have been indentified and some studies have found that almost 100% of squamus cell carcinoma of cervix is HPV positive (Bosch *et al.*, 2002). More than 100 HPV subtypes have been described with 40 of the subtypes being capable of infecting the epithelial lining of the Ano-genital tract where about 15 of the 40 subtypes have been classified as high risk types which are responsible of almost 100% of all cervical cancer. The rest are low risk types which produce Ano-genital warts (Disaia *et al.*, 2002). More than 70% of all cases of cervical cancer have been shown to be a result of been infected with sub type 16 and 18 while the rest is caused mainly by type 31, 33, 45, 52 and 58. (Disaia *et al.*, 2002; Bosch *et al.*, 2002).

Sexual behavior of a person especially risky sexual behavior such as having multiple sexual partners and early sexual debut has been shown to be closely linked to HPV infection (WHO, 2006). It has been proved that the more sexual

partners a woman has the higher the risk of acquiring HPV infection and hence cervix cancer, with the risk increasing to 94% in women with more than 3 sexual partners in their life time compared with those with only one partner. The association of HPV infection with sexual behavior and the fact that the incidence of HPV infection is so high in sexually active adults has in part contributed to the high incidence of cancer of cervix globally (Parkin *et al.*, 2005; Bosch *et al.*, 2006).

2.5.2 Immunosuppression

Women such as those living with Human Immunodeficiency Virus (HIV), or those with conditions where immunity is compromised like those who are malnourished, pregnant or those on immunosuppressive chemotherapy when infected with high risk HPV have an increased chance of progressing from normal cervical cytology through abnormal cytology to invasive cervix cancer. This is thought to be due to persistence of HPV as a result of poor individual immune response which then leads to abnormal cervical cytology (Luque *et al.*, 1999; Temmerman *et al.*, 1999). For example it has been shown that women living with HIV infection or those who have organ transplant have up to 6 and 2 times risk of developing cervical cancer if they are infected with high risk HPV respectively (Grulich *et al.*, 2007).

2.5.3 Smoking as a risk factor for cervical cancer

Smoking reduces the normal immunological clearance of HPV leading to its persistence in the epithelial cells with subsequent initiation and progression of

abnormal cytology (Kjellberg *et al.*, 2000). This risk is dose dependent and studies have shown that the odds ratio for a woman who smokes more than 20 cigarettes in a day and who is infected with high risk HPV developing abnormal cytology is more than 2.5 (Deacons *et al.*, 2000). Smoking is thought to lead to inactivation of the Fragile Histidine Suppressor gene in cervical tumors as well as a reduction in the Langerhans cells within the epithelium which effectively leads to the disruption cell mediated immunity within the cervical epithelium. Furthermore it has been shown among smokers, high-risk HPV are much more common than in non-smokers. It has therefore been suggested that an additive effect may exist between these two factors in the development of cervical cancer (Roteli-Martins *et al.*, 1998). This increased risk still persists in HPV positive women who have ever smoked even if they stopped smoking (Plummer *et al.*, 2003). In the United Kingdom, 7% of cervical cancers are attributed to smoking (Parkin *et al.*, 2011).

2.5.4 Socio- economic factors as risk factors to cervical cancer

2.5.4.1 Resource constraints

A strong relationship between poor socio-economic status as well as other multiple interdependent social factors and cervical cancer has been well documented (Harris *et al.*, 1998). For example a higher incidence has been noted among black and Mexican Americans compared to the whites and this has been attributed to lower socio-economic status (Desaia *et al.*, 2002). Poor women living in resource constrained areas have been shown to have increased risks of up to 3 times

compared to those living in areas with high resources (Harris et al 1998). This condition of poor socio-economic status exists in many areas in the developing countries.

2.5.4.2 Literacy level

Women of low literacy levels have also been shown to have a greater risk of having never been screened for cervical cancer thus increasing their risks (Nathoo, 1988). For example a study done in Haiti showed those at high risk of developing the disease are the poor, uneducated, have economic barriers that prevent access to health services and are more likely to live in rural areas (Hilairie, 2011). These are the conditions that exist in most low and middle income countries like Kenya where cancer of cervix is highest. In addition, data has shown that there is a strong correlation between social class and cervical cancer; where women of low social class have been found to have a higher incidence compared to those of higher social class (Brown *et al.*, 1997).

2.5.5 Combined oral contraceptive pill as a risk factor to cervical cancer

The use of Combined Oral Contraceptive (COC) Pill has been shown to increase the susceptibility infection with high risk HPV, developing abnormal lesions and subsequent cervix cancer. After prolonged use, this risk may be up to 4 times more than for none users (Moreno *et al.*, 2002). Those women who have used oral contraceptives for 5 years and above have almost a 2 times increased risk of cervical cancer compared to those who have never used oral contraceptives.

However this risk decreases after stopping use of COCs and by the 10th year of stopping the risk is the same as per women who have never been on the COCs. This risk is higher in women living in developing countries (Appleby *et al.*, 2007).

2.6 Diagnosis, Treatment and Prevention of cervical cancer

2.6.1 Diagnosis and staging of cervical cancer

The pre-cancerous disease is commonly not symptomatic and is normally diagnosed through cervical cancer screening. Early invasive cervical cancer can also be asymptomatic. Post-coital bleeding is the earliest and commonest presenting complaint followed by increased vaginal discharge. Majority of women present with advanced disease with symptoms such as foul smelling vaginal discharge and unprovoked bleeding. As the disease progresses the patient may present with renal failure, severe anemia and fistula formation, pelvic pain, urinary and stool incontinence due to fistula, haematuria and constipation. Pre-invasive and invasive cervical cancer is commonly diagnosed from cervical cytology or visual inspection. Other more invasive tests like colposcopy, endocervical curettage and directed biopsy are done if initial screening tests are abnormal (Cox, 1999; Pecorelli *et al.*, 2009).

Once cervical cancer is suspected the patient is usually taken for examination under anesthesia, staging and biopsy of the tumor is taken for histological confirmation of the disease. A speculum examination will usefully reveal a cervical mass which may be fungating and easily bleeds to touch. Cervical cancer

is staged according to a system developed by International Federation of Obstetrics and Gynecology (FIGO). Stage 1A is cervical cancer diagnosed microscopically with no visible tumor; where 1A1 is tumors less than 3 mm invasion and less than 7 mm in diameter. Stage 1B are visible tumors which are confined to the cervix with stage 1B1 being tumors less or equal to 4 cm and 1B2 being tumors that are greater 4cm in diameter. Stage 2 cervical cancer is tumors that have gone outside of the uterus but not involving the pelvic side wall with stage 2A being tumors that involves the upper third of the vagina and stage 2B being tumors that involves the parametrium. Stage 3 cervical cancer is defined as disease that has extended to the lower third of the vagina and or to the pelvic side wall with stage 3A being cancer extending to the lower third of the vagina but not involving the pelvic side wall and 3B being tumors extending to the pelvic side wall. If a patient has a non functional kidney as a result of cervical cancer they are staged as stage 3B. Stage 4 is tumors that have spread to the bladder, rectums and to or to other distant organs (IARC, 2005; Pecorelli *et al.*, 2009).

2.6.2 Treatment of cervical cancer

Treatment depends on the stage of the disease. For pre-cancerous cervical lesions treatment is usually curative and the patient needs no admission. The main method for treatment for these lesions is the Large Electro-surgical Excision (LEEP) procedure, Cryotherapy or Laser ablation (Cox 1999; Kyrgiou *et al.*, 2006; Plante *et al.*, 2005). Early invasive disease (stage 1-2A) has been treated successfully

with radical hysterectomy and dissection of the pelvic lymph nodes. The patient is thereafter given radiotherapy and chemotherapy. All other stages of the cervical cancer are treated primarily with radiotherapy followed by chemotherapy. Prognosis of cervical cancer depends on the stage of the disease as well as how far it has spread. If treated appropriately women with stage IA disease have a 95% five year survival compared to only 20% of those with stage IV disease (Cox 1999; IARC 2005; Green *et al.*, 2005).

2.6.3 Prevention of cervical cancer

2.6.3.1 Primary prevention

This can be ensured by preventing women from acquiring HPV infection either by reducing risks related to sexual activities or by offering them vaccination. There are currently two vaccines available in the market, based on HPV virus-like particles available and approved for primary prophylaxis against HPV. This includes a bivalent vaccine against HPV type 16 and 18 and a quadrivalent vaccine against HPV6, 11, 16 and 18. Vaccination is currently recommended for adolescent girls from the age of 9 to 12 years although some benefit has been shown even in those women aged up to 26 years (Smith *et al.*, 2011). However due to the high cost of the vaccines, the multiple doses needed and the need for maintenance of the cold chain this strategy is unavailable to the developing countries where the burden of the disease exists.

2.6.3.2 Secondary prevention

This involves regular screening of women who are at risk. Screening enables early detection and treatment of women with abnormal cytology (CIN 2/3) and detecting and treating early stage cancers which are completely curable. Three main screening methods have been developed as discussed in the subsequent subsections:

2.6.3.2a The Papanicolaou test

The Papanicolaou (Pap) smear test has been used extensively in cervical prevention programs worldwide. A Cusco's vaginal speculum allows exposure of the cervix. Using a Cyto-brush the cervix is swabbed to obtain a cytological smear by rotating the Cyto-brush through 180 degrees. The Pap smear is then spread on a labeled glass slide and immediately fixed and transferred for cytological examination. Abnormalities of the Pap smear were graded using the Bethesda classification (Solomon *et al.*, 2002). To date, there is strong evidence that cytology-based screening programs using the Papanicolaou (Pap) test have been used with a lot of success in reducing cervical cancer in the developed countries where there are well organized cervical cancer screening programs (Hakama, 1997). The Pap smear test has a high specificity of up to 97% but low sensitivity of about 51% (Nanda *et al.*, 2000). To increase the sensitivity, newer techniques such as computer assisted screening and liquid based cytology are being used with differing success.

2.6.3.2b Human Papilloma Virus DNA test

Due to the fact that almost all cases of cervical cancer develop as a result of infection with high risk HPV, screening for these viruses in cervical specimens offers an alternative or complementary screening test to cytological screening. The currently available HPV tests have ability to detect high grade dysplasia although they are less specific but more sensitive when compared to cytological tests like Pap smears (Bosch *et al.*, 2002; Schiffman *et al.*, 2000; Wright *et al.*, 2000). They are a number of diagnostic kits that have been developed with two types currently being sold in the market (Schiffman *et al.*, 2000; Victor *et al.*, 1993).

2.6.3.2c Visual inspection (VIA)

This technique uses 3-5% acetic acid which is applied onto the cervix. Thereafter, the cervix is examined using the naked eye and a light source. Abnormal areas are indentified as well-defined aceto-white areas close to the squamo-columnar junction (SCJ). Advantages of VIA are that since the results are available immediately, it is possible to offer treatment in one sitting, is inexpensive and can easily be taught to many cadres of health professionals. It needs no Colposcopy or histological sampling and is performed with only few and easily available equipment and consumables and there is no need for laboratory (Sankaranarayanan 2008; Denny *et al.*, 2000). This method of screening has a high sensitivity and is a good alternative to cytological screening in resource constrained areas (Cecchini *et al.*, 1993; Megevand *et al.*, 1996; Denny *et al.*, 2000). However it depends a lot

on the performers subjectivity and has been shown to have a low specificity which may lead to over investigation of false positive lesions, increased referral of such patients as well as overtreatment (Cecchini *et al.*, 1993; Gaffikin *et al.*, 2007; Van Le *et al.*, 1993). In some instances it has been found that due to the low specificity up to 40% of women may have false positive results leading to unnecessary treatment (Van Le *et al.*, 1993). To improve on VIA, Lugos iodine can be added to VIA in order to enhance the cervical lesion by coloring it banana yellow.

2.6.4 Interval of screening

For a cervical cancer screening program to be effective women at risk need to be started on screening programs and also the interval between screenings must be maintained. Mathematical modeling has shown that yearly screening gives a 93% reduction of cancer of cervix thus suggesting that this might be the best interval of screening (Miller, 1992). It has been shown that cervical cancer screening coverage is crucial to reduction of cancer of cervix (Sasieni, 1991) and where coverage is above 70%, cervical cancer has been drastically reduced. This high coverage has been enhanced by invitation-based system, combined with target payments for general practitioners (Sasieni, 1991). However in developing countries like Kenya there exists no integrated way of reminding women of the next scheduled repeat screening with possible resultant low repeat screening (WHO, 2006). The availability of the mobile phone technology is proposed to

increase numbers of those having regular screening as well as improve on those women getting their results.

2.6.5 Factors that hinder effective screening

Cervical cancer mainly affects poor marginalized women especially from low and middle income countries which are often resource constrained and have difficulty in implementing successful cervical cancer prevention programs (Denny *et al.*, 2006). Cancer prevention in these countries often compete with increased health burden from other diseases, lack of resources, under-developed health care services, disempowered and uninformed women, widespread poverty and the choice of screening tests among others (Denny *et al.*, 2006). In these countries the populations at the highest risk of developing cervical cancer have poor access to information on prevention and screening benefits as well as health centers where cervical cancer is offered. Such women have other constraints related to social and cultural issues and may not know when cervical cancer is screened, where the services are offered or even whether cervical cancer screening is important. Many of the women in developing countries who get screened are done so without a structured program and in most of the time they decide on when and how often to be screened (WHO, 2006; Bailie *et al.*, 1995; Chirenje *et al.*, 2001).

Other factors that influence uptake of screening include socio-demographic factors, (Lyimo *et al.*, 2012; Abotchie *et al.*, 2009), knowledge and awareness of the screening (Cyril *et al.*, 2009), low attitudes towards cervical cancer screening

(Abdullahi *et al.*, 2009; Chumnan *et al.*, 2009) and cultural factors (Bener *et al.*, 2001) as well as location of screening sites in relation to the clients (Daskin *et al.*, 2004; Baron *et al.*, 2008).

2.7 The call recall system

The WHO (2002) has recognized that for an effective cervical cancer screening programme, an integrated system of recalling women to the screening cycle when due must be in place. Countries like Britain have an effective computer based call recall system which automatically calls eligible women for cervical cancer screening when they are due (Levi *et al.*, 2000). This system is set to indentify women aged 25-64 years of age to be included into the screening program and has a call recall of all this women using mail, letters and their general practitioners. Individuals are sent invitations for screening 5-6 weeks before test due date (United Kingdom NHS, 2010). Such a program of disseminating information on the need for screening and sending reminders to eligible women for rescreening does not exist in Kenya and the Short Message Service (SMS) text will be explored in this study to establish whether it can fill this gap.

2.8 The mobile phone for health (M-health)

The fast evolving communications platforms, such as mobile phone platform, that has recently emerged and been highly accepted across Africa gives the medical field a great and novel opportunity of integrating such platforms in health care delivery. This technologies has the opportunity of having an easy tool that can be

placed close to those who need health care most to give an almost real time source of interaction and information. Such advantages as addressing health care access, providing continuous medical education, offering medical education as well as treatment and monitoring treatment adherence have been shown in studies using mobile phones platforms (Akhila *et al.*, 2010).

The International Telecommunication Union estimates that over 5 billion of the global population has subscribed to wireless communication by 2010 and out of this, 70% are in resource poor countries (ITU 2010). In Kenya, this new technology has been acquired by at least 60% of the population with 85.2% of urban and 55.5 of rural population owning a mobile phone (Republic of Kenya KNBS & ICF Macro 2010; Collymore, 2012).

The mobile phone has been used in 5 key areas of health. These include health care information systems for collection of health care information, monitoring of compliance to treatment and health promotion, as a support tool to health workers for prevention of diseases and surveillance of diseases as well as in emergency medical response systems. The Short Text Message Service (SMS) is the primary feature of mobile phones that has been significantly documented to have good results especially for reminders (Metchel, 2007; Armstrong *et al.*, 2009; Ollivier *et al.*, 2009). The few studies conducted in resource constrained countries have investigated use of mobile technology for drug adherence and appointment reminders for infectious diseases like TB as well as in ARV compliance for HIV management. In these areas, there is proof that use of mobile phone technology is

feasible in diverse settings (Mechael *et al.*, 2010; Lester *et al.*, 2010; Gombachika *et al.*, 2011). However no randomized controlled trials have been conducted on the use of the SMS to enhance adherence scheduled screening for cervix cancer. Kenya like most developing countries lack a system of disseminating information on importance of regular screening and also have no call recall system to enhance scheduled screening. This study aims to determine the influence of using the SMS reminders on adherence of scheduled repeat screening for cervical cancer in Thika Level 5 Hospital.

2.9 Public health implication of cervical cancer

Currently, cancer has been ranked 3rd among the main diseases after infectious diseases and cardiovascular diseases. In Kenya the annual incidence of all cancers is about 28,000 while the annual mortality is estimated to be 22,000 accounting for 7% of all deaths in the country. The commonest cancers among Kenyan women are breast cancer, cervical cancer and esophageal cancer (Korir *et al.*, 2011). Despite progress in understanding the epidemiology of cervical cancer, it is still a disease that is ravaging many women especially those in resource constrained countries. East Africa has been found to lead in having the highest morbidity and mortality rates in the world (Ferlay *et al.*, 2005). Cervical cancer is contributes to many years of life lost in women aged between 25 and 64 in low income countries and with the projected age specific incidence and changes in population dynamics, it is estimated that newly diagnosed disease in such countries will rise to 63% by

2030 with a 50% increase being seen in the younger woman (Ferlay *et al.*, 2005; Parkin *et al.*, 2003; Rust *et al.*, 2010). Women affected by this disease have been shown to die while they are much younger, when they are economically at the peak of their productive life when compared to those having other forms of cancers. The high burden of cervical cancer in resource constrained areas where there is a large population which is economically constrained may be explained by differences in the availability, accessibility, utilization and organization of cervical cancer screening services which is made worse by variation in the underlying distribution of cervical cancer risk factors (McDougall *et al.*, 2007; Saraiya *et al.*, 2007). Early detection and treatment by using organized, timely and appropriate screening methods on women at risk makes this cancer the only cancer that has the potential for eradication or complete cure. However it continues to ravage women in developing countries putting more strain to the economy (IARC 2005; Goldie *et al.*, 2006). It is therefore important that prevention and control strategies be focused to understand the magnitude and nature of the cervical cancer burden; recognize avoidable risk factors, and emphasizing public health priorities to enhance adherence to screening for populations at risk (Patel *et al.*, 2009).

2.10 Gaps indentified in the literature review

The prevalence of cervical cancer is an area that shows a lot of disparity between countries. Those that are resource constrained have more of the disease compared to those with a higher per capita income. Drastic reduction in mortality and

morbidity has been achieved in developed countries but the disease remains rampant in developing countries like Kenya. The risks of developing cervical cancer include infections with viruses like high risk human papilloma viruses, early sexual debut and immunosuppression among others; these risks cut across countries. However in developing countries the risks are compounded by lack of regular screening of a significant percentage of the population at risk. This is unlike what is done in developed countries where organized screening programs with a strong recall component ensures at least 70% of the women at risk are kept in the screening cycle. Few women are regularly screened in developing countries and there lacks ways of recalling women for future screening. Developed countries have incorporated recall for scheduled cervical cancer screening by using the fixed telephones, emails and letters. These types of service are not easily available in developing countries like Kenya. The mobile phone SMS which has high penetration in the developing countries and has shown great potential in HIV and TB treatment in resource-constrained settings has not been used as a tool for sending reminders on scheduled cervical cancer screening and is seen as a possible recall tool to enhance screening in developing countries.

CHAPTER THREE: METHODOLOGY

3.1 The study design

This was a facility based single blind Randomized Controlled Trial (RCT) with an intervention using SMS reminders (Appendix V) and a control arm where no SMS reminders were sent. This design was used for this study as it was deemed the best to demonstrate cause and effect through manipulation of independent variables. To make it a true experimental design (Mugenda, 2008), random sampling of eligible women attending the general outpatient clinic at Thika Level 5 Hospital was conducted in order to get the sample of those with normal cytological smears. The sampled women were then randomly allocated to the intervention arm where four Short Message Service (SMS) Texts reminders were sent and a control group where no SMS text reminders were sent. Randomization was conducted using a computer based randomization to control for confounders and to allow homogeneity of the two arms.

3.2 The study variables

3.2.1 The Independent variables

The independent variables were grouped into experimental independent variable and the measurement independent variables (Mugenda, 2008). The experimental independent variable for this study was the Short Message Service Text sent to the study participants in the study arm while the measurement variables included

socio-economic factors such as age and income, risks factors such as age at marriage and contraceptive use, perceived health beliefs such as perceptions of susceptibility to cervical cancer and benefits of being screened as well as access factors such as distance to the hospital and means of transport used by the participants to access the hospital.

3.2.2 The dependent variable

The dependent variable was adherence to scheduled rescreening at end line. Adherence was defined as attendance for rescreening by the study participants who had normal cervical cytological smears in a period of 14 days set at baseline exactly 12 months after the recruitment. A patient was deemed adherent if she attended the screening in the 14 days set for the end line screening in the Thika Level 5 Hospital exactly 12 months after the baseline.

3.3 The study site

The study was conducted in Thika Level 5 Hospital in Kiambu County (Appendix II). The hospital has wide outpatient coverage with patients coming from all over Kiambu County as well as from other neighboring counties such as Machakos, Nairobi and Muranga. It has 300-bed capacity and is situated in Thika town, about 50 km north east of Nairobi. The hospital serves a high population of outpatients per day from diverse background, has a high burden of patients presenting with advanced cancer of the cervix (Thika Hospital Data 2011) and is also in an area

where most of the population has mobile phones (Republic of Kenya NBS & ICF MACRO,2010).

3.4 The study population

The study population was eligible women attending the general female outpatient's clinics at the Thika hospital and who consented to participate in the study.

3.5 The inclusion and exclusion criteria

3.5.1 Inclusion criteria

The inclusion criteria included women:

- a. Above 25 years of age and attending the general outpatient clinic
- b. Who had never had cervical cancer screening
- c. Who consented to the study
- d. Who owned a mobile phone and consented to receive communication through their mobile phones during the study period.
- e. Who had normal cervical smear after the initial baseline screening

3.5.2 Exclusion criteria

The following women were excluded:

- a. Those not consenting to the study or to receive SMS

- b. Those with abnormal cytological smears
- c. Women who had previous hysterectomies
- d. Those who did not own a mobile phone
- e. Those too sick and needed hospital admission
- f. Those with vaginal bleeding
- g. Those who were pregnant

3.6 The sample size determination

The sample size was calculated according to the formula developed by Chan for comparison of 2 proportions (two-sided) at 5% level of significance and 90% power (Chan, 2003). In Kenya less than 5% of women have regular repeat Pap smear as scheduled and in this study it was assumed that the intervention of using the SMS reminders will raise the percentage of women attending for scheduled cervical cancer screening as per the preset schedule from 5% to 20%. Therefore the intervention will have an intervention effect of 15%. The formula for the sample size was as shown below;

$$N = c \times \frac{\pi_1(1 - \pi_1) + \pi_2(1 - \pi_2)}{(\pi_1 - \pi_2)^2}$$

Where: N=sample size required in each group, C=10.5 for 90% power and 5% significance, π_1 =first proportion= 0.05, π_2 =second proportion=0.20, $\pi_1 - \pi_2$ =size difference of clinical importance for this study= 0.15.

Therefore

$$n=10.5 \times \{0.05(1-0.05) + 0.20(1-0.20)\} / (0.05 - 0.20)^2$$

$$= 114 \text{ per group}$$

Assuming a dropout rate of 20% then each arm had 143 participants or 286 for the whole sample.

3.7 The Research questionnaire

3.7.1 Pretesting the questionnaire

A questionnaire was designed in order to capture the data. The questionnaire contained sections on socio-demographic characteristics, perceptions on cervical cancer screening and assessment of participant's risk factors towards cervical cancer. The questionnaire was pretested at Kiambu Hospital female outpatient clinic in Kiambu County. The pretesting was conducted among 20 eligible women attending the general outpatient clinic in the hospital. Kiambu Hospital general outpatient clinic was chosen for pretesting as it serves women with the same characteristics as those seen in the Thika Level 5 Hospital. After the pretesting, the questionnaire was reviewed for accuracy, completeness and language appropriateness.

3.7.2 Validity and reliability

To ensure reliability and validity of data collected, a research assistant with previous experience on data collection was recruited and trained on how to administer the questionnaire. The questionnaire was well designed and the investigator ensured that the appropriate data collection and sampling procedure was followed. Completeness of the filled questionnaires was continuously assessed on a daily basis and any error was corrected promptly to reduce random as well as systematic data errors.

3.8 Data collection technique

3.8.1 Sampling and recruitment

Women attending the female outpatient clinic at the Thika Level 5 Hospital were assessed for eligibility at the outpatient clinic by the principal investigator and the research assistant. A health talk on cervical cancer screening was given as part of the morning health talk to all women at the general outpatient clinic. Eligible women who consented to participate signed an informed and were then recruited and screened for cervical cancer after their outpatient care. To get a representative sample for inclusion into the study, systematic random sampling was employed (Mugenda, 2008). From the hospital records approximately 20 women aged 25 years and above attend the general outpatient clinic at the hospital daily. With the study scheduled to recruit 286 participants in 8 weeks the study aimed to recruit 8 study participants each working day until the sample size was acquired. The

sampling interval was thus 20/8 which was translated to an interval of 2. Thus every 2nd woman above the age of 25 years was systematically randomly sampled to be included into the study. The first 8 women attending the general outpatient clinic were given numbers from 1 to 8 which were written on an opaque paper, folded and put into a container. One number was randomly picked from the container, the woman whose number was picked was considered as the first in the sequence and from then every second eligible woman who consented was invited and recruited for the study. If the sampled woman was not eligible, the next eligible woman was recruited.

3.8.2 Data collection process

Those recruited had their baseline data recorded in an investigator administered questionnaire (Appendix I). They were then screened for cervical cancer until a sample of 286 participants with normal cytology was obtained for inclusion into the study. The questionnaire was administered through face to face interview by the principal investigator or the study assistant. The baseline data captured in the questionnaire included socio-demographic and economic data, cervical cancer risks profiles as well as mobile phone usage. The participant's perceptions of health beliefs to cervical cancer (perceptions of susceptibility, severity, benefits) were also assessed and scored using a 5-point Likert-type scale where those who strongly agreed were scored 5 going down to 1 for those who strongly disagreed to a set of perceptions questions.

3.8.3 Screening for cervical cancer

To get the required sample of 286 participants with normal cytological smears for randomization and allocation into the intervention and control arms of the study, recruited women were screened for cervix cancer using the Papanicolaous cytological test. The principal investigator inserted a Cusco's vaginal speculum which allowed for visualization of the cervix with the naked eye. Using a Cyto-brush the cervix was swabbed to obtain a cytological smear by rotating the Cyto-brush through 180 degrees. The Pap smear was then spread on a labeled glass slide and immediately fixed using a standard fixative and transferred to the laboratory for examination. Only those with normal smear were retained for randomization while those with abnormal smears or cervical cancer were excluded and treatment given.

3.9 Allocation and Randomization of study participants to the two study arms

3.9.1 Allocation and randomization

A database of the entire study participant's mobile phone numbers was developed by the investigator. All the study participants were requested to provide an alternative number of a significant other person for which the Short Message Service (SMS) Text could be re-routed in case their number was out of reach. Using the participant's mobile phone, a 1:1 computer generated random allocation into an intervention (SMS reminders) and control group (no SMS reminders) was performed. This allocation was concealed and blinded to the principal investigator

and his assistant. A software expert developed the system (appendix XI) and administered the system. The systems administrator was not blinded to the study. The system was set to automatically randomly allocate the study participant's by their mobile phone numbers to either the intervention or control arm. The system subsequently automatically sent the reminder SMS as per the predetermined schedule. If the participant's mobile phone number was unreachable the SMS was automatically routed to the alternative number through the computer program.

The mobile phones data was first put in clusters so as to prevent a skewed selection of participant's to receive reminders which would happen if a large number of clients in adjacent memory location are selected. Participants were registered chronologically as they were recruited hence those in adjacent locations were registered in relatively the same period. The number of participant's in each block was first determined at 50% and then selected randomly from it according to the proportion. The clusters needed to be small enough to ensure a uniform selection of clients yet large enough for efficiency and practicality.

The block size was set to be automatically determined by the system as per the following formula (Balakrishnan 1997, Kupper *et al.*, 2013)

$Pr = N / R$ i where

N.....Number of clients (286).

R.....Number to be selected to receive the SMS (143).

It was noted that the total sum of intervals between data increased as data was more evenly distributed. These intervals were calculated as $n - (n-1)$; where n represented position of selected client in the list and $n-1$ the position of last selected participant's.

Since a proportion of 50% was being used, the best intervals would be 2 where for every 2 participants, one was randomly selected. The worst case scenario would be where 143 participants in adjacent locations were selected. The intervals would be 1 all through for those selected.

Average case scenario interval $i = \text{best case} + \text{worst case} / 2 = (2+1)/2 = 1.5$;

Block sizes were to be small enough to ensure uniform distribution but large enough for practicality and efficiency.

The number of blocks was determined by function:

$$B = P * i * \log N$$

Where Boptimum number of blocks, Pproportion determined by data size (Number of participants)/Number to be selected, iaverage interval size, NData size (Number of participants).

For this study, the optimum number for 286 participants and 50% selection was 7 blocks.

Data was then divided into the blocks to get the block size of each block.

$B_s = 286 / 7 = 40.85$ hence blocks of 40 were used.

Therefore for every 40 participant's clustered together, 20 were randomly allocated into the intervention group while the rest were allocated to the control group. This was done automatically by the computer system. This meant that 140 participants were randomly selected from all clusters and then each of remaining 3 participants was selected randomly from a randomly picked cluster.

3.9.2 Description of the interventions

3.9.2.1 The intervention group

The intervention group received reminders via Short Message Service (SMS) texts for the next scheduled screening. For this study four (4) Short Service Messages (SMS) Texts (Appendix V) were automatically sent to the intervention group at 3 months, two months, a month and a week before their next repeat screening automatically using a computer. Dates on which the SMS texts reminders were sent were:

5th February 2014

5th March 2014

5th April 2014

30th April 2014

If the study participant's mobile phone number was unreachable the SMS text were automatically routed to the alternative numbers. This allocation was blinded to the investigator until un-blinding which was done on 19th May 2014.

3.9.2.2 The control group

For participants in the control group, the date of next scheduled repeat screening was verbally given and noted on the participant's card as is the routine standard of care in cervical cancer screening programme. No SMS text reminders were sent to the women in the control group.

3.9.3 Follow up

All the study participants in the two study arms were followed up with subsequent screening for cervical cancer using cytological smears at end line. The 286 study recruited participants with initial normal Pap tests were scheduled for rescreening exactly 12 months after the baseline screening which was set for a period of two weeks starting from 5th May to 16th May 2014. A participant was deemed adherent to scheduled screening if she was screened for cervical cancer at the same site (Thika Level 5 Hospital) between 5th to 16th May 2014. To account for those lost to follow-up and to fulfill the intent to treat, a call was made to the study participant's using the personal mobile phone number immediately after un-blinding the study. The calls were made to determine the reason of not attending to the scheduled screening. If the study participant's number was unreachable, further attempt to trace her was made using the alternative number given at baseline.

3.10 Data management and analysis

After creating an EPI Data screen, data was double entered to create a clean data set and to ensure accuracy. Regular file backup was done to avoid any loss or tampering of the data. The backup files were stored in an external hard disk. Data verification, cleaning and analysis was conducted using STATA version 11 (STATA Corp, College Station, Texas, USA). Analysis was done on Intent to Treat (ITT) analysis principle (Peduzzi *et al.*, 2002). The Health Belief Model constructs of susceptibility, severity, benefits, and barriers were scored using a Likert-type scale. Each item was scored using a 5-point Likert-type scale where those who strongly agreed were scored 5 going down to 1 for those who strongly disagreed. Negatively worded questions had their scales reversed. For analysis of associations between the health beliefs and adherence to scheduled repeat screening, the total scores were averaged and percentages calculated for each of the constructs. The score were put into 3 categories of low scores, medium and high scores with low score (Byrd *et. al.*, 2003) and thus analyzed as a categorical variable.

Categorical variables such as education levels and marital status were summarized by frequencies and proportions while continuous variables such as age at marriage and parity were summarized by means and standard deviations. Uni-variable descriptive analysis was used to describe the characteristics of the sample population such as their socio-demographics characteristics. Chi square test was used to establish the relationship between various categorical variables. Bi-

variable analysis was used to determine the relationship between the independent variables and dependent variable. Cronbach's alpha was used as a measure of the internal consistency of the health belief questions. Simple logistic regression was conducted to determine the influence of the SMS text reminders on repeat scheduled screening. Multiple logistical regressions were conducted to determine the influence of socio-demographics variables, socio-economic variables as well as health beliefs variables on adherence to scheduled screening. All analysis to test the impact of using the SMS text reminders to attend to scheduled repeat cervical cancer screening between the intervention and control group was done at 90% power and 5% significance level. Odds ratios with confidence intervals were generated from logistic regression as measures of associations. The study findings were presented as per the Consolidated Standards of Reporting Trials (CONSORT) guidelines. The results were presented by use of tables, charts and bar graphs.

3.11 Ethical considerations

Ethical approval was sought from the Kenyatta University Biomedical Research Ethics Review Committee (Appendix VII). Authority to conduct the research was granted by the graduate school (Appendix VI), the National Council of Sciences and Technology (Appendix VIII) and the management of the Thika Level 5 Hospital (Appendix IX). Review was also done by the Pan African Clinical Trials Registry and approval given (Appendix X). All study participants signed an

informed consent which had an English and Kiswahili version (Appendix IVa and IVb). Any patient who refused to participate was not denied service at the hospital. No incentives were offered to the study participants. All the questionnaires were stored in a lockable drawer for confidentiality. The participant's with abnormal cervical lesions and overt cervical cancer were given the standard care such as colposcopy, surgery or radiotherapy.

CHAPTER FOUR: RESULTS

4.1 Trial profile

4.1.1 Summary of the trial reporting

Figure 4.1 shows the Consolidated Standards of Reporting summary for the study.

During the period 15th April to 14th June, 964 eligible women attended the general female outpatient's clinic and were assessed for recruitment out of which 193 women were excluded as they had been screened for cervical cancer before. The rest (771) were consented and systematic random sampling employed to get the study sample.

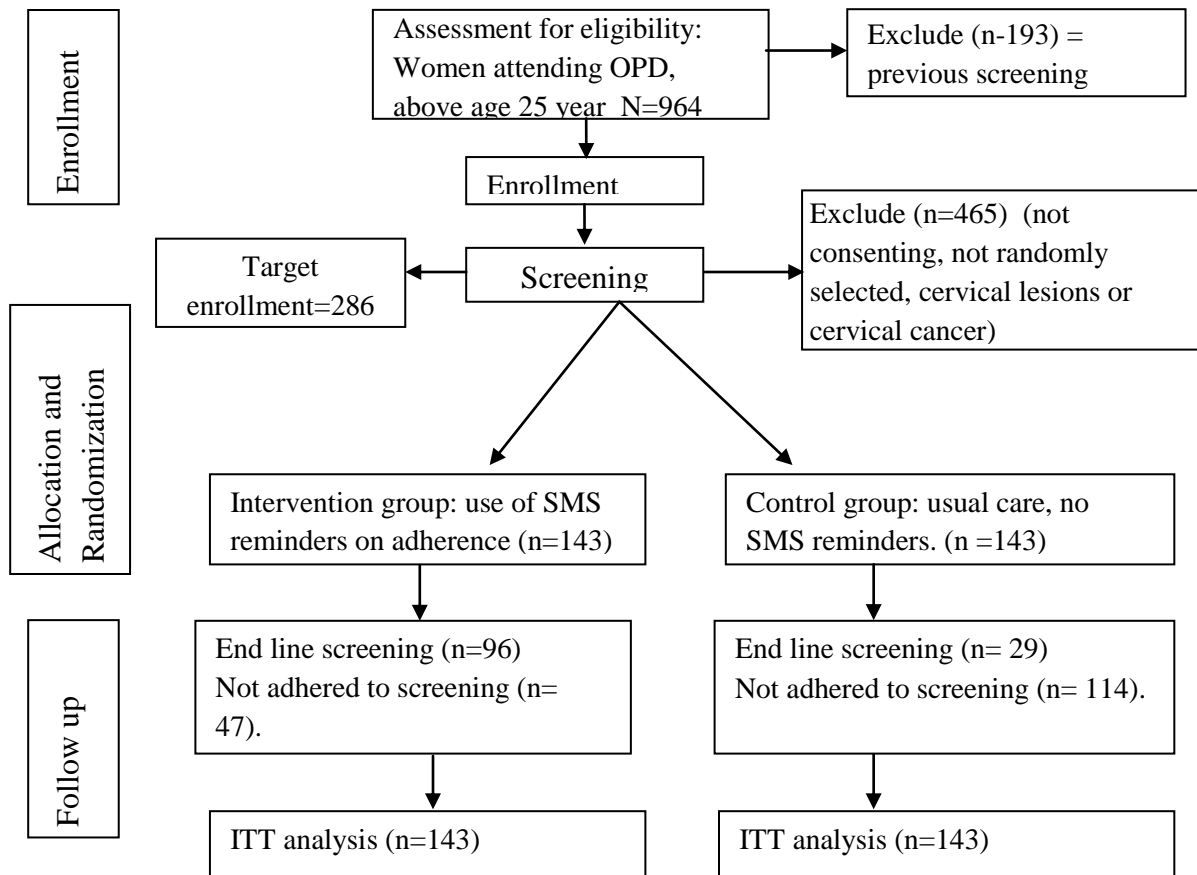


Figure 4.1 Consolidated Standards of Reporting summary for the study

4.1.2 Comparative analysis of socio-demographic characteristics of the trial arms

Table 4.1 compares socio-demographic characteristics of the two study arms which were done after unmasking the study arms. Most of them showed no statistical difference between the two arms.

Table 4.1 Comparative analysis of the trial arms

Age	Control arm		Intervention arm		Total		p-value	Chi-square
	143	%	143	%	286	%		
25-29 yrs	35	24.5	31	21.7	66	23.1	0.093	7.95
30-34 yrs	19	13.3	28	19.6	47	16.4		
35-39 yrs	22	15.4	27	18.9	49	17.1		
40-44 yrs	17	11.8	25	17.4	42	14.7		
>45 yrs	50	35.0	32	22.4	82	28.7		
Marital Status	143	%	143	%	286	%	0.908	1.54
Married	108	75.5	108	75.5	216	75.5		
Single	19	13.3	19	13.3	38	13.3		
Divorced	10	7.0	11	7.6	21	7.4		
Widowed	6	4.2	5	3.6	11	3.8		
Education	143	%	143	%	286	%	0.560	2.04
Non formal	2	1.3	0	0.0	2	0.7		
Primary	58	40.6	57	39.9	115	40.2		
Secondary	59	41.3	61	42.7	120	42.0		
Tertiary	24	16.8	25	17.4	49	17.1		
Employment	143	%	143	%	286	%	0.047	7.95
Employed	37	25.9	26	18.2	63	22.0		
Self employed	30	21.0	49	34.2	79	27.6		
Casual	8	5.6	4	2.8	12	4.2		
Unemployed	68	47.5	64	44.8	132	46.2		
Cell Phone	143	%	143	%	286	%	0.521	4.12
1-2 yrs	18	12.6	23	16.1	41	14.3		
3-4 yrs	22	15.4	26	18.2	48	16.8		
5-6 yrs	42	29.4	29	20.3	71	24.8		
>6 yrs	61	42.6	65	45.4	126	44.1		
Parity	143	%	143	%	286	%	0.077	8.42
0 children	6	4.2	9	6.3	15	5.2		
1-2 children	58	40.6	66	46.2	124	43.4		
3-4 children	41	28.7	48	33.5	89	31.1		
>4 children	38	26.5	20	14	58	20.3		

4.2 Socio-demographic characteristics of the study participants

4.2.1 Socio- demographic characteristics of the study participants

Table 4.2 below shows the socio-demographic characteristics of the study participants. The mean age of the participants was 38.8 ± 10.8 with the youngest being 25 and the oldest 70 years old. Most of the study participants (82.2%) had primary or secondary school education and were married (75%).

Table 4.2 Socio- demographic characteristics of the study participants

Age of study Population	N=286	Proportion (%)
25-29 yrs	66	23.1
30-34 yrs	47	16.4
35-39 yrs	49	17.1
40-44 yrs	42	14.7
>45 yrs	82	28.7
Total	286	100.0
Education		
No formal education	2	0.7
Primary	115	40.2
Secondary	120	42.0
College	49	17.1
Total	286	100.0
Marital status		
Married	216	75.5
Single	38	13.3
Divorced/Separated	21	7.4
Widow	11	3.8
Total	286	100

4.2.2 Socio-economic characteristics of the study participants

Table 4.3 shows the socio-economic characteristics of the study participants. It was found that 46.2% of the participants were unemployed. Majority of the participants (84%) earned less than 10,000 Kenya Shillings per month. Out of the 248 participants who were married, only 47.4% of the husbands were employed. Majority of the study participants (90%) used public transport to access the hospital.

Table 4.3 Socio-economic characteristics of the study participants

Employment	N=286	Proportion (%)
Employed	63	22.0
Self employed	79	27.6
Casual	12	4.2
Unemployed	132	46.2
Total	286	100.0
Spouse Employment		
Employed	102	47.4
Self employed	58	27.0
Casual	15	7.0
Unemployed	40	18.6
Total	215	100.0
Personal income		
Kshs 1000 - 10000	102	68.9
Kshs 10001 - 20000	29	19.6
Kshs 20001 - 30000	11	7.4
Kshs 30001 - 40000	3	2.0
Kshs 40001 - 50000	2	1.4
Kshs > 50000	1	0.7
Total	148	100.0
Transport to facility		
Walking	20	7.0
Bicycle or motorcycle	5	1.7
Public means	257	89.9
Personal vehicles	4	1.4
Total	286	100.0

4.3 Study participants utilization of the mobile phone

4.3.1 Study participants utilization of the mobile phone

Table 4.4 shows that majority of the study participants (43%) had owned a mobile phone for a period of between 5-8 years. The mean duration of mobile phone ownership was 6.3 years \pm 3.6. Change of the mobile phone numbers was very low with only 8.4% having changed their numbers once and most of the participants (88.5%) never ever changed mobile phone number. Very few of the study participants had ever received a health related SMS before the study.

Table 4.4 Study participants utilization of the mobile phone

Years of Mobile Phone Ownership	N=286	Proportion (%)
< 5 years	89	31.1
5-8 years	123	43
>8 years	74	26
Total	286	100.0
Times changed phone numbers		
0	253	88.5
1	24	8.4
>2	9	3.1
Total	286	100

4.3.2 Study participants perceptions on the use of mobile phone for health information at baseline

Figure 4.2 shows the study participants perception on the use of the mobile phone for health care. Over 90% of the study participants felt that the SMS can be used for health promotion and that they would like to receive educational messages on cervical cancer screening. Almost all felt that being reminded about the next booking for cervical cancer screening through SMS texts would help them to adhere to scheduled cervical cancer screening. Majority (74.5 %) also felt that results can be sent through an SMS text without interfering with their privacy.

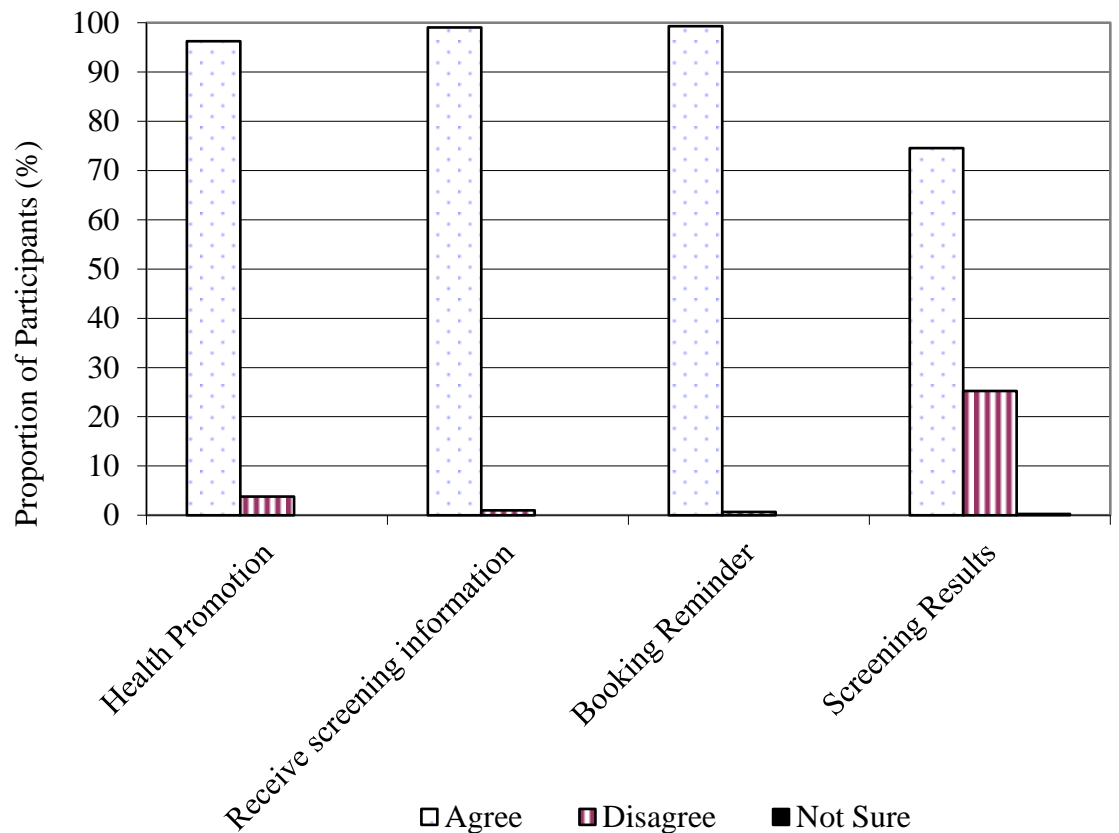


Figure 4.2 Study women perception on the use of mobile phone for health information at baseline

4.4 Study participants reasons for having never been screened for cervical cancer

As shown in Table 4.5, about half of the study participants (45.5%) indicated that they did not know where to go for cervical cancer screening while 23.8% said they had no knowledge about cervical cancer screening services. Cost of the test was given as a reason of having never been screened by 12.2% of the participants, while fear of being screened was given by 8.4% of the women. Other reasons mentioned included fear of pain during screening, lack of time and lack of female health providers in the cervical cancer screening clinic.

Table 4.5 Study participants reasons for having never been screened for cervical cancer

Reasons of not being screened	N=286	Proportion of participants (%)
Lack of knowledge about where to go for screening	130	45.5
Lack of knowledge about cervical cancer screening	68	23.8
Cost of screening too high	35	12.2
Fear of being screened	24	8.4
Others	29	10.1
Total	286	100

4.5 Study participants risks factors to cervical cancer

4.5.1 Age at Marriage and parity of the study participants

Young age of marriage and increased parity has been associated with increased risk of cervical cancer. Table 4.6 shows the ages at marriage and parity of the study participants. The mean age at marriage was 22.4 ± 3.9 . Almost half of the participants (48.3%) got married at the age of 19-24 years while 13.3% married below the age of 20 years with the youngest marriage age been 13 years of age and the oldest at 38 years. The mean number of children delivered by the participants was 3. The mean age at first delivery was 21.8 years.

Table 4.6 Age at Marriage and parity of the study participants

Age at marriage	N=286	Proportion (%)
Never married	38	13.3
< 18 years	38	13.3
19-24 years	138	48.3
25-29 years	60	21.0
>29 years	12	4.1
Total	248	100.0
Number of children delivered		
0 children	16	5.3
1-2 children	124	43.5
3-4 children	89	31.2
>5 children	57	20
Total	286	100.0

4.5.2 Study participants age of sexual debut

Table 4.7 shows the age of sexual debut of the study participants. More than a third of the participants (35.3%) had sexual debut below the age of 20. Almost half of the study participants (49%) initiated sexual activity between 20-24 years and only 1% had sexual debut after 30 years. Over 80% of the participants had initiated sexual activity by the age of 24 years; many of whom started to have sexual intercourse before their 18th birthday.

Table 4.7 Study participants age of sexual debut

Age at 1st sexual intercourse	N=286	Proportions (%)
< 20 yrs	101	35.3
20-24 yrs	140	49.0
25-29 yrs	42	14.7
>30 yrs	3	1.0

4.5.3 Number of participants other sexual partners

As shown in Figure 4.3, of the 95 study participants with history of more than one sexual partner in their life time, 54.7% had engaged in sexual activity with one other sexual partner, 25.3% with 2 other sexual partners while 20% indicated that they had engaged in sexual activity with more than 2 sexual partners. Of participants currently living with a partner, 59 (23.7%) knew that their current partners had engaged in sexual behavior other sexual partners with 61% indicating that their current spouse had one other sexual partner and 20.4% indicating that their current partner had 2 to 3 other partners. Almost a fifth of the participants (18.6%) indicated that their current partner had more than 3 other sexual partners.

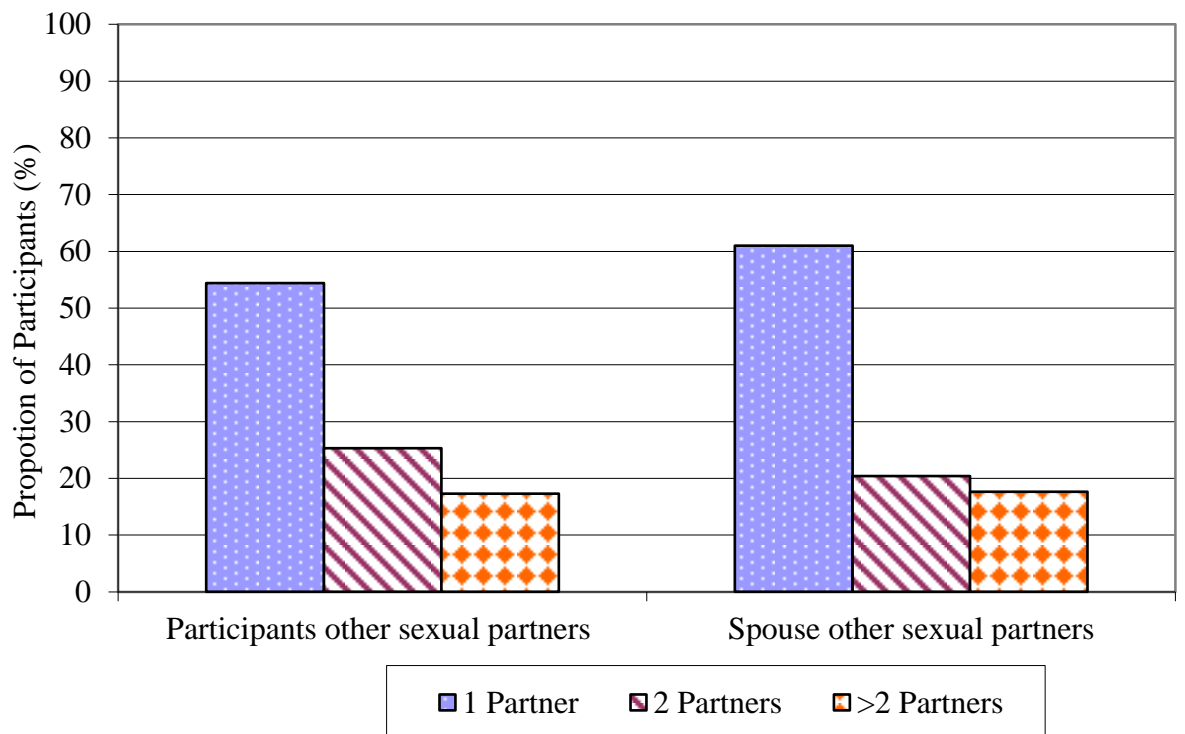


Figure 4.3 Number of sexual partners

4.5.4 Study participants cigarette smoking behavior and previous HIV test

Cigarette smoking and immune-suppression are key major risk factors for cervical cancer. Table 4.8 shows cigarette smoking habit and previous HIV test of the study participants. Most of the participants (93.6%) indicated that they had never smoked cigarettes with only 6.4% indicating that they have ever smoked cigarettes. Most of the study participants (94.4%) had been tested for HIV before. Out of those who had ever been tested for HIV, 2.2% indicated that they were HIV positive while the rest indicated that they were negative.

Table 4.8 study participants cigarette smoking behavior and previous HIV test

Ever smoked cigarettes	N=286	Proportions (%)
No	268	93.6
Yes	18	6.4
Total	286	100.0
Ever had a HIV TEST?		%
No	16	5.6
Yes	270	94.4
Total	286	100.0

4.5.5 Types of contraceptive methods used by the study participants

As shown in Table 4.9 concerning the type of contraceptive used, the commonest form of contraception used by the participants was the combined oral contraceptive pill (40.9%) followed by the Depo- Provera (30.8%). Condom use was almost negligible. The mean duration of use of the combined oral contraceptive pill was 4.2 ± 4.5 years with a minimum usage of one year and a maximum use of 20 years.

Table 4.9 Types of contraceptive methods used by the study participants

Type of contraceptive used	N=286	Proportions (%)
Never used contraceptives	20	7.0
Condom	2	0.7
Contraceptive pills	117	40.9
Intra uterine device (IUD)	33	11.5
Bilateral tubal ligation (BTL)	20	7.0
Depo-Provera injection	88	30.8
Emergency Contraception	6	2.1
Total	286	100

4.6 Health beliefs of study participants to cervical cancer at baseline

4.6.1 Perception of susceptibility of the study participants to cervical cancer

Table 4.10 shows perception of susceptibility of study participants to cervical cancer. Only 58% of the participants agreed that every woman of child bearing age is at risk of cervical cancer while 23.8 % were not sure. Most (63.3%) of the participants agreed that having multiple sexual partners increased the risk of developing cervical cancer. Slightly more than half of the study population (51.4%) was not sure that having increased number of deliveries was a risk to developing cervical cancer. Over half of the study population (56.7%) was not aware of the risk of cervical cancer when a woman is HIV positive.

Table 4.10 Perception of susceptibility of study participants

N=286	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
Every woman of child bearing age is at risk of cervical cancer	7	2.5	166	58.0	68	23.8	44	15.3	1	0.4
Woman with multiple sexual partner are more prone to cervical cancer	6	2.1	181	63.3	76	26.6	23	8.0	0	0.0
Risk to cervical cancer is increased with number of pregnancy	1	0.4	36	12.6	147	51.4	102	35.6	0	0.0
Cervical cancer is more common to women who are HIV positive	2	0.7	122	42.6	78	27.3	83	29.0	1	0.4
Cervical cancer only affects women who are above the age of 50 years	1	0.4	26	9.09	8	2.80	247	86.4	4	1.4

4.6.2 Perception of seriousness of study participants to cervical cancer

Perception of seriousness of a condition will make people to use preventive measures. As shown in Table 4.11, most (57%) of the participants thought that there is effective cure to cervical cancer. Majority (79%) of the participants believed that having the cancer will make life difficult. Most of the study participants (69.6%) perceived cervical cancer being as serious as other cancers.

Table 4.11 Perception of seriousness of study participants to cervical cancer

N=286	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
There is effective treatment for cervical cancer	3	1.05	163	56.99	34	11.89	86	30.07	0	0.00
Having cervical cancer will make life difficult for the woman	20	6.99	226	79.02	15	5.24	23	8.04	2	0.70
Cervical cancer is not serious as other type of cancers	1	0.35	36	12.59	44	15.38	199	69.58	6	2.10
Cervical cancer is easily cured	1	0.35	98	34.27	52	18.18	134	46.85	1	0.35
Having cervical cancer can result in infertility	4	1.40	172	60.14	75	26.22	35	12.24	0	0.00
Deaths resulting from cervical cancer are not common	3	1.05	44	15.38	42	14.69	190	66.43	7	2.45

4.6.3 Perception of benefits of cervical cancer screening by the study

participants

Table 4.12 shows the study participants perceptions of benefits to cervical cancer screening. Most (79.7%) of the participants agreed that it is important for a woman to have regular cervical cancer screening and that screening can diagnose early cervical changes before they become cancerous (83.6%) and that if these changes are diagnosed early they are curable (85.7%).

Table 4.12 Perception of benefits of cervical cancer screening

N=286	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
It is important for a woman to have cervical cancer screening	37	12.94	228	79.72	5	1.75	16	5.59	0	0.00
Cervical cancer screening can find changes in the cervix before there become cancerous	7	2.45	239	83.57	31	10.84	9	3.15	0	0.00
If cervical changes are found early and treated, they are easily curable	9	3.15	245	85.66	22	7.69	10	3.50	0	0.00
Cervical cancer screening can decrease the chances of a woman having an abortion	0	0.00	60	20.98	184	64.38	41	13.99	1	0.35

4.6.4 Study participants perceived knowledge of risk factors of cervical cancer

One important factor that will make people seek preventive health care services before a disease develops is their knowledge on the risks to develop a disease. As shown in Table 4.13 below 55.2% of the participants agreed early sexual debut is a risk factor to developing cervical cancer while 54.9% agreed that having multiple sexual partners is a risk factor. Only 54.9% perceived having some sexually transmitted infections increased risk of cervical cancer. Majority were aware that smoking is a risk factor to cervical cancer while 56.6% of the study participants agreed the risks are higher if their spouses had multiple sexual partners.

Table 4.13 Participants perceived knowledge of risk factors on Cervix cancer

N=286	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
Starting to have sex early is a risk factor	8	2.8	158	55.24	76	26.57	44	15.38	0	0.00
Having sex with multiple partners is a risk factor	7	2.45	157	54.90	84	29.37	38	13.29	0	0.00
Some sexually transmitted infections are risk factors	7	2.45	158	55.24	76	26.57	44	15.38	0	0.00
Smoking is a risk factor	7	2.45	198	69.23	55	19.23	26	9.09	0	0.00
Having sex with an uncircumcised man is a risk factor	4	1.40	71	24.83	165	57.69	46	16.08	0	0.00
My spouse having multiple sexual partners puts me at risk cervical cancer	4	1.40	162	56.64	77	26.92	42	14.69	1	0.35
Use of the contraceptive pills is a risk factor	5	1.75	155	54.20	91	31.82	35	12.23	0	0.00

4.6.5 Participants perceived individual barriers to cervical cancer screening

Table 4.14 shows the perceived individual barriers to cervical cancer screening. It was found that 73.4% of participants did not think that cervical screening is embarrassing. Majority (63.6%) of the study population did not perceive screening as painful. Over half of the participants (52.4%) knew that if a woman is still a virgin, her virginity will not be taken away during screening. Not knowing where to go for screening was identified as a barrier by over 50 % of the participants.

Table 4.14 Participants perceived individual barriers to cervical cancer screening

N=286	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
It is too embarrassing to undergo cervical cancer screening	2	0.7	50	17.5	20	7.0	210	73.4	4	1.4
The cervical cancer screening procedure is painful	1	0.4	31	10.8	182	63.6	70	24.5	2	0.7
Being screened for cervical cancer will only make one worry	1	0.4	52	18.2	31	10.8	200	69.9	1	0.4
If a woman is still a virgin, cervical cancer screening will take away her virginity	2	0.7	39	13.6	91	31.8	150	52.5	4	1.4
Not knowing where to go for screening is a reason why people do not undergo screening	5	1.8	153	53.5	14	4.9	114	39.9	0	0.0
Only women who have had babies need to undergo screening	0	0.0	12	4.2	265	92.7	2	0.7	0	0.0
My partner will not want me to undertake cervical cancer screening	0	0.0	8	2.8	10	3.5	253	88.5	15	5.2

4.6.6 Participants perceived facility and access barriers to cervical cancer screening

As shown in table 5.15, most participants did not seem to have facility or access barriers. The main access barriers that most of the participants identified were cost of travel (58.7%) and cost of the screening test (58.0%).

Table 4.15 Study participants perceived facility and access barriers to cervical cancer screening.

N=286	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
Lack of female clinicians to conduct screening in health facilities is reason for not doing cancer	0	0.0	26	9.1	12	4.2	241	84.3	7	2.5
Negative attitude of health workers can discourage one from going for cervical cancer	3	1.1	71	24.8	16	5.6	193	67.5	3	1.0
Lack of convenient clinic is barrier to routine cervical cancer screening	2	0.7	107	37.4	14	4.9	159	55.6	4	1.4
Lack of information about cervical cancer procedure is a barrier to screening	6	2.1	145	50.7	9	3.2	124	43.4	1	0.4
Distance to screening sites is a barrier to screening	8	2.8	131	45.8	1	0.4	145	50.7	1	0.4
Time taken from home to screening center is a barrier to screening	6	2.1	127	44.4	3	1.1	149	52.1	1	0.4
Cost of travel from home to screening sites is a barrier to screening	7	2.5	161	56.3	2	0.7	116	40.6	0	0.0
Cost of screening test is a barrier to screening	11	3.9	166	58.0	4	1.4	105	36.7	0	0.0

4.7 Uptake of cervical cancer screening at the general outpatient clinic and adherence to regular screening

4.7.1 Uptake of cervical screening among women attending the general outpatient clinic during the recruitment period and their adherence to regular cervical

Table 4.16 shows the uptake of cervical cancer screening in women aged 25 years and above attending the general outpatient clinic at Thika Level 5 hospital as well as adherence to regular screening of those who had ever been screened previously. Out of the 964 women above 25 years of age attending the general female outpatient clinic between 15th April 4, 2013 to 14th June 2013, only 193 (20%) had ever been screened for cancer screening at least once during their lifetime while most (80%) had never been screened. Of the 193 women who had been screened, only 17 (8.8%) adhered to regular scheduled screening.

Table 4.16 Uptake of cervical screening among women attending the general outpatient clinic during the recruitment period and adherence to regular cervical cancer screening

Uptake of cervical screening	N=964	Proportion (%)
Women who had ever had cervical cancer screening	193	20
Women who had never had cervical cancer screening	771	80
Total	964	100
Women who adhered to regular cervical cancer screening	17	8.8
Women who never adhered to regular cervical cancer screening	176	91.2
Total	193	100

4.8 Prevalence of cervical abnormalities as found during the enrollment among women who had never been screened and attending the general outpatient clinic

4.8.1 Prevalence of cervical abnormalities as found during the enrollment of study participants among women who had never been screened and attending the general outpatient clinic

Table 4.17 below shows the distribution of abnormalities of the cervix among 309 women who were randomly examined using a speculum during Pap test as part of the enrollment process for the study participants. A total of 23 (7.4%) were found to have some cervical pathology. Out those with cervical pathology, 10 (3.2%) had invasive cervical cancer and 12 (3.9%) had low grade intraepithelial lesions (LGSIL).

Table 4.17 Prevalence of cervical abnormalities among women who had never had cervical cancer screening before

Screening results	N=309	Proportion (%)
normal	286	92.6
Low Grade Intraepithelial Lesions	12	3.9
Invasive	10	3.2
High Grade Intraepithelial Lesions	1	0.3
TOTAL	309	100

4.9 Impact of the intervention on re-attendance to scheduled cervical cancer screening

4.9.1 Adherence to scheduled screening for women with abnormal smears

In the study, 12 women had low grade squamous intraepithelial lesion (LSIL). Of these, six (6) were randomly selected to receive reminders at 3, 2, 1 month and a week before scheduled re-screening 6 months after the initial screening, the other 6 did not receive. Figure 4.4 shows adherence to scheduled screening of women with abnormal smears after 6 months. Out of the 6 who received the SMS, 5 (83.3%) adhered to the scheduled screening while only 1 (16.7%) did not attend. Of those who did not receive, 3 re-attended while 3 did not re-attend as scheduled.

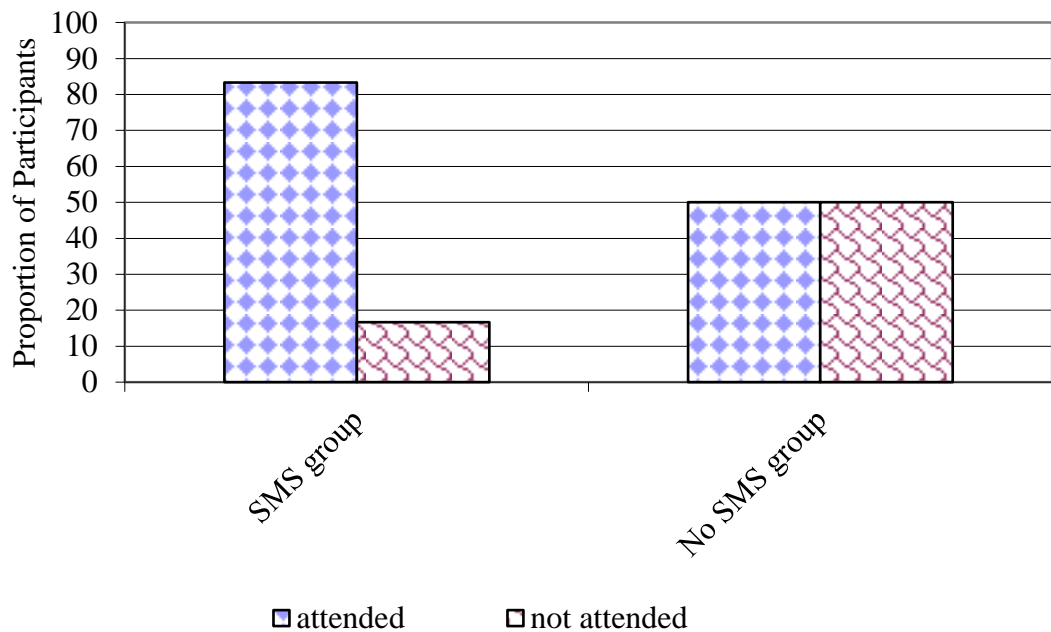


Figure 4.4 Adherence to scheduled screening of women with abnormal smears

4.9.2 Re-attendance to scheduled cervical screening from the two study arms

Figure 4.5 shows the re-attendance of the study population from the two study arms who were scheduled for repeat screening one year after the baseline screening. They were divided into an interventional group who received SMS text reminders screening while the control group received the standard care which included being counseled on need to adhere to screening date and date written on their card. The overall re-attendance to scheduled screening of all the study participants was 43.7% (125) while 56.3% (161) did not attend. Out of the interventional group, 96 (67.1%) re-attended as scheduled while only 47 (32.9%) did not attend. From the control arm, only 29 (20.3%) re-attended whereas 114 (79.7%) did not re-attend as scheduled for rescreening.

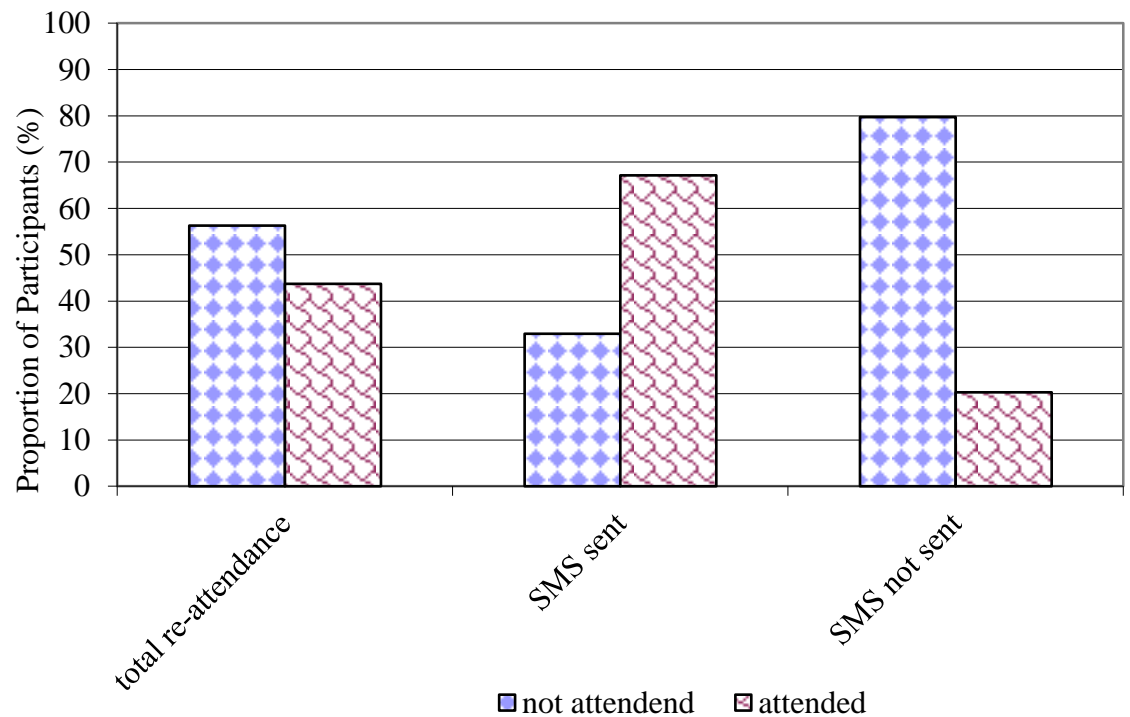


Figure 4.5 Re-attendance to schedule cervical screening of the study population

4.9.3 Influence of socio-demographic characteristics on re-attendance

In order to determine the influence of the socio-demographic factors on the re-attendance, bi-variable analysis was conducted. Table 4.18 shows that none of the socio-demographic factors; age, marital status, level of education and employment levels did not seem to influence re-attendance in either arm ($p > 0.005$).

Table 4.18 Influence of socio-demographic characteristics on re-attendance

Age	Control arm (No SMS)		p-value	Intervention arm (SMS)		p- value	Total Re-attendance	
	143	%		143	%		286	%
25-29 yrs	5 (30)	3.5		16	11.2		21	7.3
30-34 yrs	2	1.4		22	15.4		24	8.4
35-39 yrs	5	3.5		17	11.9		22	7.7
40-44 yrs	4	2.8		17	11.9		21	7.3
>45 yrs	13	9.1		24	16.8		37	12.9
Total	29	20.3	0.541	96	67.1	0.187	125	43.7
Marital status	143	%		143	%		286	%
Married	21	14.7		74	51.7		95	33.2
Single	7	4.9		11	7.7		18	6.3
Divorced	0	0.0		7	4.9		7	2.4
Widow	1	0.7		4	2.8		5	1.7
Total	29	20.3	0.210	96	67.1	0.837	125	43.7
Education level	143	%		143	%		286	%
Non-formal	0	0.0		0	0.0		0	0.0
Primary	12	8.4		36	25.2		48	16.8
Secondary	14	9.8		42	29.4		56	19.6
Tertiary	3	2.1		18	12.6		21	7.3
Total	29	20.3	0.605	96	67.1	0.684	125	43.7
Employment	143	%		143	%		286	%
Employed	9	6.3		18	12.6		27	9.4
Self Employed	5	3.5		32	22.4		37	12.9
Casual	1	0.7		2	1.4		3	1.0
Unemployed	14	9.8		44	30.8		58	20.3
Total	29	20.3	0.821	96	67.1	0.865	125	43.7

4.9.4 Logistic regression to determine influence of SMS text reminders on re-attendance to scheduled re-screening for the study participants

In order to determine the influence of sending four SMS reminders on adherence to scheduled repeat screening of participants who had a normal Pap smear at baseline simple regression was done. As Table 4.19 below shows, the participants who received SMS text reminders were 8 times more likely to adhere to the scheduled rescreening than those who did not (OR 8.02; CI 95% 4.69-13.73; $p < 0.001$).

Table 4.19 Influence of SMS reminders on re-attendance

Variable	Re-attended	Not re-attended	OR	95% C.I	p-value
No SMS(ref.)	29	114	8.02	4.69-13.73	0.000
SMS reminders	96	47			

4.9.5 Regression analysis to determine influence of individual socio-demographic on adherence to repeat scheduled screening after using SMS reminders

As shown in Table 4.20 on the influence of individual socio- demographic factors on adherence to scheduled screening after sending the intervention, participants aged 30-34 were more likely to adhere to re-attendance after being sent SMS text reminders (OR 2.24 CI 1.03-4.84 $p < 0.05$) compared to the reference age 25-29 years. All the other age groups did not show a significant influence. When regression analysis was conducted, education status did not seem to have any

influence on adherence to attendance to scheduled screening after sending SMS text reminders. Although the adherence to scheduled screening seemed to increase with age of sexual debut for participants who received the SMS text reminders (OR 1.4 in age 19-24 years, 1.82 in age 25-29 years and 3.3 in those aged 30-34 years), the difference was not statistically significant P values 0.253, 0.105 and 0.334 respectively.

Table 4.20 Influence of socio-demographic factors on scheduled repeat cervical cancer screening after using the SMS reminders

Age (years)	OR	95% CI	p-value
25-29 (ref.)	1.00		
30-34	2.24	1.03-4.84	0.041
35-39	1.75	0.81-3.75	0.153
40-44	2.14	0.97-4.75	0.061
< 45	1.76	0.89-3.47	0.101
Marital Status			
Single(ref)	1.00		
Married	0.90	0.40-1.70	0.677
Divorced/Separated	0.60	0.10-2.60	0.450
Widowed	0.90	0.20-3.60	0.911
Education Level			
None	3.29		
Primary (ref)	1.00		
Secondary	1.20	0.50-1.10	0.138
Tertiary	1.05	0.50-1.10	0.100
Age of Sexual Debut			
<18 yrs (ref)	1.00		
19 -24 yrs	1.40	0.80-2.30	0.253
25 -29 yrs	1.82	0.90-3.70	0.105
30- 34 yrs	3.30	0.33-0.78	0.334

4.9.6 Regression analysis to determine influence of individual socio-economic factors on adherence to repeat scheduled screening after using SMS text reminders

As shown in Table 4.21, those participants who were not employed were more than 2 times likely to adhere to rescreening as scheduled compared to those in casual employment after being reminded of the scheduled dates with SMS text reminders while those who were employed were 2.3 times likely to adhere after being sent the SMS text reminders. However these differences in re-attendance were not statistically significant ($p > 0.005$). The study showed that participants whose spouses were employed were 2.2 times more likely to adhere to scheduled rescreening after being sent SMS text reminders (OR 2.2 CI 1-1.47 $P < 0.05$).

Table 4.21 Regression analysis to determine influence of individual socio-economic factors on adherence to repeat scheduled screening after using SMS reminders

Employment status	OR	CI	p-value
Not employed	2.01	0.40-0.50	0.100
Self employed	1.70	0.40-7.80	0.508
Casual (ref.)	1.00		
Employed	2.30	0.50-10.90	0.300
Spouses Occupation			
Not employed (ref)	1.00		
Self employed	1.60	0.70-3.70	0.291
Casual	1.00	0.30-3.70	0.953
Employed	2.20	1.00-4.70	0.040
Income			
0-1000 (ref)	1.00		
1001-10000	1.30	0.60-2.70	0.479
10001 - 20000	1.70	0.70-4.50	0.258
> 20000	1.10	0.30-3.30	0.976

4.9.7 Regression analysis to determine influence of access factors on adherence to repeat scheduled screening after using SMS reminders

Table 4.22 shows the influence of access factors on adherence to repeat scheduled screening after using SMS reminders. The closer the person was to the hospital, the less the likelihood that they re-attended. This was significant for those who lived within one and two kilometers from the hospital (OR 0.3 and 0.4, $P < 0.001$). It was found that those participants who used public mode of transport to access the hospital had a 3.29 chance of adhering to scheduled rescreening after being sent SMS text reminders (OR 3.29 CI 1.1-10.1 $P < 0.05$). When regression was conducted to compare those who used less than 50 shillings for transport and those who used more, there was no statistical difference (OR 1.1; CI 0.7-1.9; $P = 0.600$).

Table 4.22 Influence of participant home location on repeat scheduled screening after using SMS reminders

Location	OR	CI	p-value
Less than 1 Kilometer (ref.)	1.00		
1 Kilometer	0.40	0.30-0.50	0.000
2 Kilometer	0.40	0.40-0.50	0.000
3 Kilometer	0.50	0.20-1.00	0.051
4 Kilometer	0.60	0.40-0.80	0.002
>5 kilometer	0.70	0.50-0.90	0.014
Means of Transport			
Walking(ref)	1.00		
Bicycle	6.00	0.70- 4.90	0.094
Public means	3.29	1.10-10.10	0.038
Private means	4.00	0.40-3.80	0.226
Cost of Travel to the hospital			
0 – 50(ref)	1.00		
>50	1.10	0.70-1.90	0.600

4.9.8 Perceptions of Health Beliefs and re-attendance after SMS reminders

Figure 4.6 shows the relationship between health beliefs perceptions to cervical cancer and re-attendance to scheduled screening after sending SMS reminders. It was shown that 36.5% of those whose perception of susceptibility was in the lower quintiles (30%) of the score re-attended after the intervention compared to 27% and 36.5% in the middle (30-60%) and highest (>60%) perception quintile respectively. The study also showed that 34.4%, 36.5% and 29.1% of participants in the lowest, middle and highest quintiles of perception of the seriousness of cervical cancer re-attended the scheduled rescreening respectively. When perceptions of benefits of cervical cancer screening were considered it was shown that the re-attendance was 57.3%, 24 % and 18.7% for low, medium and high quintiles.

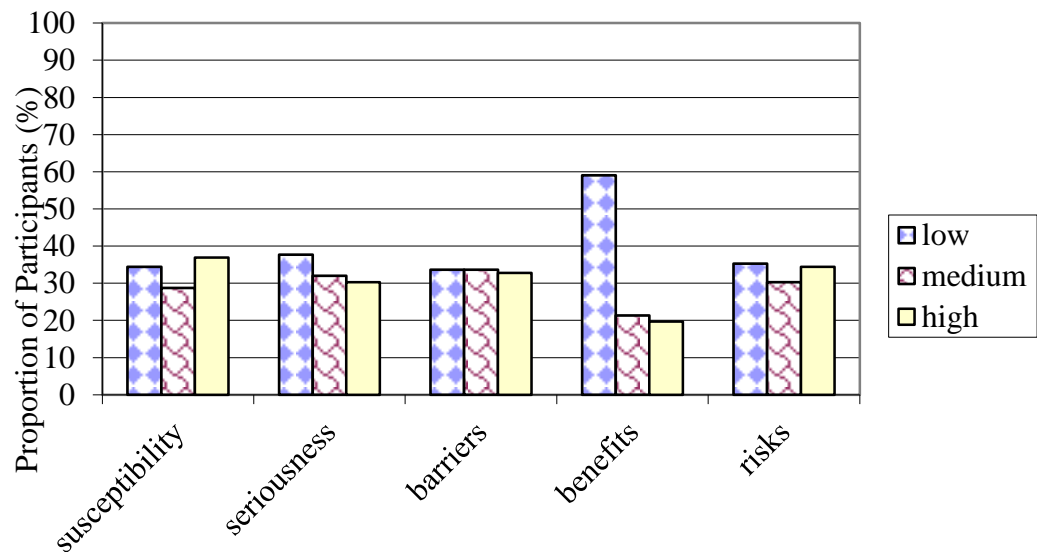


Figure 4.6 Perceptions of Health Beliefs and re-attendance after SMS reminders

4.10 Bi-variable regression analysis to determine the influence of perceptions of health beliefs on repeat scheduled screening after using SMS reminders.

The influence of various health beliefs on re-attendance to scheduled repeat cervical cancer screening after sending SMS reminders. As shown in Table 4.23, none of the health beliefs constructs; susceptibility to cervical cancer, seriousness of cervical cancer, benefits of being screened and barriers to being screened showed any significant relationship to adherence to scheduled rescreening after sending SMS text reminders.

Table 4.23 Influence of health beliefs on scheduled screening after using SMS reminders.

Perception to susceptibility to cervical cancer	Odds	P- value
Low (Ref)		
Medium	0.899	
High	1.26	0.507
Perception towards seriousness of cervical cancer		
Low (Ref)		
Medium	0.876	
High	0.932	0.902
Perception of benefits of being screened for cervical cancer		
Low (Ref)		
Medium	1.258	
High	0.871	0.619
Perception of barriers to being screened for cervical cancer		
Low (Ref)		
Medium	1.019	
High	1.109	0.931
Low (Ref)		
Medium	0.958	
High	1.077	0.923

4.11 Multi-variable regression analysis

Table 4.24 shows the outputs of multiple variable regression analysis. It was found the participants who received SMS text reminders and had owned a mobile phone for more than 2 years were 8.08 times more likely to adhere to the scheduled rescreening (OR 8.08 CI 95% 4.72-13.85, $p < 0.001$). Those sent SMS text reminders and were married were 8.03 times more likely to re-attend as scheduled (OR 8.03 CI 95% 4.69-13.73, $p < 0.001$). Those sent SMS and were married and had owned a mobile phone for more than 2 years were 8.09 times more likely to re-attend (OR 8.09 CI 95% 4.72-13.85, $p < 0.001$). There was also a very slight increase in the odds for adherence to rescreening (OR 8.03) if one was sent an SMS and was educated above secondary school level and was married.

Table 4.24 Multi- Variable regression analysis

Variable	OR	95% CI	Standard error	p-value
Sent SMS text reminders	8.02	4.69-13.73	2.19	0.000
Sent SMS, owned phone for > 2years	8.08	4.72-13.85	2.22	0.000
SMS sent when one is married	8.03	4.69-13.73	2.19	0.000
SMS sent if married and has had a phone > 2 years	8.09	4.72-13.85	2.22	0.000
SMS sent if married and educated above secondary school	8.03	4.69-13.74	2.20	0.000
SMS sent if educated above secondary school and owned phone for >2years	8.08	4.71-13.83	2.20	0.000

4.12 Reasons for non re-attendance to screening at end line

A phone call was made one month after the scheduled screening date to all those who never attended as scheduled to establish reasons why they did not re-attend. Figure 4.7 below shows the reasons given for not re-attending to the scheduled screening for the interventional and control groups. As shown in the table, most of the various reasons were given for not re-attendance. Majority of those who were not sent an SMS said they had forgotten the dates 64% compared to only 14.9% of those who were sent an SMS. Other reasons given by those who were sent an SMS were that the test was done elsewhere (10.6%), (8.5%) lacked time to attend, while (6.3%) said they were pregnant.

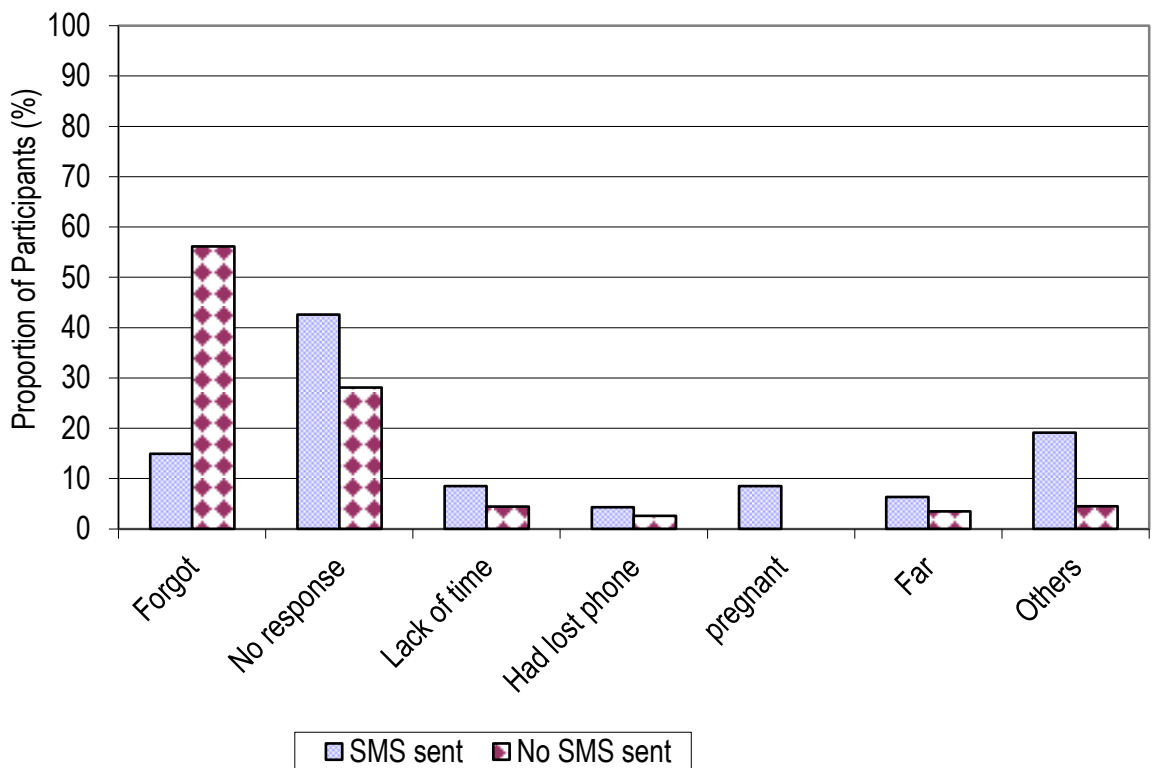


Figure 4.7 Reasons for non re-attendance to screening at end line

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Socio- demographic and economic characteristics

The majority of study participants were either below 29 years or above 45 years. It means that the unscreened population of women at risk attending the general outpatient clinic is likely to be the younger women and the older women. These age distribution where the younger women and the elderly women are less likely to be screened have been shown in other studies conducted elsewhere (Liao *et al.*, 2006; Fernández *et al.*, 2009; Cyril 2009). The National Cervical Cancer Screening Strategy recommends that women start being screened from the age of 25 years (NCCPP, DRH/ MOPH/GOK, 2012). In this study, 23.1% of women were found to be 25-29 years old.

Most of the study participants were married showing that the population of the unscreened women closely follows the national marital status distribution as has been seen in the 2008/2009 and 2014 Kenya National Demographic and Health Surveys where 58% and 60% of women were married respectively. Their education status was slightly higher than what was found in the 2008/2009 and 2014 KDHS where 9% and 7% of women had no formal education, whereas 22% and 42.7% had attained secondary education respectively (KNBS and ICF Macro

2010; KNBS and ICF Macro, 2015). In their study in India, Singh *et al.*, 1998 showed the same pattern of marital status among the unscreened population where most of those unscreened women were married; with the single women being more likely to have been screened (Singh *et al.*, 1998). This phenomenon where more married women are unlikely to be screened for cervical cancer than the single women has been attributed to the role of the man being important in health seeking behavior. In such situations, the husband may prevent the woman from being screened for cervical cancer (Singh *et al.*, 1998). However other studies have shown a contradicting picture with more married women attending to cervical cancer screening compared to single women (Lao *et al.*, 2006; Lyimo *et al.*, 2012).

Having delivered children has been shown as a co-factor of persistence of high risk Human Pappiloma Virus with subsequent increased risk of development of cervical lesions with subsequent risk of developing cervical cancer (Gargano *et al.*, 2012; Limo *et al.*, 2012). This increased risk is directly related to the number of children delivered (Mhasike *et al.*, 2011). In this study, it was found that over 50% of the study population had delivered more than 3 children. Therefore there is need to actively seek ways of initiating and retaining these women into the cervical screening cycle in order to reduce the chances of developing this cancer.

Literacy levels in women have also been shown to influence screening for cervical cancer. For example, it was shown by Nathoo (1988) that women of low education

level fail to utilize cervical cancer screening services leading to a higher chance of cervical cancer compared to those with a higher education level. This study showed that most of the study participants were of low education; majority being of primary and secondary school education. This may be part of the reason why they have never been screened before.

Women who are poor, uneducated and those who have economic barriers that prevents access to health services as well as being more likely to live in rural area have been shown to have a higher prevalence of cervical cancer compared to women with higher socio-economic status (Hilairie, 2011). The same risks have been found in rural women in India (Mhasike *et al.*, 2011). These are the conditions that exist in many countries like Kenya where cervical cancer is most prevalent. The participants in this study showed a low socio-economic status with most not employed and having a low personal income. For those who had spouses, most of their spouses were not gainfully employed. This therefore shows that the unscreened woman attending the general outpatients at the Thika Level 5 Hospital have the same socio-economic factors that have shown to have a strong relationship of increased cancer of cervix (Mhasike *et al* 2011; Van der Velden *et al.*, 1999; Krug *et al.*, 2005) and extra effort may be needed to improve their socio-economic status in order to increase cervical cancer screening uptake.

Access to preventive care services such as screening for cervical cancer has also been found to influence the utilization of such services. Long distances to cervical

cancer screening sites and poor transportation systems have been cited as factors that reduce the chances of screening for cervical cancer for women at risk (Lyimo, 2012; Daskin *et al.*, 2004; Zimmerman 1997). Most of the study participants in this study used public means to the hospital with very few being able to walk to the hospital. The unreliability of public transport and its associated cost may be a contributing factor of lack of screening for majority of the women who attends the Thika Level 5 Hospital outpatient clinics.

Wesolowski *et al.*, (2012) found that 85% of all Kenyans use the mobile phones with 44% owning a mobile phone. Those who did not own a mobile phone shared with a house hold member (39%) while 57% shared with a friend or a family member and 4% shared with a mobile phone agent. Only 15% of the Kenyan population was non users of the mobile phone (Wesolowski *et al.*, 2012). In this study all the participants owned a mobile phone as part of the inclusion criteria and could provide an alternative number of a significant other person. Majority of the participants had owned the mobile phones for more than 5 years and few had ever changed their cell phone numbers. Most of the study participants viewed the mobile phone SMS as a good tool that can be used for educating them on cervical cancer as well as for reminders on next scheduled screening. Many also thought that the SMS can be used for sending out results after cervical cancer screening without fearing that their privacy may be interfered with. However despite this high perception on the utility of the mobile phone for health, very few had ever received a health related message through their mobile phones and even fewer had

received messages on cervical cancer. This enthusiasm on the utilization of the mobile phone to improve health care can explain the success that have been found in other health related mobile phone platform utilization (Lester *et al.*, 2010, Gombachika *et al.*, 2011) and needs to be used in the national fight against cervical cancer screening.

Many studies have shown that personal attitudinal factors like fear of the cervical cancer screening test, religious beliefs and fear of embarrassment during the pelvic examination, being not comfortable with the sex of the person performing the Pap smear as well as cultural factors contribute negatively towards screening for cervical cancer (Lyimo *et al.*, 2012, Hummeida *et al.*, 2009). Women who know where to go for screening and those aware of importance of being screened are more likely to be screened than those who are not aware (Lyimo *et al.*, 2012). Factors like perceived facility barriers, attitudes of the health care workers offering the screening services and partner being unsupportive to screening for cervical cancer have also been shown to hinder the use of screening services (Monjurul *et al.*, 2008). In this study, not knowing where screening services are offered was cited as the main reason of having never been screened by almost half of the study participants while more than 20% cited lack of knowledge on the importance of being screened as the main reason for having never been screened before. These two factors have also been found to be the main reasons of not ever having been screened among women in Tanzania (Lyimo *et al.*, 2012). Other factors that were mentioned by the study women included cost of the test being high, fear of the test

results as well as fear of pain during the procedure. Unlike other studies which found religious and cultural factors as main barriers to cervical cancer screening, these did not seem to be major barriers in this study (Chumnan *et al.*, 2009, Abdullahi *et al.*, 2009).

5.1.2 Risks factors of study participants to cervical cancer

Increased chances of cervical cancer have been attributed to such risky sexual behavior such as early sexual debut, multiple sexual partners and having a spouse with multiple sexual partners (WHO 2006, Cooper *et al.*, 2007, Appleby *et al.*, 2009). Early sexual debut especially engaging in sexual activity before the 18th birthday drastically increases the risk of developing this cancer (Mhasike *et al.*, 2011). The Kenya demographic health survey of 2008-9 showed that by the age of 18 years almost 50% of women have had sexual intercourse (KNBS and ICF Macro 2010). This trend of early sexual debut was observed in this study where over 84% of the study participants had started to have sex before the age of 24 years with more than a third of the women having had sexual debut by 18 years. This also compares well with what Were *et al.*, 2010 found in Eldoret where 62% of the population had had sexual debut by the age of 20 years. The same trend was also found in a cervical cancer study in South Africa, where it was found that the medium age of initiation of sexual activity was 17 years (Cooper *et al.*, 2007). This early sexual activity on its own puts women in Sub Saharan Africa at high

risk of developing cervical cancer and is made worse since many of these women are never screened as required.

Another risk factor for cervical cancer is the number of sexual partners (Biswas *et al.*, 1997, Williams *et al.*, 1994, Stone *et al.*, 1995). In the 2014 Kenya Demographic and Health survey, 13% of men and 1% of women had multiple sexual partners with the mean lifetime sexual partners of 2.1 and 7.2 in women and men respectively (KNBS ICF Macro 2015). In this study more than 30% of participants indicated that they had more than one sexual partner while over 20% of the study population indicated that their spouses have other sexual relationships. Such increased numbers of women with multiple sexual partners has also been found in Eldoret where 54% of women indicated that they had multiple sexual partners (Were *et al.*, 2010). It is therefore important to educate women attending the general outpatient clinic on delaying their sexual debut, on the risks of having multiple sexual partners as well as advising their spouses on not having multiple sexual partners.

Concerning contraceptive use, most of the study population (83.7%) had used some form of contraception with majority (40.9%) having used the combined oral contraceptive pill (mean period of use 4.2 years with usage going up to 20 years. This was followed by the Depo- Provera (30.8%). Condom use which offers some protection to cervical cancer was rarely used (0.8%). Studies have demonstrated an increased risk of cervical cancer among combined oral contraceptive users

(ICESCC, 2007, Urban *et al.*, 2012). The risk has been shown to be as high as 4 times after prolonged use (Moreno *et al.*, 2002). If a person has currently been using the pill for more than 5 years, the risk of invasive cervical cancer is 1.9 more compared to those who have never used the method (Urban *et al.*, 2012, Appleby *et al.*, 2007). This risk has been shown to be higher in women living in developing countries (Appleby *et al.*, 2007). Most of the participants in this study were using the oral contraceptive pill with many having used it for more than 4 years.

The prevalence of cigarette smoking in this study was 6.4% which was much higher than what was found in the Kenya Demographic Health Survey of 2008-9 where the prevalence of cigarette smoking was less than 1% among adult women (Republic of Kenya KNBS and ICF Macro 2010). The prevalence of cigarette smoking in this study was closer to what has been found in a study on cervical cancer screening in Eldoret (Were *et al.*, 2010). Cigarette smoking has been found to have a strong relationship of persistence of HPV and development of abnormal cytology and subsequent increased chances of cervical cancer (Kjellberg *et al.*, 2000; Deacons *et al.*, 2000). In the United Kingdom, 7% of all cervical cancers are attributed to smoking (Parkin *et al.*, 2011).

Many studies have shown that reduced immunity either as a result infection with Human Immunodeficiency Virus (HIV) or those with conditions where immunity is compromised like immunosuppressive chemotherapy and malnutrition puts women at increased risk of developing cervical cancer. This attributed to

persistence of HPV as a result of poor immune response with resultant development of abnormal cervical cytology (Luque *et al.*, 1999; Temmerman *et al.*, 1999). This risk is up to 6 times more in women who are HIV positive (Grulich *et al.*, 2007). The overall number of women who have ever tested and received results of HIV in Kenya as estimated in the KDHS 2014 is 83% of all women aged 15-49 years with the testing rate in central province being at 84.4% and 83.9% in Kiambu County (Republic of Kenya KNBS and ICF Macro 2015). On average it has been found that HIV prevalence among women 15-49 is 8.0%, with central Kenya having a prevalence of 6.2% (KNBS and ICF Macro 2010). In this study HIV testing among the study participants was much higher at over 90% with a self reported HIV positivity of 2.2.

5.1.3 Health belief perceptions of study participants towards cervical cancer

In the Health Belief Model a feeling of being susceptible to a condition has been shown to increase the chances of a person seeking preventive care (Hill *et al.*, 1985, Becker *et al.*, 1987). If women believe they are not susceptible, studies have shown that such women think that they do not need cervical cancer screening (McFaland 2003; Lee Lin *et al.*, 2007). In Africa low perception on susceptibility has been cited as a reason of non attendance to cervical cancer screening in Nigeria (Oche *et al.*, 2013). The participants in this study had low level of perception of susceptibility towards cervical cancer which may partly explain the fact that they had never been screened before. It is therefore imperative to educate

such women at risk on their susceptibility in order to bring and retain them in the cervical cancer screening programs.

Perceived seriousness of a disease is likely to increase seeking of preventive health care (Becker *et al.*, 1987). In this study, most of the participants had good perception on the seriousness of cervical cancer. For example 79% believed that developing cervical cancer will make life difficult while almost 70% knew that it presents the same seriousness as other cancers. This good level of perception to seriousness of cervical cancer has been found by other researchers where majority know that having this cancer is a serious problem which makes life hard for the individual and the family and that deaths resulting from cervical cancer are high (Tacken *et al.*, 2007, Moreland *et al.*, 2006). The fact that the study population had a good perception on the seriousness of cervical cancer yet they had never been screened means that other mechanisms may be influencing women not to undergo screening for cervical cancer.

Participants in this study showed a positive perception towards benefits of being screened for cervical cancer. This level of perception of benefits among women who have never been screened before have been found in Chile where 89.9% of women studied believed that it is possible to cure cervical lesions if they are found early and over 85% of them believed for prevention of this cancer it is important to detect the disease early enough (Byrd *et al.*, 2004). This strong perception of

benefits should be leveraged on in order to attract more women who have never been screened to be screened.

Studies conducted elsewhere among women at risk of developing cervical cancer have shown that knowledge of cervical cancer risks is low. For example in South Africa it has been found that of a rural population, only 24% know that starting to engage in sexual activity early in life put the women at risk of developing the disease while only 19% knew that having multiple sexual partners is a risk factor. In the same study, only 35% of the study participants knew that smoking is a risk factor while even fewer knew that prolonged use of oral contraceptive pill and having sexually transmitted infections are risk factors (Monjurul *et al.*, 2008). In Eldoret, Kenya, a study on women at risk found that less than a quarter knew they were at risk (Were *et al.*, 2011). In this study, the participant's knowledge of the risk factors of cervical cancer was equally low. This low level of knowledge on factors that puts women at risk explains the large number of the women who engaged in high risk behavior like early sexual debut, engaging in sex with many partners. It is therefore important to educate women on risk factors so that risk reduction can be achieved as well as improve demand for screening.

Individual factors influencing cervical cancer screening include socio-demographic factors, (Lyimo *et al.*, 2012; Abotchie *et al.*, 2009), knowledge and awareness of the screening services (Cyril *et al.*, 2009; Hummeida *et al.*, 2009), low attitudes towards cervical cancer screening (Abdullahi *et al.*, 2009; Chumnan

et al., 2009), cultural factors (Hummeida *et al.*, 2009; Bener *et al.*, 2001) as well as location of screening sites in relation to the clients (Daskin *et al.*, 2004; Zimmerman 1997; Baron *et al.*, 2008). Other personal factors that have been identified to hinder screening for cervical cancer include lack of knowledge on the need to be screened as well as not knowing about the test itself (Flyan 1998; Summers *et al.*, 1995; Peters *et al.*, 1989), feeling of embarrassment during the screening and fearing that the test could be painful (MacGregor *et al.*, 1994; Doyle 1991; Flyan 1998) as well as fear that virginity could be lost if a woman has not had sexual intercourse (Johnson *et al.*, 2008). In this study it was found that participants had minimal perceived individual barriers in that almost 75 % of the women did not think that cervical screening is embarrassing and over 90% were aware that screening is necessary in all women of childbearing age even if they have not had children. Husband's refusal of screening and fear of loss of virginity was also seen as a minimal impediment to screening in this population. The same minimal individual barriers had been shown elsewhere in an African population during Pap smear with many women accepting the procedure and reporting very little discomfort during the screening (Ibekwe *et al.*, 2011; Rositch *et al.*, 2012). However this is contrary to what other studies have found where personal factors have been cited as major barriers to being screened for this disease (Bener *et al.*, 2001; Flyan 1998). The main barrier to screening in this study was identified as lack of knowledge on location of screening facilities. Other studies have identified the same barrier (Cyril *et al.*, 2009, Hummeida *et al.*, 2009).

Perceived facility barriers have also been identified as major factors in hindering cervical cancer screening. In the review on attitudes towards cervical cancer screening, it was found that facility factors such as lack of women staff to do the screening and clinic times that were not convenient to women lead to non-participation of cervical cancer screening programs (Fylan, 1998). However the finding of this study did not concur with this study. The main facility barrier identified in this study was paucity of information on the screening procedure. Other studies have identified this lack of information on the screening procedure as a factor in women not participating in screening (Johnson *et al.*, 2008; Cyril *et al.*, 2009).

Location of the screening facility in relation to where the women come from and the costs of the screening test itself influence uptake of cervical services (Eze *et al.*, 2012; Ebu *et al.*, 2015; Lyimo *et al.*, 2012). In this study most of the women did not perceive the location of the screening sites as a barrier to screening. However, most identified the cost of screening and the cost of travel as main barriers to screening for cervical cancer and this needs to be put into consideration when programs for cervical cancer screening are being developed.

5.1.4 Uptake of cervical cancer screening at the general outpatient clinics at Thika Level 5 Hospital and adherence to regular screening

Less than a quarter of women attending the general outpatients' clinic during the study period at Thika Level 5 Hospital had ever been screened before. Even fewer

were adherent to regular screening. The same low level of cervical cancer screening uptake has been found by other researchers in the country. For example Sudenga *et al.*, (2013) found that the screening uptake in Kisumu is only 6% while Were *et al.*, (2011) found that only 12.6% of women attending the Moi Teaching and Referral Hospital have ever been screened. Ombecha *et al.*, (2012) found that 41% of teachers in selected primary schools in Nairobi had ever been screened but this still falls short of screening levels in developed countries. The same low level of uptake to cervical cancer screening has been found in other Sub Saharan African countries (Oche *et al.*, 2013; Monjurul *et al.*, 2008; Mupepi *et al.*, 2011). This low level of cervical cancer screening may explain why cervical cancer is still rampant in the region. Countries like the United Kingdom that have managed to reduce cervical cancer have managed to put almost 80% of their women in the screening cycle (UK Cancer Research, 2008).

For women to benefit fully from being screened, it is important for them to be put into the cervical cancer screening cycle and to have regular scheduled screened. In this study only 8.8% of women who had ever been screened indicated that they adhered to regular screening. The W.H.O has reported the same level of low adherence to regular cervical cancer screening with less than 5% of women in developing countries reportedly adhering to regular cervical cancer screening and only 3.2% of Kenyan women being adherent (WHO, 2006). This low level of screening adherence among women at risk of in developing countries may explain

the prevalence of cervical cancer in these countries. For countries like Kenya to reduce the prevalence of cervical cancer, there is need to put in place mechanisms that will help to place at least 70% of the women at risk into the cervical screening cycle since it has been shown elsewhere that if this is achieved, cervical cancer rates reduces drastically (Sasieni, 1991; UK Cancer Research, 2008).

5.1.5 Prevalence of cervical abnormalities among women who have never been screened before attending the general outpatient clinic

Concerning abnormalities of the cervix among the study population, it was found that 7.4% of the women had some abnormality on speculum examination as well as after cytological smear analysis. The spectrum of abnormal lesions ranged from mild dysplasia to invasive cancer. This concurs with other studies conducted elsewhere among women who have never been screened before. For example in a study conducted in Romania it was found that 5.9% of those women who had never been screened had abnormal cervical lesions (Stonicu *et al.*, 2014) while in a study conducted in Eldoret, Were *at al.*, 2010) found cervical abnormalities of up to 16.9% among a population of women attending the family planning clinic. In the United Kingdom it has been found 8% of a population of women between 50 and 60 years who had never been screened has an abnormal smear with up to 4.5% having invasive cancer (Robertson *et al.*, 1989). Therefore it is important to intensify screening in populations who have never been screened before as such screening will be able to diagnose a significant number of cervical lesions.

5.1.6 Influence of SMS reminders on attendance to scheduled cervical cancer screening

At least 70% of women at risk should be put in the cervical cancer screening cycle for a screening programme to have a significant impact on reducing morbidity and mortality (Sasieni, 1991). Many studies have looked at methods of trying to increase the number of women entering into and remaining in the cervical cancer screening cycle (Camilloni *et al.*, 2013, Eaker *et al.*, 2004; Morrell *et al.*, 2005). In the United Kingdom a call system evaluation study found that using such a system was able to raise the percentage of women in the cervical screening cycle from 58 to 84% (Robertson *et al.*, 1989). In their meta-analysis Seng *et al.*, 2001) found that sending letter reminders on screening for cervical cancer significantly improved the screening rate by 64% compared to the non-interventional group. On the contrary mailed letter reminders were found to have no effect in adherence to screening in Canada (Sharon *et al.*, 1997). In Japan it was found that reminders for cervical and breast cancer screening significantly increased attendance rates and were cost effective especially in the smaller municipalities (Komoto *et al.*, 2014). Forbes and colleagues in a Cochrane review found that out of 9 studies (n=9400) assessing invitational letters to enhance cervical cancer screening, 8 of the studies found that invitational letters increased the attendance rates with 5 of the studies finding a significant difference(Forbes *et al.*, 2002). Even in countries like Belgium where screening programs are well attended the effect of inviting non attendees using letters significantly increases attendance to screening (de Jonge *et*

al., 2008). However, the above studies did not look at the efficacy of using the mobile phone platform.

The fast growing mobile phone platform has offered new opportunities by placing tools and information in the hands of people seeking health related services. Acceptability of the mobile phone has led to an increased interest in the use of the SMS platform of a GSM phone to solve many social problems. Many studies conducted in the developed countries have shown benefits on the use of the mobile phones devices in enhancing access to health care and provision of medical education (Akhila *et al.*, 2010), promotion of health (Scherr *et al.*, 2006; Ollivier *et al.* 2009; Armstrong *et al.*, 2009), adherence to treatments regiments (Mao, 2009) as well as for management of clinic appointments (Liew *et al.*, 2009; Koshy *et al.*, 2008; Foley *et al.*, 2009). The platform has also been shown to be useful in disease surveillance, collection of health information, improving adherence to treatment of chronic illnesses as well as in promotion of health (Armstrong *et al.*, 2009). Application of the mobile phone SMS platform in improving behavior change for health promotion has proved to be a very efficient tool (Foley *et al.*, 2009; Cole-Lewis *et al.*, 2010).

Despite the use of the mobile phone technology being highest in resource constrained countries like the Sub- Saharan African region, the World Health Organization and International Telecommunications Union has reported that the region is the least active in the use of the mobile phone platform for health (ITU,

2010; WHO 2011). A lot of interest is therefore being shown in the potential use of this platform for health promotion in resource constrained countries (Curioso *et al.*, 2007; Lester *et al.*, 2008). The few studies that have been done in countries like Kenya have investigated use of mobile phone platform for appointment reminders in the management of infectious diseases such as Tuberculosis (TB) as well as for Antiretroviral (ARV) treatment compliance for HIV management where there is proof that use of mobile phone technology is feasible and acceptable in diverse settings (Lester *et al* 2010; Gombachika *et al* 2011). The SMS simplicity and cost effectiveness compared to telephone calls has also been proved beyond any doubt in its application to health care (Leong *et al.*, 2006; Waller *et al.*, 2006).

In this study where the intervention was four SMS reminders on the next scheduled cervical cancer screening dates compared to a control group where no SMS reminders were sent, it was found that of the study participants in the interventional group 67.1% re-attended to scheduled repeat cervical cancer screening while only 32.9% did not. This is in contrast to what was found in the control group where it was found that only 20.3% re-attended as scheduled while 79.7% did not re-attend. The re-attendance for cervical cancer screening as scheduled was found to be 8 times more likely when SMS reminders were sent compared to not sending an SMS. This was found to be statistically significant ($p < 0.001$ 95% CI 4.69-13.73). The results clearly demonstrates that the SMS

reminders as a tool to enhance adherence to cervical cancer screening is as efficacious in women attending the general outpatients clinic just as it has proved successful in other areas of health care (Mechael *et al.*, 2010; Gombachika *et al.*, 2011). It also underscores the fact that many other studies have found that calling and recalling women for cervical cancer screening increases the screening re-attendance (Camilloni *et al.*, 2013; Eaker *et al.*, 2004; Morrell *et al.*, 2005).

5.1.7 Influence of socio-demographic factors on scheduled repeat cervical cancer screening after sending the SMS reminders

Socio-demographic factors such as low socio-economic status, age and education status have been found to influence re-attendance to screening for cancer of cervix. For example women of low socio-economic status and women who are elderly have been found to be less likely to be regularly screened (Murray *et al.*, 1993; Summers *et al.*, 1995). In this study, age of the participants, their spouses' employment status and means of transport were found to have a positive influence on re-attendance. Participants aged between 30 to 34 years had a more than 2 times likelihood to re-attend for rescreening compared with others after sending the SMS reminders (OR 2.24 CI 1.03-4.84 $p < 0.05$). Spouse's employment was also found to have a positive influence. After sending the SMS reminders, those participants whose spouses were employed were found to have a significant re-attendance rate of more than two times compared to those whose spouses were not

employed (OR 2.2 CI 1-1.47 P<0.05). This may be due to the support that an employed spouse may give to a wife who needs to re-attend screening.

Among access factor the use of public means was also found to have a significant influence on re-attendance after sending an SMS reminder (OR 3.29 CI1.1-10.1 P<0.05). Other socio-demographic factors like income, education level, marital status, location, cost of travel and time taken to travel did not have significant influence and in fact the nearer the person came to the screening site and the less money spent to travel was seen to have a negative influence to screening re-attendance when using the SMS. The null hypotheses were hence rejected and the alternative hypotheses adopted.

5.1.8 Influence of perceptions of health beliefs on repeat scheduled screening after sending SMS reminders

The re-attendance after sending an SMS reminder in participants who have never been screened did not seem to depend on health beliefs perceptions such as those of susceptibility, seriousness, risks, benefits or barriers. This is unlike many studies that have been conducted in the developed countries where reasons of women not been regularly screened included perception that the test is not beneficial, women not considering themselves at risk and considering the test being unnecessary (Doyle, 1991; Nathoo, 1998; Bonelli *et al.*, 1996; Seow *et al.*, 1995). However there was a clear trend when perceptions of seriousness and benefits were considered. A consistent increase of re-attendance was observed

from those with higher, medium and low perceptions respectively. For example when seriousness was considered the re-attendance was 30.3%, 32 and 37.7 respectively for higher, medium and low perceptions while for benefits it was observed that 19.7%, 21.3% and 59.0% of those with higher, medium and low perceptions re-attended. This is unlike what is predicted in the health belief model which predicts that if belief of being more susceptible to a particular disease is high; and that the disease is severe and the benefits of being screened are high, chances of that person being screened are increased compared to those with lesser perception (Hill *et al.*, 1985; Becker *et al.*, 1987). The trend observed in influence of perceptions on repeat screening in this study could be attributed to the fact that participants who had low perceptions on their risks and seriousness as well as lower risk of benefits could have been influenced more by the SMS reminders and counseling with a possible increase in perception and hence re-attendance. However when the differences were subjected to significance testing, they did not show any statistical significance.

5.1.9 Reasons for non re-attendance to screening at end line

Many studies have shown that personal attitudinal factors like fear of the test, religious factors, fear of embarrassment during the conduct of the test, being uncomfortable with the gender of the person conducting the cervical cancer smear as well as cultural factors contribute negatively towards screening for cervical cancer (Lyimo *et al.*, 2012; Chumnan *et al.*, 2009; Hummeida *et al.*, 2009). It has

also been shown that not knowing where to go for screening as well as not being aware of the importance of being screened affects uptake of screening services in Tanzania (Lyimo *et al.*, 2012). Other factors hindering uptake of screening are perceived facility barriers, attitudes of the health care workers offering the screening services and partner being unsupportive to cervical cancer screening (Monjurul *et al.*, 2008). In this study, 56.1% of the participants in the control arm said the reason why they never re-attended was that they had forgotten the return date compared to only 14.9% in the intervention group. The number who had forgotten among those who were not reminded was almost 4 times higher than those who were reminded. It was noted that 10.6% of those who were sent an SMS were screened elsewhere compared to only 0.9%.

5.2 Conclusions

- i. Only 20% women attending the general outpatient clinic at Thika Level Five Hospital have ever been screened for cervical cancer and of those who had ever been screened, only 8.8% adhered to regular screening hence 80% of women at risk of developing the disease attending the general out patients clinic have never been screened before.
- ii. Of those women who had never been screened for cervical cancer prior to the study, 7.4% had abnormal cervical lesions on speculum examination and cytological smears with these cervical lesions ranging from mild dysplasia to invasive cervical cancer.
- iii. For those study participants who were sent 4 SMS reminders informing them of the date of the next scheduled screening, 67.1% returned as scheduled compared to only 20.3% of those in the control group. On significant testing, this level of re-attendance after SMS reminders was significantly higher at 8 times more than those who were not sent reminders hence the null hypothesis was rejected.
- iv. After sending 4 SMS reminders, it was found that those who were aged between 30-34 years, those whose spouses were employed and those who used public means were more likely to return after being reminded using the SMS reminders. Other socio-demographic factors did not seem to significantly influence re-attendance to scheduled screening when using the SMS reminders.

- v. After sending 4 SMS reminders, health belief perceptions did not seem to significantly influence re-attendance to scheduled screening when using the SMS reminders.

5.3 Recommendations for programme and policy

- i. Since few of the women attending the general outpatient clinic have ever been screened for cervical cancer and due to the fact that many of them are at risk, the National Government through the Ministry of Health should look into ways of integrating cervical cancer screening into the general female outpatient clinic. This can be done through a program that can incorporate provider initiated counseling and screening for cervical cancer as the general outpatient clinic offers an opportunity to reduce cancer of cervix as many of these women have increased risks and most have never been screened.
- ii. The National and County governments should provide infrastructure for treatment and referral for cervical lesions in women diagnosed during the integration as almost 10% of these women are likely to have an abnormality of the cervix including cervical cancer.
- iii. To enhance adherence to scheduled screening, the government through public private partnership should explore ways to incorporate the Short Message Service (SMS) Text messages as a reminder tool for next scheduled screening into the National Cervical Cancer Screening Program. Majority of the study participants had high acceptance on the use of the SMS for reminders and

therefore this platform should be utilized to educate women at risk of developing cancer of the cervix on the need for regular screening.

5.4 Recommendation for further research work

There is need to conduct a study to explore the optimal number of SMS necessary to optimize return to scheduled repeat cervical cancer screening. In addition it is necessary to conduct research on cost effectiveness of using an SMS recall tool or voice call as reminder for next scheduled screening in resource constrained settings.

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APPENDICES

Appendix I Interview guide

SERIAL NUMBER.....

MOBILE PHONE NUMBER (OWN).....

MOBILE PHONE NUMBER (SIGNIFICANT OTHER).....

BASELINE DATE..... ENDLINE DATE.....

SECTION A

SOCIO-DEMOGRAPHIC DATA

1. Age in completed years.....

2. Marital status

- 1. Married
- 2. Single → go to number 4
- 3. Divorced
- 4. Widow
- 5. Cohabiting
- 6. Separated

3. At what age were you married (specify age).....

4. Highest educational level attained.

- 1. None
- 2. Primary
- 3. Secondary
- 4. Tertiary (Specify)

5. Employment

1. Employed
2. Self Employed
3. Casual
4. Unemployed

6. Spouse employment (if married)

1. Employed
2. Self Employed
3. Casual
4. Unemployed

7. Monthly personal income (Ksh) _____

8. Spouse income (Ksh) (If married) _____

9. How many children have you delivered _____ → go to number 11

10. Age at first delivery-----years.

11. Where is your home located? Sub-location.....location.....

12. What means of transport did you use to come to this hospital

1. Walking
2. Bicycle/Boda-Boda
3. Public transport
4. Private means

5. Others Specify

13. If you used any other method other than (1) above, what was the approximate cost in Ksh.....

14. Approximately how much time in hours did you spend from your home to this hospital? _____

SECTION B

Perception about susceptibility to cervical cancer

Rate the following according to the following scale

1.=Strongly Agree 2.=Agree 3. = Not Sure 4. = Disagree 5. =Strongly disagree

15. Every woman of child bearing age is at risk ofcervical cancer.

16. Women with multiple sexual partners are more prone to cervical cancer.

17. Cervical cancer is more common to women who are HIV positive.

18. Susceptibility to cervical cancer increases with numbers of pregnancy.

19. Cervical cancer only happens to women who are above the age of 50 years.

SECTION C: Perceived seriousness of cervical cancer

20. There is effective treatment for cervical cancer.

21. Having cervical cancer will make a woman's life difficult.

22. Cervical cancer is not a serious other type of cancers.

23. Cervical cancer is easily cured.

24. Having cervical cancer can result to infertility

25. Deaths resulting from cervical cancer are rare.

SECTION D: Perceived benefits of cervical cancer screening

26. It is important for a woman to have cervical cancer screening to know if she is healthy.

27. Cervical cancer screening can find changes in the cervix before they become cancer.

28. If cervical changes are found early from cervical cancer screening, they are easily curable.

29. Cervical cancer screening can find changes in the cervix before they become cancer.

30. Cervical cancer screening can decrease the chances of a woman having an abortion.

SECTION E: Perceived barriers to cervical cancer screening

31. It is too embarrassing to do cervical cancer screening.

32. Cervical cancer screening is painful

33. If young unmarried woman does cervical cancer screening, everyone will think she is having sex.

34. Doing cervical cancer screening will only make one worry.

35. If a woman has not had sex, cervical cancer screening will take away her virginity.

36. Not knowing where to go for cervical cancer screening is a reason why people don't do cervical cancer screening.

37. Only women who have had babies need to do cervical cancer screening.

38. My partner will not want me to do cervical cancer screening.

39. Lack of female screening in health facilities is a reason for not doing cancer screening.

40. Attitudes of health workers can discourage one from going for cervical cancer screening.

41. Lack of convenient clinic is a barrier to routine cervical cancer screening.

42. Lack of information about cervical cancer procedure is a barrier to uptake of cervical cancer screening.

43. Distance to screening sites is a barrier to screening.

44. Time taken from home to screening centre is a barrier to screening.

45. Cost of travel from home to screening site is a barrier to screening.

46. Cost of screening test is a barrier to screening

SECTION F: Perceived knowledge of risk factors on cervix cancer.

1=Strongly Agree 2=Agree 3. = Not Sure 4. = Disagree 5. =Strongly disagree

47. Starting to have sex early is a risk factor

48. Having sex with multiple partners is a risk factor

49. Some sexually transmitted infections are risk factors

50. Smoking is a risk factor

51. Having sex with a man who is not circumcised is a risk factor.

52. My spouse having sex with other women is a risk

53. Use of contraceptive pills is a risk

SECTION G: Use of the mobile phone

54. How long have you had the phone-----years?

55. How many times have you changed your mobile number over the last one year._____?

56. Are you able to write and read SMS

1. Yes → go to number 58

2. No

57. If not is there anybody in your family who reads SMS for you.

1. Yes

2. No

58. Have you ever received a health related message on your mobile phone?

1. Yes

2. No → go to number 60

59. If yes was this message on cancer prevention and screening

1. Yes

2. No

60. Do you think the mobile SMS can used to promote health?

1. Yes

2. No

3. Not sure

61. Do you think SMS can be used as a reminder to people of the next booking for screening

1. Yes

2. No

3. Not sure

62. Would like to receive information from your doctor on importance of cervical cancer screening through the SMS

1. Yes

2. No

3. Not sure

63. Do you think being reminded of your next screening through the SMS will help you to return for screening?

1. Yes

2. No

3. Not sure

64. Can your results be sent through the SMS?

1. Yes

2. No

3. Not sure

65. If the results are sent through the SMS do you think that your privacy may be interferedwith

1. Yes

- 2. No
- 3. Not sure

SECTION H: Assessment for risk factors

66. How old were you when you had your first sexual contact. _____ years.

67. How many sexual partners have you had _____

68. Do you know how many sexual partners your spouse has ever had?

- 1. Yes
- 2. No

69. If yes how many? _____

70. Have you ever used any Family Planning?

- 1. Yes
- 2. No → go to number 73

71. If yes, what have you ever used?

- 1. Condoms
- 2. Pills → go to number 72
- 3. Coil
- 4. Implants
- 5. Others (specify)

72. If the pills how long have you used them _____ years.

73. Have you ever smoke cigarettes

- 1. Yes
- 2. No → go to number 75

74. If yes for how long.....years

75. Have you everdone a HIV TEST?

1. Yes
2. No → Screening

76. If yes what is your status

1. Positive
2. Negative
3. Don't Know

SECTION J: Screening

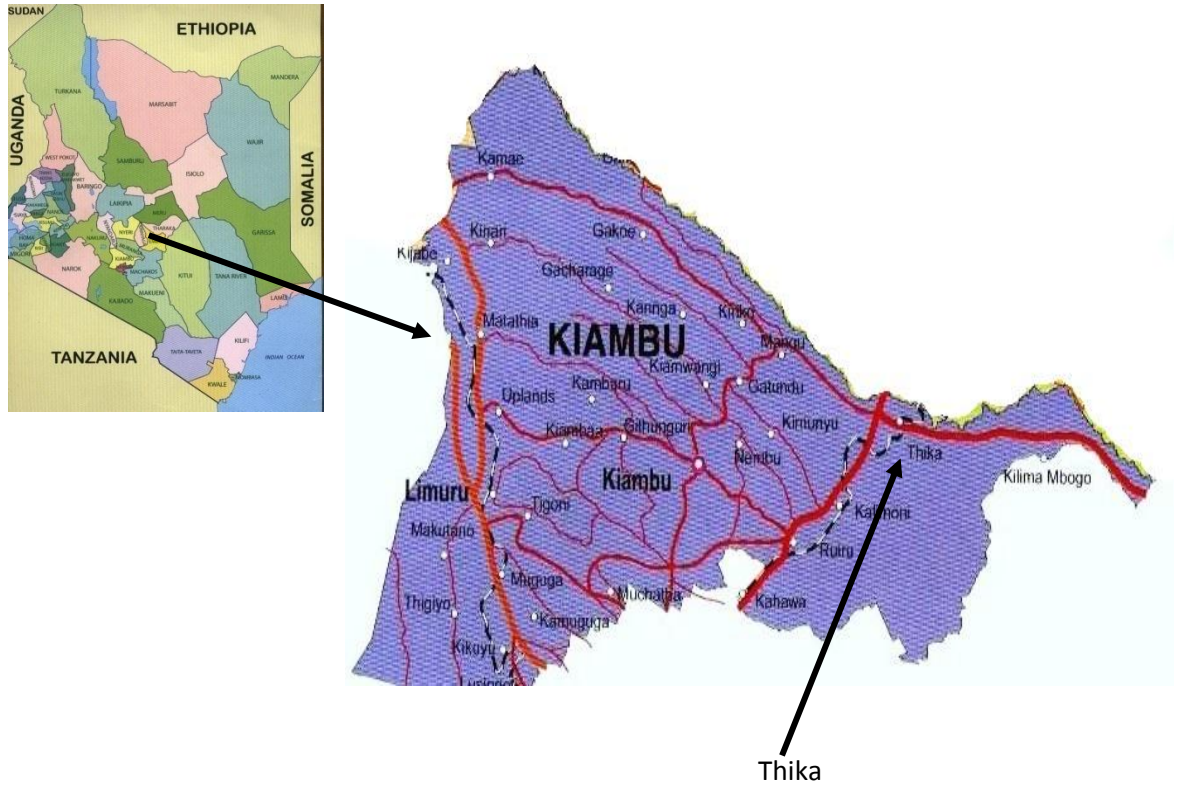
We will screen you using the Pap test, if you are noted to have a problem you will be referred for treatment, but if you are normal we will reschedule you for future screening within six months or one year.

79. Pap test results of primary screening _____

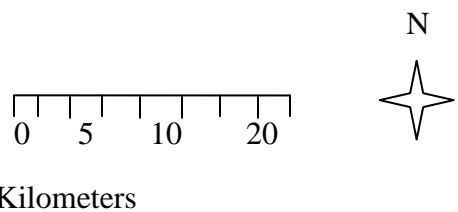
80. Pap test results for endline screening (if attended) _____

81. If not attended reason for not attending (after call) _____

Appendix II Map of study area



Thika



Appendix III Thika Hospital Cervical Cancer Screening report form

Primary screening----- Secondary screening-----

Name _____ Age _____

Own mobile phone number _____

Significant other mobile phone number _____

Results

- 1. Normal
- 2. Inflammatory
- 3. LGSIL/HPV effect
- 4. HGSIL
- 5. Malignant

Cytologist's name _____

Signature _____

Date: _____

Appendix IVa English Informed Consent form

My name is Dr Wanyoro. I am a PHD student from Kenyatta University working in conjunction with the Ministry of Health. I am conducting a study on the use of the mobile phone through the SMS to improve screening for cervical cancer. The information will be used by the Ministry of Medical Services and Ministry of Public Health and Sanitation to improve access and quality for screening of cervical cancer in this hospital as well as in other regions of Kenya.

Procedures to be followed

Participation in this study will require that I ask you some questions and also examine you in order to screen you for cervix precancer. Some cervix specimens will be taken from you for further tests. I will record the information from you in a questionnaire.

You have the right to refuse participation in this study. You will get the same care and medical treatment whether you agree to join the study or not and your decision will not change the care you will receive from the clinic today or that you will get from any other clinic at any other time.

Please remember that participation in the study is voluntary. You may ask questions related to the study at any time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you receive from this clinic or any other organization now or in the future.

Discomforts and risks

Some of the questions you will be asked are on intimate subjects and maybe embarrassing or make you uncomfortable. If this happens, you may refuse to answer these questions if you so choose. You may also stop the interview at any

time. The interview may add approximately half an hour to the time you wait before you receive your routine services. The examination needed will involve us doing a vaginal examination in order to obtain material from the cervix for screening.

Benefits

If you participate in this study you will help us to learn how to provide effective screening services that can improve the health of women and reduce the risk of cancer of cervix. You will also benefit from being screened for cervix cancer and if you are found to have a problem you will be advised on treatment.

Confidentiality

The interviews and examinations will be conducted in a private setting within the clinic. Your name will not be recorded on the questionnaire. The questionnaires will be kept in a locked cabinet for safe keeping at Kenyatta University. Everything will be kept private.

If you have any questions you may contact Dr Wanyoro on 0722747903 or the Kenyatta University Ethical Review Committee Secretariat PO Box 43884-00100 or the Medical Superintendent of Thika Hospital or the nurse in charge of the outpatient clinic on telephone 0722106797 or 067 21621.

Subject's Statement

The above information regarding my participation in the study is clear to me. I have been given a chance to ask any questions I may have and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will still get the same care and medical treatment whether I decide to leave the study or not and my decision will not

change the care I will receive from the clinic today or that I will get from any other clinic at any other time.

Signature or Thumbprint

Date

Investigator's statement

I, the undersigned, have explained to the volunteer in a language she understands the procedures to be followed in the study and the risks and benefits involved.

Interviewer signature

Date

Appendix IVb Fomu ya idhini

Jina langu ni.....na ninafanya kazi katika Chuo Kikuu Cha Kenyatta. Tunafanya utafiti kuhusu seratani ya nyungu ya mtoto kwa wanawake katika eneo hili na unaombwa kushiriki katika utafiti huu. Kabla haujaamua kushiriki katika utafiti huu, unahitaji kujua kiini ambacho kimepelekea utafiti huu kufanywa na kile ambacho kitahitajika katika utafiti huu. Tafadhali chukua muda usome au usikize ninaposoma maagizo yafuatayo. Unaweza kusemezana na wengine kuhusiana na utafiti huu ukipenda. Tafadhali niulize iwapo kuna jambo usilolielewa au iwapo unahitaji habari zaidi kuhusiana na utafiti huu. Baada ya maswali yako yote kujibiwa na kuridhika kuwa sasa unaelewa utafiti huu, utaulizwa ikiwa utashiriki katika utafiti na uchunguzi huu, iwapo ni ndiyo, basi utaijaza fomu hii ya idhini. Utapewa nakala iliyotiwa sahihi uihifadhi.

Malengo ya utafiti: Utafiti huu unalenga kuelewa juu ya kupimwa na kutimbiwa saratani ya nyumba ya watoto.

Utaratibu: Utafiti ni wa kuwahoji na kuwapima akina mama ambao wamekuwa wakihudhuria huduma za matibabu katika kliniki.

Muda wa mahojiano: Mahojiano haya yatachukua karibu dakika 30.

Madhara/ Kero: Utafiti huu hauna madhara ya moja kwa moja. Kunaweza kuwa na madhara kutokana na maswala nyeti kuhusu afya ya uzazi. Lakini si lazima kujibu swali ambalo litakuadhiri kihisia. Unaweza kukatiza mahojiano wakati wowote bila adhabu yoyote au kupoteza manufaa yoyote ambayo umethibitishiwa.

Manufaa: Huu ni mradi wa utafiti. na hauna manufaa ya moja kwa moja kwa mshiriki. Itaifanufaisha tu sayansi kwa kutoa habari kwa watafiti kuhusu changamoto ya saratani ya nyumba ya mtoto. Kama utapatikana na shida yeyote baada ya kupimwa utapatiwa matibabu ile inafaa.

Usiri wa habari: Majibu yote utakayotoa kwa maswali yatakuwa siri. Hojaji zitawekwa kodi na baada ya mwaka mmoja zile za mwanzo zitakupwa. Majina yako au kitambulisho chako chochote hakitajumuishwa katika ripoti ya utafiti. Data hii itaifadhiwa kwenye tarakilishi na kufungiwa kwenye rafu iliyotengewa utafiti huu na kwamba habari inaweza kupatikana tu kwa wanakamati wa utafiti.

Malipo:

Ikiwa utakubali kushiriki katika mahojiano haya, hutalipwa wala kuulizwa kulipa pesa zozote..

Una swali lolote? (ikiwa ndio, andika swali na ujibu swali lake.)

Je ungependa kushiriki katika mahojiano haya? (Ikiwa La, mshukuru mhojiwa kisha katisha mahojiano.)

Ukiwa na shida au swala lolote, kuhusiana na uchunguzi huu wasiliana na Daktari Anthony Karanja Wanyoro on 0722747903 au Kenyatta University Ethical Review Committee, P.O Box 43884-00100, Nairobi; Nambari ya simu: 020 8710901-18 au Mkuu msimamizi wa hopitali kuu ya Thika au MguuziMsimamizi wa outpatient clinic wa Thika Hospital Nambari ya simu 0722106797 ama 067 21621.

Respondent's signature (sahihi) Or Thumb-print (Kidole) _____

Date_____

Interviewer's signature _____ Date_____

Appendix V SMS message (English and Kiswahili)

How are you____(Name)_____.This is the Thika hospital cervical cancer screening clinic reminding you about your next date of screening. Your date for the next screening at the Thika Level 5 Hospital will be on----- (date)-----Please adhere to this date since regular cervical cancer screening reduces the chance of you getting cervical cancer which is one of the commonest cancers among women in Kenya.

Kiswahili version

Habari yako _____(Jina)_____ Hii ni Kliniki ya uchunguzi ya ugonjwa wa seratani ya nyungu ya mtoto katika hospitali ya Thika. Tungetaka kukukumbusha tarehe ya kurudi kwako kwa uchunguzi wa hii seratani. Tarehe yako ya kurundi ni_____ (Tarehe) _____. Tafadhali hakikisha umetimiza huu uchunguzi kama ilivyoandaliwa, kwasababu hii ndio njia muhimu ya kukuzuia kupatikana na hii seratani ambayo inadhuru wanawake wengi hapa Kenya.

Appendix VI Kenyatta University graduates school approval



**KENYATTA UNIVERSITY
GRADUATE SCHOOL**

E-mail: admissions-graduate@ku.ac.ke
dean-graduate@ku.ac.ke
 Website: www.ku.ac.ke

P.O. Box 43844, 00100
 NAIROBI, KENYA
 Tel. 8710901 Ext. 57530

Our Ref: P97/26013/11

Date: 22nd January, 2013

The Permanent Secretary,
 Ministry of Higher Education, Science & Technology,
 P.O. Box 30040,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION
MR. WANYORO ANTHONY KARANJA - REG. NO. P97/26013/11

I write to introduce Dr. Wanyoro Anthony Karanja who is a Postgraduate Student of this University. He is registered for a Ph.D. degree programme in the Department of Community Health in the School of Public Health.

Dr. Wanyoro intends to conduct research for a Thesis entitled, "The Use of the Mobile Phone Short Text Message Service to Enhance Cervical Cancer Screening at Thika Hospital, Kiambu County, Kenya".

Any assistance given will be highly appreciated.



 for: **MRS. LUCY N. MBAABU**
FOR: DEAN, GRADUATE SCHOOL

LNM/cww

Appendix VII Ethical review approval



**KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE**

Fax: 8711242/8711575
Email: kuerc.chairman@ku.ac.ke
kuerc.secretary@ku.ac.ke
Website: www.ku.ac.ke

P. O. Box 43844
Nairobi, 00100
Tel: 8710901/12

Our Ref: KU/R/COMM/51/155

Date: April 18th, 2013

Wanyoro Anthony Karanja
School of Public Health
Kenyatta University
P. O. Box 43844, Nairobi.

Dear Mr. Wanyoro,

APPLICATION NUMBER PKU/103/I92 OF 2013 – ‘THE USE OF THE MOBILE PHONE SHORT TEXT MESSAGE SERVICE TO ENHANCE CERVICAL CANCER SCREENING AT THIKA HOSPITAL, KIAMBU COUNTY, KENYA’. VERSION 2

1. IDENTIFICATION OF PROTOCOL

The application before the committee is with a research topic, ‘The use of the Mobile Phone short Text Message Service to Enhance Cervical Cancer Screening at Thika Hospital, Kiambu County, Kenya’ *version 2* dated 15th April 2013.

2. APPLICANT

Wanyoro Anthony Karanja
School of Public Health
Kenyatta University
P. O. Box 43844, Nairobi.

3. SITE

Thika Hospital, Kiambu County, Kenya

4. DECISION

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines, and is of the view that against the following elements of review,

- (i) Scientific design and conduct of study,
- (ii) Recruitment of research participant,
- (iii) Care and protection of research participants,
- (iv) Protection of research participant’s confidentiality,
- (v) Informed consent process,
- (vi) Community considerations.

AND APPROVED and that the research may Proceed for a period of ONE YEAR starting 5th April 2013.

Appendix VIII NaCoSTI Approval

REPUBLIC OF KENYA



NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephone: 254-020-2213471, 2241349, 254-020-2673550
 Mobile: 0713 788 787 , 0735 404 245
 Fax: 254-020-2213215
 When replying please quote
 secretary@ncst.go.ke

P.O. Box 30623-00100
 NAIROBI-KENYA
 Website: www.ncst.go.ke

NCST/RCD/13/013/58

10th June 2013

Date:

Our Ref:
 Anthony Karanja Wanyoro
 Kenyatta University
 P.O Box 43844-00100
 Nairobi.

RE: RESEARCH AUTHORIZATION

Following your application dated 27th May, 2013 for authority to carry out research on "*The use of the mobile phone short text message service to enhance cervical cancer screening at Thika Hospital, Kiambu County, Kenya.*" I am pleased to inform you that you have been authorized to undertake research in **Thika District** for a period ending **30th June, 2014.**

You are advised to report to the **District Commissioner, District Education Officer and the Medical Officer of Health, Thika District** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. M. K. RUGUTT, PhD, HSC.
DEPUTY COUNCIL SECRETARY

Copy to:
 The District Commissioner
 The District Education Officer
 The Medical Officer of Health
 Thika District

Appendix IX Thika Level 5 hospital study support

MINISTRY OF MEDICAL SERVICES

Tel.Thika 067 21621/2 fax 21778
All correspondence should be addressed to
MED.SUPT.
When replying please quote



THIKA LEVEL 5 HOSPITAL
P.O. BOX 227
THIKA

Ref; NO. MOMS/TKA/


Date: 10th June, 2013

TO WHOM IT MAY CONCERN

RE: SUPPORT FOR PHD RESEARCH

This is to certify that Thika Level 5 Hospital supports Dr. A.K. Wanyoro PHD research entitle "**The use of the mobile phone sms to enhance cervical cancer screening at Thika hospital Kiambu County, Kenya**".

This research has a lot of potential in reducing the burden of cancer of cervix in Kenya.


Dr. Jonah M. Mwangi
Medical Superintendent/DMSO
Thika Level 5 Hospital



Appendix X Randomized Controlled Trials registration

PACTR Registry Account Activation

PACTR Trial Approval

Your trial **THE USE OF THE MOBILE PHONE SHORT TEXT MESSAGE SERVICE TO ENHANCE CERVICAL CANCER SCREENING AT THIKA HOSPITAL, KIAMBU COUNTY, KENYA. (SMART SCREENING)** has been reviewed and approved.

Your trial number is : PACTR201305000526384

Appendix XI Cervical Cancer Screening Reminders Randomization System

1.0 SYSTEM REQUIREMENTS

1.1 Hardware requirements

256 MB RAM

20 GB hard disk to accommodate the operating system.

450 MHz processor.

1.2 Software requirements

The system used the following as support programs.

Kannel SMS gateway

This binds the modem to system and provides a way to send the SMS. It is the software responsible for sending the SMS and is freely available in the Internet.

Wamp server

This provides the environment for the system to operate and contains the libraries used by the system.

Browser

This provides the interface for the system to interact with the users.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OBJECTIVES

Send reminders to clients selected randomly.

Keep track of screening attendance dates of clients.

Analyze the data of attendance rates at the end of the research.

Produce relevant analytical diagrams at the end of the research.

Send text message to client as required by the user.

2.2 GENERAL DESCRIPTION

The system is web-based and interacts with the user through a computer browser.

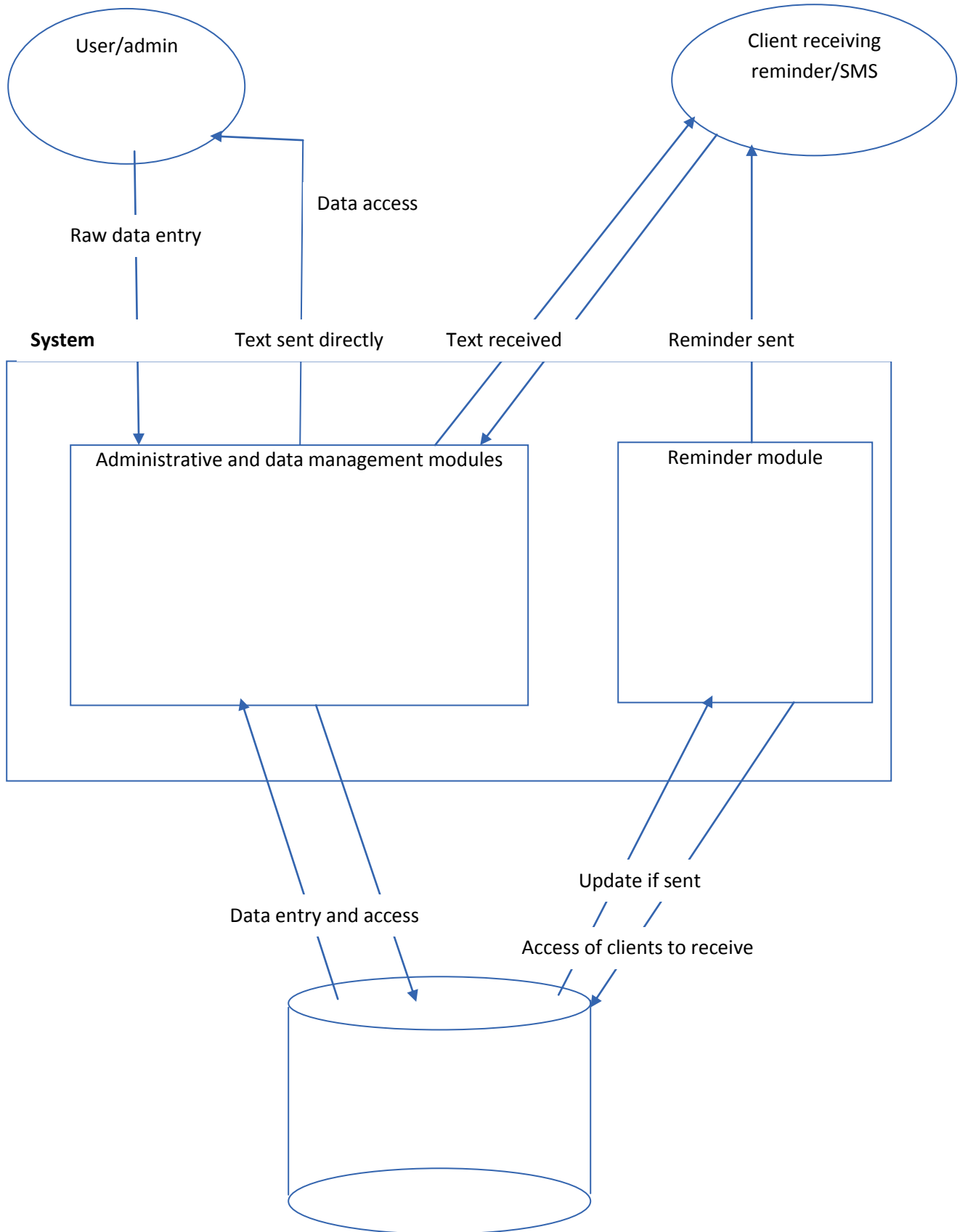
A web-based application runs on the Internet while desktop application is installed in a personal computer. Web-based applications may be used as desktop application if installed in a personal computer. The main reason a web-based system was preferred vis-a-vis desktop application were:

Availability and accessibility: Web-based applications run on the Internet and can be accessed anywhere using any device capable of accessing the Internet. This means that it could be used by the researcher during data collection in the field if it was hosted in online servers. Data could be input into the system using a phone.

The system is accessible via different devices connected to the Internet.

Security: Data hosted on on-line servers cannot be lost if data in personal computer is lost. On-line servers are more secure than personal computers. This enhances data security.

GRAPHICAL SYSTEM DESCRIPTION



2.3 SYSTEM USAGE SUMMARY

Client baseline data was first collected by the researcher or research assistants using a an investigators administered questionnaire. Select data was fed into the system. The data put into the system included:

- Client name
- Questionnaire's serial number
- Attendance date
- Phone number
- Next of kin's phone number

Next of kin's phone number was used so that if the client's phone was unreachable the SMS could be automatically re-routed to the other number.

The systems administrator set the period intervals in which the clients were to be sent SMS reminders. The intervals were set as follows:

- Three months before the next scheduled screening
- Two months before the next scheduled screening
- One month before the next scheduled screening
- One week before the next scheduled screening

Dates on which the reminders were automatically sent were:

- 5th February 2014
- 5th March 2014
- 5th April 2014
- 30th April 2014

The dates for sending reminders were the same for all clients since all were set to re-attend at a period of two (2) weeks starting from 5th May to 16th May 2014.

The administrator then determined the proportion of clients to receive the reminders. For this case, the proportion was 50%. The selection was randomly performed as explained below. Data was first clustered together in blocks. Clustering occurred in data in adjacent memory locations since they represented the same collection period. Such selection is done randomly. This means that for every randomization procedure, a different set of clients is selected randomly.

The selected clients were hidden from the researcher and other system users. This is referred to as blinding of data. The purpose of blinding was to remove any bias from the system users to manually manipulate data. The un-blinding of that data was set for a later date two weeks after the end of study and was in build in the system to be 30th May 2014.

Reminders were sent to selected clients automatically on the date shown above. No feedback was expected from the clients since the administrator was not supposed to know who had been selected.

2.4 RANDOMIZATION PROCESS

The data was first put in clusters. Reason for data clustering or creating blocks is to prevent a skewed selection of clients to receive reminders. This would happen if a large number of clients in adjacent memory locations are selected leaving others. Clients were registered chronologically as they came hence those in adjacent memory locations were registered in relatively the same period. Since selection is random, there was minimal risk for skewing and this was further reduced by creating blocks.

The number of clients in each block was first determined and then clients selected randomly from it according to the proportion. e.g. Select 5 clients randomly from each block if the block size is 10 and the proportion set is 50%.

The clusters need to be small enough to ensure a uniform selection of clients yet large enough for efficiency and practicality.

The block size was set by the administrator to be automatically determined by the system as per the following formula:

$$Pr = N / R \dots\dots\dots i$$

N.....Number of clients (size of data).

R.....Number to be selected (Clients set to receive reminders).

It was noted that the total sum of intervals between data increased as data was more evenly distributed. These intervals were calculated as $\rightarrow n - (n-1)$; where n represented position of selected client in the list and $n-1$ the position of last selected client.

Since we were using a proportion of 50%, the best intervals would be 2 where for every 2 clients, one was randomly selected. The worst case scenario would be where 143 clients in adjacent locations were selected. The intervals would be 1 all through for those selected.

Average case scenario interval $i = \text{best case} - \text{worst case} / 2 \Rightarrow (1+2)/2 = 1.5$;

Block sizes were to be small enough to ensure uniform distribution but large enough for practicality and efficiency. The number of blocks grew in a smaller proportion to data size increase.

The number of blocks was determined by function:

$$B = P * i * \log N$$

Where B>optimum number of blocks

P>proportion determined by data size (Number of clients)/Number to be selected

i>average interval size

N>Data size (Number of clients)

For our case, the optimum number for 286 clients and 50% selection is 7 blocks.

Data was then divided into the blocks to get the block size of each block.

$B_s = 286 / 7 = 40.85$ hence we take 40.

For every 40 clients clustered together, 20 were randomly selected. This means 140 clients were randomly selected from all clusters and then each of remaining 3 were selected randomly from a randomly picked cluster.

3.0 SYSTEM SCOPE

Client management module and a database to record data. SMS module which dealt with sending and receiving messages.

Administrative module.

Client management module: It provided a list of all clients in the system and gave an option of editing, texting, viewing or deactivating a client. For registration of new clients and editing, it provides a form where client details were inserted.

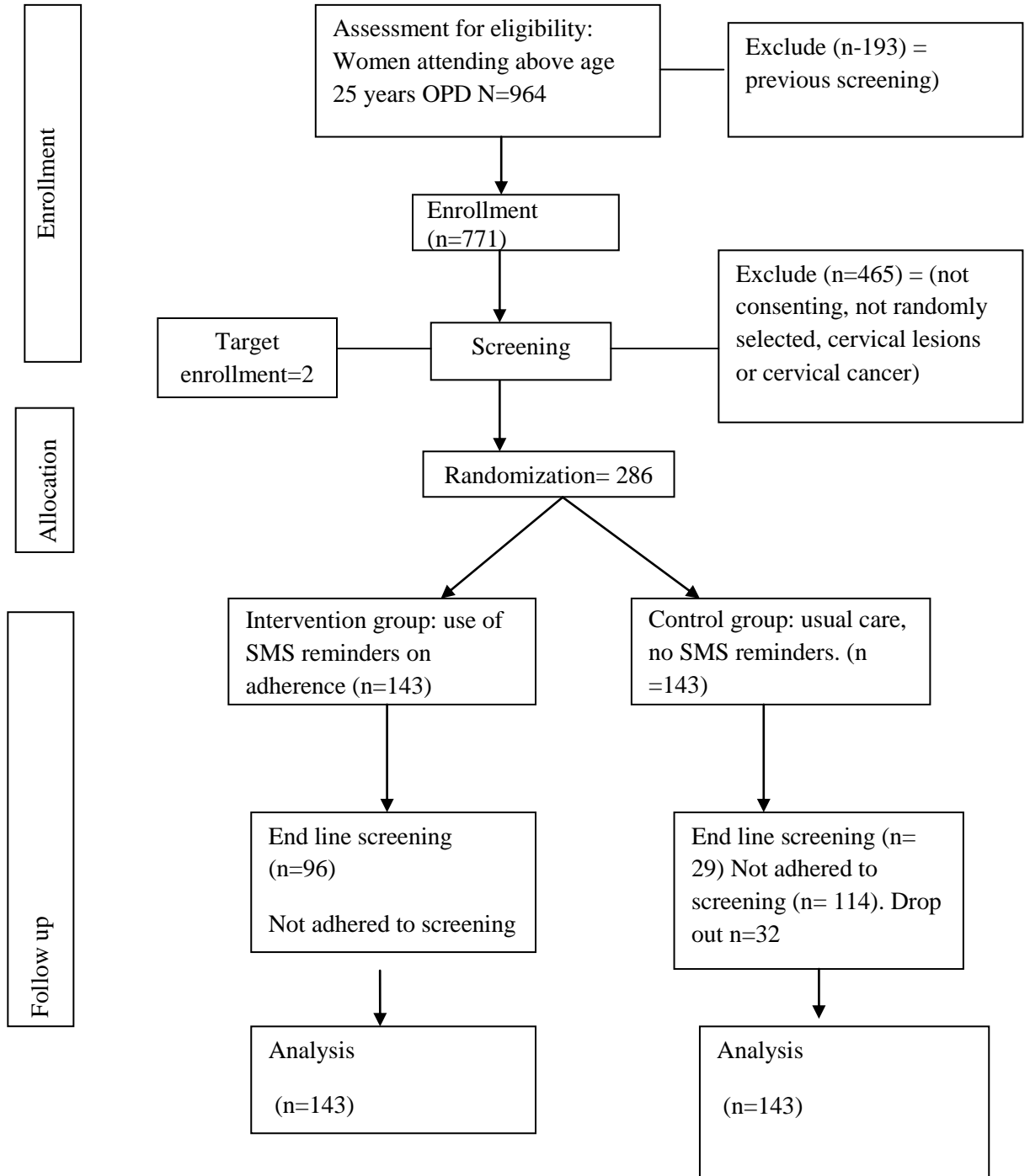
SMS/Reminder module: This module used software called Kannel which binds the modem to the system. This software receives and sends messages from the system and connects the modem to the system. The text messages were charged according to the payment plan with the service provider.

Administrative module: It allowed the systems administrator to:

- Set the number/proportion of clients to receive reminders and automatically randomize them.
- Set the reminder message to be sent to clients
- Update attendance details of clients
- Un-blind clients who received reminders
- Send a text message to any client registered
- Edit profiles
- Perform any other administrative action required by the system

Appendix XII Randomized Trial reporting tool

Summary of study reporting flow chart: modified from CONSORT



Appendix XIII List of publications and conference presentations.

1. **Wanyoro A.K**, Kabiru E, Bukusi E (2015): Cervical Cancer Screening Adherence And The SMS: Screening Adherence And Availability Of The Mobile Phone SMS in Women Attending the Outpatient Clinic At Thika Hospital. *The East and Central African Medical Journal* 2015(2).
2. **Wanyoro A.K**, Kabiru E, Bukusi E (2015): Pattern of Cervical abnormalities in a cervical cancer screening naïve population at a selected hospital in Kenya. A paper presented during the annual African Federation of Obstetricians and Gynecologist/Kenya Obstetrical and Gynecologic Conference, Nairobi, Kenya.
3. **Wanyoro A.K**, Kabiru E, Bukusi E (2015): Use Of Mobile Phone Short Text Message Service to Enhance Cervical Cancer Screening: A Case Study Of Thika Level 5 Hospital, Kiambu County, Kenya. A paper presented during the 1st Global Patient Centered Care Conference, Nairobi, Kenya
4. **Wanyoro A.K**, Kabiru E, Bukusi E (2014). Cervical Cancer Screening Adherence and the SMS: Screening adherence and availability of the mobile phone SMS in women attending the outpatient clinic at Thika Hospital. A paper presented during the annual Kenya Obstetrical and Gynecologic Conference, Nyeri, Kenya.