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THE EFFECT OF mHealth TEXT MESSAGING INTERVENTION ON THE ANTENATAL CARE CONTACTS, INSTITUTIONAL DELIVERIES AND INFANTS' BIRTH-WEIGHTS OF EXPECTANT ADOLESCENTS AND YOUNG MOTHERS – A QUASI-EXPERIMENTAL STUDY IN KWALE COUNTY, KENYA

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BY

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DECLARATION

I, Jefferson Mwaisaka Mtongolo, author of this thesis, do declare that except for references from other authors which have been duly acknowledged, this is my work which has been undertaken as partial fulfilment of the requirements for the award of Doctor of Philosophy in Public Health at the University of Ghana, Legon and has neither in part nor in whole been presented elsewhere for another degree.

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DEDICATION

I dedicate this work to my two sons, Mwanyalo Mwaisaka and Mtongolo Mwaisaka and my wife, Audrey Khadija; they were my constant source of support and inspiration during this Doctoral program. Also, a special dedication to all the study participants who accepted to be in this study.

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ABSTRACT

Background

Poor referral channels and wanting knowledge on the significance of antenatal care have been shown to impede expectant adolescents and young women from having the recommended antenatal contacts. The ubiquity of mobile phones and the extensive use of text messages can improve ANC knowledge and hence increase antenatal contacts for expectant young women through prompt educational and reminder messages when integrated into existing antenatal service delivery points.

Objective

This study sought to determine the feasibility and acceptability of a mHealth-text messaging intervention. The specific objectives were to investigate the intervention's effect on antenatal care utilization, institutional deliveries, and infants' birthweights among young women aged 24 and below in Kwale County, Coastal Kenya.

Study method

This was a quasi-experimental trial using a mixed methods approach. The initial design was to have two arms, the mHealth text messaging intervention arm and the control arm. However, the low uptake of clinical services, a consequence of the COVID-19 pandemic forced some facilities in Kwale County to conduct clinical outreaches and to provide ANC and other maternal services at the community level. One control facility conducted monthly community outreaches which provided maternal related services to pregnant women. A substantial number (147 out of 213) of the control arm study participants in that facility were among those reached during outreaches.

This situation was unexpected and had to be addressed by amending the control arm during data analysis. Thus, the original control group was split into "pure controls" and "outreach participants." This resulted in having three study arms: (1) mHealth-text messaging intervention participants (2) pure control participants, and the (3) outreach arm participants. All quantitative data analyses were done using STATA version 15. Univariate, bivariate and multivariate regression analyses were done. Multivariate logistic regression with a 95% confidence interval was used to assess the relationships between independent variables and the study's outcomes. Findings were presented as odds and risk ratios. Results were statistically significant at $p<0.05$. Additionally, a sensitivity analysis was done excluding Mkongani health centre from the analysis. Sensitivity analysis was done to estimate the consistency of the results using the ideal study subgroups, mHealth-text message vs pure control. Also, audio recordings from qualitative data were transcribed word for word and translated into English. This was followed by the identification of repeated patterns which were thematically analysed using NVivo version 12

Results

A total of 817 participants were successfully linked to their background data and were included in the analysis. Findings from this study revealed that participants in the control arm had increased risk for low ANC contacts compared to those from the mHealth text-message intervention arm (Risk Ratio, RR: 0.5 [95% CI: 0.4 – 0.7], $p<0.001$) and outreach arm (RR: 0.1 [95% CI: 0.0 – 0.7] $p = 0.024$. It was also determined that, participants in the control arm had increased odds of unskilled deliveries compared to those in the mHealth-text message intervention arm (OR: 0.2 [95% CI: 0.1 – 0.4, $p<0.001$] and the outreach arm (OR: 0.1 [95% CI: 0.0 – 0.6], $p=0.007$). In contrast, babies born to participants from the mHealth-text message intervention (OR: 5.9 [95%

CI: 1.7 – 20.8, p=0.006]) and outreach arms (OR: 6.6 [95% CI: 1.7 – 25.7], p=0.007) had significantly greater odds of low birth weight, compared to those born to control arm participants. On feasibility and acceptability of the mHealth intervention, this study found that mHealth text messaging intervention was feasible and acceptable to the young mothers; whereas interviewed healthcare providers were cautious with their views.

Conclusion

mHealth-text messaging is a feasible and acceptable intervention in the provision of ANC services targeting expectant young women. Together with community-based clinical outreaches, mHealth text messaging interventions can improve antenatal contacts and deliveries by a skilled healthcare practitioner. Policy makers and the public health community should consider implementing both mHealth and community clinical outreaches to improve maternal outcomes of young women in Kenya.

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LIST OF ABBREVIATIONS

ANC	Antenatal Care
CHV	Community Health Volunteer
FANC	Focused Antenatal Care
HCPs	Healthcare Providers
ICT	Information and Communication Technology
LMICs	Low and Middle Income Countries
MAMA	Mobile Alliance for Maternal Action
NMR	Neonatal Maternal Rate
PMTCT	Prevention of Mother to Child Transmission
RRI	Rapid Results Initiative
SMS	Short Message Service
SRH	Sexual and Reproductive Health
SRHR	Sexual and Reproductive Health and Rights
SSA	Sub-Saharan Africa
STDs	Sexual Transmitted Diseases
RH	Reproductive Health
WHO	World Health Organisation

CHAPTER ONE
INTRODUCTION

1.1 Background

Adolescence, which lasts from ages 10 to 19, is a phase of physiological changes leading to adulthood (Forsyth & Rogstad, 2015). Since most persons experience their biological and social transformations before the age of 24, adolescence age is presently being considered for extension to include young people up to 24 years (Blakemore, 2019; Jaworska & MacQueen, 2015). Additionally, puberty, which marks the beginning of adolescence and is influenced by socioeconomic determinants of health, brings about physical changes that compromise adolescent and young people's sexual, reproductive and mental health (Blakemore, 2019). Pubertal physical body changes are associated with the onset of sexual activity, which places young people, particularly girls at risk of unplanned early pregnancies as well as Sexual Transmitted Diseases (STDs) like HIV.

In many societies worldwide, teenage pregnancies remain a call for public health concern. Despite declining, adolescent birth rates worldwide—from around 65 for every 1,000 women in the 1990s to about 47 for every 1,000 women in 2015; adolescent fertility is still a problem in various parts of the world (UNICEF, 2021). The rate of adolescent births from 2010 to 2015 was 99 per 1000 women in Africa, followed by 67 per 1000 women in the Caribbean and South American countries (United Nations Department of Economic and Social Affairs, 2017). Each year, 2 million young girls aged 14 years and below and 21 million adolescent girls aged between 15-19 give birth in underdeveloped countries (WHO, 2022). Around 27% of young women in the least developed nations between the ages of 20 and 24 had given birth before 18. Sub-Saharan Africa recorded

the greatest rate of early childbearing (UNICEF, 2021). In Kenya, an estimated 20%, approximately one in every five girls in the age bracket of 15 - 19 are either pregnant or have given birth to their first child (Kenya National Bureau of Statistics, 2015).

According to Mombo-Ngoma et al., (2016), in several regions of sub-Saharan Africa, young females are more likely to deliver premature and low birthweight neonates than in any other part of the continent. Additionally, pregnancy and childbirth complications are significant causes of death in adolescents and young mothers. Stillbirths and new-born deaths occur approximately 50% more frequently in new-borns born to adolescent mothers than in babies delivered to older women (World Health Organisation, 2014). Young women and adolescent girls frequently die from pregnancy-related problems and childbirth despite knowledge of how to detect and manage common and life-threatening pregnancy complications, such as heavy bleeding, infections, and botched abortion (UNICEF, 2021). These issues can be identified and avoided with timely and quality antenatal care, delivery services, and post-partum and baby care services (Mekonnen et al., 2019).

Frequent antenatal check-ups and assessments have many benefits; they can help with early identification of any complications for prompt interventions. In the 1990s, the WHO had initially advised pregnant women to have at least four antenatal contacts with a skilled healthcare provider. However, pregnant women's utilization of ANC services, particularly among expectant young women, has been low, especially in areas with limited resources (Worku & Woldesenbet, 2016). Kenya had less than 50% of all expectant women attaining the recommended four ANC visits in 2015, with as little as 20% getting pregnancy care in their first trimester (Micronutrient Initiative,

2016). Lately, it's been suggested that increasing prenatal contact with healthcare providers is directly proportional to positive pregnancy outcomes (World Health Organisation, 2018). With this evidence, the WHO now recommends eight ANC contacts at a minimum, with five contacts preferable in trimester three, two contacts in trimester two, and one contact in the first trimester. It is therefore crucial to implement interventions designed to enhance antenatal care usage and quality of services for young women especially adolescent girls.

Text messages to educate and prompt pregnant young women of their ANC schedules as well as address stigma associated with preventing young women from seeking healthcare is one capable intervention that needs to be explored. Several research trials have established the possibility of achieving positive changes in behaviour among young people through mobile text messaging (Hampshire et al., 2015; LEngle et al., 2016; Rokicki et al., 2017). At present, the effectiveness of textual health resources to bring about positive changes in antenatal behaviours among expectant young women is still in question, hence educational health messages and reminders from a mHealth platform could be a promising alternative that is yet to be explored among this population.

Prenatal health services provided to pregnant women including expectant adolescent girls include identification of pregnancy risks and complications, prevention and management of these complications as well as health education (World Health Organisation, 2018). The WHO recently updated its antenatal care guideline from four initial visits to eight clinical contacts. A recent analysis of the WHO antenatal care trial recently found that the four-visit focused antenatal care (FANC) model had higher perinatal mortality compared to models of ANC with eight or more clinical interactions between expectant women and medical professionals (Vogel et al., 2013;

World Health Organisation, 2018). There is proof that increased ANC contacts result in skilful deliveries and favourable pregnancy outcomes. The most crucial intervention that could lower maternal mortality, including new-born fatalities, is timely ANC contact. It has been demonstrated that having at least four clinical antenatal contacts and consulting a competent healthcare provider during pregnancy lowers the risk of perinatal death by 3.09% and reduces the risk of delivering low-birth-weight infants by 6.65% (Kuhnt & Vollmer, 2017). This association notwithstanding, ANC uptake is still low among women. A study from several low income countries determined that a substantial number of women needing ANC services had at least three ANC contacts and a little over 40% had more than four clinical antenatal contacts (Benova et al., 2018). In Kenya, a study done to assess the effectiveness of prenatal services opined that almost 40% of neonatal mortalities can be prevented by adherence to ANC appointments (Arunda et al., 2017). In line with the World Health Organization guidance of increased prenatal contacts with healthcare workers for better maternal outcomes, evidence-based and effective interventions to help increase prenatal services' utilization by expectant young women should be put in place.

Community health interventions have been introduced to help increase ANC service uptake among expectant young women. For instance, the antenatal health programme for expectant adolescent girls in Canada which involved their spouses to enhance psychological support and ANC coverage (Wiemann et al., 2014); this programme determined that adolescents' male spouses were likely to repeatedly attend clinics with their partners for antenatal support group meetings if asked by a male facilitator to "demonstrate that they care" and their being present is valued. Additionally, being certain that other fellow men will be in attendance was also a motivating factor. Essentially, clinical prenatal sessions were presumed as women's affair while men seized the chance to discuss

their issues like how to deal with family matters. Community awareness interventions on the significance of ANC (Choudhary, 2021; Denno et al., 2021), birth plans utilization in Tanzania to improve institutional deliveries (Magoma et al., 2013), in kind incentives like provision of basins, clothes for the infants, and disposable nappies to inspire safe deliveries at health facilities, household visits by community health volunteers in low income countries (Mbuagbaw et al., 2015) and providing facilities with modern equipment like ultrasound in Kampala, Uganda (Cherniak et al., 2017) are among the many interventions initiated to help increase uptake of prenatal services. In spite of these initiatives, the percentage of young expectant women achieving the recommended prenatal contacts is currently very low. mHealth incorporation into existing clinical service delivery points and community led initiatives have a promising potential to increase timely prenatal health seeking behaviours for expectant young girls and women (Ayiasi et al., 2016).

According to Demirguc-Kunt, Klapper, Singer, Ansar, & Hess, (2017), 74% of women and 84% of men in developing nations own a mobile phone, with those aged 15 to 25 having the most number of cell phone users (Vaidya et al., 2016). In Kenya, 91% and 86% of men and women own a mobile phone respectively (GSM Association, 2020). Majority of young people in Kenya, especially girls, can easily access cell phones, creating a significant opportunity to change how health care information can be delivered. Mobile health (mHealth) is one of the innovations that WHO says is essential for improving health systems (Foster et al., 2015). The rapid growth of cell phones' availability makes them suitable for advancing sexual and reproductive health information and education. In India, for instance, a mobile phone intervention was associated with increased prenatal uptake, iron tablets consumption, skilled deliveries and tetanus toxoid immunization (Bangal et al., 2017). This was seemingly attributed to a feeling of being recognized by the

healthcare providers (HCPs) as well perceived comprehensive care from the said HCPs (Lau et al., 2014) and the need and desire for getting text messages with specific gestational and infant-related information (Cormick et al., 2012; Endehabtu et al., 2018) as was established in Ethiopia, South Africa and South America.

The increased availability of cell phones and young women's readiness to get health education messages via their mobile phones (Endehabtu et al., 2018; Fedele et al., 2017) point to the possibility that mHealth will change the way that formal healthcare is provided in low-income settings. Moreover, the effectiveness of traditional approaches like ANC referrals cards and community interventions including outreaches to positively influence antenatal behavioural changes for expectant young girls and women in Kenya is uncertain (Gitonga, 2013). mHealth reminders and educational messages could be an effective complement which is yet to be tried and recognised particularly targeting expectant young girls and women in Kenya.

1.2 Problem statement

In Kenya, 18% of adolescent girls aged 15-19 have had a birth or are expecting their first born (Kenya National Bureau of Statistics, 2015). In Kwale County, 24% (more than the Kenyan average) of adolescent girls (15 – 19) have started child bearing (Kenya National Bureau of Statistics, 2015). Approximately (67%) two thirds of all expectant women including adolescent girls and young women in Kwale County don't adhere to their planned prenatal schedules (Mwaniki et al., 2014).

A presidential directive through the ministry of health in Kenya abolished all maternal health payments effective 1st of June, 2013. This maternal no-pay policy was intended to increase access and utilization of maternal health services and to reduce pregnancy related morbidities and mortalities (Ministry of Health Kenya, 2016). This policy notwithstanding, prenatal care uptake of four or more contacts by expectant adolescent girls and young women in Kenya is less than half (48.9%) (UNICEF, 2018a). In addition to cost of maternal services, several other factors have been attributed to low utilization of prenatal services in Kenya including poor and inadequate referral channels and poor quality of services provided to pregnant women (Gitobu et al., 2018). In Kenya, referral strategies have mainly relied on community health volunteers to encourage positive antenatal health behavioural changes. Undoubtedly this approach and the utilization of ANC appointment cards have been suboptimal in improving uptake of prenatal health services (Gitonga, 2013).

Expectant young women go to prenatal clinics for different motives. Research in Uganda and Kenya found that securing the antenatal appointment card was seen by young women as a sure pass to receiving priority services when giving birth (Ndambuki et al., 2017; Turyasiima et al., 2015). For that reason, majority of expectant young girls and women in Kenya attend at least one prenatal clinic to ordinarily get the clinical appointment card. Also, a significant number of expectant young girls and women don't know their clinical schedules even though the dates are usually written on their clinic booklets and cards; knowledge gaps among expectant young girls and women on the required number of clinical contacts have also been documented (Ndambuki et al., 2017). These overlooked opportunities to prompt expectant young girls and women of their clinical schedules and timely antenatal contact have led to increased maternal complications

including new-born deaths among expectant young women. Furthermore, health workers and expectant young women's guardians have to some extent been shown to experience moral distress grounded on their individual morals about teenage motherhood leading to stigmatizing inclinations hence impairing their capacity to afford quality moral care and comprehensive antenatal services to the young women (Nyblade et al., 2019). Healthcare workers' and adult caregivers' attitudes whether real or perceived as well as the provision of inadequate support to expectant young girls and women coupled with judgemental services contribute to less than the recommended ANC contacts. Absence of systematic integrations focussing on expectant young girls and women, their caregivers and HCPs may exacerbate these concerns. Using a multifaceted method to reach pregnant young girls and women and their spouses including caregivers with tailored reminders as way of extending health services to the households by the HCPs will not only encourage expectant young girls and women to observe their prenatal schedules but can also contribute to stigma reduction as well as improve the quality of prenatal services. HCPs involvement in the development and application of adaptable appointment strategies is anticipated to contribute to the creation of caring interactions among pregnant young women, their spouses/caregivers and the HCPs.

Although studies have been done on the effectiveness of mHealth interventions on maternal, new-born and child health care, systematic reviews have shown ambiguities in the way interventions were described; some had combined multiple mHealth applications thereby presenting difficulties in interpreting and determining the attribution effect of each intervention resulting in inconclusive findings (Abejirinde, Bardají, et al., 2018; S. Lee et al., 2016; Watterson et al., 2015). Furthermore controlled-trials and quasi-experimental studies to strengthen the literature on mHealth maternal

interventions have been found to be inadequate (Chen et al., 2018; Feroz, Perveen, et al., 2017) while very few have integrated mHealth interventions within existing ANC service delivery points as well as involved health care providers in developing the interventions (Feroz, Rizvi, et al., 2017). Furthermore, a small number of controlled trials have been done in the field of mHealth and prenatal care targeting expectant adolescents and young women, thus qualifying the need for additional research to increase the evidence.

In light of the knowledge gaps identified above, this quasi –experimental study sought to determine the feasibility and acceptability of a mHealth-text messaging intervention. The specific objectives were to investigate the intervention's effect on antenatal care utilization, institutional deliveries, and infants' birthweights among expectant adolescent girls and young women in Kwale County, Coastal Kenya. This study took into consideration essential components of expected antenatal services and the timing of health interventions during pregnancy.

1.3 Study justification

The significance of prenatal care for a positive pregnancy outcome cannot be overemphasized. Certainly, there is enough scientific proof associating poor perinatal outcomes and other birth complications to inadequacy of ANC care among expectant adolescents and young women (Mekonnen et al., 2019). In spite of the Kenya's ministry of health's efforts to have beneficial policies aimed at improving prenatal care, expectant young girls and women have not been able to make the recommended clinical contacts with HCPs. Innovative and effective strategies to supplement prevailing demand-creation strategies need to be designed, tested and evaluated. The increased availability of cell phones presents the prospects to positively alter the way health

information and services are provided and evaluated for specific outcomes. mHealth interventions have shown the potential to improve the quality of health services and improve timeliness and coverage. However, there is little evidence regarding the effectiveness of mHealth platforms targeting expectant young women aimed at improving ANC uptake and service utilization in Kenya.

This study is about the first to test the effectiveness of using mHealth text messaging (SMS) intervention to deliver aspects of ANC services among expectant adolescents and young women in Coastal Kenya. Findings from this study provide information on the feasibility and acceptability of integrating mHealth into existing antenatal service delivery points and will also help to elucidate the health care workers' perceptions regarding mHealth-ANC integration. Moreover, findings contribute to the body of knowledge and evidence regarding mHealth intervention's effects on antenatal care service utilization by expectant young women and on specific maternal health outcomes including institutional deliveries and infant birthweights. Also, this study provides suggestions on potential solutions to address HCPs and service user-level challenges associated with incorporating mHealth interventions into prevailing service delivery points. In addition, findings from this research can be utilized to advance the design and application of mHealth client/patient tracking and follow up strategies not only in prenatal clinics but to other comprehensive care and treatment adherence clinics like HIV clinics, TB clinics and other maternal, new-born and child health related services.

1.4 Objectives

1.4.1 General objective

The general objective of this study was to determine whether mHealth text message intervention integrated into an existing ANC service delivery system improves antenatal health outcomes among expectant adolescents and young women aged 24 and below in Kwale County, Coastal Kenya.

1.4.2 Specific objectives

1.4.2.1 Primary objectives

1. To assess the feasibility and acceptability of using mHealth-text messaging intervention to deliver aspects of ANC services to expectant young women in Kwale County, Kenya.
2. To design, implement and assess the effect of mHealth – text messaging intervention on utilization of ANC services

1.4.2.2: Secondary Objectives

1. To determine the effect of mHealth-text messaging intervention on institutional deliveries
2. To determine the effect of mHealth-text messaging intervention on infant birthweights.
3. To assess health care providers' perceptions and service user-level challenges of integrating mHealth-text messaging intervention into an existing ANC delivery system.

1.5 Research questions

1.5.1 Primary Research questions

1. Is the use of mHealth-text messaging intervention to deliver aspect of ANC services feasible and acceptable among expectant young women and healthcare providers in Kwale County, Kenya?
2. What is the effect of mHealth-text messaging intervention on utilization of ANC services?

1.5.2 Secondary research questions

1. What is the effect of mHealth-text messaging intervention on institutional deliveries?
2. What is the effect of mHealth-text messaging intervention on infants' birthweights?
3. What are the health care providers' perceptions regarding integrating mHealth-text messaging intervention within the existing ANC delivery system?

1.6 Conceptual framework

This study's conceptual framework (figure 1.1) was adapted from Family and Reproductive Health Indicators Database - conceptual framework in reproductive health programs which has been utilized to demonstrate the pathways by which Reproductive Health (RH) programs achieve their objectives (USAID, 2018). The RH framework illustrates the different components including system level factors (social, cultural, political, economic and legal) individual factors, demand for healthcare indicators, service utilization, health behaviours and the policy environment which are critical to achieve the desired reproductive health outcomes. This study adapted the RH framework to represent the factors (individual, accessibility & demand creation strategies) recognised as key factors associated with expectant young women's uptake of prenatal services. Some of the

components present in the RH framework and which could not be measured by this study were dropped; they included the system level factors and the policy environment.

While prenatal service use was important to this study as it formed the base for enrolling study participants, adherence to clinical antenatal schedules and increased prenatal contacts to four or more were specifically what the intervention intended to effect. Expected proximal outcome of the mHealth-text message intervention was increased prenatal contacts to four or more. This study postulated that, increased prenatal contacts will influence skilled deliveries at the health facilities and subsequently lead to normal infants' birthweight of ≥2500 grams as a result of the nutritional messages sent from the mHealth platform and comprehensive prenatal care given during pregnancy. Also, gaps in ANC knowledge and stigma associated with teenage motherhood have all been found to be contributing to low uptake of prenatal services by expectant young girls and women. Text messages were therefore sent to both expectant young women and their spouses and caregivers referred to as "treatment supporters" in this study as a strategy to address stigma related concerns and hence promote and increase antenatal service use by targeted girls and women.

Similar to RH framework, this study also appreciated the potential effects of other variables including individual variables like age of the participants, their educational levels, marital status, employment status, religion and parity as well as accessibility influences like distance to health facilities; perceived benefits of prenatal care and pregnancy type including which have all been associated with antenatal behaviours of expectant young women. As a result of these factors, some expectant young girls and women avoid going for timely prenatal services hence delaying early identification of any pregnancy complications resulting in adverse maternal outcomes. These

factors were therefore considered in the analysis of the study's outcomes of interest. Further, the mHealth intervention was also expected to work together with prevailing approaches presently being applied locally. In Kenya, house and community visits done by community health volunteers is the most commonly used community intervention while antenatal cards with antenatal schedules are used by many maternal health facilities. The supposition in most instances was that these approaches will also be effective to expectant adolescent girls and young women. Reviewed literature has however highlighted insufficient referral approaches and stigma as the greatest determining factors of young women's uptake of prenatal services in Kenya (Gitobu et al., 2018). A complementing mobile health strategy targeting expectant adolescent girls and young women and their spouses/caregivers with informative and reminder messages has the potential to contribute to stigma reduction and improve prenatal service uptake by expectant young girls and women.

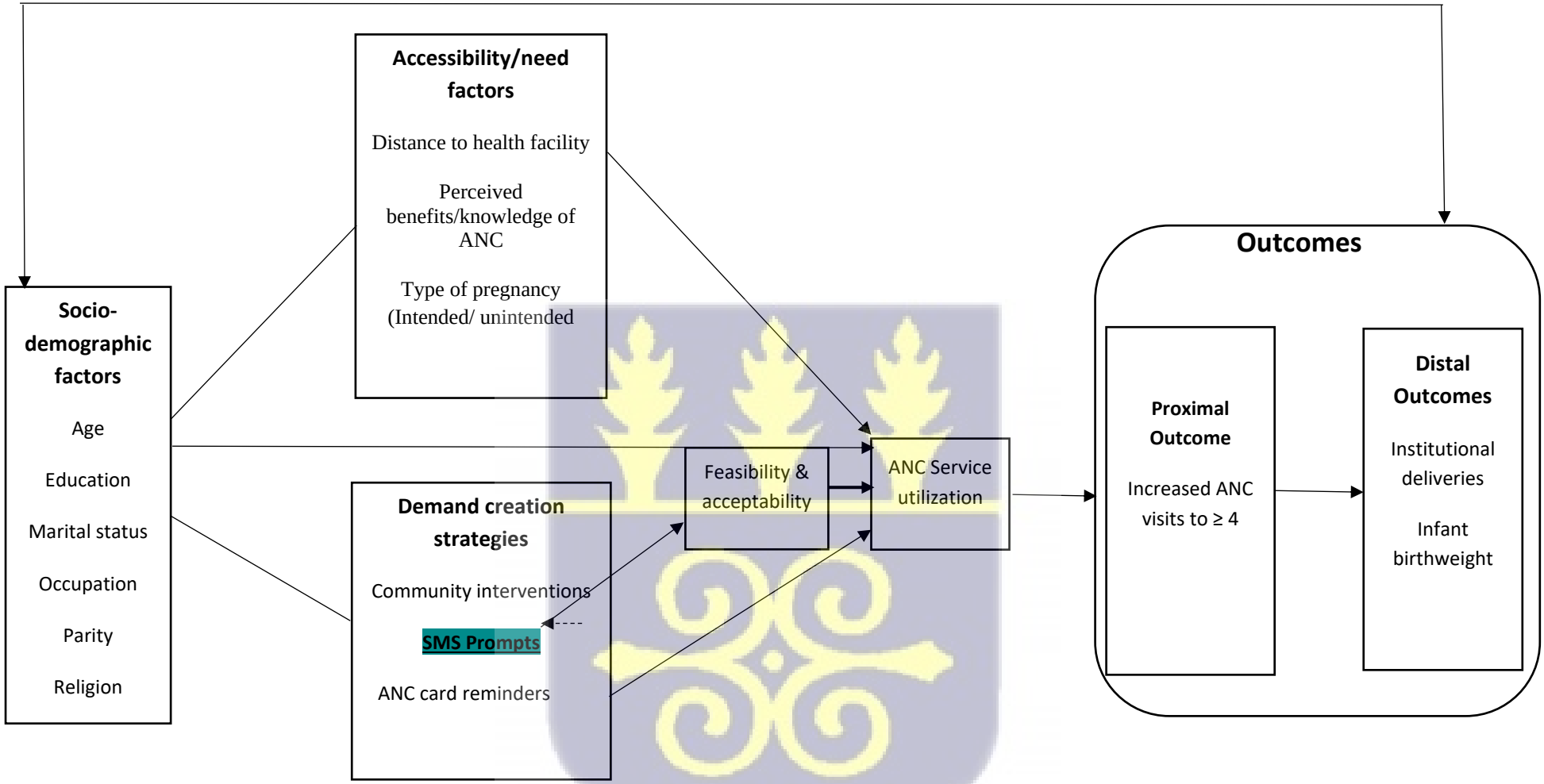

Figure 1.1 the mHealth-text messaging intervention conceptual framework

(USAID, 2018)

Lastly, in the conceptual framework is the assessment of the mHealth text messaging intervention's feasibility and acceptability. Key Constructs from the Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2016) were used to qualitatively assess the intervention as envisioned while considering the viewpoints of the participants and the HCPs. The key constructs of UTAUT that influence individual's use of technology considered for this study included, mHealth performance expectation, anticipated efforts to interact with the intervention, facilitating conditions and social influence (figure 1.2). According to this theory, feasibility, acceptability and use of a technological intervention is influenced by several factors as illustrated in figure 1.2 below. For this study, feasibility and acceptability of the mHealth intervention was assessed and presumed to be influenced by the degree to which the study participants and especially the HCPs believed that using mHealth will enhance their job performance by improving their ANC indicators; degree of ease associated with its use from both the HCPs' and expectant young women's perspectives; how other people will perceive the technology (social influence) as well as the participants' perceptions regarding the existence of the technical infrastructure to support the use of the mHealth technology (facilitating conditions).

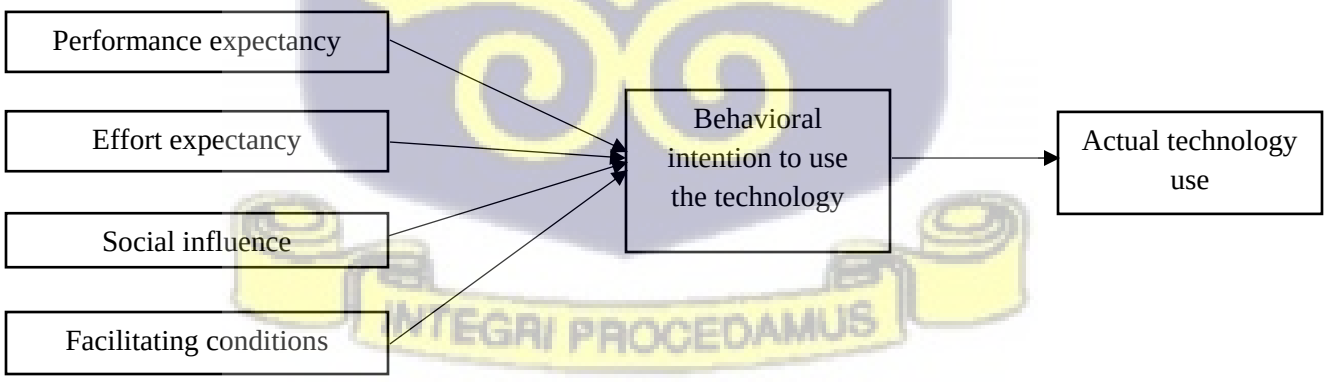

Figure 1.2: UTAUT Conceptual framework

(Venkatesh et al., 2016)

Though not yet tried in mHealth sexual and reproductive health research, the UTAUT theory has been found to have the potential to describe and determine factors affecting the practicability, acceptability and utilisation of mobile health interventions from patients' and HCPs' perspectives (Alam et al., 2018).

1.7 Chapter Summary and thesis outline

This chapter described the problem of adolescents' and young women's pregnancies and the low antenatal contacts in Sub-Saharan Africa and Kenya in particular. The study objectives and the research question have also been described. This study's conceptual framework has also been explained and illustrated in this chapter. The rest of the thesis is organized as follows: Review of relevant literature (Chapter 2); Methods (Chapter 3); Results (Chapter 4); Discussions (Chapter 5) and Summary and Recommendations (Chapter 6).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a detailed review of literature on teenage pregnancies, barriers to antenatal care and adverse pregnancy outcomes among expectant adolescents and young women. Maternal care demand creation strategies, including mHealth interventions to improve health outcomes, including ANC coverage and the feasibility and acceptability of these interventions have also been discussed. The literature review was based on the objectives and research questions for this study and is organized sequentially by themes and sub-themes. Online databases used for the literature review included PubMed, ScienceDirect, JSTOR and Google Scholar as the primary source for gathering relevant literature. The search terms were carefully selected to reflect the objectives of the study. The specific search terms included mHealth OR digital health AND young people AND sexual and reproductive health, digital health AND behaviour change, teenage pregnancies AND ANC uptake, adverse pregnancy outcomes AND young women, mHealth usability AND feasibility AND acceptability, maternal care AND demand creation. Each identified publication was critically evaluated for appropriateness and relevance before being included in the review. The synthesis process was done by developing an outline where common themes were identified and their sources were summarized before structuring the writing of this chapter. This chapter closes with a summary of the literature reviewed.

2.2 The burden of teenage pregnancies

Globally, more than 10 million 15-19 years old girls and more than half a million girls below 15 years get pregnant annually, with at least 10 million unintended pregnancies occurring annually among adolescents in developing countries (WHO, 2020). These early pregnancies are more concentrated among adolescent girls from poor regions, especially those living in rural areas (Neal et al., 2020). The rate of teenage pregnancies is highest in Sub-Saharan Africa (28%), while 19% of 20-24 year-olds reported to have had a child before 18 years and 3% before 15 years (Ramraj et al., 2018). Young girls' health including their future are negatively impacted by early and unwanted pregnancies, which frequently prevent them from getting any meaningful education and, as a result, limit their ability for self-support and providing for their families in future. An analysis of risk and protective causes related to early motherhood highlighted gender inequality, poverty, and a lack of education as facilitators of early marriage and childbirth that prevents adolescent girls and young women from realizing their potentials (Wado et al., 2019).

2.2.1 The Kenyan Situation

Comparable to other Sub Saharan African nations, Kenya's population is largely young, with an estimated 40% of people under the age of 20 (National Council for Population Development, 2020). These young people are frequently at risk of economic, social and health issues that impact their lives and general well-being. Kenyan women start having children at young ages, with over 25% giving birth before the age of 18 and 50% of them by the age of 20 (Kenya National Bureau of Statistics, 2015). From as low as 10% in the Central province to as high as 22% in Nyanza, teenage pregnancies in Kenya vary in prevalence depending on the region. County teenage pregnancies' rates range from as low as 6% in Kiambu and Murang'a counties to as high as 33%

in Homa Bay County (Kenya National Bureau of Statistics, 2015). Kwale County (together with Tana River County) remains one of the top two counties in Kenya's coastal belt having the highest proportion (24%) of childbearing teenagers, this prevalence in Kwale County is expected to stagnate or increase in the near future (Population Reference Bureau, 2016).

The rising number of pregnant teenagers is a public health quandary because most of them avoid skillful prenatal health services hence resulting to maternal problems and unfavorable health outcomes (Mekonnen et al., 2019). Inadequate or a lack of timely and quality ANC has been primarily linked to preterm births and maternal deaths associated with this population (World Health Organisation, 2018).

2.3 Barriers to Antenatal Care among Adolescents and Young Women

In SSA, uptake of recommended antenatal care by expectant adolescent girls is low; figure 2.1. Expectant young girls' uptake of four or more prenatal contacts in SSA is approximately 10 points less than mature women (46% adults vs 36% adolescents) (UNICEF, 2017). Similarly in Kenya, uptake of four or more prenatal contacts was shown to be less than 50% (48.9%) for expectant adolescents aged 19 years and below and ~60% for women between the ages of 20-34 years (UNICEF, 2018a). Inadequate pregnant women's uptake of well-timed and regular prenatal care is a critical obstacle for improving prenatal indicators in Kenya, and specifically for expectant young women.

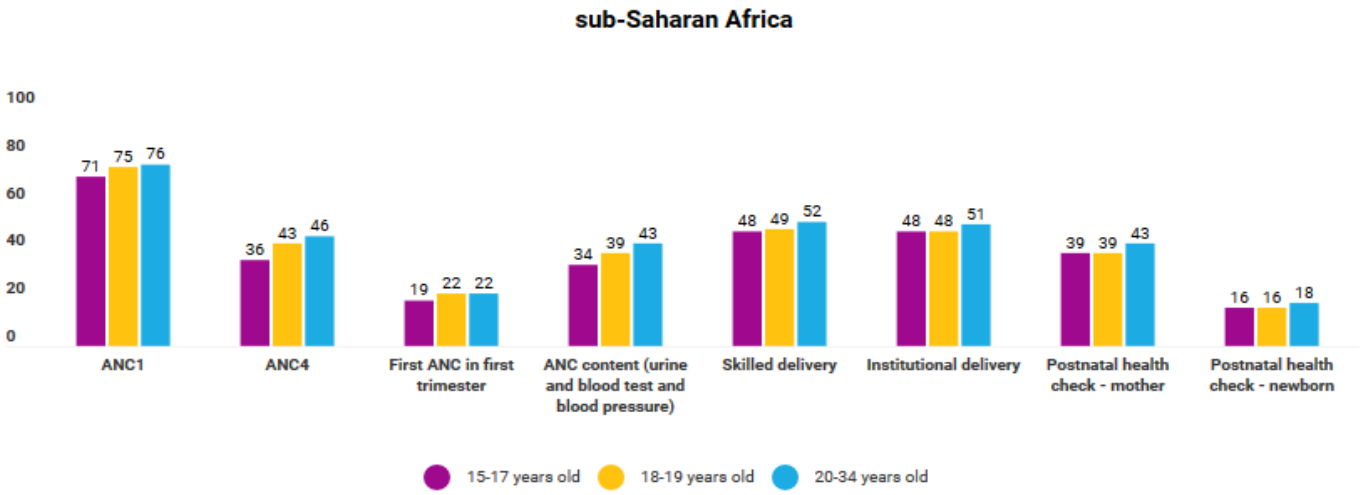

Figure 3.1 Coverage of maternal health indicators among women aged 15-34 (UNICEF, 2017)

To access the necessary ANC services, adolescent girls and first-time mothers must overcome a variety of uncertainties, difficulties, and obstacles. Stressful experiences may cause teen mothers to develop negative attitudes toward ANC and make them less likely to seek these services. Evidence based and supportive interventions should henceforth be designed and implemented to address the social determinants of health mainly targeting young women. This can be achieved by sensitizing and making HCPs sensitive and receptive to young girls and women's sexual and reproductive health and rights (SRHR) needs. Certainly, appropriate interventions are needed to provide standard ANC services at standalone service delivery points for young people as well as modernize prenatal referral channels as a way of extending care via regular and frequent interaction between expectant young women and HCPs.

2.3.1 Socio-Demographic factors and antenatal uptake among expectant young women

Several intrapersonal, economic, and cultural barriers prevent young women from adhering to their antenatal clinical appointments. Self-stigma resulting from societal perspectives and self-blame leads to withdrawal behaviours, which in effect leads to poor timing of clinical contacts with health care providers (Ronen et al., 2017). Delays in access to prenatal care (ANC) and poor fetal outcomes have been strongly linked to teenage pregnancies (Budu et al., 2021), greater parity, single motherhood, stressful settings, and young women's reluctance to disclose their pregnancies out of fear of rejection (Carvajal et al., 2020; Kapaya et al., 2015).

A study examining ANC uptake in SSA countries with the highest prevalence of teenage pregnancies determined a very low uptake of ANC among expectant adolescent girls (9.3%), with adolescent girls from households with the highest income levels (odds ratio OR = 2.44, 95% confidence interval (CI) = 2.23-2.68), residing in urban areas (OR = 1.25, 95% CI = 1.18-1.33) and with a post primary education (OR = 1.61, 95% CI = 1.50-1.73) having higher odds of getting prenatal care compared to their counterparts in the low income households, residing in rural areas and not having a post primary education (Carvajal et al., 2020). Age was also a significant predictor of ANC uptake with expectant adolescents between the ages of 15 and 17 years and 18-19 having respectively 26% (OR = 0.74, 95% CI = 0.67-0.82) and 9% (OR = 0.91, 95% CI = 0.84-0.98) lower odds of receiving the basic antenatal care compared to women 20-49 years old. Early married girls had 12% (OR = 0.88, 95% CI = 0.84-0.93) lower odds of receiving prenatal care compared to women who were married after their 18th birthday (Carvajal et al., 2020).

In Kenya, it has been shown that ANC uptake depends on the mother's age, level of education, residential area and their household income. In 2015, 68% of urban women and 51% of rural pregnant women had at least four ANC contacts with a healthcare professional (UNICEF, 2018a). During the same period, 49% of expectant adolescents aged 19 and below had not less than four clinical contacts, with 62% giving birth in a medical facility attended by a skilled provider (UNICEF, 2018a). This significantly low ANC turnout among expectant adolescents and young women may be a factor contributing to low birthweight infants and an increase in neonatal mortality (Mbuagbaw et al., 2016).

Similarly, a multi-country study conducted in Senegal, Ethiopia and Kenya found a positive correlation between ANC uptake and higher levels of education, household income, ownership of mobile phones, and the employment status of the woman (Verney et al., 2018). In essence, compared to pregnant young women from low-income households, those from well-to-do families were more likely to have at least four ANC contacts. Similar to this, a multilevel analysis of factors associated with ANC visits in Nigeria found that age, parity, maternal health education, occupational status, place of residence, partner's education, ethnicity, religion, wealth index, region, media exposure, and community literacy level were associated with inadequate ANC services uptake (Bolarinwa et al., 2021).

2.3.2 Accessibility and need factors associated with ANC uptake among expectant young women

In addition to sociodemographic factors, several other factors, such as out-of-pocket expenses (like transportation and purchasing medication), stigma, poor prenatal care services and inadequate

resources required to provide comprehensive prenatal healthcare are connected with suboptimal utilization of ANC among expectant young girls (Mekonnen et al., 2019). Specifically, distance and inaccessibility of health centres and poor quality of clinical services have been associated with young women's suboptimal uptake of prenatal care (Worku & Woldesenbet, 2016). At the individual level, knowledge and perceived need of antenatal care have been associated with expectant adolescents low ANC uptake in SSA (Mekonnen et al., 2019).

Self-shame and community perceptions associated with teenage pregnancies are among the forms of stigma experienced by expectant adolescents and young women. According to some studies, the stigma associated with premarital sex prevents unmarried pregnant adolescents and young women from seeking antenatal care (Hokororo et al., 2015; Mekonnen et al., 2019). Since their parents worry about negative judgments from their neighbors, the stigma also extends to them. Stigma at healthcare facilities can take many forms, such as outright service denial, poor ANC services, verbal and physical abuse, intentionally long waiting times, and the shifting of tasks to less experienced or competent coworkers (Nyblade et al., 2019). This results in poor uptake of ANC care by pregnant young women leading to severe maternal health outcomes. Also, as stigma teachings are not normally included within the HCPs pre-service training, some HCPs may display stigma propensities unintentionally mainly influenced by their spiritual or societal upbringings.

Expectant and teenage mothers in Kenya have stated receiving reprimands from healthcare workers (Kumar et al., 2018). In addition, healthcare workers' attitudes, beliefs and practices have been associated with feelings of marginalization as reported by expectant young women in Kenya (Kumar et al., 2018). The main source of social and moral care for pregnant adolescents and young

women is usually from their mothers, with little support if any from other members of the family, their spouses included (Kumar et al., 2018). Indeed, strategies to spur expectant adolescent girls and young women's ANC contacts should address both individual stigma, communal stigma and HCPs' negative tendencies. Additionally, interventions must be culturally relevant because stigmas are felt differently and also vary depending on the context (Nyblade et al., 2019).

Further, the low utilization of clinical services among expectant young women has been linked to health care providers' inadequate knowledge of dealing with young people's SRHR issues, communication challenges between HCPs and young people, including a failure to utilize data for endless quality enhancement (Hallum-Montes et al., 2016; Mekonnen et al., 2019). In Kenya, one study highlighted uncertainties about pregnancy as a factor associated with delayed ANC uptake (Oluoch et al., 2015). Females in the study reported missing their monthly periods as a pregnancy sign; however irregular periods occasionally associated with some family planning methods made it challenging for them to differentiate between gravidity and contraceptives' effects, many therefore chose to delay starting their ANC clinics as they wait for foetal kicks/movements (Oluoch et al., 2015).

2.4 Antenatal missed appointments and unfavorable maternal outcomes among expectant adolescents and young women.

In Kenya, in 2015, the neonatal mortality rate was 1.3 times higher (27 for every 1,000 live births) for young mothers aged below 20 years compared to mothers aged between 20-29 years (21 for every 1,000 live births) (UNICEF, 2018a). Almost 40% of all newborn mortalities would not have happened if pregnancy related complications were identified and treated early had the mothers

adhered to their antenatal appointments (Arunda et al., 2017). Despite the available knowledge and resources to prevent maternal deaths, pregnancy and childbirth complications continue to be the major contributors of maternal deaths among expectant adolescent girls aged 19 and below worldwide (WHO, 2022). Hemorrhage, infections, hypertension and indirect causes, mainly caused by the combination of pre-existing medical disorders and pregnancy, are the leading causes of preventable mortalities. All these causes are manageable and treatable if appropriate measures are implemented to guarantee that pregnant adolescents and young women attain the necessary clinical services during their pregnancies.

Missed or delayed ANC services make expectant young women even more vulnerable, resulting in maternal mortalities. From a research perspective which links adolescent girls to undesirable antenatal and postnatal outcomes, (Grønvik & Sandøy, 2018), expectant young women need skilled and dependable clinical and psychological interventions to prevent the pregnancy from harming the infant and mother. Certainly, approaches aimed at improving ANC contacts of expectant young women must appreciate their special wants and be incorporated within the prevailing service delivery points. Additionally, adaptable friendly services and referral networks for young women need to be designed by policy makers and HCPs during prenatal visits with expectant young women for a sustained and seamless clinical and psychosocial support system.

2.4.1 ANC and HIV prevention of Mother to child transmission (PMTCT)

Inadequate ANC uptake might have prolonged negative effects to the young mothers and their infants especially for HIV exposed infants. There is scientific proof from studies in SSA indicating poor PMTCT outcomes and higher prevalence of HIV infections among babies born of HIV

positive young women aged 19 and below compared to older women (Callahan et al., 2017). Similar to low ANC coverage among young women, several surveys in South Africa have determined that expectant adolescents had lower PMTCT uptake and increased risks of mother to child transmission of HIV compared to older women (Ramraj et al., 2018). Comparable trends were seen in Kenya where expectant adolescents living with HIV were less likely than adults to be on antiretroviral therapy (65.0% vs 85.8%, $P = 0.01$) or to have their babies on antiretroviral (85.7% vs 97.7%, $P = 0.005$), hence putting their neonates at risk of HIV infections (Ronen et al., 2017).

These findings further underscore the need for innovative strategies to have young women begin and observe their postnatal schedules. Moreover, postnatal care presents a chance for early diagnosis of HIV infected expectant young women and start them on ARVs to protect their newborns from the virus. Additionally, timely and regular prenatal contacts for young women will also present an opportunity for HCPs to identify HIV negative young women with risky SRH behaviours who may benefit from prevention care like pre-exposure prophylaxis (PEP) post-delivery and condom use among other behaviour change interventions.

2.5 Demand creation strategies to improve antenatal care uptake

One substantial risk associated with maternal morbidities and deaths is inadequate antenatal care. In light of this, numerous SSA countries have attempted to implement policies to encourage pregnant women, especially young girls and their partners, to receive quality and timely antenatal care. Some of these demand creation interventions are explored in the remaining sections of this chapter

2.5.1 Community-based outreach interventions to increase ANC uptake

According to WHO (2020), community-based outreach programmes are an extension of primary healthcare services offered at health facilities and utilised to reach underserved communities and attain high population coverage. These outreaches have been found to have the potential to improve access to maternal services in sub-Saharan Africa (Annobil et al., 2021; Mash et al., 2019). Kenya also appreciates the power of community outreach programmes. The ministry of health in Kenya has developed an all-inclusive community health strategy outlining how coordinated outreaches and health awareness activities should be carried out (Ministry of Health Kenya, 2020). As will be discussed below, several community-based programmes that enhance maternal health have been implemented and evaluated in sub-Saharan Africa:

Home visits by Village Health Teams to remind pregnant women including adolescent girls of their prenatal schedules and the need for institutional deliveries is one intervention trial that was done in Uganda (Ayiasi et al., 2016). Though the main outcome was skilled deliveries, improved ANC uptake and birth readiness was significant to have women give birth in a health facility. Significant post-trial findings gathered comprised of delivery places adjusted Odds Ratio (aOR): 17.94 (95% CI: 6.26 – 51.37); $p<0.001$ cord care [aOR: 3.05(95% CI: 1.81– 5.12); $p<0.001$] thermal care [aOR: 7.58(95% CI: 2.52–22.82); $p<0.001$], and timely uptake of clinical services in case of an ailment [aOR: 4.93(95% CI: 1.59–15.31); p = 0.006]. Women between the ages of 13 – 24 years also participated in the study; however, the intervention effects were not age specific thus presenting challenges linking the findings to expectant young women's antenatal and postnatal outcomes. Similarly, in Tanzania and Ethiopia, community outreaches have been shown to have

the potential to improve maternal outcomes including antenatal contacts and skilled deliveries (Dearden et al., 2021; Defar et al., 2021).

Other community initiatives with the potential to enhance ANC coverage include community-focused primary care outreach programmes (Mash et al., 2019), coupons for expectant women to attend to their clinical schedules, restrictive cash allocations for women who attain specific prenatal target, and rewards given to traditional birth attendants serving as delivery buddies (Engmann et al., 2016). These initiatives notwithstanding, a scoping review of community-based primary care determined that the effectiveness of clinical community outreaches was very low and therefore recommended further research to be conducted to comprehensively describe community outreach models and assess their efficacy in sub-Saharan Africa (Choudhary, 2021; Mash et al., 2019). Further, some of the community interventions like vouchers and cash transfers are largely donor funded; upholding such programmes is a challenge because of the donors' ever-changing priorities thereby distracting the donations anticipated by the beneficiaries. Indeed, it is necessary to design sustainable programmes that will motivate and change the behaviours of expectant young women in need of reproductive healthcare. Community led strategies and varied interventions aimed at strengthening the health system have shown their ability to increase the first ANC uptake for women (Ediau et al., 2013) but lacked sufficient proof of retaining them on prenatal care. Moreover, promoters of community interventions in health service delivery have suggested a speedy adoption of innovative technologies to address developing health concerns in SRHR including improved postnatal coverage for young women (Arifeen et al., 2013; Wallis et al., 2017). These scientific advances should complement prevailing community-led approaches presently ongoing SSA.

2.5.2 Ultrasound Use and Associated Improvement in ANC coverage

A randomised controlled trial with the main goal of enhancing prenatal attendance found that expectant women's motivation to frequent ANC clinics was for the reason that they will be able to see their yet to be born infants via the ultrasound scan (Cherniak et al., 2017). The ANC attendance rate in communities where movable ultrasound was promoted through varied media was found to be 65.1 for every 1000 pregnant women, compared to a rate of 11.1 for every 1000 pregnant women in control communities (rate ratio 5.9, 95% CI 2.6-13.0, $p<0.0001$) (Cherniak et al., 2017). Despite the study demonstrating the positive result of movable ultrasound in improving prenatal uptake by expectant women in Uganda, there was no information to account for unskilled deliveries as the main aim of prenatal uptake. Women may have been motivated by the novel equipment and reverted back to their conservative ways including home deliveries.

In Kenya, Oluoch et al. (2015) determined that expectant young women's and health care providers' doubts concerning gestational age and pregnancy status were significant determinants of the timely utilisation of ANC services. Therefore, it was anticipated that the introduction of ultrasound scanning in healthcare facilities would increase the use of ANC services by confirming pregnancy status and permitting more precise gestational age calculations (Oluoch et al., 2015). Although hypothetical, equipping facilities with state-of-the-art technology and transforming the mindsets of healthcare professionals can improve the use of ANC, with a focus on adolescents and young women.

2.5.3 Participation of Men to Enhance the ANC Coverage

The public health community has also promoted male partner involvement throughout pregnancy as a sign of care and support for their pregnant partners during pregnancy and after birth. Family planning and PMTCT services are the two main drivers of this initiative. However, effective participation of males requires sustained efforts, including young adult men in reproductive health services. It is challenging to change gender stereotyping and enhance communication and cooperative decision-making among couples (Measure evaluation, 2017). A Ghanaian study of mobile midwifery technology discovered that expectant women enrolling with their spouses' mobile phone obtained prenatal backing from their partners because their spouses became interested in their women's gravidities and could listen to the messages before handing the phone to their wives (Entsieh et al., 2015). Unexpectedly, male's participation in their wives' pregnancies was a favourable intermediate finding which improved ANC uptake.

A comparable study in Mozambique showed that incorporating male partners in ANC appointments, including HIV testing services had a positive effect (Audet et al., 2016). Male partners' approval to test for HIV while attending their partners' antenatal clinics had a good outcome: the odds of women consenting to do a HIV test were 19 times higher compared to when they showed up the clinics unaccompanied (Audet et al., 2016). A pre-post intervention study evaluating the effect of a male-centred Rapid Result Initiative (RRI) to increase partner participation in SRH services including postnatal services in Kenya discovered that linking HIV care for couples increased from 58.6 to 85.9% (RD 0.27, CI 0.24–0.30) and 97.3% post-RRI (RD 0.39, CI 0.36–0.41) while facility deliveries among HIV infected women increased from 40.0 to 49.9% (RD 0.10, 95% CI 0.06–0.13) and 65.0% post-RRI (RD 0.25, 95% CI 0.22–0.28) (Akama

et al., 2018). This explains the missed opportunities (when men are not involved) in SRH service provision and particularly in prenatal care since HIV testing is crucial especially during pregnancy.

In the USA, young couples taking part in group-based prenatal care programmes stated improved engagement in the provision of care to their spouses resulting in improved antenatal outcomes (Wiemann et al., 2014). It occurred even though young men wanted to form a club where they could discuss manly affairs while their spouses sought medical attention. Certainly, there is evidence to suggest that improving male involvement in antenatal care can increase ANC uptake by their female partners. This can be potentially achieved by developing and implementing well-designed, adaptable, and sustained male-friendly interventions.

2.5.4 Birth Preparedness Plans to improve antenatal contacts and skilled institutional deliveries

Birth preparedness plans (also known as birth complication readiness) is a strategy to improve hospital deliveries facilitated by increased antenatal contacts. Since their introduction as a communication tool in the 1970s, birth plans have steadily been incorporated into females' prenatal childbirth readiness (Afshar et al., 2018). A randomised trial in Tanzania found that birth preparedness plans used during antenatal care had a significant positive impact on skilled births. Compared to the control group, the intervention arm where birth plans were implemented recorded higher skilled deliveries 16.8% [95% CI 2.6 – 31.0; $p = 0.02$] (Magoma et al., 2013). Systematic reviews have however questioned the effect of birth preparedness plans on maternal satisfaction because of insufficient data to back or disprove their impact on improving maternal

gratification, (Afshar et al., 2018; Mirghafourvand et al., 2019) essential in addressing the inadequate uptake of prenatal care among expectant young women.

Most ANC demand creation initiatives were implemented consistently across all pregnant women, regardless of their ages or other social considerations. Reported findings have not been separated to describe their effect on expectant adolescent girls and young women regarded as vulnerable compared to older mothers. Forthcoming demand creation strategies should be age and context specific.

2.6 Mobile health (mHealth) Interventions

Contemporary growth of information and communication technologies (ICT) presents avenues for advances in health service provision. Basic ICT solutions centering on enhancing the quality of healthcare in low income countries continue to be employed to improve literacy in health and to inform and educate HCPs. Some ICT projects in healthcare have started showing encouraging outcomes in SRHR, disease surveillance, electronic medical reporting (EMR) and in non-communicable diseases. One of the most recognized and applied invention linking ICT and healthcare is mHealth. It is described as "use of personal wireless communication devices including mobile phones and smartphones, smart watches, wireless sensors worn or carried by individuals, tablet computers, and other point of care devices to support continuous health monitoring, feedback and behaviour modification of individuals and populations" (Samples et al., 2014), page. 330).

Learnings from high-income countries have motivated SSA to embrace and adopt mobile health technologies to increase uptake of high-quality and prompt health services. However, due to the variety of mHealth applications, it has become challenging for policymakers to ascribe results to a specific application, especially when multiple applications are being used. Labrique attempted to separate mobile health from other technological health interventions and comprehensively explained mHealth approaches and the issues they seek to deal with in the healthcare space (Labrique et al., 2013). mHealth structure has therefore specified twelve common mobile health apps. Table 2.1 below shows the apps running on different mobile phones' functionalities.

Table 2.1: Mobile phone functions used in mHealth and ICT applications

	mHealth and Information & Communication Technology applications	Mobile phone function
1.	Client education and behaviour change communication	-Short Message Service -Multimedia Messaging Service -Interactive Voice Response -Voice communication/Audio clips -Video clips/ Images
2.	Sensors and point of care diagnostics	-Mobile phone camera -Tethered accessory sensors, devices -Built-in accelerometer
3.	Registries and vital events tracking	-Short Message Service -Voice communication -Digital forms
4.	Data collection and reporting	-Short Message Service -Digital forms -Voice communication
5.	Electronic health records	-Digital forms/ Mobile web (WAP/GPRS)
6.	Electronic decision support (information, protocols, algorithms, checklist)	-Mobile web (WAP/GPRS) -Stored information "apps" -Interactive Voice Response
7.	Provider to provider communication (user groups, consultation)	-Short Message Service -Multimedia Messaging Service -Mobile phone camera
8.	Provider work planning and scheduling	-Interactive electronic client lists -Short Message Service alerts -Mobile phone calendar
9.	Provider training and education	-Short Message Service -Multimedia Messaging Service

		-Interactive Voice Response -Voice Communication & Audio/video clips
10	Human resource management	-Web-based performance dashboards -Global Positioning Service (GPS) -Digital forms -Short Message Service
11	Supply chain management	-Web-based supply dashboards -Global Positioning Service -Digital forms -Short Message Service
12	Financial transactions and incentives	-Mobile money transfers and banking services -Transfer of airtime minutes
GPRS – General Packet Radio Service: WAP – Wireless Application Protocol		

Source: Labrique et al., 2013

Client education and behaviour change communication via SMS is the most common mHealth application, specifically in LMICs (Lee et al., 2016; Njoroge, Zurovac, Ogara, Chuma, & Kirigia, 2017). Owing to the LMICs' extensive exposure to mobile phones and their associated networks, customised SMS sent via cell phones have the ability to get to large proportions of individuals in remote places more effectively than other mobile functions (Njoroge et al., 2017). Also, SMS functions on basic algorithms and are effortlessly understood and uncomplicated to operate, not to mention the modest cost of basic phones in comparison to touch screens and smartphones, which are operated on more complicated applications.

2.6.1 Use of mHealth Technology to Strengthen the Health System

All structural and human resources that collaborate to restore, promote and sustain health are components of a health system. The WHO has identified six key components—human resources, information, governance, drugs, finances and service delivery—that work together to address the

healthcare needs of targeted populations (Management Sciences for Health, 2015). As shown in figure 2.2 below, mobile technology can be applied to complement each of the six pillars. Specifically, this entails facilitating the demand and supply of essential services, capacity building the health staff and tracking their performance, data and information gathering, and making sure that children and women access essential medical commodities. Additionally, mHealth technologies in health practice can be utilised during maternal cash incentivisation services through conditional cash transfers and mFinance in newborn and child health interventions.

Figure 2.2: Illustrating mHealth usages

Source: Philbrick, 2012

2.6.1.1 mHealth intervention for behavioural changes

One notable multi-country mHealth project is the Mobile Alliance for Maternal Action project commonly known as the MAMA project, which offered crucial educational health messages to expectant mothers, postnatal women, and their relatives so as to promote maternal health uptake before and after birth. Approximately 600,000 people in India, 2 million people in Bangladesh, 4,609 in Nigeria and 500,000 in South Africa, subscribed to the MAMA initiative (Rajan et al., 2017). The least number of subscribers was in Nigeria because the intervention only lasted for a single year there, as opposed to the other countries where it lasted several years (at least 3). The MAMA intervention was successful in reaching expectant women together with their relatives with crucial maternal information. Mothers stated that they valued the content they received on their cell phones, which was associated with increased antenatal knowledge, improved attitudes, and an increased uptake of health services (Rajan et al., 2017). One limitation associated with MAMA intervention was the absence of measures to sustain the project. Critics of the project have noted that potential users may lack some airtime in future to ask for information and the notion to have key stakeholders including governments to promote the project was not implemented on time. Gladly though, the messages are easily available and can be adapted and translated to fit into any local context. Additionally, and comparably to similar mobile health interventions, the MAMA project faced some challenges with retaining some individuals (Rajan et al., 2017) and also had ineffective tracking approaches. Utilizing and upholding a good intervention of that nature is essential; henceforward actions should be taken to advance public-private strategies for financing and expansion commitments and also incorporate the achievements made with prevailing health systems by sensitizing HCPs for systems' ownership and commitments.

2.6.1.2 mHealth for information and communication

Mobile health initiative in LMICs has proven that mobile devices can enhance health care through improved communication including consultations among healthcare professionals and remote surveillance and monitoring to enhance public health policies and programmes (Chib et al., 2015). Furthermore, mobile technologies have been used to gather data from clients at the hospitals via sensors and radars and virtually monitor and continuously report patients' clinical data using wearable devices. Such an approach eliminates patients' need for routine clinical visits. Fitness tracking technologies have also been attached to cell phones so individuals can continue to improve and monitor their health status (Cvrkel, 2018). However, this has led to some ethical exposures, such as the risks of giving uninformed sick people access to complex clinical data and allowing them to take control of their health conditions. Some of these individuals have reportedly changed their treatment regimens with little regard for medical professionals' advice (Cvrkel, 2018). Additionally, with the expansion of mHealth systems as communication channels and increased patient data collection, restrictive and regulatory policies designed to prevent misuse of individual data have made it challenging to access patients' information and, in other instances, made the compliant course more difficult (Rajan et al., 2017).

2.6.1.3 mHealth for tracking and treatment compliance

The effectiveness of mobile health technologies in the health sector have likewise been confirmed in healthcare facilities where non-adherence of clinical appointments has considerably reduced. In one study, the intervention group which received SMS reminders and normal care and the comparison group which only received normal care had a 14.6% difference in pediatric clinical visits adherence (p=0.04) (Lin et al., 2016). The control group had a higher rate of poor adherence.

However, the research did not have data on messages the caregivers received hence presenting challenges with determination of the exact impact of the mHealth project. Comparably, an evidence review on the effect of a mobile health intervention to improve the physical outcomes of adolescent boys and girls found a general effect of improved expected variables in projects constituting follow-up through text messages (Lee et al., 2019). Though the evidence review gave a detailed overview on the effects of mHealth interventions on adolescent physical outcomes, it lacked a comprehensive analysis of measureable research to help evaluate the impact of mobile technologies on the physical outcomes of adolescent girls and boys.

2.6.2 mHealth ethical concerns

Ethical concerns have been underscored about the integration of mobile health apps into prevailing healthcare systems. The main ethical concerns related to mHealth include individuals' access to their data like laboratory results devoid of professional explanation hence creating unnecessary mix-up and causing needless distress to ignorant individuals (Cvrkel, 2018). Occasionally, young people turn to the internet for interpretations and sometimes creating individual treatment ideas short of the guidance from a HCP. In addition, movable data on mobile gadgets carried by individuals or kept in the clouds are also predisposed to online cyberpunks regardless of the extent of safety procedures as mischievous persons have repeatedly confirmed an absence of immunity associated with cloud stored data (Cvrkel, 2018).

Prior to being made available to the public, complex mHealth applications should pass conformity assessments from regulatory bodies to ascertain their safety. This is important because some applications have provided inaccurate diagnosis to patients thereby declared unreliable in detecting

illnesses after the fact. For instance in the United Kingdom, applications claiming to be identifying the risk levels of medical emergencies like heart attack among users, have given varying results when applied independently (Armstrong, 2015). Consenting and conformity processes and assessments should therefore be implemented. People should also be educated on probable dangers related with mobile health applications.

Despite apparent complexity of the ethical situation around the mobile health application, mHealth technologies have the potential to revolutionise the public health space in LMICs. Access to timely data allows individuals and their HCPs to fully appreciate the disease dynamics, and develop effective strategies to address health complication, improve prognosis while providing real-time personalised health services. Such benefits overshadow the identified ethical issues which can be dealt with through effective policies.

2.6.3 mHealth interventions for Adolescents' and Young people's SRH

Young people have accepted mobile phones as an appropriate channel for receiving personalised health information devoid of any judgment nor stigma (Ippoliti, 2017). The privacy with which mHealth platforms address SRH matters is an important feature that appeals to both young people and healthcare professionals. In West Africa, Nigeria, a media permitting young people to request for health information and ask questions via SMS to be replied to by trained HCPs determined widespread SRH knowledge gaps (Blanc et al., 2016). Platform users, although happy with the intervention, voiced their confusions, misperception and misinformation regarding SRH as they struggle to comprehend their body changes. The amount of text messages requested and received by users in the research point to their readiness to interact with the mHealth interventions.

Furthermore, the study highlighted a need for a cost-effective, reliable and sustainable systems through which young users can get reliable and up to date SRH materials when they need while doing away with the ethos of quietness concerning SRH matters (Blanc et al., 2016). Also, in Ghana, a mobile text messages' trial for 14-24 year old girls found that interactive platforms were effective for improving adolescents' and young people's SRH knowledge (Rokicki et al., 2017). The interactive and flexible mHealth system where young people replied to probes before receiving messages produced better rates (from 31% to 60% improvement in SRHR knowledge) compared to the comparison group 26% to 32% and 30% to 45% in the unidirectional participants. Cautiousness must to be observed when duplicating such initiatives because and as commonly documented, the focus of many SRH mobile health interventions are on pregnancy avoidance with minor mentions of STDs. This was affirmed by Rokicki and co-authors in a study where the interactive intervention was attributed to risky sexual behaviours among adolescents who were found to be more fearful of getting pregnant as opposed to being infected with an STD (Rokicki et al., 2017).

A systematic review of mHealth interventions among young individuals in LMICs found that individuals between the ages of 15-24 were interested in varied sensitive SRH themes such as sexuality, pregnancy prevention and termination, unplanned pregnancies, and STDs (LEngle et al., 2016). These issues are commonly regarded as taboo subjects and not for open discussions. Stigma societal traditions, from HCPs and fear of being shamed by grown-ups certifies the need for mobile health interventions to deliver the needed information on SRH (Ippoliti & L'Engle, 2017).

It should be noted that some mHealth trials were unsuccessful and had no significant effect on SRH knowledge and behaviour change among young individuals. An evidence review of SMS interventions to increase young girls' modern family planning methods' use found unsatisfactory proof to back its expansion (Smith et al., 2015). Nonetheless, the evidence review recommended merging mHealth strategies with HCP support to deal with stigmatizing propensities via interactive and flexible informative SMS incorporated within the prevailing service delivery points. Also, some text messages can be very technical for the target audience to comprehend, therefore, it's essential to balance between clinical jargons and lay individuals' health literacy for the messages to be appreciated and eventually impact their SRH behaviours.

2.7 Mobile health to improve ANC coverage

Although mHealth interventions in maternal health are still relatively new, they are progressively being used to gather information about pregnancies and enhance the standard of pre and postpartum care (Benski et al., 2020; Feroz, Perveen, et al., 2017). Studies have also shown that SMS interventions have enhanced adherence to clinical appointments and hence contributing to timely seeking of healthcare services in several LMICs (Benski et al., 2020; Ippoliti, 2017; Lund et al., 2014; Ridgeway et al., 2018; Watterson et al., 2015). A few studies, if any, have however illustrated similar results concerning ANC uptake that are explicitly geared towards expectant young women including adolescent girls. In Burkina Faso, it was determined that mHealth interventions can improve the general SRH knowledge of pregnant women thereby encouraging them to observe their antenatal appointments (Arnaert et al., 2019). Similarly, research in Madagascar linked an increase in ANC contacts per pregnant woman to an mHealth text messaging intervention (Benski et al., 2020). The Madagascar study also found that mHealth

initiatives could enhance ANC services and associated quality, positively influence healthcare providers' behaviour, and change patients' behaviour in ways that would increase ANC contacts (Benski et al., 2020).

In Ethiopia, a non-randomized control mHealth trial targeting ANC clients was also found to have had positive maternal outcomes. mHealth intervention participants were more likely to have 4 or more prenatal contacts (27.0% versus 23.4%: AOR 1.31(95% 1.00 - 1.72); skilled births were likewise more probable to happen at the intervention participants (43.1 versus 28.4%; AOR; 1.98(95% CI 1.53 - 2.55). Comparable findings were realized with antenatal contacts, whereby women in the mHealth group were more likely to seek post-natal clinical services compared to the control group participants (Shiferaw et al., 2016). There was no difference in statistical significance on ANC contacts between mothers of different ages.

A randomized controlled mHealth trial in Zanzibar showed that the odds of having at least four prenatal visits were twice more for expectant women who received text messages from a mobile health intervention (OR, 2.39; 95% CI, 1.03-5.55) having a 16% difference in prenatal uptake between the control and the intervention arms (Lund et al., 2014). Contrasting adult mothers, girls aged 19 and below were less likely to have more than three prenatal contacts. This might be because of shame related with teenage motherhood which might not have been considered when conceptualizing the study.

Evidence reviews of mHealth studies have also established positive significant effects in healthcare seeking behaviours amongst expectant females (Chen et al., 2018). In South Africa, an

assessment of the effects of mHealth interventions on maternal healthcare services found positive effects on the uptake of ANC services resulting from the mHealth interventions. The study determined that intervention participants had greater odds of having four or more recommended prenatal contacts (OR: 3.21, 95% CI 1.73–5.98) (Coleman et al., 2020).

The assessment of maternal health indicators from systematic reviews in LMICs have produced inconsistent results with several studies lacking rigour in their methodologies and design. Similar views were underscored by Colaci, Chaudhri, & Vasan, (2016) in a review of evidence on maternal mobile health trials in low LMICs: they acknowledged that there is need for more rigorous mHealth research to expand existing evidence on their effectiveness in antenatal uptake, healthcare information gathering and trainings. These are all meant to increase access to crucial obstetric and newborn care (Colaci et al., 2016). Undeniably, the moderate to low standards of research restricts the scientific proof as findings of several research works are not thoroughly analysed to assess their effectiveness on maternal outcomes.

Insignificant findings in several mHealth trials have also been observed. For instance, in South Africa, an experimental study meant to evaluate the effectiveness of a mobile health project on ANC knowledge and antenatal contacts via SMS found statistically insignificant variances between the study arms in antenatal contacts and all the knowledge areas (Lau et al., 2014). Observations during the study underscored high dropouts of research participants as one important factor which was overlooked during sample size calculation hence affecting the validity and reliability of the results. However, individual reported replies did record the potential of mHealth to increase maternal health coverage.

Reported benefits in mHealth trials and interventions notwithstanding, the need for more age-appropriate experimental studies to reinforce the current technological proofs and build on existing literature cannot be overemphasized (Feroz, Perveen, et al., 2017). Moreover, the research community and policy makers should emphasise on the need of openness in presenting technological interventions, data and information sharing which are essential for effective reproducibility and replicability of the studies.

Perceived complexities of mHealth interventions to increase ANC contacts by expectant young women might present uncertainties when integrating the mHealth platforms in a service delivery setting. This typically happens when the key individuals anticipated to use the systems are not engaged from the beginning and hence lacking knowhow to interact with the technological interventions. In order to effectively implement a mobile health project inside a health institution from trial to expansion and for easy acceptance, there is need to involve all essential individuals at each phase along the continuum of care. The conceptual structure of mobile health functions, including medical professionals that deliver preventive maternal healthcare services, is illustrated in Figure 2.3.

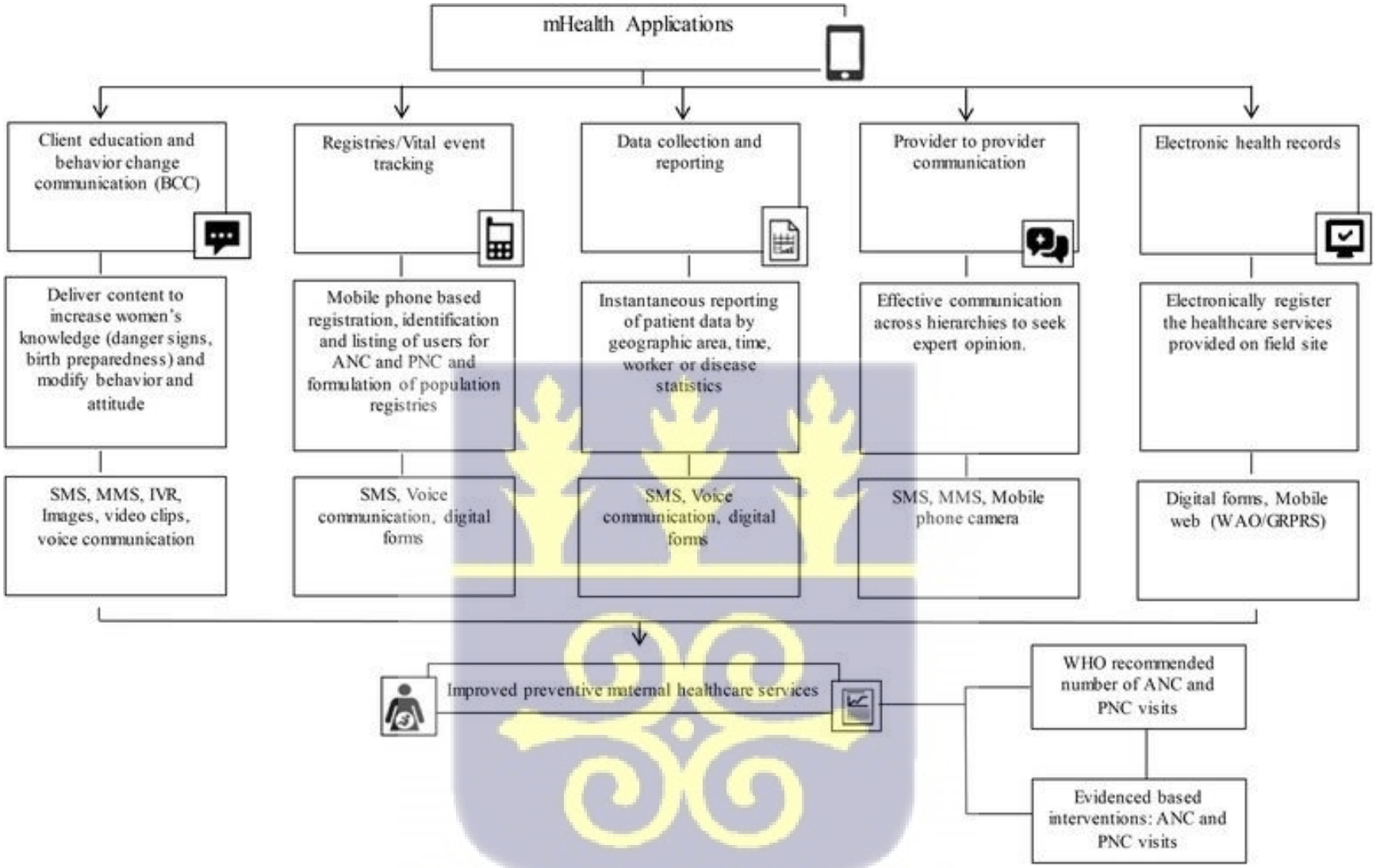

Figure 2.3 Preventive maternal health mHealth framework

Source: Feroz, Perveen, et al., 2017

2.7.1 Reduction of Antenatal Stigma through Integration of mHealth-ANC Services

Mobile technologies can provide avenues to alleviate societal stigma while focusing on the SRH needs of young women. Context specific and age appropriate projects should utilise mobile technologies for informing and empowerment of young women and HCPs to offer a supportive environment devoid of any form of stigmatizing tendencies (Nyblade et al., 2019). Text messaging applications can be made efficient and interactive between HCPs and expectant young women by facilitating private discussions and suitable arrangement of clinical schedules to avoid long periods of waiting to be attended. Moreover, and with approval from the pregnant young women, their spouses and caregivers should be actively engaged in the mobile health interactions as "treatment supporters" to aid motivate pregnant young women to observe their clinical appointments. Similarly, secured digital and simple to operate peer support systems can be developed for young mothers to openly communicate their challenges and other issues in groups and get clinical advice from selected health providers.

If well-coordinated and implemented, these groups can serve as safe spaces where expectant young women can be empowered to challenge discriminatory societal views, question judgmental health practices while at the same time share positive vibes amongst themselves while getting clinical and psychosocial support from the HCPs (Naslund et al., 2016).

2.7.2 mHealth Interventions and Associated Feasibility and Acceptability

HCPs play a substantial part in mobile health interventions. Involving HCPs early on during the design phase can encourage them to appreciate the promise that mHealth has in public health transformation. Effective integration of mobile health interventions into existing healthcare for preventive and promotive health services may foster approachable settings and address concerns of stigma and attitudinal tendencies attributed to young women's SRHR

behaviours (Samples et al., 2014). Through sufficient direction, and steadiness in the transmission of health information via mHealth platforms, HCPs can effortlessly adhere to ailments' management algorithm including patient tracking. (Agarwal et al., 2015) and motivate them towards the adoption of mHealth. This is because, incorporating mHealth within prevailing health facility without active engagement of the providers as key players can be perceived as a needless added responsibility, meant to 'interfere' with their usual mandates. Certainly, mHealth solutions should not burden the prevailing HCPs workloads or cause any inconveniences to the clients/patients by interfering with their confidentiality when sending or gathering confidential data. Instead, technological innovations should be collaboratively designed with all the key players and with ideas from all parties with the ultimate goal of integration. (Aranda-Jan et al., 2014) as illustrated in figure 2.4 below.

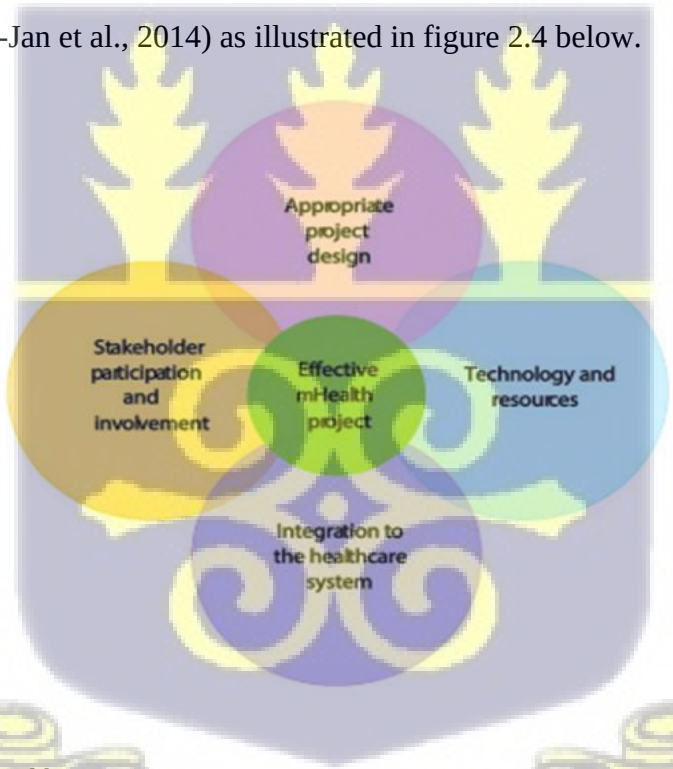

Figure 2.4 Important mHealth interventions constructs

Source: Aranda-Jan et al., 2014

According to Aranda-Jan (2014), for mobile health projects to be practically applicable, the local context must be considered, especially if the goal is to raise awareness of and enhance demand for ANC services. Resources needed include capacity building HCPs to be

acquainted with the intervention and meaningful and effective engagement of the key stakeholders relevant to provide much needed support for integration purposes.

An evidence review of literature on the feasibility and acceptability of mHealth, Agarwal and co-authors (2015) determined that mobile health solutions are able to advance communication and referral mechanisms in the public health sector, hence increasing their feasibility and acceptability in the public health space (Agarwal et al., 2015). From the literature reviewed, feasibility assessments were descriptive, making it problematic to measure their actual effect on the respective healthcare outcomes. Additionally, HCPs' mHealth utilisation can result in a "novelty effect", that is, the innovations might enthuse HCPs at the start and as this enthusiasm wears off, HCPs are likely to return to their conventional strategies. However, this can be sustained by incorporating mobile health into daily routines of the HCPs while having a user-centered outlook when developing the mHealth functions.

Similar opinions from primary HCPs in Nigeria were noted. According to Kenny et al. (2017), the HCPs would support mobile health if adequately skilled to use the platform (Kenny et al., 2017). Furthermore, perceptions of applicability and importance, benefits and anxieties and a comprehension of how the intervention works were found to be significant variables attributed to the acceptance or non-acceptance of the project (Kenny et al., 2017). If taken care of from the time the mHealth concept is hypothesized with contributions from all the stakeholders, like HCPs and expectant women and; the probability of experiencing disagreement may lessen. A multisectoral approach comprising all the major stakeholders in designing and developing a workable solution to be incorporated in to prevailing service delivery points is indeed crucial to increase uptake of ANC health by pregnant young women (Coleman et al., 2020; Feroz, Rizvi, et al., 2017).

2.7.3 Provider and service user challenges related to mHealth integration

Table 2.2 below is a summary of the different classifications of mobile health challenges and their solutions based on Gurupur and Wan (2017).

Table 2.2 Categories of mHealth challenges

Challenge	Key Component	User definition
Usability	User interface design	Maintaining a simple user interface, selecting the appropriate font style and size, and raising user satisfaction
	Trustworthy design	The user interaction design needs to be clear enough to be reliable.
	Learnability	The mobile app needs to be simple to use.
System integration	Interoperability	The ability to share necessary information with systems created by other companies is a must.
	System design	The corresponding system architecture must provide scaling and interoperability with other health systems.
Data security and privacy	Confidentially	Adherence with health care data legislation is a requirement for mHealth interventions to protect patient confidentiality.
	Data storage	Data must have been kept in a safe place.
	Data access	Access to data must be made through secure communication methods.
Network access	Availability	Access to wireless networks
	Speed and strength	The wireless technology must be robust enough to support data transmission and reception.

Source: Gurupur & Wan, 2017

Barriers to utilization of mHealth by HCPs include technological complexities posed by different functionalities employed in automated reporting, HCPs' unwillingness to utilise technology and the loads of work experienced at the health facilities (Medhanyie et al., 2015). The lack of involvement and direction before and during the mobile health employment can possibly present difficulties to acceptance and utilisation of the mobile health interventions. In

a review of mobile health trials and the performance of HCPs in LMICs - it was determined that the degree at which platform users appreciates the design of the mHealth functions, and contents received generally inspires adoption of mHealth projects (Abejirinde, Ilozumba, et al., 2018). Accessibility of health information in local dialects is similarly an important factor of mHealth acceptability for patients and HCPs. For young women who are pregnant in LMICs and with low literacy levels, simple and easily understood text messages' interventions can work better with them because they require less struggle to navigate the system. Also, automated simple text message functions will hardly add more workloads to the already overstrained HCPs.

Cell phones in areas with unstable electricity coupled with unsteady network and internet connectivity might experience operational challenges during power blackouts. Also, HCPs at times might be out of airtime hence fail to reach out to individuals in need of clinical reminders and health education (Abejirinde, Ilozumba, et al., 2018). To address these concerns, a number of mobile health projects have considered the provision of electricity energy in solar form as well as provision of regular mobile airtime to the HCPs (Abejirinde, Ilozumba, et al., 2018). Unintentional erasure of yet to be read SMS is also another obstacle described by women who are pregnant (Feroz, Rizvi, et al., 2017). In addition, data safety, particularly when conveyed through insecure numerous mobile gadgets may create mistrusts specifically with individuals with stigmatising predispositions (Gurupur & Wan, 2017).

2.8 Theoretical framework

mHealth interventions aimed at changing behaviours should consider integrating appropriate theories of behaviours in their plans to make sure that the intervention succeeds (Cho et al., 2018; Mburu et al., 2013). These theories will also help in describing behaviours while at the same time giving a justification for why these interventions are necessary (Jennings et al.,

2019). An evidence review of models employed to mobile health interventions for changing health behaviours in low income countries determined that mobile health studies in these areas are less than often grounded on theories of behaviours (Cho et al., 2018). Further, the review found that, projects and research that had employed theories of behaviour change remained unsupported by the entire model and alternatively opted to choose a few constructs from the models to reflect their study methods. Mobile health behavioural interventions have previously utilised social cognitive theory, health belief model, behaviour learning theory, transtheoretical model and integrated theory of behaviour change with the health belief model (HBM) being the one commonly applied (Cho et al., 2018). The HBM predicts that behavioural change projects will achieve their objectives if targeted individuals see the project to be advantageous free from any implementation obstacles (Jones et al., 2015). The model also has significant shortcomings such as failure to consider environmental and economic influences necessary for individuals' use or non-use of health services. Furthermore, personal behaviours for other social reasons unrelated to health like individuals' attitudes and communal acceptability are also not reflected in the health belief theory (LaMorte, 2019).

This study's theoretical framework was therefore a combination of three theories: the theory of planned behaviour (Ajzen, 1991), Unified theory of acceptance and use of technology (Venkatesh et al., 2016), behavioural model and access to medical care (Andersen, 1995). The three models were preferred because of their ability to appreciate and support people's aspects which influence the utilisation of clinical services and the technical procedures necessary to produce effective mobile health outcomes as envisioned by this research.

2.8.1 Behavioural theory and access to medical care

Demographic characteristics, perceived need for medical attention and enabling resources influence an individual's use of health services (Andersen, 1995). Facilitating resources described in this theory include social relations and structures at the health facilities and community levels, health personnel as well as income sources. Social relations' influencers as described by the model consist of individuals' capacity to manage their health situations, persons' social status, and individuals' capacity to select where, how and when to pursue clinical support. Age, occupation, educational levels and marital status are regarded as indicators of societal status. Additional concepts of this theory which influence individuals' health behaviours include beliefs that persons have about health services and levels of health literacy.

As described earlier, expectant young girls usually suffer stigma emanating from undesirable societal associations and amplified societal susceptibility spread through cultural traditions like single motherhood, sex before marriage, and their lack of maternal knowledge and steady income to improve their access to prenatal services. Benefits and needs' perceptions of prenatal contacts by pregnant young women in this research were also anticipated to influence their clinical prenatal care uptake. mHealth educational messages were expected to change young women's views of prenatal care. Also, the intervention was expected to influence HCPs' judgemental tendencies and close relatives to give moral support to the young expectant girls for increased prenatal coverage and maternal contentment. To the knowledge of the researcher, this was the first time the theory of behavioural model and access to medical care was applied in a mHealth intervention aimed at increasing prenatal contacts. This theory however does not take into account individual's attitudes and beliefs which are key determinants for individuals

to accept a health behaviour. This drawback necessitated the need for inclusion of the theory of planned behaviour in the study.

2.8.2 Theory of planned behaviour

The second theoretical model that this study drew was the model of planned behaviour (Ajzen, 1991). This model presents three constructs: perceived behavioural control, subjective norm, and attitudes towards the behaviour. Ajzen postulated that, purpose inspires the undertaking of a certain behaviour. He further says that change in behaviour may not be attained if one has little knowledge about the behaviour and that purpose is influenced by other factors including social pressure to act or not, attitude towards the acts and supposed simplicity or difficulty of carrying out the behaviour.

Attitude in this study was regarded as a major influence of prenatal seeking behaviours of pregnant young women. The level to which a pregnant young woman will rate the HCPs' services, whether perceived or real, will mostly affect her intent to seek prenatal care. Additionally, perceptions of young mothers regarding the easiness or difficulty of achieving the recommended prenatal contacts may be due to several factors like gender dynamics, perceptions of self-efficacy, perceptions of prenatal benefits, inadequate enabling resources (similar to Andersen, 1995, postulations) like cost of getting to the health facilities, and accessibility of competent providers. The text messaging intervention therefore intended to create a positive social environment with the goals of addressing subjective norms and undesirable attitudes. Also, the mHealth project intended to improve self-efficacy through educational health messages with the aim of improving ANC contacts of expectant young girls bearing in mind the availability or absence of enabling factors in the analyses of prenatal achievements. A number of studies have suggested this theory (Jennings et al., 2019; Mburu et

al., 2013) as being capable to increase the effectiveness of the mobile health projects. The main limitation of this model is that it overlooks the timelines between "intention" and "behavioural act" (LaMorte, 2019).

2.8.3 Unified theory of acceptance and use of technology (UTAUT)

With regards to the UTAUT theory, Venkatesh (2016) listed four main factors which determine person's utilisation of technology. They are social influence, performance expectancy, facilitating conditions and effort expectancy. Per this model, an intent to utilise a technology is determined by an individual's supposed efficacy of technology, their social environment, and the time one will need to invest in. Similar to Andersen's and Ajzen's models, Venkatesh too posited that behavioural intent to utilise new technologies and available enabling environments (like technological value) will influence the use of technology.

By these models, this research focused on determining the effect of mobile health-text message intervention on antenatal outcomes of expectant young girls and women in Kwale County, Coastal Kenya. Precisely, the models complemented one another in measuring the HCPs dynamics and expectant intervention participants' views by investigating the rate of recurrence of remote and physical interactions with the main goal of improving young females' ANC contacts.

2.9 Summary of literature review

The chapter discussed about the public health concerns of teenage motherhood together with challenges pregnant young women go through when attending prenatal clinics. Discussed associations of low coverage of prenatal services among expectant young girls and women included HCPs' attitude, poor quality of ANC services, stigma, individual characteristics such as level of education and income inequalities, and ineffective referral channels. The review underscored the role and effects of community health projects, technological and clinical interventions presently being applied to address the main obstacles preventing expectant young girls and women from achieving the recommended prenatal contacts. Mobile health intervention was recognised as a promising complement to prevailing demand creation approaches which can contribute to improved prenatal care coverage among expectant young girls and women in Kenya. Moreover, mHealth interventions have been evinced to have the potential to reinforce societal relations between the HCPs and expectant young women thereby addressing the real or perceived hostility which seemingly exist between the two. Notably, it was confirmed in the reviewed literature that mHealth intervention studies designed to improve maternal outcomes were not age specific and almost all were not specifically designed for expectant young women thereby necessitating the need for this study.

CHAPTER THREE
METHODS

3.1 Introduction

This chapter presents the research methods for this study. The primary sections of this chapter include: philosophical orientation of the study, study design, setting of the study, study population, sample size calculations, participant recruitment, sampling procedure, and inclusion criteria, quality control and data analysis. The data collections tools are also described including the data collection procedures. The ethical considerations relevant for this study are also discussed.

3.2 Philosophical orientation of the study

The philosophical foundation of this study was premised on both ontological and epistemological assumptions. The ontological assumption for this study was that individual and societal factors are the major determinants of ANC uptake among expectant adolescents and young women. The epistemological assumption for this study was that these individual and societal factors can be studied epidemiologically and facilitating factors can be explored and addressed at the individual and societal levels. In addition to the two philosophical foundations, this study was also grounded on a pragmatist philosophy which states that the key determining factor of the research philosophy to be applied are the research objectives and questions which also guide the other aspects of the research design (Chakravartty, 2021). This research philosophy was preferred for this study because it allowed for flexibility and adaptability to use varied combination of methodologies and to investigate from multiple perspectives as we sought to explore and understand the problem under study (Kaushik & Walsh, 2019).

3.3 Study Design

This was intended to be a two arm quasi-experimental trial using both qualitative and quantitative methods. One study arm was exposed to the interventions while the other arm was not. This study compared study's outcomes between intervention and control arm participants at the end of the trial while controlling for potential confounders. These confounders included background information like demographic data and basic ANC knowledge collected from all the study participants during enrolment. Additionally, since this study had not fully randomly assigned participants to either intervention or control arm, pre-existing differences between the two arms existed, and these imbalances were actually observed during data analysis. There was therefore a need to control for these unanticipated pre-existing differences (confounding variables/baseline imbalances) between the study's arms in the regression models – and this is what the background characteristics data collected at enrolment sought to do. A quasi-experimental design was preferred because it was difficult to do a complete randomised controlled trial due logistical limitations including the need to ensure geographical non-proximity to prevent information spill overs and the time needed to implement the study.

Selected study facilities were distant apart and had same healthcare provision models. Previous evidence reviews on mobile health and prenatal uptake have found that several mHealth studies were mainly observational and largely utilised historic comparison arms while some had no comparison arms hence reducing the reliability of their findings (Watterson et al., 2015). This study employed a quasi-experimental design owing to its practicability to undertake in a real world setting. One weakness of this method is its susceptibility to internal validity threats (White & Sabarwal, 2014). This was partly addressed by recruiting from similar settings and having the two arms (control and treatment) to be as similar as possible before the intervention as well as controlling for any confounding variables as described in the analysis section. To reduce contamination, geographic non-proximity was taken into account, and selection of

participants was done at the health facilities' level instead of the individuals' level. Health facilities' level of selection was preferred in order to control for informational spill overs hence maintaining the validity of the control group.

Four public health facilities (Kikoneni, Mkongani, Mnyenzeni and Mazeras health centres) were carefully selected from 11 health centres stratified by burden of teenage motherhood. Kwale County's public health centres with at least 200 young girls seeking pregnancy care in 2018 were used as a proxy for identification of health facilities with high rates of teenage mothers. Following this, a random assignment of health centres to either control or intervention arm within the strata (>200 teenage mothers in 2018) was done. Selected facilities had a single arm of either control or intervention. To increase internal validity, selected health centres were matched to make sure that they were alike in terms of participants' geographical access to health centres, mobile telephone network coverage of neighbouring people and their operational capacities to implement the intervention. To minimize bias in participants' selection, aggregate matching was used in selecting both treatment and control group participants, based on selected characteristics including similar age ranges, same gestational age range in weeks, health centres' accessibility and network availability. Owing to the limited study time and the need for closeness in assessing the effectiveness of the intervention, at least a twelve-week difference in gestational age was maintained amongst all participants in the study. Figure 3.1 below illustrates the study flow.

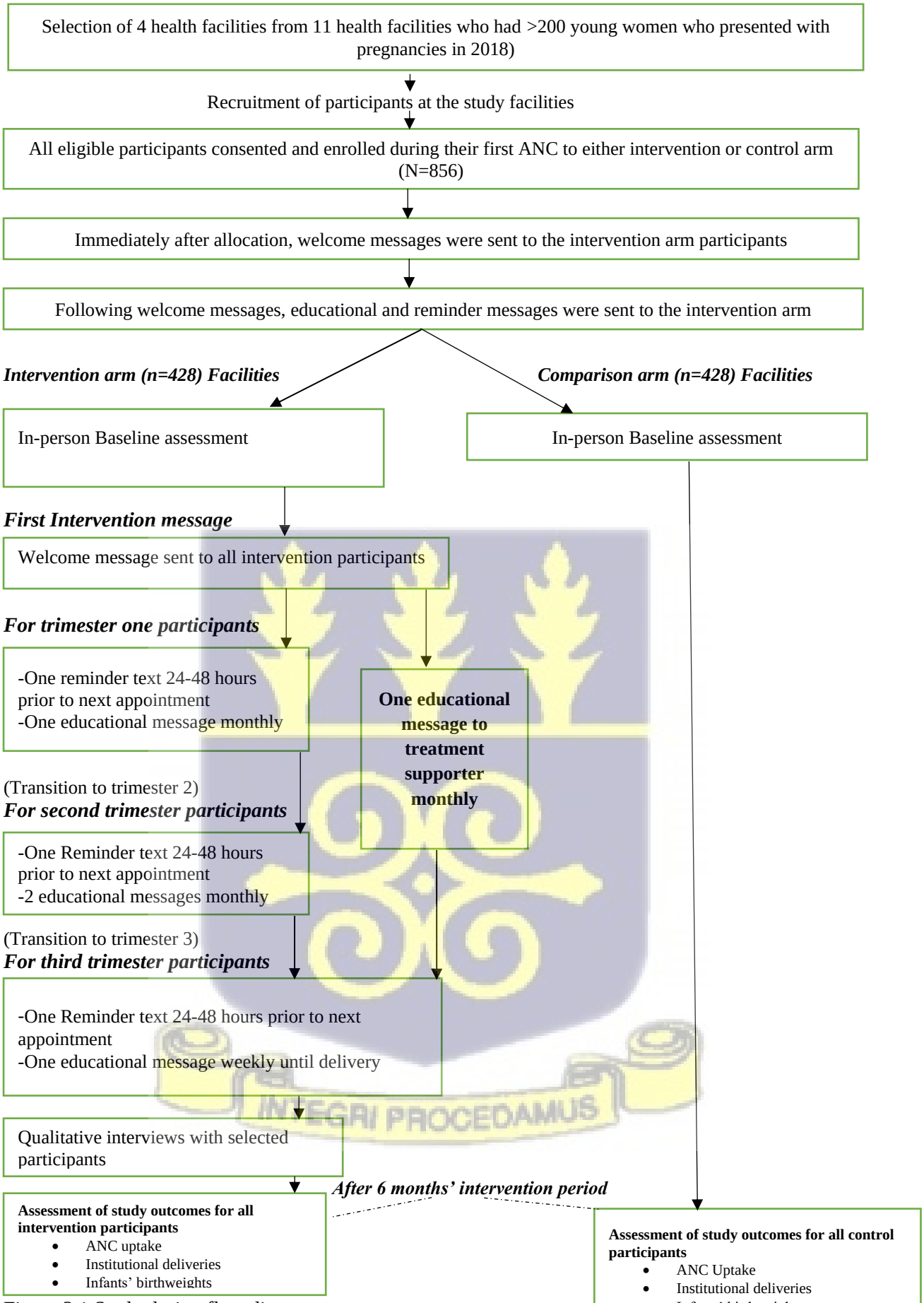

Figure 3.1 Study design flow diagram

Figure 3.1 shows the study flow and design. Messages from Mission Motherhood (Babycentre, 2017) were used in this study. These messages were translated from English to Swahili to suit and relate to the targeted study population. Before the trial began, Focus Group Discussions (FGDs) were held with expectant young girls to vet the messages for relatability and comprehension.

All study participants were provided with standard prenatal care as per the Reproductive, Maternal, Neonatal Child and Adolescent Health (RMNCAH) Kenyan guidelines which included intermittent preventive treatment for expectant women, tetanus toxoid vaccine, four or more antenatal care contacts, PMTCT and delivery by a HCP (Ministry of Health Kenya, 2016). In addition, all participants were given their respective health centres' mobile contacts to directly reach out to their HCPs in case of any emergencies.

3.4 Intervention description

The intervention in this study comprised mainly of text messages. Text messages (SMS) were sent to mHealth intervention participants from the platform. To supplement educational health messages given to pregnant young women as per their gestational age, text messages were tailored, personalized and staggered according to their gestational ages. All participants in the intervention group received an opening welcome note irrespective of their gestational stage. Reminder and educational SMS were also sent 24 hours prior to their next clinical appointments. mHealth communication was both unidirectional and bidirectional with the first communication coming from the mobile health platform as illustrated in figure 3.2.

Figure 3.2 mHealth platform interface

In alignment with the new WHO ANC guidelines of increased prenatal contacts to at least eight, one in the first trimester, two contacts in trimester two and five in trimester three (World Health Organisation, 2018), the frequency of the messages received from the mHealth platform followed a comparable pattern. One monthly message was sent in the first trimester, two monthly messages trimester two and then messages increased to one weekly from week 27 to childbirth. Customized Mission Motherhood messages were translated into Swahili and matched the gestational needs of participants in the intervention arm. The messages were jointly vetted by clinicians and nurses in the Maternal, New-born and Child Health (MNCH) clinic in Kwale County. Messages were all delivered in Swahili language, the most dominant language in Kwale County and selected by all intervention participants.

Intervention participants were also asked to provide phone numbers of their spouses or caregivers considered as 'treatment buddies' in this study. Gender concerns and stigma associated with low uptake of antenatal services were taken into account. This research intended to address these factors via supplementary monthly educational messages sent to either of the selected 'treatment buddies'. This was voluntary and was not part of the study inclusion criteria. All participants from Kikoneni Health Centre and Mnyenzeni Health Centre received the text message interventions (n=398 [48.7%]; hereafter referred as the mHealth-text message intervention arm), while those from Mazeras Health Centre and Mkongani Health Centre did not receive the text message interventions (n=419 [51.3%]. The intervention ended when the last participant to be enrolled got her final message at the 38th week or six months 'after the trial. Following this, endline qualitative assessments were done with randomly selected mHealth participants and HCPs to gather their mHealth experiences and viewpoints. Clinical outcomes were taken as recorded from the ANC and maternity registers.

3.5 mHealth-text messaging intervention logic model to increase ANC uptake

A logic model (figure 3.3) to visually demonstrate how the intervention factors interacted to produce the anticipated outcomes was developed. As was expected every participant was provided with standard prenatal care.

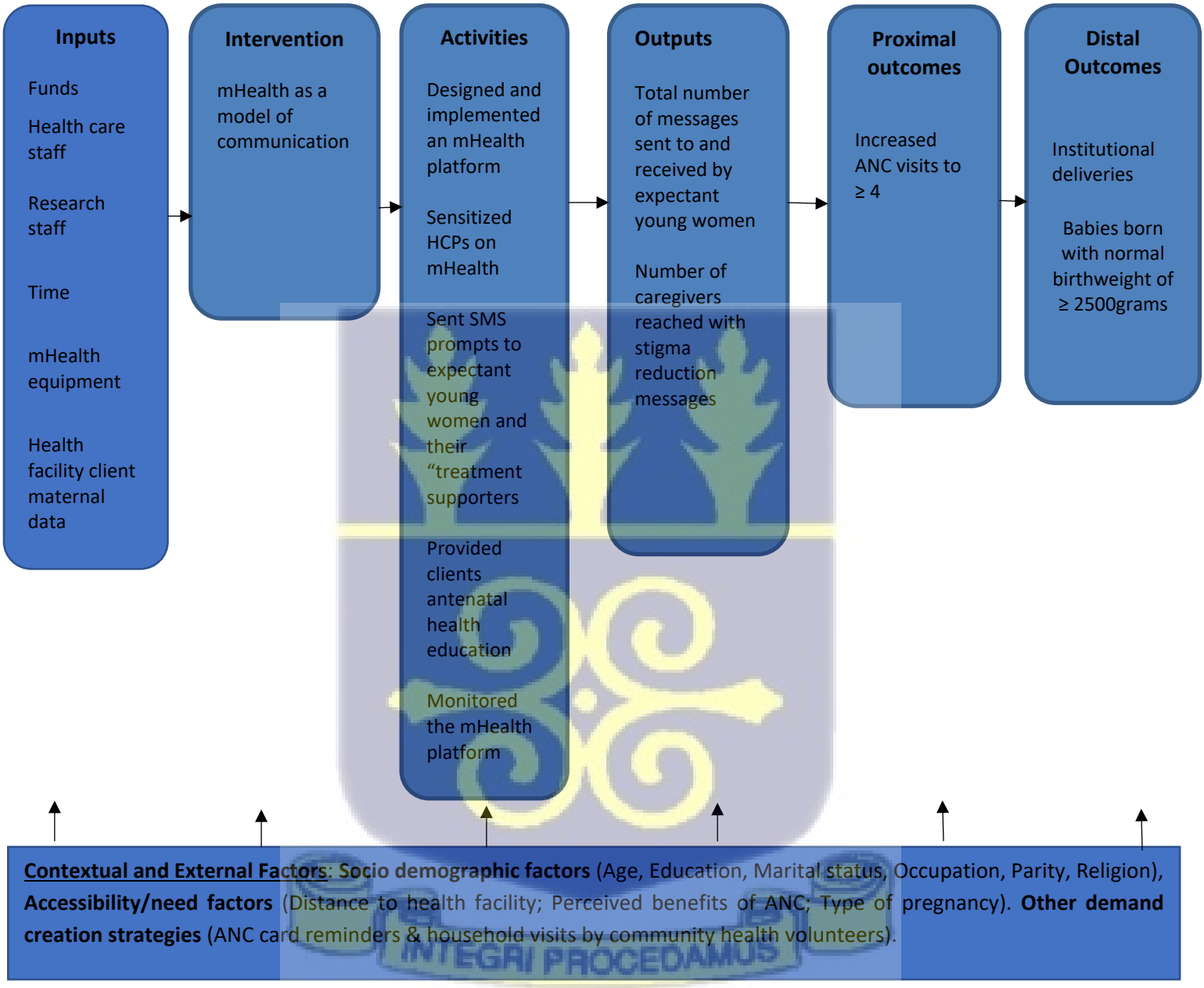

Figure 3.3 mHealth-text messaging intervention logic model to increase ANC uptake

3.6 Study phases

This study had four phases. The first phase of the study included the pre-intervention activities like recruitment of research assistants, selection of study facilities that met the eligibility criteria and testing of the study messages with expectant young women in Kwale County, this pilot group was not part of the study participants. Phase two of the study included collection of background information from all study participants. In phase three, educational and reminder messages were sent to the mHealth intervention arm participants in line with their gestational age. Finally, in phase four, relevant quantitative data was extracted from the four health centres using the ANC and maternity registers, MOH 333. IDIs were also held with selected HCPs to get their opinions concerning mHealth integration and with randomly selected mHealth participants to describe their experiences while interacting with the platform and the relevance of the messages.

3.7 Study design modification

There were some unintended deviations from the original study plan as the trial was ongoing. The Kwale County Department of Health introduced community outreach activities in selected health facilities in the county to boost uptake of health care service. These outreaches were introduced after the commencement of the study, and the study team had no control over the situation. This significantly affected the implementation of the study. After the study had commenced, health workers in Kenya went on strike for almost six months (August 2020 – February 2021) during the COVID-19 pandemic period. This was around the same time when the Government of Kenya had lifted some of the COVID-19 prevention measures including the inter-county lockdowns. The Kwale County government addressed some of the HCPs' concerns and health workers in Kwale called off their strike at the end of December 2020. The reopening of health facilities in Kwale County after the strike was faced with some challenges as a result of COVID-19 including low uptake of health care. Generally, fear of contracting

COVID-19 at the health facilities was one of the main reasons for low uptake of clinical care in Kenya and Kwale County in particular. To ensure there was continuity of select essential health services, the Kwale county department of health and facility in-charges organized community outreaches for specific health services that could be safely delivered at the community level.

Some facilities in Kwale County therefore conducted clinical outreaches to provide ANC and other maternal services at the community level. Of the four-study health centres, one control facility, Mkongani Health Centre conducted monthly community outreaches which provided maternal related services to pregnant women including expectant young women at the community level. Services provided at the outreaches included, general and maternal health education and health screening. A substantial number (147 out of 213) of the study participants at Mkongani health centre were among those reached during outreaches. This situation was unexpected and had to be addressed by amending the control arm during data analysis. Thus, the original control group was split into "pure controls" and "outreach participants." This resulted in having three study arms: (1) mHealth-text messaging intervention participants (2) pure control participants, and the (3) outreach arm participants. The Control arm therefore constituted of all Mazeras Health Centre participants (since no outreaches were reported in this control facility) and Mkongani participants who did not attend the outreaches. Thus, all the data analyses and results presented in Chapter four were based on three-arms.

3.8 Study setting

Kwale County is among the six counties in the Coastal region of Kenya. Kwale has four sub-counties; Lunga-Lunga, Kinango, Matuga and Msambweni. It has three major urban towns; Msambweni, Kwale and Ukunda. As per recent national census of 2019, the county has a population of 866,820 (425,121 males, 441,681 females and 18 intersex) (KNBS, 2019). Population considered to be working age (15-64years) is estimated to be almost half of Kwale residents. Persons between the ages of 15-24 years were approximated to be 174,947 (82,946 males and 92,001 females) by 2018 and predictable will get to 368,149 (174,547 males and 193,602 females) by 2022, representing almost 20% of Kwale people. Approximately 18% of all people in Kwale live in the urban areas. Almost 75% of the entire county has telephone network coverage; urban areas in the county including Ukunda/Diani, Msambweni and Kwale town fully connected with telephone network services (Kwale County Government, 2018).

Kwale has a fertility rate of 4.7 children per female with approximately half of women giving birth at the health facilities (Kwale County Government, 2018). Major challenges facing young people in Kwale county are drugs and substance abuse, teenage pregnancies and sexually transmitted infections (National Council for Population and Development, 2017). In 2014, the median age at first marriage in Kwale County among women was less than the national average at 19.1 years compared to the Country's 20.2 years. However, the median age at first sexual intercourse in the county was 16.6 years among women (national average being 18.0 years) and 18.5 years among men slightly more than the national average at 17.4 years. The percentage of teenagers who had begun child bearing was 24.2%, and this was higher than both regional and national averages reported at 20.8% and 18% respectively (Kenya National Bureau of Statistics, 2015). Figure 3.4

shows the study health facilities (all are level 3, public health centres) while table 3.1 gives a summary of the four selected facilities.

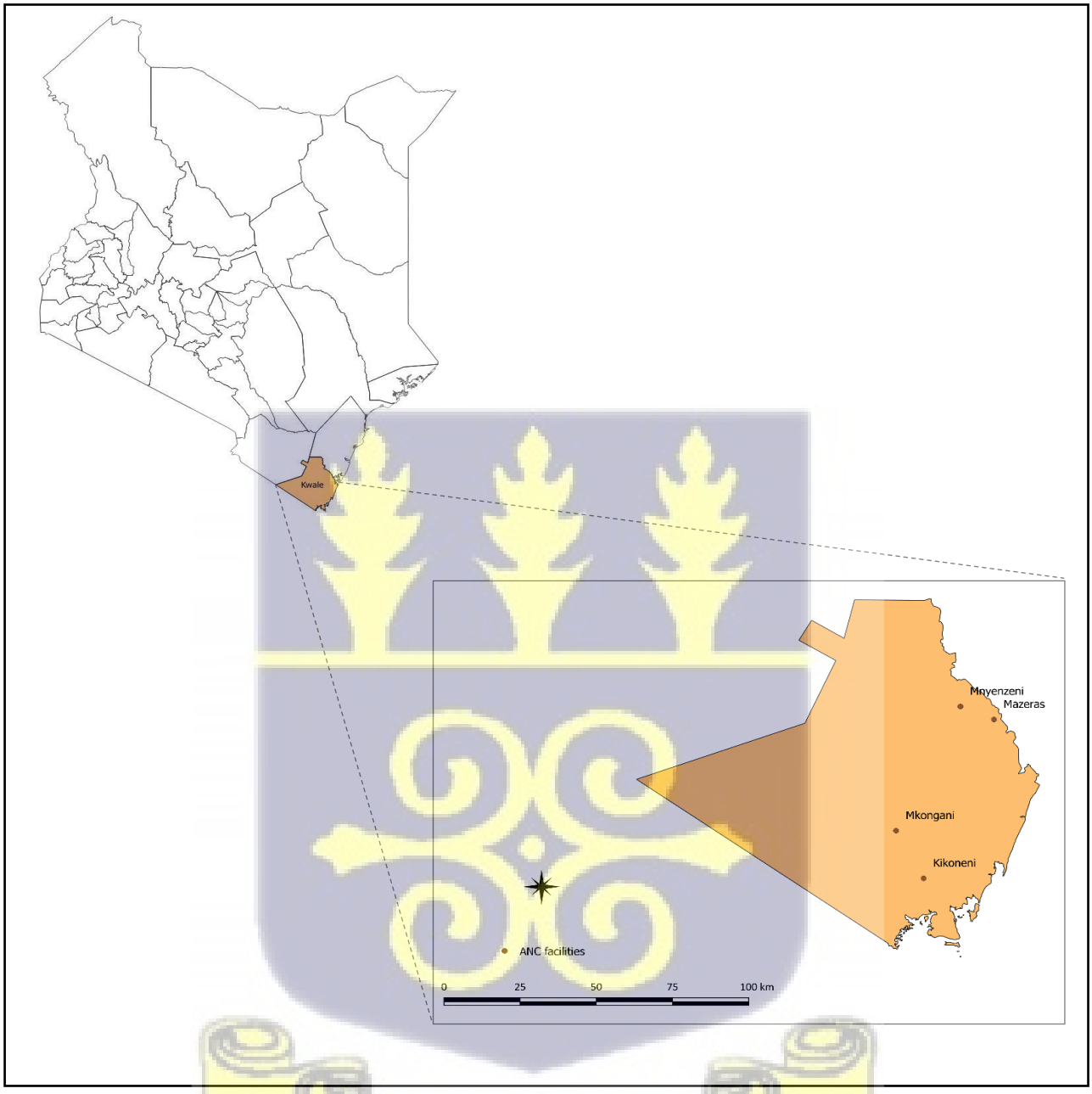

Figure 3.4 Geographical location of the study sites in Kwale County

Table 3.1 Teenage pregnancies in the four selected facilities

	Facility name	Owner	Constituency	Adolescents (10-14 years) presenting with pregnancy in 2018	Adolescents (15-19 years) presenting with pregnancy in 2018
1.	Kikoneni	MoH	Msambweni	3	287
2.	Mkongani	MoH	Matuga	10	377
3.	Mazeras	MoH	Kinango	4	280
4.	Mnyenzeni	MoH	Kinango	25	231

All the four selected health centres in this study are run by clinical officers and nurses. Services provided by the health centres include antenatal and post-natal services, baby well clinics, maternity in-patient services including basic emergency obstetric care, laboratory services, Tuberculosis clinics, and Comprehensive care clinics for patients living with HIV, Family planning services, pharmacy and counselling services among other clinical services.

Generally, the healthcare sector in Kwale comprises of curative, preventive, promotive and rehabilitative components. The County has a total of five government hospitals, eleven health centres and ninety dispensaries located in Msambweni, Matuga, Lunga-Lunga and Kinango sub-counties. Additionally, the County has thirty-six private health facilities and nine faith-based organizations owned health facilities. Malaria, Anaemia, HIV, diarrhoea, respiratory conditions and non-communicable diseases are among the major contributors to morbidity in the County (Kwale County Government, 2018). The doctor to population ratio in the County is 1:76,741 while nurse to population ratio stands at 1: 3,133. The average distance to the nearest health facility is seven kilometres (Kwale County Government, 2018). At a bare minimum, all health facilities in Kwale County provide ANC, child welfare and immunization services. According to the KDHS

2014, approximately 50.1% of all births in the County were done by a skilled health care provider (Kenya National Bureau of Statistics, 2015).

Kenya has four levels of health care namely; community, primary care, county referral and national referral. Primary care service units are the first physical levels of health systems comprising of health centres (level 3) and dispensaries (level 2) (Ministry of Health Kenya, 2012). For this study, the four health facilities were level 3, public health centres that have attended to at least 200 pregnant young women in 2018. All the four health facilities selected for this study were run by clinical officers and nurses. The selected public health facilities had shared characteristics like provision of comprehensive primary health care including SRHR (maternal and child-health care services), have 24-hour services, have a clinical officer as the in-charge, have in-patient wards and also had laboratories where diagnostic tests were done. Other services provided include in-patient services including basic emergency obstetric care, laboratory services, Tuberculosis clinics, and comprehensive care clinics for patients living with HIV, family planning services, pharmacy and counselling services among other clinical services. Additionally, the study sites had better accessibility to the targeted community members, steady electricity and steady mobile network coverage.

3.9 Study population

The study population included expectant young women aged 24 years and below attending their first antenatal clinics in any of the four selected public health facilities in Kwale County. In addition to selected expectant young women in the mHealth intervention arm who participated in the qualitative study, four healthcare workers providing antenatal care service in the two treatment facilities were also interviewed to get their insights regarding integrating mHealth within an existing antenatal care system.

3.9.1 Inclusion criteria

- Expectant young women aged 24 years and below residing within the study setting and had no travel plans during the study period.
- Expectant young women with a gestational age not exceeding 24 weeks. A nationally representative cross-sectional survey in Kenya established that, for expectant young women, the mean gestational age at first ANC was 23.8 weeks (Ronen et al., 2017). With this in mind, eligible participants coming for their first antenatal visit with a cut-off gestation period of 24 weeks or less were informed about the study and consent sought from them before enrolment.
- Expectant young women with uneventful first trimester.
- Expectant young women who had their own mobile phone at the time of recruitment.
- Expectant young women who could read and write either English and/or Swahili.
- Eligible participants who gave written consent.

3.9.2 Exclusion criteria

- Expectant young women who presented with complications during their first ANC contact. These complications included hyperemesis gravidarum, placenta Previa, gestational hypertension, gestational diabetes mellitus, Pre-eclampsia and iron deficiency anaemia.

3.10 Sample size determination

3.10.1 Sample size calculation for quantitative survey

The sample size estimation for comparing difference in two proportions according to Dhulkhed et., al (2008) was used to determine the sample size for this study: (Dhulkhed et al., 2008)

$$n = \frac{2(\acute{p})\,(1-\acute{p})(Z\alpha+Z\beta)^2}{d^2}$$

Where:

n = Sample size in each arm

ṕ = Measure of variability

Zα = 1.96 (critical value at 95% confidence interval and 0.05 significance level)

Zβ = 0.84 (critical value at 80% desired power)

d= 10% (51-41) (Effect size of the intervention /difference in proportion)

$\acute{p} = \frac{p1+p2}{2}$ = (51+41)/2 = 46%

The sample size estimation was based on the number of expectant teenagers in Kenya who did not attend at least four antenatal care visits, estimated to be 51% (UNICEF, 2018a). For this study, a 10% effect size in proportion increment of expectant young women receiving at least four antenatal contacts currently recommended by RMNCAH in Kenya was considered to be clinically beneficial. Assuming the 51% (in the Kenyan context) is in the intervention group - to receive text messages; a sample size of 778 (389 in each arm) would achieve 80% power to detect a difference of 10% at 95% confidence level and a 5% error margin. To account for loss to follow up (estimated to be 10%), this study recruited 856 expectant young women (428 in each arm). The sample size was thus mathematically calculated as follows:

$n = \frac{2(0.46)(1-0.46)(1.96+0.842)^2}{0.1^2}$ = 389 participants per arm (778 in total)

Finally, the sample size was adjusted for a 10% lost to follow-up (110/100 x 778 = 855.8), resulting in an overall sample size of 856, comprising of 428 per arm.

3.10.2 Sample size for qualitative survey

Prior to the start of the trial, 18 expectant young women were identified within the Kwale County and took part in two separate FGDs to test the study messages and confirm the key barriers, misperceptions and attitudes around the utilization of antenatal services by expectant young women. Also, after the trial, total of 29 In-Depth Interviews (IDIs) were held; 25 with different intervention study participants and four with HCPs providing MCH services at the two intervention health facilities. The main aim of the qualitative component was to assess the feasibility and acceptability of the mHealth text messaging intervention and health care providers' perceptions regarding integrating mHealth-text messaging intervention within the existing ANC delivery system. The concept of saturation in qualitative research was used to determine participants in this study (Dworkin, 2012).

3.11 Sampling procedure

3.11.1 Quantitative study sampling procedure

Following the selection of the four study-facilities, eligible participants were enrolled in the study based on the inclusion/exclusion criteria. Antenatal registers in the selected health facilities were utilized to select eligible participants for the study. The ANC register contains clinical and demographic details of expectant women attending their clinics at their respective facilities. Eligibility information from the ANC registers used to identify study participants in the four health centres included, number of ANC visits to establish if indeed that was the first and only visit made, age, gestation in weeks and other health conditions observed during the first visit including hypertension and diabetes among others. Before enrolment, the HCP at the ANC clinics identified eligible participants from the ANC registers, contacted and explained the study to the identified participants asking them if they'll be interested to participate. Those who agreed to participate and who lived nearby came to the health facility, were introduced to the study team and were given

detailed information about the study, those who provided written consent were immediately enrolled. Those who lived far from the health facilities were visited by their respective research assistant and informed about the study before they could get enrolled.

Additionally, expectant young women coming for their first ANC during the study period and meeting the inclusion criteria were informed about the study by the HCPs after receiving their ANC services. The HCPs providing ANC services in the study facilities were the first point of contact who identified and provided the study information to eligible participants. Those who agreed to participate were linked with the trained female research assistants who at the time of the study were all stationed at the study facilities. These facilities had initially set aside Tuesdays and Thursdays as dedicated days for the ANC clinics; but due to the COVID-19 disruptions and the low turnout at the ANC clinics, all the four facilities allowed expectant women to come to the clinic at any day (between Monday and Friday) of their choice. Similarly, the research team was available at the clinics everyday between Monday and Friday until each facility attained its sample size of at least 214 participants. All participants were provided with information sheets which was part of the informed consenting process and allowed up to two days to decide if they'll wish to participate. Fortunately, all participants made decisions to consent or not to within the same day. Participants' background characteristics data and that of longitudinal follow up visits were collected separately before and after the trial respectively.

3.11.2 Qualitative study sampling procedure

For the qualitative part of the study, purposive sampling method was applied to recruit 18 study participants for the pre-trial FGDs. Participants were selected based on specific characteristics to match the characteristics of the ideal study participants. These criteria included being below 24 years of age, having a gestation period below 24 weeks, residing in Kwale County, possessing a

mobile phone, and demonstrating some literacy in either English or Swahili. This purposive sampling approach facilitated a deliberate and targeted selection of participants, ensuring that the chosen individuals closely matched the characteristics deemed ideal for the study. Community health extension workers in Kwale County assisted with the recruitment exercise. Additionally, 25 different intervention participants were randomly selected from the mHealth intervention participants' list and participated in the in-depth interviews. Four healthcare workers providing ANC services at the intervention sites were purposively selected to gain their perceptions regarding the mHealth platform.

3.12 Data collection and measurement tools

3.12.1 Measurement tools for quantitative data

3.12.1.1 Baseline quantitative data

An interviewer-administered questionnaire adapted from an evaluation to assess a new Adolescent Reproductive Health programme (In-Their-Hands) in Kenya which used a digital platform that linked adolescent girls to SRH services was used (APHRC, 2019) in this study. The questionnaire included questions on participants' demographic details such as age, educational level, religion, marital status, their spouse age and educational status, occupation of the participant and male partner if available and type of pregnancy, that is, whether the pregnancy was wanted or not. Other background information collected included number of children alive and young women's autonomy regarding their reproductive health service utilization. Additionally, the questionnaire also captured quantitative data on basic knowledge and source of information about ANC services including perceived benefits of ANC and perceived receptive tendencies of the healthcare providers when young women sought antenatal care. Both sets of background data were electronically collected using open data kit (ODK). Five female data collectors with a minimum

of secondary certificate qualification were recruited and trained on Open Data Kit (ODK) by the principal investigator. Data collectors were provided with smart phones to collect study data through face to face interaction with study participants while observing all the COVID-19 prevention measures.

3.12.1.2 Post-trial quantitative data

After the trial, relevant quantitative data was extracted from the four health centres using the Ministry of Health's Antenatal Care registers, MOH 405 and Maternity registers, MOH 333. Specifically, the antenatal registers presented data on the number of ANC visits made by the study participants, gravidity, gestation in weeks, estimated date of delivery and services given at ANC including detection and treatment of any pregnancy complications. The maternity registers on the other hand provided quantitative data relating to the delivery process and baby's outcomes. Relevant extracted data included gestation at birth in weeks, mode of delivery (Normal, caesarean, breech or assisted vaginal delivery), and condition of the mother after delivery whether alive or dead. Additionally, the babies' details in both arms were extracted. These included birth weights in grams, birth outcomes (live birth, fresh still birth or macerated still birth), birth deformities and the professional who conducted the deliveries. Any referrals made to the study participants in both arms were also recorded. Phone details of the study participants were used to contact those who had not delivered within the study facilities and information was requested from delivery facilities.

Unique ANC numbers given to expectant young women at the health facilities were recorded and utilized throughout the study period. Pre-intervention background information recorded the individual ANC unique numbers and linked them to the outcomes' data of each participant as recorded in the ANC registers during analysis.

3.12.3 Measurement tools for qualitative data

3.12.3.1 Qualitative topic guide for focus group discussions

Open-ended discussion guides were used to moderate focus group discussions. Preceding the baseline survey, two FGDs were held with young mothers in Kwale County. These FGDs were conducted to confirm the key barriers, misperceptions and attitudes around utilization of antenatal services by expectant young women. Additionally, the FGDs were also used to test the study messages as well as to understand young women's thoughts regarding the qualities of an ideal ANC friendly environment at the community and facility levels. These FGD participants did not participate in the main trial. The FGDs were moderated by trained female research assistants with a minimum of secondary certification and attended by expectant young women aged 24 and below and with a gestation period of not more than 24 weeks. Participants were residents of Kwale County. Findings from these FGDs were used to fine-tune the trial messages prior to the start of the intervention.

3.12.3.2 End-line intervention qualitative data collection

Semi-structured interview guides were used to facilitate in-depth interviews to assess the feasibility and acceptability of the mHealth text message intervention. In-depth interviews were conducted with 25 randomly selected different intervention participants to describe their mHealth experiences including experiences interacting with the platform and the relevance of the mHealth content. An additional four IDIs were conducted with HCPs from the two intervention facilities to gain insights on their experiences, barriers and motivating factors in using mHealth platforms at the antenatal clinics as well as to get their views regarding mHealth integration within the MCH clinics. Open ended questions in the IDI guide were based on, system usability specifically on what worked and their dislikes about the mHealth-text message intervention; relevance of the

messages to check on the usefulness of the information received, whether the information was new and the messages they loved most. The qualitative interviews also sought to hear from the intervention participants if their caregivers had any thoughts and opinions on the relevance of the messages they were receiving on a monthly basis. Specifically, for HCPs, we sought to understand their views relating to the systems integration and their general thoughts regarding the mHealth interventions. Upon consent, all the IDIs were audio-recorded and moderated by female research assistants and took approximately 45 minutes, all interviews were conducted in Swahili language. All interviews were later transcribed and translated into English.

3.13 Quality assurance procedures

3.13.1 Quality control of clinical data

Healthcare providers at the intervention sites were sensitized on the mHealth platform by the lead researcher. Since all study participants in both arms were provided with standard antenatal care, the probability that service provision would differ at the two sites was expected to be close to nil. De-identified clinical data used to assess the study's health outcomes were extracted from the national antenatal and maternity registers from the four study facilities; this guaranteed uniformity in information gathered.

3.13.2 Quality control of background characteristics and intervention specific data

Pretested tools in both English and Swahili were used to collect background and intervention-specific data. Five female data collectors with a minimum of secondary certificate qualification were recruited and trained by the principal investigator on research ethics, study procedures, data collection techniques, data quality assurance and Open Data Kit (ODK). Data collectors used smart phones to collect study data which was then transmitted to a cloud server accessed only by the principal investigator. All completed data collection tools (including online ODK transmissions) were inspected by the research team on the very same day for completeness and internal

consistencies. All inconsistencies were immediately followed up with the research assistant who reached out to their respective participants to check on the responses and updated accordingly. For qualitative data, recordings were coded with unique numbers and stored in password secured computers immediately after ending the interviews.

3.13.3 Pretesting non-clinical data collection tools

Pretesting was done with young mothers in Tiwi, a different location from the selected study sites but within Kwale County. The adapted structured questionnaires used to collect participants' background information was pretested with 5% (43) of the sample size. There were minor recommendations from the pre-test exercise which were taken into consideration prior to the actual administration of the background tool. One addition included asking participants if they were registered with any digital platform which provided them with SRH related information.

3.13.4 Monitoring the mHealth platform

At the time of participants' recruitment, data collectors confirmed the presence and ownership of the phone by calling the phone number given. Subsequently during the trial, messages sent to the intervention participants had a 'received-alert' notification attached to the message as evidence that the message has been received by the intended recipient. Participants were asked to send back a response (*reply yes*) as evidence that they had read the message. Additionally, delivery reports were generated by the mHealth platform after the messages were sent indicating whether the messages were delivered, not delivered to the participant and/or whether the messages had been received. Since all the mHealth intervention participants confirmed receipt of the first two messages, the analysis of this study was based on the assumption that all mHealth intervention participants received and read all the other subsequent messages. This study did not experience any glitches with the mHealth platform.

3.14 Data analysis

3.14.1 Study variables

3.14.1.1 Outcome/Dependent variables

Table 3.2 shows the variables and their operational definitions. Increased antenatal contacts to four or more was the main outcome of the study. This was defined as number of clinical antenatal visits made by study participants throughout the study period up until delivery. This was categorized as 0 = less than 4, and 1 for ≥ 4 antenatal contacts. Other outcome variables included: Institutional deliveries defined as hospital childbirths under skilled birth attendant, that is, competent maternal and new-born health professionals, educated, trained and regulated to national standards; measured as categorical dichotomous variable, that is, 0 = unskilled deliveries, and 1 = institutional deliveries. And Infant birthweights defined as body weight of the infant immediately after birth. Babies born weighing less than 2,500 grams were termed low birthweight babies; measured as a ratio variable and categorized as: low birthweights < 2500 grams and normal birthweight ≥ 2500 grams.

Table 3.2 Study variables and their operational definitions

Variable name	Variable definition	Variable measurement	Scale of measurement
DEPENDENT / OUTCOME VARIABLES			
Increased antenatal contacts to four or more	Number of clinical antenatal visits made by study participants throughout their pregnancy period	0 = less than 4 1 = ≥ 4 antenatal contacts.	Categorical
Institutional deliveries	Hospital childbirths under skilled birth attendant, that is, competent maternal and new-born health professionals, educated, trained and regulated to Kenyan standards	0 = unskilled deliveries 1 = institutional deliveries.	Categorical

Infant birthweights	Body weight of the infant immediately after birth	0 = low birthweights < 2500 grams 1 = normal birthweight ≥ 2500 grams.	Categorical
INDEPENDENT VARIABLES			
Age	Participant age at enrolment	Raw ages Categorical	Discrete Categorical
Educational level	Participant education level at enrolment	1= Incomplete primary; 2 = Complete primary; 3 = Secondary and above	Categorical
Marital status	Participant marital status at enrolment	1 = Single/Dating/Cohabiting 2 = Engaged/Married	Categorical
Occupation	Participant occupation at enrolment	1 = employed or in business or 2 = not doing any	Categorical
Parity	Participant's parity level at the time of enrolment	1=one live birth; 2 = two live births 3 = three or more live births	Categorical
Religion	Participant religion at the time of enrolment	1= Christians; 2 = Muslims; 3 = Others	Categorical
Time taken to get to the health facilities	Participant travel time recorded during enrolment	1 = 0-30 minutes 2= 31-60 minutes 3 = 61+ minutes	Categorical
Perceived knowledge of ANC	Participant ANC knowledge at enrolment	When a woman should start ANC clinic 1 = Immediately or within the first 13 weeks 2 = After 13 weeks Recommended number of ANC contacts throughout pregnancy 1 = 4 or more 2 = Less than 4	Categorical Categorical
Type of pregnancy	Participant current pregnancy type at enrolment	1 = Intended 2 = Unintended	Categorical

3.14.1.2 Independent variables

- *Sociodemographic factors* included: Age, educational level, marital status, occupation, parity and religion.

- Age was measured as a continuous variable but was later categorized in 15-19 and 20-24 years.
- Education level was measured as a categorical variable and categorized as Incomplete primary; Complete primary; Secondary and above
- Marital status was measured as a categorical variable and categorized as: Single/Dating/Cohabiting or Engaged/Married
- Occupation was measured as a categorical variable and categorized as: either employed or in business or not doing any
- Parity was measured as a continuous variable and later categorized as; nulliparous; 1=one live birth; 2 = two live births and 3+ = three or more live births
- Religion was measured as a categorical variable and categorized into three: Christians; Muslims; Others

- *Accessibility/Need factors attributed to increased or low uptake of ANC among young expectant women* comprised of:
  - Time taken to get to the health facilities, measured as continuous variable in minutes and later categorized as: 0-30; 31-60 and; 61+ minutes
  - Perceived knowledge of ANC, measured as a categorical to assess participant's knowledge on:
    - when a woman should start ANC clinic
    - Recommended number of ANC contacts
  - Type of pregnancy measured as a categorical variable (Intended/Unintended)

3.14.2 Quantitative data analysis

Prior to actual analysis, quantitative data were inspected for completeness and consistency. Background characteristics of study participants were presented using descriptive statistics. Means and standard deviations were used to summarize continuous variables in the three study arms. Categorical variables were checked for differences between the three groups using chi square tests. The Kruskal-Wallis test was used to determine if there was a statistically significant mean difference between the three groups regarding antenatal contacts, institutional deliveries and infant birth weights. Analysis of Covariance was done to control for any unanticipated pre-existing differences between the three study groups based on their pre-intervention background characteristics. This was followed by multivariate logistic regression analysis on the study binary outcomes of (1) four or more antenatal contacts (yes or no). (2) Institutional deliveries (yes or no), and (3) infant birthweights (low birthweight =<2500grams or normal birthweight infants >2500grams) to assess the effect of the mHealth-text messaging and outreach interventions. Multivariate logistic regression with a 95% confidence interval was used to assess the relationships between independent variables and the study's outcomes. Findings were presented as odds and risk ratios. Results were statistically significant at $p<0.05$.

To examine the extent to which the results were affected by the introduction of an outreach arm, a sensitivity analysis was done excluding Mkongani health centre from the analysis. The aim of the sensitivity analysis in this study was to assess the consistency of the results under different statistical methods (t-test vs Kruskal-Wallis test) and ideal study subgroups, mHealth-text message vs pure control.

All quantitative data analysis was done using STATA version 15 (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC).

3.14.3 Qualitative data analysis

Audio recordings from the IDIs were anonymized, labelled with unique identifiers and deleted from digital recorders once transcription was completed. The discussions were transcribed verbatim, translated into English, coded and analysed thematically using NVivo version 12. A thematic analysis approach was used to organize and analyze the data, and to assist in the development of a codebook and coding scheme. A preliminary code book was developed using the interview guide and the IDIs' transcripts. Data was analysed by first reading all the transcripts, familiarizing with the data and noting the emergent themes and concepts. A thematic framework was developed from the identified themes and sub-themes, and then used to create codes for the raw data. This study's qualitative analysis followed a pattern of association on the key identified themes, particularly focusing on narratives related to experiences interacting with the mHealth interactive platform, mHealth relevance and whether the content was understood by the mHealth intervention participants and HCPs' insights related to mHealth technological adoption and system usability. Direct quotations from participants were used to characterize key issues and themes emerging from the study. To further establish the trustworthiness of the qualitative methods, peer debriefing was done to establish dependability where my supervisors reviewed and examined the qualitative research process and data analysis in order to validate the interpretations derived from the qualitative data. The analysis and findings are presented in accordance with the Consolidated criteria for reporting qualitative research (COREQ) (Tong et al., 2007).

3.15 Ethical considerations

3.15.1 Institutional ethical approval

This study was approved by the Noguchi Memorial Institute for Medical Research Institutional Review Board at the University of Ghana, (NMIMR-IRB CPN 066/19-20), the University of Nairobi, Ethics and Review Committee at the Kenyatta National Hospital (KNH-UoN ERC) KNH-ERC/A/234), and the National Commission for Science, Technology and Innovation (NACOSTI) (NACOSTI/P20/6389). Permission to conduct the research was sought from the Kwale County Health Management Team and in-charges of the four health facilities involved in the study.

3.15.2 Informed consent

Prior to beginning any interview, research staff obtained written informed consent from each study participant. During the consenting process, study participants were provided with detailed information about the study's background, objectives and its public health relevance. They were given the opportunity to ask questions after the study had been explained to them. Confidentiality was maintained throughout the study and participation was on one's own volition. Respondents in the study were either asked to sign or thumbprint an informed consent form. However, it was made known to them that their names will not be linked to any information they provided. In compliance with the ethical obligations and as evidence of voluntary participation, two informed consent forms were filled by the study participants, one copy remained with the expectant young woman and the other copy with the principal investigator.

3.15.3 Voluntary participation

The main ethical issue of concern in this study was the age of expectant adolescents, specifically those below 18 years. However, since they qualified as emancipated minors by virtue of being pregnant and expecting a child of their own, all the ethic committees granted a parental consent waiver. Participants were informed during consenting process that they were free to leave the study

at any point if they felt uncomfortable without penalties. In addition, they were informed that their opting out will not interfere with their health care service provision in any way.

3.15.4 Perceived risks and benefits of the study

This study did not have any identifiable biological risk to participants. However, some participants may have felt some discomfort answering some of the questions. To minimize discomforts and any unforeseen embarrassments, female data collectors were engaged throughout the study. Participants were also told that they did not need to respond to questions they were not comfortable with. Additionally, to ensure that expectant young women did not attach service provision to one's participation in the study, research assistants were adequately trained to ensure that recruitment and consenting was done after the first ANC clinical contact had been established.

One main benefit of participating in this study was for expectant young women to gain knowledge on the importance of clinical contacts necessary for a positive pregnancy outcome. Treatment supporters and healthcare providers also appreciated the need for social support to reduce stigma in service provision to young mothers. Long term benefits will depend on the adoption of the platform by the Kwale health facilities to reduce maternal morbidities and deaths associated with low uptake of antenatal services by expectant young women. It was made clear to participants that they would not get special services besides the messages for the intervention arm. IDIs respondents were reimbursed their travel costs (USD$5) and all study participants in both arms were given a token amount of airtime worth USD$0.5 upon recruitment to facilitate their communication with health care providers.

3.15.5 Minimizing the risk of COVID-19 disease

To minimize the risks of infection of COVID 19 disease, the research team ensured that interview participants sat two meters from the data collector in order to observe physical distancing as recommended by the Kenyan Ministry of Health and WHO. Additionally, the principal investigator provided the study participants and research team with surgical face masks during each interview. All research staff and study participants were sensitized on the importance of wearing face masks including how to wear them. Alcohol-based hand sanitizers were also available for use at all times during data collection.

3.15.6 Potential adverse events and proposed interventions

Pregnancy related messages seen by individuals not in the study without the respondent's consent and/or knowledge could potentially create discomfort especially for participants distressed with family or community stigma. However, there were no reported cases of verbal or physical confrontations between parents/caregivers and/or partners of expectant young women throughout the study period. Further, an opt-out choice was presented to the mHealth text-message intervention participants in case one wanted to be unenrolled from the mHealth platform. All study participants were also provided with the lead researcher's phone details to contact him in the event of any real or perceived threats resulting from their study participation. Moreover, as part of the eligibility criteria, participants were required to have their own mobile phones, this was meant to reduce the 'risk' of having study messages appearing on a shared phone. Since the messages were strictly educational and relevant to the period of pregnancy, privacy concerns were anticipated to be a non-issue. Treatment supporters selected by intervention participants were alerted about the intervention and presented with an opt-out choice from the mHealth platform at each message received.

3.15.7 Confidentiality, Anonymity and Privacy

All study participants were interviewed in a private room within the health facilities, all interviews were conducted by trained female data collectors. Participants were given unique ID numbers and all personal identifies were not linked with their data. All the study tools including informed consent forms, questionnaires and interview guides were serialized to preserve the anonymity of the participants and locked in a safe cabinet accessed only by the lead researcher. Additionally, de-identified coded clinical data was used in analyzing the study data and all results were kept confidential in password-protected files accessible only by the lead researcher and the supervisory committee upon request. Study participants were informed that data collected were solely for the intended academic purposes and information gathered will be treated with utmost privacy.

3.16 Chapter summary

This chapter discussed the methods used in this study. The chapter provided information on the philosophical premise on which this study was based on and a description of the research design selected for this study and the reasons for the choice. An explanation of the study design modification and criteria for participants' inclusion/exclusion was also provided. Sample size determination, sampling procedure, data collection and analysis procedures and ethical considerations employed in this study have also been discussed. The next chapter presents the study results.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the findings of the study. Results include descriptive presentation of the background characteristics of the study participants and a comparison of the distribution of study participants by their intervention status (receiving text messages, participated in outreaches and pure controls who maintained the status quo). The chapter also presents the quantitative findings on the effect of text message and outreach interventions on: antenatal care contacts, institutional deliveries, and on infant birthweights. Further, the qualitative findings on the feasibility and acceptability of mHealth interventions are also presented in this chapter.

4.2 Characteristics of study participants.

Of the 844 participants captured in the longitudinal follow up visits after the trial, 27 (3%) participants could not be linked to their first ANC visit and background data due to erroneous identifiers. The remaining 817 participants were within the expected sample size and therefore statistical power important for internal validity was not affected. The 817 participants were successfully linked to their background data and were included in the analysis (Figure 4.1). A total of 213 (26.1%) respondents were from Mkongani Health Centre, 205 (25.1%) were from Kikoneni Health Centre, 193 (23.6%) were from Mnyenzeni Health Centre and 206 (25.2%) were from Mazeras Health Centre. Figure 4.1 below is a flow chart illustrating sources of data and eligibility of expectant adolescents and young mothers attending antenatal care visits in Kwale county, coastal Kenya

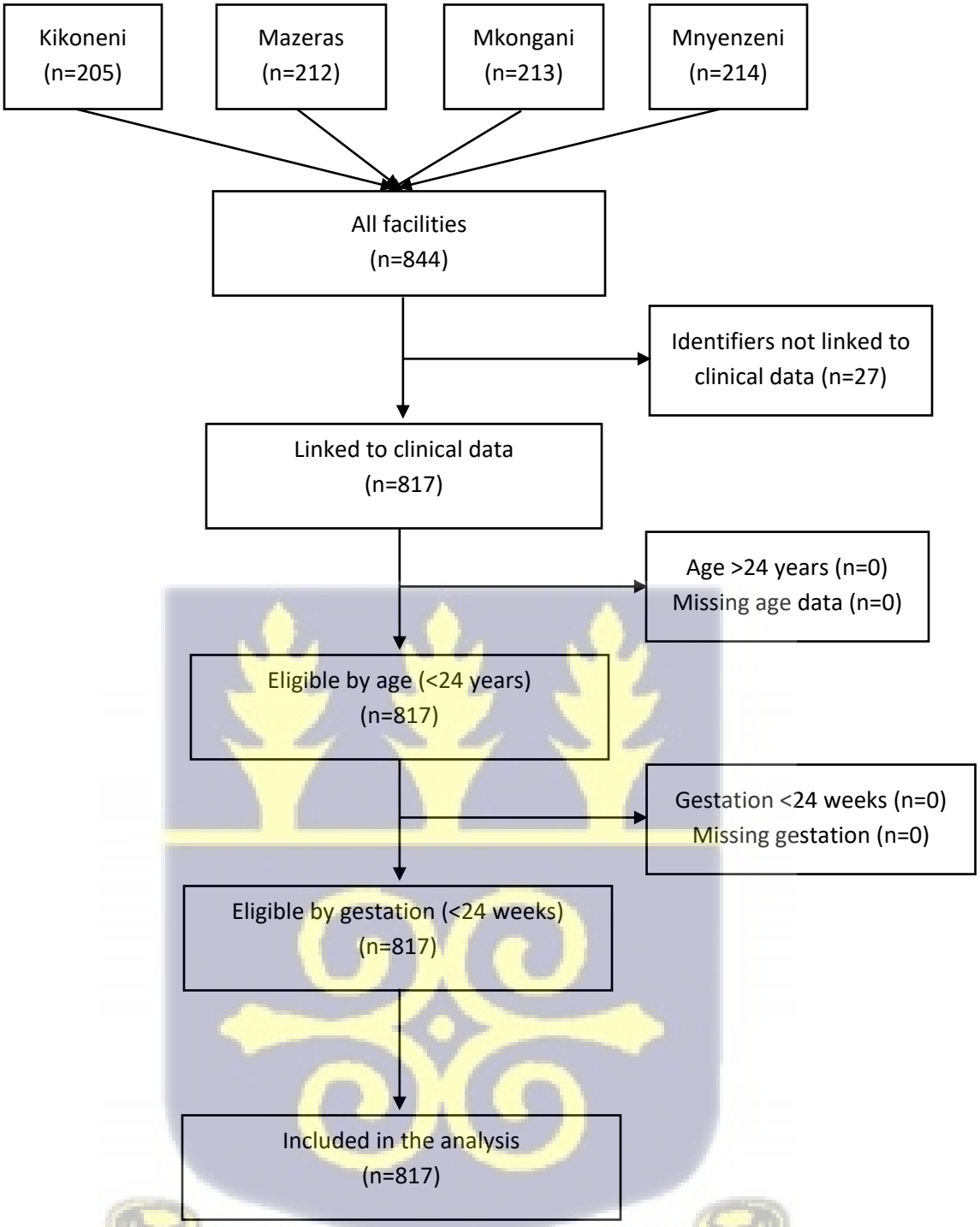

Figure 4.1 Analysis flow chat

The mean age at first ANC visit was (21.1 [standard deviation- SD, 2.4]) years, at sex debut (17.4 [SD, 2.2]) and at first pregnancy (18.8 [SD, 2.5]) years. The mean age of the spouse/partner was 26.8 (SD, 4.8) years. Majority of participants had primary level education (82.2%), were Muslim (71.1%), had their sexual debut at >18 years (51.3%), and were engaged or married (83.7%). Additionally, majority of the participants in this study were neither formally employed nor doing business (90.8%), had a male partner as their primary caregiver (79.2%), reported that their pregnancy was planned (72.0%), said that this was their first pregnancy (57.2%) and also reported that their age at first pregnancy was <20 years (61.0%). Majority were also more than 20 weeks pregnant at their first ANC visit (70.0%), reported to have received some ANC information since becoming pregnant (60.1%), and reported that it took them more than 30 minutes to get to the health facility from home (70.5%) (Table 4.1).

Table 4.1 Background characteristics of study participants (N=817)

	Mkongani (n=213)	Kikoneni (n=205)	Mnyenzeni (n=193)	Mazeras (n=206)	Overall (n=817)
Mean age (standard deviation)	20.4 (2.4)	20.8 (2.6)	21.7 (2.4)	21.4 (2.0)	21.1 (2.4)
Age group (years):					
15-19	73 (34.3)	66 (32.2)	37 (19.2)	39 (18.9)	215 (26.3)
20-24	140 (65.7)	139 (67.8)	156 (80.8)	167 (81.1)	602 (73.7)
Highest education level:					
Incomplete primary	107 (50.2)	104 (50.7)	106 (54.9)	52 (25.2)	369 (45.2)
Complete primary	76 (35.7)	70 (34.2)	59 (30.6)	98 (47.6)	303 (37.1)
Secondary and above	30 (14.1)	31 (15.1)	26 (13.5)	56 (27.2)	143 (17.5)
Missing	0 (0.0)	0 (0.0)	2 (1.0)	0 (0.0)	2 (0.2)
Religion:					
Christian	43 (20.2)	31 (15.1)	53 (27.5)	103 (50.0)	230 (28.2)
Muslim	170 (79.8)	174 (84.9)	135 (70.0)	102 (49.5)	581 (71.1)
Others	0 (0.0)	0 (0.0)	5 (2.6)	1 (0.5)	6 (0.7)
Mean age at sex debut (sd)	17.4 (1.8)	17.2 (2.2)	15.9 (2.0)	19.0 (1.6)	17.4 (2.2)
Age at sex debut:					
10-14 years	8 (3.8)	17 (8.3)	59 (30.6)	3 (1.5)	87 (10.7)
15-17 years	95 (44.6)	91 (44.4)	84 (43.5)	18 (8.7)	288 (35.2)
18-24 years	110 (51.6)	82 (40.0)	50 (25.9)	177 (85.9)	419 (51.3)
Missing	0 (0.0)	15 (7.3)	0 (0.0)	8 (3.9)	23 (2.8)

Marital status:					
Single/Dating/Cohabiting	29 (13.6)	76 (37.1)	5 (2.6)	23 (11.2)	133 (16.3)
Engaged/Married	184 (86.4)	129 (62.9)	188 (97.4)	183 (88.8)	684 (83.7)
Primary caregiver:					
None	2 (0.9)	1 (0.5)	2 (1.0)	1 (0.5)	6 (0.7)
Male partner	182 (85.5)	105 (51.2)	179 (92.8)	181 (87.9)	647 (79.2)
Parents	26 (12.2)	91 (44.4)	11 (5.7)	22 (10.7)	150 (18.4)
Siblings/Relatives/Others	3 (1.4)	8 (3.9)	1 (0.5)	2 (1.0)	14 (1.7)
Mean age of male partner (sd)	25.7 (4.1)	26.9 (6.4)	28.0 (4.9)	26.6 (3.4)	26.8 (4.8)
Age group of male partners:					
17-24 years	84 (39.4)	61 (29.8)	48 (24.9)	45 (21.8)	238 (29.1)
25-29 years	101 (47.4)	74 (36.1)	76 (39.4)	108 (52.4)	359 (43.9)
30+ years	28 (13.2)	40 (19.5)	69 (35.8)	40 (19.4)	177 (21.7)
Missing	0 (0.0)	30 (14.6)	0 (0.0)	13 (6.3)	43 (5.3)
Employed or in business:					
No	201 (94.4)	183 (89.3)	169 (87.6)	189 (91.8)	742 (90.8)
Yes	12 (5.6)	22 (10.7)	24 (12.4)	17 (8.3)	75 (9.2)
Planned pregnancy:					
Yes	112 (52.6)	121 (59.0)	175 (90.7)	180 (87.4)	588 (72.0)
No	100 (47.0)	78 (38.1)	18 (9.3)	26 (12.6)	222 (27.2)
Unsure	1 (0.5)	6 (2.9)	0 (0.0)	0 (0.0)	7 (0.9)
Parity:					
Nulliparous	114 (53.5)	131 (63.9)	61 (31.6)	161 (78.2)	467 (57.2)
1	50 (23.5)	37 (18.1)	44 (22.8)	33 (16.0)	164 (20.1)
2	42 (19.7)	21 (10.2)	36 (18.7)	5 (2.4)	104 (12.7)
3+	7 (3.3)	16 (7.8)	52 (26.9)	7 (3.4)	82 (10.0)
Mean age at first pregnancy (sd)	18.5 (2.1)	19.0 (2.5)	17.3 (2.3)	20.5 (1.9)	18.8 (2.5)
Age group at first pregnancy:					
14 - 17 years	63 (29.6)	60 (29.3)	101 (52.3)	8 (3.9)	232 (28.4)
18-19 years	87 (40.9)	69 (33.7)	53 (27.5)	57 (27.7)	266 (32.6)
20-24 years	63 (29.6)	76 (37.1)	39 (20.2)	141 (68.5)	319 (39.1)
Mean Gestational age in weeks at first ANC	19.3 (4.4)	20.5 (3.9)	18.8 (5.7)	19.5 (4.6)	19.6 (4.8)
Gestation at first ANC:					
0-13 weeks	21 (9.9)	12 (5.9)	47 (24.4)	19 (9.2)	99 (12.1)
14-19 weeks	38 (17.8)	45 (22.0)	20 (10.4)	43 (20.9)	146 (17.9)
20-24 weeks	154 (72.3)	148 (72.2)	126 (65.3)	144 (70.0)	572 (70.0)
Received any information on the importance of ANC since becoming pregnant:					
No	134 (62.9)	63 (30.7)	15 (7.8)	114 (55.3)	326 (40.0)
Yes	79 (37.1)	142 (69.3)	178 (92.2)	92 (44.7)	491 (60.1)
Knowledge on when a woman should start ANC clinic:					
On missing periods	13 (6.1)	21 (10.2)	16 (8.3)	11 (5.3)	61 (7.5)
1st trimester	28 (13.2)	92 (44.9)	155 (80.3)	63 (30.6)	338 (41.4)
2nd trimester	110 (51.6)	73 (35.6)	21 (10.9)	103 (50.0)	307 (37.6)
3rd trimester	22 (10.3)	3 (1.5)	1 (0.5)	3 (1.5)	29 (3.6)

Don't know	40 (18.8)	16 (7.8)	0 (0.0)	26 (12.6)	82 (10.0)
Knowledge on how many ANC visits is recommended:					
None	10 (4.7)	1 (0.5)	0 (0.0)	14 (6.8)	25 (3.1)
Between 1-2	2 (0.9)	0 (0.0)	33 (17.1)	1 (0.5)	36 (4.4)
Between 3-5	21 (9.9)	82 (40.0)	19 (9.8)	77 (37.4)	199 (24.4)
At least 4	80 (37.6)	48 (23.4)	73 (37.8)	49 (23.8)	250 (30.6)
As many as possible	100 (46.9)	74 (36.1)	68 (35.2)	65 (31.6)	307 (37.6)
Time to facility (minutes):					
0-30	53 (24.9)	59 (28.8)	34 (17.6)	95 (46.1)	241 (29.5)
31-60	77 (36.2)	79 (38.5)	77 (39.9)	84 (40.8)	317 (38.8)
61+	83 (39.0)	67 (32.7)	82 (42.5)	27 (13.1)	259 (31.7)

Compared to participants from the control and outreach arms, participants from the mHealth intervention arm were more likely to have an incomplete primary school education (52.8% vs control 31.6% and outreach 49.7%, p<0.001), to have a younger age at sexual debut (<15 years, 19.1% vs control 2.2% and outreach 3.4%, p<0.001) and to be single/dating/cohabiting (20.4% vs. control 10.7% and outreach 15.7%, p=0.002). mHealth intervention participants were also more likely to be supported by their parents (25.6% vs control 10.3% and outreach 13.6%, p<0.001), to be employed or doing business (11.6% vs. control 8.1% and outreach 4.8%, p=0.04) and to have the current pregnancy as their third or more pregnancy (17.1% vs control 3.7% and outreach 2.7%, p<0.001). Moreover, intervention participants were more likely to have been less than 18 years at their first pregnancy (40.5% vs control 11.8% and outreach 26.5%, p<0.001) and to have received any ANC information since becoming pregnant (80.4% vs control 46.0% and outreach 31.3%, p<0.001).

Further, the outreach arm participants were more likely to be Muslims (78.2% vs. control 57.7% and intervention 77.6%, p<0.001), and more likely to take longer time to get to the facility from home (>60 minutes, 42.2% vs. control 17.7% and intervention 37.4, p<0.001).

Control participants were more likely to be having a planned pregnancy (80.9% vs intervention 74.4% and outreach arm 49.0%, p<0.001), (Table 4.2).

Table 4.2 A comparison distribution of study participants by their intervention status (N=817)

Characteristics	Control (n=272)	Intervention (n=398)	Outreach (n=147)	p-value*
Median age (IQR)	21 (20-23)	21(19-24)	20 (19-22)	<0.001
Age group (years):				
15-19	55 (20.2)	103 (25.9)	57 (38.8)	
20-24	217 (79.8)	295 (74.1)	90 (61.2)	<0.001
Highest education level:				
Incomplete primary	86 (31.6)	210 (52.8)	73 (49.7)	
Complete primary	118 (43.4)	129 (32.4)	56 (38.1)	
Secondary and above	68 (25.0)	57 (14.3)	18 (12.2)	
Missing	0.0	2 (0.5)	0.0	<0.001
Religion:				
Christian	114 (41.9)	84 (21.1)	32 (21.8)	
Muslim	157 (57.7)	309 (77.6)	115 (78.2)	
Others	1 (0.37)	5 (1.3)	0.0	<0.001
Median age at sex debut (IQR)	19 (18-20)	16 (15-18)	18 (16-18)	0.0001
Age group at sexual debut:				
10-14 years	6 (2.2)	76 (19.1)	5 (3.4)	
15-17 years	48 (17.7)	175 (44.0)	65 (44.2)	
18-24 years	210 (77.2)	132 (33.2)	77 (52.4)	
Missing	8 (2.9)	15 (3.8)	0.0	<0.001
Marital status:				
Single/Dating/Cohabiting	29 (10.7)	81 (20.4)	23 (15.7)	
Engaged/Married	243 (89.3)	317 (79.7)	124 (84.4)	0.004
Primary caregiver:				
None	2 (0.7)	3 (0.8)	1 (0.7)	
Male partner	239 (87.9)	284 (71.4)	124 (84.4)	
Parents	28 (10.3)	102 (25.6)	20 (13.6)	
Relatives/Neighbors/Others	3 (1.1)	9 (2.3)	2 (1.4)	<0.001
Media age of male partner (IQR)	26 (24-28)	26 (24-30)	25 (23-28)	0.003
Age group of male partners:				
<25 years	71 (26.1)	109 (27.4)	58 (39.5)	
25-29 years	139 (51.1)	150 (37.7)	70 (47.6)	
30+ years	49 (18.0)	109 (27.4)	19 (12.9)	
Missing	13 (4.8)	30 (7.5)	0.0	<0.001
Employed or in business:				
No	250 (91.9)	352 (88.4)	140 (95.2)	
Yes	22 (8.1)	6 (11.6)	7 (4.8)	0.04

Planned pregnancy:				
Yes	220 (80.9)	296 (74.4)	72 (49.0)	
No	51 (18.8)	96 (24.1)	75 (51.0)	
Unsure	1 (0.4)	6 (1.5)	0.0	<0.001
Parity:				
Nulliparous	195 (71.7)	192 (48.2)	80 (54.4)	
1	47 (17.3)	81 (20.4)	36 (24.5)	
2	20 (7.4)	57 (14.3)	27 (18.4)	
3+	10 (3.7)	68 (17.1)	4 (2.7)	<0.001
Median age at first pregnancy (IQR)	20 (18-21)	18 (16-20)	18 (17-20)	0.0001
Age group at first pregnancy:				
14 -17 years	32 (11.8)	161 (40.5)	39 (26.5)	
18 – 19 years	77 (28.3)	122 (30.7)	67 (45.6)	
20 – 24 years	163 (60.0	67 (45.6)	41 (27.9)	<0.001
Gestation at first ANC:				
0-13 weeks	26 (9.6)	59 (14.8)	14 (9.5)	
14-19 weeks	56 (20.6)	65 (16.3)	25 (17.0)	
20-24 weeks	190 (69.9)	274 (68.8)	108 (73.5)	0.151
Received any ANC information since becoming pregnant:				
No	147 (54.0)	78 (19.6)	101 (68.7)	<0.001
Yes	125 (46.0)	320 (80.4)	46 (31.3)	
Knowledge on when a woman should start ANC clinic:				
On missing periods	15 (5.5)	37 (9.3)	9 (6.1)	
1st trimester	76 (27.9)	247 (62.1)	15 (10.2)	
2nd trimester	138 (50.7)	94 (23.6)	75 (51.0)	
3rd trimester	6 (2.2)	4 (1.0)	19 (12.9)	
Don't know	37 (13.6)	16 (4.0)	29 (19.7)	<0.001
Knowledge on how many ANC visits is recommended:				
None	18 (6.6)	1 (0.3)	6 (4.1)	
Between 1-2	3 (1.1)	33 (8.3)	0.0	
Between 3-5	83 (30.5)	101 (25.4)	15 (10.2)	
At least 4	77 (28.3)	121 (30.4)	52 (35.4)	
As many as possible	91 (33.5)	142 (35.7)	74 (50.3)	<0.001
Time to facility (mins):				
0-30	115 (42.3)	93 (23.4)	33 (22.5)	
31-60	109 (40.1)	156 (39.2)	52 (35.4)	
61+	48 (17.7)	149 (37.4)	62 (42.2)	<0.001

*Continuous variables assessed using Kruskal-Wallis test; categorical variables assessed using the chi-square test

4.3 Effect of text message and outreach interventions on antenatal care contacts

Participants made a median of 4 (IQR, 3 - 5) antenatal care (ANC) contacts. Overall, 273 (33.4% [95% CI: 30.2% – 36.8%]) participants had low (< 4) ANC contacts. Among the three study arms, participants in the outreach arm had a significantly lower prevalence of low ANC contacts (2% [95% CI: 1%-6%]) compared to mHealth text message intervention arm (30% [95% CI: 25%-35%]) and control arm which had the highest prevalence of low ANC contacts (55% [95% CI: 49% – 61%]), p<0.001) (Figure 4.2).

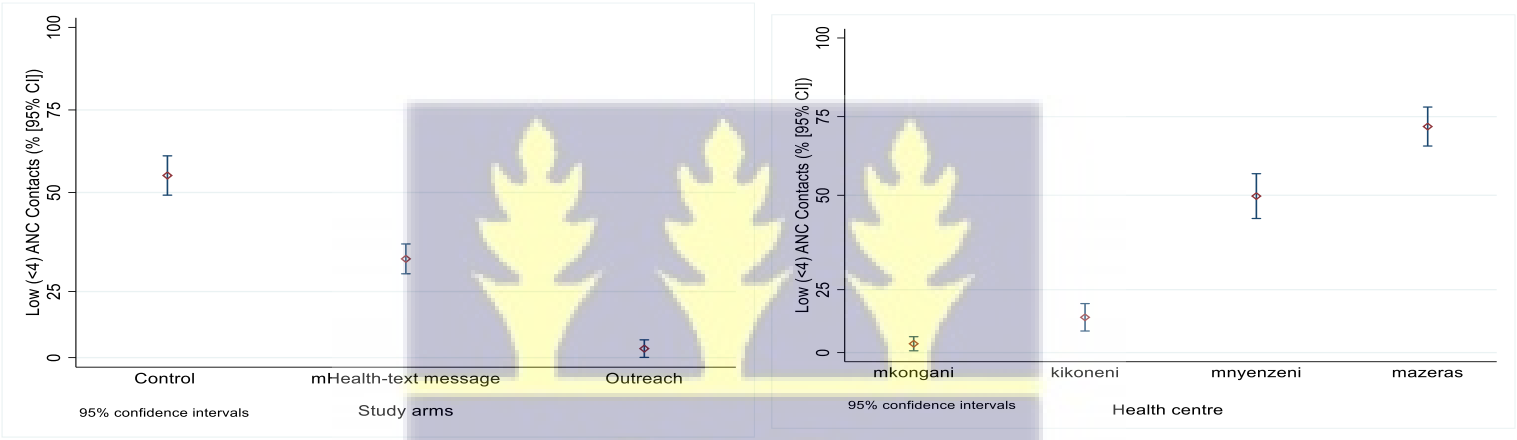

Figure 4.2 Graphs comparing proportion of participants who had low (<4) antenatal contacts between the mHealth text message intervention, outreach and control arms

In a multivariate regression model and after controlling for covariates, participants in the control arm had increased risk for low ANC contacts compared to those from the mHealth text-message intervention arm (Risk Ratio, RR: 0.5 [95% CI: 0.4 – 0.7], p<0.001) and outreach arm (RR: 0.1 [95% CI: 0.0 – 0.7] p = 0.024, (Table 4.3). These findings indicate a statistically significant association, with lower risk ratios suggesting a reduced likelihood of low ANC contacts in the intervention arms compared to the control group.

Other factors that were associated with low ANC contacts included whether the pregnancy was planned and gestation at first ANC contact. Specifically, participants with a planned pregnancy had significantly higher risk (higher likelihood) of low ANC contacts compared to those with an unplanned pregnancy (RR, 2.3 [95% CI: 1.5 – 3.5], p<0.001). There was also an increase in the prevalence of low ANC contacts with increasing gestation at first ANC visit. Specifically, participants attending their first ANC clinic at 20 or more weeks of gestation had significantly increased risk (higher likelihood) of low ANC contacts compared to those attending their first ANC clinic at 13 or less weeks of gestation (RR, 1.6 [95% CI: 1.2 – 2.1], p=0.003). (Table 4.3). These findings indicate a statistically significant association, with higher risk ratios suggesting an increased likelihood of low ANC contacts among participants with a planned pregnancy and those attending their first ANC clinic at 20 or more weeks of gestation.

Table 4.3 Effect of mHealth text message and outreach interventions on low (<4) ANC contacts amongst study participants (N=817)

Characteristics	Low ANC visits (%)	Crude Risk Ratio (95% CI)	p-value	Adjusted Risk Ratio (95% CI)	p-value
Interventions:					
Control	150 (55.1)	Ref		Ref	
MHealth intervention	119 (29.0)	0.5 (0.4-0.6)	<0.001	0.5 (0.4 – 0.7)	<0.001
Outreach participants	4 (2.7)	0.04 (0.02-0.1)	<0.001	0.1 (0.0 – 0.7)	0.024
Age group (years):					
15-19	59 (27.4)	Ref		Ref	
20-24	214 (35.6)	1.3 (1.0-1.7)	0.04	0.7 (0.5 – 1.0)	0.063
Highest education level:					
Incomplete primary	108 (29.3)	Ref		Ref	
Complete primary	107 (35.3)	1.2 (1.0 – 1.5)	0.094	1.1 (0.9 – 1.3)	0.382
Secondary and above	56 (39.2)	1.3 (1.0 – 1.7)	0.027	1.2 (1.0 – 1.5)	0.080
Religion:					
Christian	104 (45.2)	Ref			
Muslim	166 (28.6)	0.6 (0.5 – 0.8)	<0.001	0.9 (0.8 -1.1)	0.410
Others	3 (50.0)	1.1 (0.5 – 2.5)	0.808	0.8 (0.4 – 1.9)	0.660
Age group at sexual debut:					
10-14 years	32 (36.8)	Ref		Ref	
15-17 years	66 (22.9)	0.6 (0.4 – 0.9)	0.008	0.7 (0.5 – 1.1)	0.094
18-24 years	160 (38.2)	1.0 (0.8 – 1.4)	0.807	0.7 (0.5 – 1.1)	0.094

Marital status:					
Single/Dating/Cohabiting	30 (22.6)	Ref			
Engaged/Married	243 (35.5)	1.6 (1.1 – 2.2)	0.007	1.2 (0.9 -1.6)	0.305
Primary caregiver:					
None	2 (33.3)	Ref			
Male partner	240 (37.1)	1.1 (0.4 – 3.5)	0.854		
Parents	28 (18.7)	0.6 (0.2 – 1.8)	0.335		
Relatives/Neighbors/Others	3 (21.4)	0.6 (0.1 – 2.9)	0.567		
Age group of male partners:					
<25 years	65 (27.3)	Ref			
25-29 years	123 (34.3)	1.3 (1.0 – 1.6)	0.078	1.1 (0.9 – 1.4)	0.362
30+ years	68 (38.4)	1.4 (1.1 – 1.9)	0.016	1.3 (1.0 – 1.6)	0.080
Employed or in business:					
No	247 (33.3)	Ref			
Yes	26 (34.7)	1.0 (0.8 – 1.4)	0.808		
Planned pregnancy:					
No	32 (14.4)	Ref		Ref	
Yes	241 (41.0)	2.8 (2.0 – 4.0)	<0.001	2.3 (1.5 – 3.5)	<0.001
Parity:					
Nulliparous	169 (36.2)	Ref		Ref	
1	52 (31.7)	0.9 (0.7 – 1.1)	0.309	1.1 (0.8 – 1.4)	0.572
2	25 (24.0)	0.7 (0.5 – 1.0)	0.027	0.7 (0.5 – 1.1)	0.128
3+	27 (32.9)	0.9 (0.7 – 1.3)	0.577	0.8 (0.6 – 1.3)	0.399
Age group at first pregnancy:					
14 - 17 years	63 (27.2)	Ref		Ref	
18 – 19 years	77 (29.0)	1.1(0.8 – 1.4)	0.658	1.1 (0.8 – 1.5)	0.621
20 – 24 years	133 (41.7)	1.5 (1.2 – 2.0)	0.001	1.2 (0.8 – 1.8)	0.383
Gestation at first ANC:					
0-13 weeks	24 (24.2)	Ref		Ref	
14-19 weeks	41 (28.1)	1.2 (0.8 – 1.8)	0.507	1.2 (0.9 – 1.7)	0.257
20-24 weeks	208 (36.4)	1.5 (1.0 – 2.2)	0.029	1.6 (1.2 – 2.1)	0.003
Received any ANC information since becoming pregnant:					
No	92 (28.2)	Ref		Ref	
Yes	181 (36.9)	1.3 (1.1 – 1.6)	0.012	1.0 (0.8 – 1.2)	0.772
Knowledge on when to start ANC clinic:					
On missing periods	16 (26.2)	Ref		Ref	
1st trimester	139 (41.1)	1.6 (1.0 – 2.4)	0.045	1.4 (1.0 – 2.1)	0.053
2nd trimester	102 (33.2)	1.3 (0.9 – 2.0)	0.303	1.1 (0.7 – 1.6)	0.771
3rd trimester	2 (6.9)	0.3 (0.1 – 1.2)	0.062	0.2 (0.1 – 3.2)	0.242
Don't know	14 (17.1)	0.7 (0.3 – 1.2)	0.186	1.0 (0.4 – 1.4)	0.362
Knowledge on how many ANC visits is recommended:					
None	7 (28.0)	Ref		Ref	
Between 1-2	22 (61.1)	2.2 (1.2 – 4.3)	0.025	1.8 (1.0 – 3.5)	0.061
Between 3-5	79 (39.7)	1.4 (0.7 – 2.7)	0.294	1.0 (0.6 – 1.9)	0.880

At least 4	92 (36.8)	1.3 (0.7 – 2.5)	0.409	1.2 (0.7 – 2.1)	0.609
As many as possible	73 (23.8)	0.8 (0.4 – 1.6)	0.627	0.9 (0.5 – 1.6)	0.667
Time to facility (minutes):					
0-30	80 (33.2)	Ref			
31-60	114 (36.0)	1.1 (0.9 – 1.4)	0.498		
61+	79 (30.5)	0.9 (0.7 – 1.2)	0.518		

4.4 Effect of text message and outreach interventions on skilled deliveries

Of the 817 participants included in the analysis, 25 (3.1%) were missing data on birth attendant and were excluded from this sub-analysis. Of the remaining 792 participants, 31 (3.9% [95% CI: 2.6% – 5.5%]) were delivered by unskilled traditional birth attendants. Compared to participants from the control arm, those from the mHealth-text message intervention and outreach arms had significantly lower prevalence of unskilled deliveries (9.0% [95% CI: 6.0% – 13.4%] vs. mHealth-text message intervention arm 1.2% [95% CI: ~1.0% – 3.0%] and outreach arm 1.4% [95% CI: ~1.0% – 4.9%], p<0.001) (Figure 4.3).

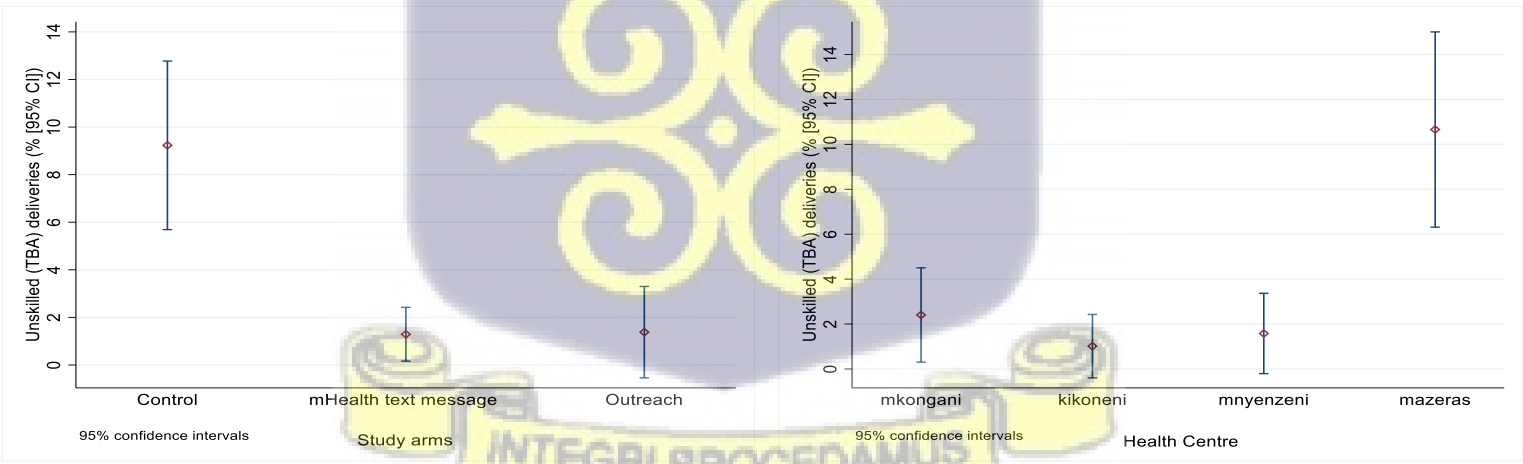

Figure 4.3 Graph comparing proportion of participants who had unskilled deliveries between mHealth text message intervention, outreach and control arms

In a multivariate regression model and after controlling for covariates, participants in the control arm had increased odds of unskilled deliveries compared to those in the mHealth-text message intervention arm (OR: 0.2 [95% CI: 0.1 – 0.4, p<0.001] and the outreach arm (OR: 0.1 [95% CI: 0.0 – 0.6], p=0.007) (Table 4.4). These results show a statistically significant association, with lower odds ratios indicating a reduced likelihood of unskilled deliveries in the intervention arms compared to the control group. The only other factor that was associated with unskilled deliveries was the level of education. Specifically, participants who had completed primary education as their highest level of education had significantly higher odds of unskilled deliveries compared to those who had incomplete primary education (OR, 3.2 [95% CI: 1.2 – 8.2], p=0.019), though these results should be interpreted with caution because of the small numbers in both categories (Table 4.4).

Table 4.4 Effect of text messaging and outreach interventions on unskilled deliveries

Characteristics	TBA (%)	Crude Odd Ratio (95% CI)	p-value	Adjusted Odd Ratio (95% CI)	p-value
Interventions:					
Control	24 (8.8)	Ref		Ref	
MHealth intervention	5 (1.3)	0.1 (0.04 – 0.3)	<0.001	0.2 (0.1 – 0.4)	<0.001
Outreach participants	2 (1.4)	0.1 (0.03 – 0.6)	0.08	0.1 (0.0 – 0.6)	0.007
Age group (years):					
15-19	6 (2.8)	Ref			
20-24	25 (4.2)	1.5 (0.6 – 3.7)	0.376		
Highest education level:					
Incomplete primary	6 (1.6)	Ref		Ref	
Complete primary	19 (6.3)	4.1 (1.6 – 10.5)	0.003	3.2 (1.2 – 8.2)	0.019
Secondary and above	6 (4.2)	2.7 (0.8 – 8.4)	0.094	1.5 (0.5 – 5.0)	0.472
Religion:					
Christian	12 (5.2)	Ref			
Muslim	18 (3.1)	0.6 (0.3 – 1.2)	0.135		
Others	1 (16.7)	3.5 (0.4 – 32.0)	0.275		
Age at sexual debut:					
10-14 years	2 (2.3)	Ref			
15-17 years	4 (1.4)	0.6 (0.1 – 3.2)	0.535		
18-24 years	25 (5.7)	2.6 (0.6 – 11.0)	0.208		

Marital status:					
Single/Dating/Cohabiting	2 (1.5)	Ref			
Engaged/Married	29 (4.2)	2.8 (0.7 – 12.1)	0.156		
Primary caregiver:					
None	0 (0.0)	Ref			
Male partner	29 (4.5)	0.1 (0.0 – 0.8)	0.096		
Parents	2 (1.3)				
Relatives/Neighbors	0 (0.0)				
Age group of male partners:					
17-24 years	6 (2.5)	Ref			
25-29 years	17 (4.7)	1.9 (0.7 – 4.8)	0.200		
30+ years	5 (2.8)	1.1 (0.3 – 3.6)	0.887		
Missing	3 (7.0)				
Employed or in business:					
No	30 (4.0)	Ref			
Yes	1 (1.3)	0.3 (0.04 – 2.3)	0.258		
Planned pregnancy:					
No	6 (2.7)	Ref			
Yes	24 (4.1)	1.6 (0.6 – 3.8)	0.343		
Parity:					
Nulliparous	16 (3.4)	Ref			
1	7 (4.3)	1.2 (0.5 – 3.1)	0.644		
2	5 (4.8)	1.4 (0.5 – 3.9)	0.526		
3+	3 (3.7)	1.0 (0.3 – 3.7)	0.950		
Age group at first pregnancy:					
14 – 17 years	6 (2.6)	Ref			
18 – 19 years	11 (4.1)	1.6 (0.6 – 4.5)	0.341		
20 – 24 years	14 (4.4)	1.8 (0.7 – 4.7)	0.252		
Gestation at first ANC:					
0-13 weeks	5 (5.1)	Ref			
14-19 weeks	4 (2.7)	0.5 (0.1 – 2.0)	0.356		
20-24 weeks	22 (3.9)	0.8 (0.3 – 2.0)	0.574		
Received any ANC information since becoming pregnant:					
No	17 (5.2)	Ref			
Yes	14 (2.9)	0.5 (0.3 – 1.1)	0.093		
Knowledge on when to start ANC clinic:					
On missing periods	4 (7.1)	Ref			
1st trimester	9 (2.7)	0.4 (0.1 – 1.2)	0.103		
2nd trimester	14 (4.7)	0.6 (0.2 – 2.0)	0.441		
3rd trimester	1 (3.6)	0.5 (0.1 – 4.5)	0.523		
Don't know	3 (3.9)	0.5 (0.1 – 2.4)	0.405		
Knowledge on how many ANC visits is recommended:					
None	3 (12.0)	Ref			
Between 1-2	0 (0.0)	(empty)			
Between 3-5	5 (2.5)	0.2 (0.0 – 0.8)	0.024	0.2 (0.0 – 1.1)	0.072

At least 4	9 (3.6)	0.3 (0.6 – 1.0)	0.052	0.5 (0.1 – 2.1)	0.333
As many as possible	14 (4.6)	0.3 (0.1 – 1.2)	0.102	0.6 (0.1 – 2.4)	0.460
Time to facility (minutes):					
0-30	14 (5.8)	Ref			
31-60	9 (2.8)	0.5 (0.2 – 1.1)	0.078		
61+	8 (3.1)	0.5 (0.2 – 1.2)	0.130		

4.5 Effect of text message and outreach intervention on infants' birth weight

Of the 817 participants included in the analysis, 28 (3.4%) had babies who were missing data on birth weight and were excluded from this sub-analysis. Of the remaining 789 participants, 51 (6.5% [95% CI: 4.9% – 8.4%]) had babies with a low (<2,500 grams) birth weight while 738 (93.5%) had normal birthweights. Compared to babies born to participants from the control arm, those born to participants from the mHealth-text message intervention and outreach arms had a significantly higher prevalence of low birth weights (1.1% [95% CI: ~1.0% – 3.3%]) vs. mHealth-text message intervention arm 10.1% [95% CI: 7.3% – 13.6%]) and outreach arm (6.2% [95% CI: 2.9% – 11.5%]), p<0.001) (Figure 4.4).

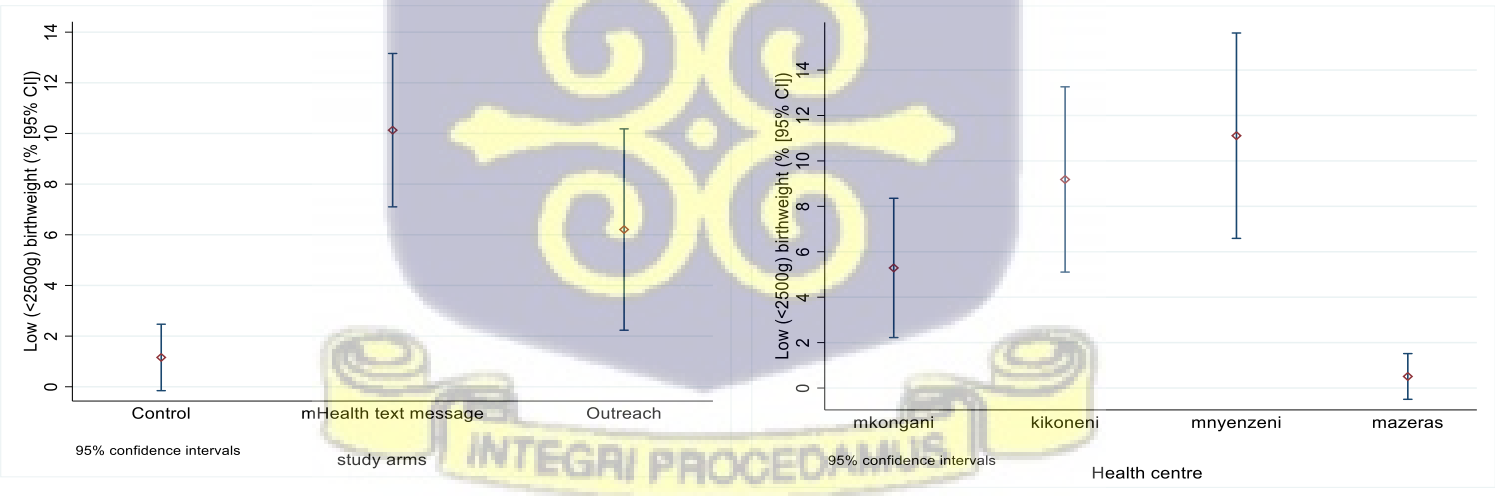

Figure 4.4 Graph comparing proportion of participants who had babies with low (<2500 grams) birthweight between the three arms (N=817)

In a multivariate regression model and after controlling for covariates, babies born to participants from the mHealth-text message intervention (OR: 5.9 [95% CI: 1.7 – 20.8, p=0.006]) and outreach arms (OR: 6.6 [95% CI: 1.7 – 25.7], p=0.007) had significantly higher odds of low birth weight, compared to those born to control arm participants (Table 4.5). These findings indicate a statistically significant association, with higher odds ratio indicating an increased likelihood of low birthweights in the intervention arms compared to the control arm.

The other factors that were associated with low birth weight were parity, whether participants received any ANC information since becoming pregnant and participants' knowledge on when to start their ANC clinic. Specifically, participants who reported a parity of three or more had significantly lower odds of delivering low birth-weight babies compared to nulliparous participants (OR: 0.2 [95% CI: 0.0 – 0.8], p=0.026]). Participants who received some ANC information after getting pregnant had significantly higher odds of delivering low birth weight babies compared to those who did not receive any ANC information after getting pregnant (OR, 3.3 [95% CI: 1.4 – 8.2], p=0.008). Participants' knowledge of when to start their ANC clinic was also significantly associated with low birthweight babies. Compared to participants who reported that pregnant women should start their antenatal clinics on missing their monthly periods, those who responded that they should start at the first trimester ((OR, 0.3 [95% CI: 0.1 – 0.7], p=0.004), second trimester (OR, 0.3 [95% CI: 0.1 – 0.8], p=0.021) and those who didn't know (OR, 0.2 [95% CI: 0.0 – 0.9], p=0.034) had significantly lower odds of delivering low birthweight babies. These results should also be interpreted with caution because of the small numbers in both categories (Table 4.5).

Table 4.5 Table demonstrating the effect of text messaging and outreach interventions on low (<2500) birthweight amongst the study participants

Characteristics	Low birth weight (%)	Crude Odd Ratio (95% CI)	p-value	Adjusted Odd Ratio (95% CI)	p-value
Interventions:					
Pure control	3 (1.2)	Ref		Ref	
MHealth intervention	39 (10.1)	9.6 (2.9 – 39.4)	<0.001	5.9 (1.7 – 20.8)	0.006
Outreach participants	9 (6.2)	5.6 (1.5 – 21.2)	0.010	6.6 (1.7 – 25.7)	0.007
Age group (years):					
15 – 19	11 (5.3)	Ref			
20 - 25	40 (6.9)	1.3 (0.7 – 2.6)	0.435		
Highest education level:					
Incomplete primary	21 (5.8)	Ref			
Complete primary	19 (6.6)	1.1 (0.6 – 2.2)	0.688		
Secondary and above	10 (7.2)	1.3 (0.6 – 2.8)	0.573		
Religion:					
Christian	12 (5.5)	Ref			
Muslim	39 (6.9)	1.3 (0.7 – 2.5)	0.466		
Others	0 (0.0)	(empty)	(empty)		
Age at sexual debut:					
10 – 14 years	9 (11.0)	Ref		Ref	
15 – 17 years	22 (7.8)	0.7 (0.3 – 1.6)	0.367	0.5 (0.2 – 1.2)	0.126
18 – 24 years	18 (4.5)	0.5 (0.2 – 0.9)	0.023	0.4 (0.1 – 1.2)	0.099
Marital status:					
Single/Dating/Cohabiting	7 (5.5)	Ref			
Engaged/Married	44 (6.6)	1.2 (0.5 – 2.8)	0.634		
Primary caregiver:					
None	0 (0.0)	(empty)	(empty)		
Male partner	40 (6.4)	0.4 (0.1 – 1.9)	0.253		
Parents	9 (6.3)	0.4 (0.1 – 2.1)	0.278		
Relatives/Neighbors	2 (14.3)	Ref			
Age group of male partners:					
<25 years	9 (3.8)	Ref			
25-29 years	26 (7.2)	1.9 (0.9 – 4.2)	0.102		
30+ years	12 (6.8)	1.8 (0.7 – 4.4)	0.195		
Employed or in business:					
No	45 (6.3)	Ref			
Yes	6 (8.1)	1.3 (0.5 – 3.2)	0.547		
Planned pregnancy:					
No	13 (6.0)	Ref			
Yes	36 (6.4)	1.1(0.6 – 2.1)	0.844		
Parity:					
Nulliparous	25 (5.6)	Ref		Ref	
1	11 (6.9)	1.3 (0.6 – 2.6)	0.552	0.9 (0.4 – 1.9)	0.739
2	12 (11.8)	2.3 (1.1 – 4.7)	0.028	1.3 (0.6 – 2.9)	0.520
3+	3 (3.8)	0.7 (0.2 – 2.3)	0.517	0.2 (0.0 – 0.8)	0.026

Age group at first pregnancy:					
14 – 17 years	17 (7.3)	Ref			
18 – 19 years	15 (5.6)	0.8 (0.4 – 1.5)	0.444		
20 – 24 years	19 (6.0)	0.8 (0.4 – 1.6)	0.543		
Gestation at first ANC:					
0-13 weeks	8 (8.3)	Ref			
14-19 weeks	5 (3.6)	0.4 (0.1 – 1.3)	0.126		
20-24 weeks	38 (6.9)	0.8 (0.4 – 1.8)	0.607		
Received any ANC information since becoming pregnant:					
No	7 (2.2)	Ref		Ref	
Yes	44 (9.3)	4.6 (2.0 – 10.2)	<0.001	3.3 (1.4 – 8.2)	0.008
Knowledge on when to start ANC clinic:					
On missing periods	10 (17.9)	Ref		Ref	
1st trimester	24 (7.3)	0.4 (0.2 – 0.8)	0.013	0.3 (0.1 – 0.7)	0.004
2nd trimester	15 (5.0)	0.2 (0.1 – 0.6)	0.001	0.3 (0.1 – 0.8)	0.021
3rd trimester	0 (0.0)	(empty)	(empty)	(empty)	(empty)
Don't know	2 (2.6)	0.1 (0.0 – 0.6)	0.008	0.2 (0.0 – 0.9)	0.034
Knowledge on how many ANC visits is recommended:					
None	1 (4.4)	Ref			
Between 1-2	3 (8.6)	2.1 (0.2 – 21.1)	0.542		
Between 3-5	9 (4.7)	1.1 (0.1 – 8.9)	0.942		
At least 4	23 (9.4)	2.3 (0.3 – 17.8)	0.428		
As many as possible	15 (5.1)	1.2 (0.1 – 9.3)	0.876		
Time to facility (mins):					
0-30	15 (6.5)	Ref			
31-60	17 (5.5)	0.8 (0.4 – 1.7)	0.618		
61+	19 (7.5)	1.2 (0.6 – 2.3)	0.673		

4.6 Sensitivity Analysis (Excluding Mkongani Health Centre)

4.6.1 Effect of text message intervention on low antenatal care contacts

Sensitivity analyses were done excluding Mkongani Health Centre from the analysis to have the originally planned two arm study (mHealth-text message and control health facilities). Results showed that participants made a median of 4 (IQR, 3 - 5) antenatal care (ANC) contacts. Of the 604 participants in this sub-analysis, 267 (44.2% [95% CI: 40.2 – 48.3]) participants had low (< 4) ANC contacts. Participants in the control arm had a significantly higher prevalence of low ANC contacts (72% [95% CI: 65-78]) compared to the mHealth text message intervention participants (30% [95% CI: 25-35]) p<0.001) (Figure 4.5).

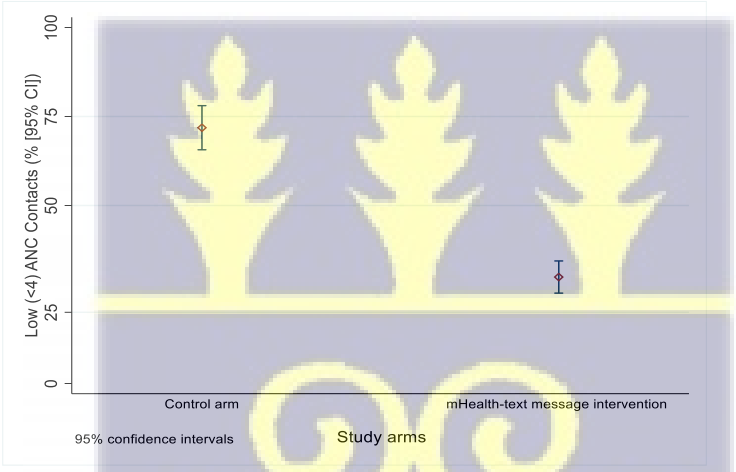

Figure 4.5 Graph comparing proportion of participants who had low (<4) ANC contacts between mHealth text message intervention and control arms (N=604) excluding Mkongani Health Centre

4.6.2 Effect of mHealth-text message interventions on institutional deliveries

Of the 604 participants included in the analysis, 20 (3.1%) were missing data on birth attendant and were excluded from this sub-analysis. Of the remaining 584 participants, 26 (4.5% [95% CI: 2.9 – 6.5]) were delivered by unskilled traditional birth attendants. Control arm participants had a higher prevalence of unskilled deliveries (11.0% [95%CI: 7.0– 16.0] compared to mHealth-text message intervention arm 1.2% [95% CI: ~1.0 – 3.0] (Figure 4.6).

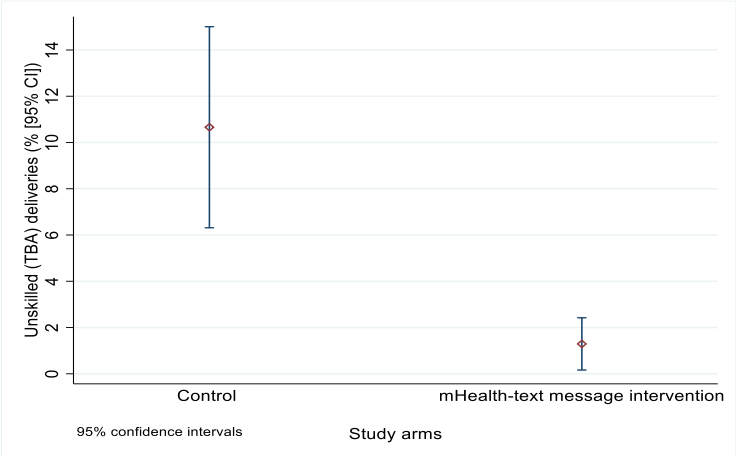

Figure 4.6 Graph comparing proportion of participants who had unskilled deliveries between mHealth text message intervention and control facilities (N=604) excluding Mkongani Health Centre

4.6.3 Effect of text message intervention on low birth weight

Of the 604 participants included in the analysis, 23 (3.8%) had babies who were missing data on birth weight and were excluded from this sub-analysis. Of the remaining 581 participants, 40 (6.9% [95% CI: 5.0 – 9.3]) had babies with a low (<2,500 grams) birth weight. Compared to babies born to participants from the control arm, those born to participants from the mHealth-text message intervention arm had a significantly higher prevalence of low birth weight (1.0% [95% CI: ~0.0 – 3.0]) vs. mHealth-text message intervention arm 10.1% [95% CI: 7.3 – 13.6]) (Figure 4.7).

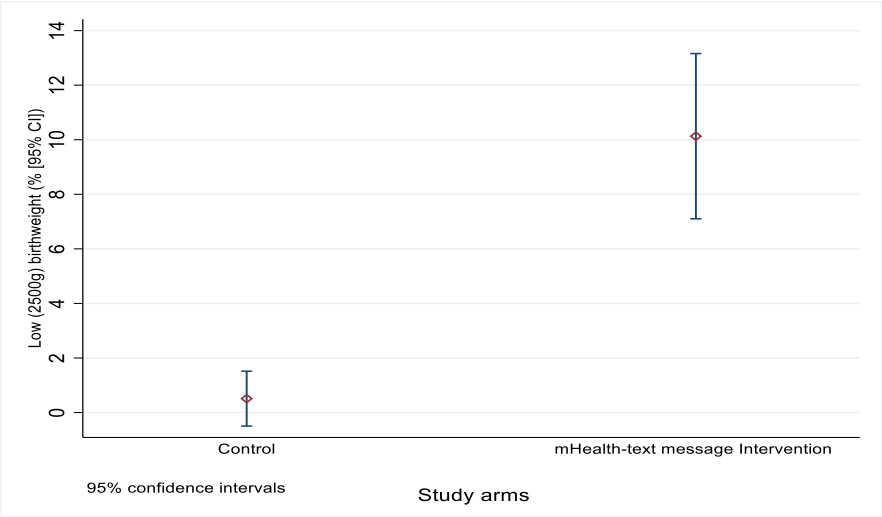

Figure 4.7 Graph comparing the proportion of participants who had babies with low (<2500 grams) birthweight between mHealth text message intervention and control facilities (N=604) excluding Mkongani Health Centre

4.7 Feasibility and acceptability of mHealth interventions

This study also explored the experiences of expectant young women and Health care providers on the mHealth text messaging intervention. A total of 29 in-depth interviews were conducted, consisting of 25 young mothers randomly selected from the mHealth intervention participants and four health care providers providing care at the maternal and child health clinics in Kikoneni and Mnyenzeni health centres (mHealth-text messaging intervention sites). The analysis of interviews with HCPs and expectant adolescents and young women revealed their perceptions on technological adoption through the following four main themes:

1. The good and the unpleasant features of an mHealth interactive platform
2. Accepting the inevitability: *"It's the technological age anyway"*
3. ANC messages relevance and comprehension
4. Balancing HCPs workload and technological adoption

4.7.1 The good and the unpleasant features of a mHealth interactive platform

The mHealth platform was designed to be interactive where participants could also send messages and ask questions for free. The ability to engage and seek clarifications beyond the research health messages was one of the design considerations. Intervention participants were happy they could get answers to their concerns although this was not real time as expected.

> *One day I woke up and was feeling nauseous and vomiting, I usually don't vomit much like I see with my mates, but that day it was bad and so I wrote a message to the platform to check if someone will respond, to my surprise I was answered and told its normal but I should immediately go to the clinic if it persists. This was a good thing but I will like to see answers coming in fast like in a call centre* (20-year-old intervention participant)

> *I felt so connected to the clinic when I got a message on good nutrition, I inquired about something … I can't remember exactly but someone responded and I was so happy because also … my airtime was not deducted … I was testing to check if indeed the service was free … and it was*! (19-year-old intervention participant)

Some participants reported to have ignored the earlier messages as they did not recognize the sender. Participants were skeptical about the messages due to the very many sources of unverified information being sent quite often by the many service providers in Kenya.

> *At first, I was not paying much attention to the messages but when I got a message from the same number telling me that I should go to the clinic tomorrow … and they even mentioned the name of my clinic, I knew that was the one I was told about and I started saving the messages on my phone for references in case I needed to remind myself.* (20-year-old intervention participant).

Interactive mobile platforms are not common in Kenya, individuals are used to pushed messages from various service providers not only in the health sector but also from the corporate world including banks and from the mobile service providers themselves. The pushed messages usually come with a prompt like *"can't reply to this short code".* For this study, mHealth intervention participants were allowed to write back to the mHealth platform. When asked about their experiences interacting with the system, some participants reported that the instructions were easy to follow, participants were required to start with the word "ANC" (this was not case sensitive) and proceed to write their message:

> *I think it was easy, because at the end, the instructions were clear telling us to first write ANC then write your message and send like any other message, this to me was very simple.* (18-year-old intervention participant).

The simplicity of use was repeated by participants interviewed. However, this ease of use was not entirely uniform. One reported challenge was the confusion created by the mandatory 'ANC' word needed for the message to be received at the system level. A few users reported ignoring the word and just clicked reply. Unfortunately, the system was not designed to send a prompt reminding them to start with ANC. Others reported to have been deducted their airtime seemingly because short codes are sometimes shared in Kenya.

> *One day, I don't know if I forgot or ignored to start with that (ANC) word we were told to start, my money was deducted. I thought this is just one number and only for the sender like my phone number, nobody else will have it then why the ANC word. When*

I repeated with the ANC, my money was not deducted. I don't even know why, maybe you can explain now that you are here … (22-year-old intervention participant).

Healthcare providers acknowledged that mHealth interventions have the potential to address critical gaps in the provision of health messages and the scaling up of health interventions. Some healthcare workers were however unsure if an interactive platform was something they would recommend. The lack of effective regulatory oversight in Kenya and whether the responses to patients including expectant women will be scientifically accurate were their major concerns.

Virtual interaction with patients is fine, I think COVID-19 has shown us that we can provide clinical care virtually. But, in Kenya, we are not yet ready. I'm afraid physical clinical contacts might reduce which is very important for expectant women especially the young ones. If we start prescribing medication to them without physical tests … that's unethical in medical practice. Let's send them relevant health information for educational purposes but we should continuously encourage them to seek physical medical help in case of any abnormalities. (Female MCH Nurse, Kwale County).

… I can only vouch for reminders and verified health information that is fine to send. I just wonder, with the many updates and revised guidelines, are we the ones to revise or that will be centrally done. Because if we are the ones from our facilities, then we might confuse our patients. And language can be confusing depending on the level of education … text book Swahili and what we usually speak could be different … anyways, that said, I think it is still important to consider integrating mHealth within the healthcare point of service. (Clinical Officer in charge, Kwale County).

The study also sought to understand the mobile network situation in the areas. When mHealth-intervention participants were asked if they had experienced any mobile network challenges during the study period, mixed responses were provided, with some participants reporting that they never had any issues with their service providers.

> *The network I use is everywhere so unless power goes and my phone is off charge, then I can be offline but being unavailable on phone because of network challenges … I have never but maybe normal network disconnections on the internet like WhatsApp which many times is a Kenyan or even global thing* (21-year-old intervention participant).

> *For me, where I live, network is a challenge sometimes especially when I'm in the house, it keeps coming and going. And even outside, some places have little to no reception. Especially internet services like if I want to watch a video, I'll have to move to a place we've identified where both regular network and internet can be received* (23-year-old mHealth intervention participant)

4.7.2 Accepting the inevitability: *"It's the technological age anyway"*

There was a sense among both healthcare providers and intervention participants that embracing technology and integrating it with routine clinical care was an inevitability. Some respondents had this to say:

> *I think we don't have an option … how else can we ensure that expectant women remember their clinic days if we don't nudge them. Plus, young women are always on their phones, and text messages are easy to send and implement at one click … so the public health sector should take advantage of mHealth to educate healthcare providers*

on technological interventions so that we can improve on our service delivery. (Female MCH Nurse, Kwale County)

You see … even now we have moved to electronic medical reporting, you (researcher) also collected your data using mobile phones … I'm longing to see a day where all our registers will be automated to be sending reminder and educational messages to our patients who are on regular care be it ANC, HIV and TB clinics … I know this day will come. I believe we give them good health education when they come for their clinic, but it will also be great to complement this with at least one educational message per week. (Female MCH Nurse, Kwale County)

The mHealth intervention participants reported positive user experience because of the simple algorithm involved in sending and receiving regular text messages. They affirmed the health workers' viewpoints about their connection with their phones as part of their everyday lives.

We young people like to be with our phones everywhere … I just can't imagine going a day without having my phone … And … those messages were timely, didn't come early or very late, just during the day when I was relaxing, they were just very easy to open, no steps, you read like the way we read our other messages (22-year-old intervention participant).

Further, intervention participants expressed their willingness to receive text message intervention for educational and reminder purposes on their clinical appointment. They acknowledged that they usually receive health education during clinic days but wanted a source of reference or a platform in which they can reach out for remote advice and assistance.

… To prevent myself from forgetting what I've been told when I come to the clinic, it's easier to refer to my phone than cracking my head, nowadays we store everything on the phone …. So I think these messages and the timely reminders will be loved by many young women. (18-year-old intervention participant)

4.7.3 ANC messages relevance and comprehension.

Message relevance and ease of comprehension were the most essential focus of this qualitative sub-study. Intervention participants expressed their general satisfaction with the contents of the messages. They described the messages as informative. While many said the information was not new to them, but the precision in which the messages were conveyed is what they reported to have liked most.

For me … I don't know about others … the messages were very nice and simple to understand, I get some of this information at the clinic, but the clinician sometimes will tell stories during health talks and I get lost in my own thoughts … For the text messages, I liked because they were straight to the point, and they helped me relate to what I was told at the clinic. (21-year-old intervention participant)

Some participants reported to have been motivated to seek medical care so that they can give birth to healthy babies.

Good thing was that the messages were sent to me using the Swahili language, although not the colloquial Swahili we speak in the village but still the messages were easy to understand and follow through … my best message was when they sent and said 'be proud of yourself as you'll soon be a mother to a beautiful baby' … this message … I

tell you inspired me to be health conscious and not to miss my clinic until I delivered, although I was not going there on time, but at least I went for I think five or six times. (23-year-old intervention participant).

The messages were very helpful to me. I wish I had received these messages and reminders in my first pregnancy, I could have done much better with my first pregnancy … you know I used to ignore clinics because almost everyone at home did not attend any clinic when they were pregnant and they just went straight to deliver. I was being told that clinics are for the weak, I had a difficult pregnancy period in my first one and even delivered just by God's grace. I wish I knew better. Now I can advise other expectant women on the importance of going to the hospital. (22-year-old intervention participant).

Although participants reported satisfaction with the platform's use of Swahili language, a few reported to have had difficulties understanding some of the words. Some participants reported to have inquired from their friends and relatives while others had to seek clarifications from health care workers:

The messages were good … but, I think one or two messages were very confusing … I think about blood test, and I don't know checking iron levels and they said scanning. I honestly didn't understand why all these will be done and I don't remember them being done in my first pregnancy. When I went back to the clinic, the nurse told me it was done maybe but it's because it was not explained as that's usually a routine procedure. (23-year-old intervention participant).

The Swahili used was the standard one and very pure, that which I learnt in primary school I think. Some of the words were coming from Tanzania I guess ... where they speak pure Swahili. I enjoyed the reading though and got a lot of new knowledge but at some point I had to seek clarity from my friends. (18-year-old intervention participants)

In addition to sending messages to the mHealth text messaging intervention participants, caregivers/male partners were also sent monthly messages to remind them of the importance of ANC contacts. For some of the participants, their caregivers and spouses were indifferent about the messages, some caregivers didn't comment on the messages at all, others engaged the young mothers while some caregivers felt the messages were not relevant to them and should instead be directed to the expectant young women.

Mine has not said anything, I don't even know if my husband received any message, maybe he ignored them ... I don't know (23-year-old intervention participant)

Yes, I told my mother about the messages I have been receiving and she showed me hers ... we saw they were coming from the same number. I think she only reminded me once or twice, I can't remember exactly and she stopped. But close to my delivery date, we talked about delivering at a hospital and the delivery messages were also on her phone ... So, I think maybe she was okay with them (18-year-old intervention participant)

Although, my husband was not saying it directly, I think he mentioned to me that these hospital messages should be yours ... you are the one going to the clinic and they should

remind you, maybe because we get so many promotional messages, he felt like his phone was getting unnecessary messages (20-year-old intervention participant).

4.7.4 Balancing HCPs workload and technological adoption

Findings from this study established that technological adoption of mHealth interventions in a clinical setting entails balancing between perceived effectiveness of mHealth in improving antenatal coverage and associated additional work to HCPs. Health workers had varied opinions about mHealth integration.

I'm not sure we can handle all this given the work and the number of pregnant women we attend to per day. You can see, I'm here but I'll need to go back and manually update the ANC registers for all the mothers we saw today, then telling me to also send messages will be too much work. Unless … I don't know …. (Female MCH Nurse, Kwale County)

One HCP affirmed that technology is a critical component of our lives but embracing such will need proper training, additional staff and patience. She alluded to the electronic medical reporting recently introduced to their facility stating that it took them time to appreciate its usefulness in the management of HIV patients.

Technology is fine, we'll need more staff though. At least for the electronic reporting we have additional record officers in some pilot facilities specifically at the comprehensive care clinics attending to HIV clients. With educational and reminder messages, if trained and computers availed for that specific purposes, then it is not a big issue … problem will be if the sending and communication via mobile phones

becomes our deliverables without additional staffing. (Male, Clinical officer, Kwale county).

Despite some hesitation, other HCPs responded well to the mHealth integration initiative. Moreover, HCPs preferences to have mHealth integrated within their clinical setting appear to have been motivated by the fact that mHealth platforms will have tailored health messages considered age appropriate to young women as opposed to general health talks they give at the clinics.

It will be so nice to send such messages at the click of a button. Not only that, but customized messages to a young mother sent depending on their gestational age. If it can be automated the better so that we don't spend time looking at the registers to check on who should come tomorrow … it should be updating itself and notify us of those who didn't come so that we can have our Community Health Volunteers reach out to them. (Female MCH Nurse, Kwale County)

4.8 Chapter summary

This chapter focused on the findings of the study. A description of the study participants by their background characteristics and their comparison by intervention status have been presented. Inferential statistics including sensitivity analyses have been used to present findings on the effects of mHealth and outreach intervention on ANC contacts, skilled deliveries and infant birthweights. Qualitative findings on the feasibility and acceptability of the mHealth intervention have also been described in this chapter. The next chapter will discuss the results.

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter focusses on the findings of the study. The findings discussed include the study participants' demographic characteristics, their observed imbalances, and their influence on the study outcomes. Discussions are organized according to the study objectives: the effect of text message and outreach interventions on antenatal uptake, the effect of text messages and outreaches on institutional deliveries and the effect of text message and outreach interventions on infants' birth weight. Results of the feasibility and acceptability of text message intervention from the viewpoints of the expectant young women and HCPs are also discussed. Finally, the strengths and limitations of this study are also explained in this chapter.

5.2 Imbalances in background characteristics of study participants

This study, being a quasi-experimental one assigned participants to the different study arms without following a 'complete random' procedure. Although a quasi-experimental design can suggest a possible association between the interventions (mHealth and outreach) and the study outcomes, it is prone to bias particularly when participants in the two groups have dissimilar background characteristics (Aggarwal & Ranganathan, 2019) as observed in this study hence to some extent affecting the validity of the findings (Wewege et al., 2022). Certainly, random allocation minimizes baseline differences between arms and ensures there's comparability of study arms by balancing unmeasured prognostic factors and confounding variables (Park & Hahn, 2022) to infer causal effects. In this study, significant imbalances were observed in all background characteristics of study participants apart from gestation at first ANC. These imbalances could have happened through chance or most likely for this study through non-randomized selection and allocation of participants to either arm. This study therefore acknowledges these observed imbalances in participants' background characteristics which

although controlled for in the analysis, might have led to important exaggeration or lack thereof of interventions' effect estimates. These results should therefore be interpreted with caution.

5.3 Background characteristics of the study participants

The majority of participants in this study had incomplete primary education at the time of enrolment. According to the Kwale County Integrated Development Plan (2018-2022), literacy level was 57% (Kwale County Government, 2018), this being lower than the national literacy rate of 81.5% (UNESCO Institute for Statistics, 2021). The low education levels in Kwale county have been attributed to sociocultural and economic factors including early marriages, poverty, malnutrition and inadequate school infrastructure (Kwale County Government, 2018). There is need for the government of Kenya and other relevant stakeholders to ensure that the policies and laws put in place to protect young girls from early marriages and ensure they complete their basic education are enforced. Key players in the social and health sectors should work together to address the sociocultural factors which continue to restrict young girls in Kwale county from accessing education, future employment and hence empowerment which are essential components associated with increased access and utilization of maternal services (Anaba et al., 2022; Mekonnen et al., 2019) . Interventions are also needed to retain young mothers in schools through the introduction of non-formal educational options for adolescent and young mothers and ensuring effective implementation of the return to school policy for those who would wish to go back to formal schooling after giving birth.

Muslims accounted for 71.1% of the study population. This matches the study expectation as per the 2019 national census in Kenya, Islamic religion in Kwale county accounted for 61% of the entire Kwale population (Kenya National Bureau of Statistics, 2019). Unlike the entire county which includes peri-urban towns like Ukunda and Diani where population variations between Christians and Muslims are not that wide, this study was done in the rural parts of

Kwale county where residents of these communities predominantly profess the Islamic faith and are mainly from the Digo community. According to the researcher, the selected study sites (being largely Digo and Muslims by faith) to some extent explains the ten percentage variation between the county Islamic rate (61%) and the study rate (71.1).

Almost similar to Kwale county's mean age at first sex of 17 (AFIDEP, 2017), participants in this study also had a mean sexual debut age of 17.4. This was however lower than the Coastal region (18.3 years) of Kenya where Kwale is located (Kenya National Bureau of Statistics, 2015). Early sexual debut in Kwale county can be attributed to high prevalence of child marriages with almost 50% of Kwale County women reporting first marriage by age 19 (AFIDEP, 2017) compared to the regional prevalence of 41% (UNICEF, 2018b). The mean age at first pregnancy for the study participants was 18.8 years, this was a marginal increase from the national teenage pregnancies' rate of 18% in Kenya and 20.8% in the Coastal region (Kenya National Bureau of Statistics, 2015). Early sexual debut among the study participants compared to national rates increased the potential for early pregnancies among young women in Kwale County. This comparison should however be interpreted with caution because this study had participants who were more than 19 years old and up to 24 years. Further, unequal power and gender norms in Kwale County expose young girls to early marriages and pregnancies. Commitment by the local and national governments to address and deal with gender inequalities cannot be overemphasized; these should move beyond individualistic approaches targeting young girls with information and behavioural interventions necessary for girls to have healthy sexual relationships. This is because power imbalances in sexual relationships render adolescent girls and young women powerless in the face of masculine sexual freedom (Ninsiima et al., 2018).

5.4 ANC uptake among study participants

WHO recommends that all expectant women should receive a minimum of eight ANC contacts with the first contact occurring within the first trimester of the first 13 weeks of pregnancy (Carvajal et al., 2020). For this study, we determined that 12.1% of the study participants attended their first ANC in the first trimester while less than half (33.4%) of the study participants had less than four ANC contacts which is against the requirement of the Kenyan Ministry of Health (Ministry of Health Kenya, 2016). These findings demonstrate untimely and suboptimal utilization of ANC care among expectant young women in Kwale County at the onset of their pregnancies and throughout their pregnancies. This finding compares to other studies in Kenya which established that adolescents and teenage girls initiate their first ANC late into their pregnancies and after their first trimester (Ikamari, 2020; Mekonnen et al., 2019). Other studies in SSA have also shown that a significant number of expectant adolescents and young women delay their ANC uptake leading to low than the required number of ANC contacts (Anaba et al., 2022; Hackett et al., 2019). Timely and optimal utilization of ANC services by expectant adolescents and young women is determined by both individual and systemic factors. Level of education, stigma especially when the pregnancy occurs outside marriage, negative attitude of HCPs towards adolescent mothers and distant to health facilities have all been associated with delayed ANC uptake by expectant young women (Anaba et al., 2022; Budu et al., 2021; Hackett et al., 2019). Young women's education level has been shown to be the most significant predictor of early ANC uptake with women having a secondary and above level of education being more likely to seek timely ANC care compared to those with lower education levels (Mekonnen et al., 2019). Although this study did not establish any significant association between secondary education level and timely ANC uptake, the finding that majority (~82%) of the study participants had lower than secondary level of education might have contributed to the overall lateness of participants ANC service uptake. Designing interventions to improve timely ANC uptake among young women in Kenya and Kwale

County in particular will require an understanding of the complexities of adolescent care-seeking behaviours and the sociocultural barriers they experience during pregnancy predisposing many adolescents to poor maternal health outcomes.

The prevalence of low ANC visits with increasing gestation at first ANC visit was also observed in this study. Specifically, participants attending their first ANC visit at 20 or more weeks of gestation had significantly increased risk of low ANC visits compared to those attending their first ANC visit at 13 or less weeks of gestation. This result supports findings from other studies which have shown that pregnant women who had late initiation of ANC contacts were more likely to have less than four clinical contacts (Hackett et al., 2019; Okedo-Alex et al., 2019). The lateness to initiate ANC care among expectant young women has been attributed to inadequate knowledge on the essentials of ANC services (Anaba et al., 2022; Hackett et al., 2019; Mekonnen et al., 2019; Ng'ambi et al., 2021). Certainly, the need to reinforce the importance of community-wide sensitizations on the importance of early initiation of ANC services among expectant young women cannot be overemphasized. This is critical given that expectant adolescents and young women are more vulnerable to complications during pregnancy which may lead to maternal mortalities or a lifetime of poor health outcomes. These maternal complications among expectant adolescents are mostly preventable through a combination of proven clinical interventions including timely and quality antenatal care provided by trained HCPs who are sensitive to expectant young women and willing to provide the much needed social support.

Contrary to other studies which found young women with unplanned pregnancies to be more unlikely to have at least four ANC contacts (Mekonnen et al., 2019; Okedo-Alex et al., 2019), this study found a significant association between planned pregnancy and low ANC contacts.

This unexpected finding compares to a multicounty analysis of Demographic and Health Surveys' data on the use of prenatal health services in SSA which revealed some inconsistencies in the association between unplanned pregnancies and ANC contacts (Amo-Adjei & Anamaale Tuoyire, 2016). In Nigeria for instance, unplanned pregnancies were significantly associated with increased frequency of ANC contacts (Amo-Adjei & Anamaale Tuoyire, 2016). These significant associations were however not age specific. Although the reasons for these unpredicted associations were beyond the scope of this study and therefore not clear, we can assume the following in relation to a similar finding; women with planned pregnancies may have low vulnerability perceptions especially when they have uneventful first and second trimesters (Amo-Adjei & Anamaale Tuoyire, 2016) thereby downplaying the need for clinical ANC care. Another plausible pathway could be that expectant young women with planned pregnancies might have a misperception that healthcare becomes critical when fetal movements begin which in most cases occurs in the second trimester. This might contrast participants who reported unplanned pregnancies and who might have experienced some hormonal and physiological changes caused by pregnancies thereby seeking clinical care unknowingly that they were pregnant. Nonetheless, these findings warrant more investigation to confirm these assertions. Specific findings related to the specific objectives of this study are discussed in the sections that follow.

5.5 Effect of text message and outreach interventions on ANC contacts

This study determined that control arm participants had a significantly higher prevalence of low ANC contacts compared to the mHealth-text message intervention and outreach arm participants. This finding supports other studies in SSA which have found that SMS-based mobile interventions have the potential to improve ANC outcomes by encouraging ANC attendance and adherence to subsequent visits (Arnaert et al., 2019; Benski et al., 2020; Coleman et al., 2020; Dol et al., 2019; Kabongo et al., 2021). The main mHealth interventions

in SSA centre on health education and reminders mainly through simple SMS; majority have been successfully implemented and have been effective in increasing the number of ANC contacts (Arnaert et al., 2019). Certainly, and in line with other findings, mHealth interventions have the potential to increase ANC contacts for expectant mothers including young women thereby improving their maternal health outcomes. However, the complexities involved in changing the healthcare seeking behaviours of expectant young women will definitely require other additional sustained societal and personal approaches like community based sensitizations and outreaches to educate the community members on the importance of timely ANC uptake while encouraging expectant young women to adhere to their ANC appointments. Policy makers and public health practitioners should therefore consider scaling up the implementation of evidence based demand creation including mHealth interventions.

mHealth technologies are being developed and used to scale up cost-effective evidence based interventions to improve maternal outcomes throughout pregnancy period (Saronga et al., 2019). The increase in access and availability of mobile phones in low and middle income countries has contributed to the increased development of mHealth applications aimed at improving efficiency and reach within the healthcare systems. Several studies have examined the effectiveness of mHealth interventions on maternal care including improving ANC uptake and skilled deliveries (Abejirinde, Bardají, et al., 2018; Saronga et al., 2019). However, few studies if any have evaluated the effectiveness of mHealth on antenatal coverage of expectant adolescents and young women.

Although, this study had not set out to test the effectiveness of community outreaches in improving ANC contacts, the analysis established that outreaches have the potential to increase ANC coverage among expectant young women. This study found that outreach arm

participants were 90% less likely to have less than four ANC contacts compared to the control arm participants. During the COVID-19 pandemic, Kenya, like the rest of world suspended many in-person interactions and programmes whose activities could increase the risk of individuals to contract the virus. The COVID-19 pandemic brought in fear to accessing health care among most people including pregnant women. There was global fear, misinformation and limitations in the movement of people and health commodities disrupting the normal delivery of health services (World Health Organization, 2020). To ensure continuity of select essential services like family planning and antenatal check-ups which could be safely delivered at the community level taking specific measures to protect pregnant and lactating women, young children and the elderly, Mkongani facility opted for outreaches after COVID-19 prevention measures were relaxed by the Government of Kenya. The increased uptake of ANC services by expectant young women in the outreach arm compares to a study done in Ethiopia which examined the effects of a community outreach program for maternal health. This study showed a significant increase in ANC knowledge and uptake among the intervention group compared to the comparison group (Bang et al., 2018). Community-based outreaches have undoubtedly been shown to be effective in providing customized interventions and enhancing maternal and child health knowledge among the hard to reach populations (Anderson et al., 2017; Bang et al., 2018; Shin et al., 2020) like expectant adolescents and young women.

In addition to the low uptake of clinical services caused by the COVID-19 pandemic, most people in rural Kwale where this study was done live in medically underserved communities where poverty, sociocultural barriers and distances to facilities might contribute to reduced access to healthcare. As observed in SSA, decreased proximity to health facilities and the cost of round-trip transportation to local health facilities limits healthcare-seeking behaviour among expectant young women thereby reducing access to maternal care including emergency

obstetrical interventions (Kinney et al., 2021). The presence of HCPs at the community level was an effective strategy to reach out to priority populations including expectant adolescents who are less likely to use maternal health services mostly due to stigma associated with their 'early sexual behaviours'. This suggests that, there remains a need to enhance the use of community led outreaches as other demand creation interventions including mHealth programs alone maybe insufficient to improve maternal outcomes (Benski et al., 2020; Ruton et al., 2018) for expectant young women. More research should be conducted to establish if a combination of community outreaches and mHealth interventions to reach out to expectant young women early in their pregnancies will address the gap in late and low ANC uptake while ensuring clinical care retention among expectant young women in the rural parts of Kenya like Kwale County.

5.6 Effect of text message and outreach interventions on institutional deliveries

This study found a relatively small proportion of almost 4% of deliveries which were done outside of the health facilities, and possibly by traditional birth attendants. Of these unskilled deliveries, this study determined that both mHealth text message and outreach arm participants had significant lower prevalence and lower odds of unskilled deliveries compared to control arm participants. These associations should however be interpreted with caution due to the low numbers of unskilled deliveries reported in this study. The proportion of unskilled deliveries in this study is much lower than the previously reported prevalence of home deliveries in Kwale county of 48% among all deliveries and 27% among teenage mothers in Kenya (Kenya National Bureau of Statistics, 2015). The sample size for this study was however not meant to be representative of Kwale County.

Similar to other mHealth text message intervention studies (Kabongo et al., 2021; Maliwichi et al., 2021; Shiferaw et al., 2016), this study found that, compared to the control participants,

the mHealth intervention participants had a lower likelihood of unskilled deliveries. A global systematic review and meta-analysis of the effectiveness of mHealth interventions found that almost 50% of the mHealth interventions were effective in improving maternal outcomes including skilled deliveries compared to the standard care (Chen et al., 2018). Comparable to this study, majority of these interventions had health educational messages and reminders which were delivered through regular text messages (SMS) functioning on simple algorithms. The reported positive findings related to mHealth text message intervention notwithstanding, one systematic review has reported limited evidence of SMS intervention in increasing skilled birth attendants and antenatal visits in sub-Saharan Africa and specifically among adolescents and young women (Marcolino et al., 2018). Findings from this study support other research works which have shown that mHealth interventions have substantial benefits and promising potential to transform the healthcare system. However, it is imperative that developers and implementers generate context and country specific evidence to identify potential challenges and opportunities prior to scaling up these interventions (Manyazewal et al., 2021).

Moreover, uptake of clinical services among adolescents and young women in resource poor settings is a complex issue found to be dependent on many factors including opinion of peers and family members, and is fundamentally influenced by the broader socio-economical and health system dynamics (Hackett et al., 2019). Teenage pregnancies have been associated with unskilled deliveries in SSA; lack of formal education, increased parity, distance to health facilities and poverty related factors have been associated with lower odds of skilled deliveries among young women in SSA (Budu et al., 2021). In Kenya, care during pregnancy and child birth in some rural settings are sometimes dependent on sociocultural values such as age of the mother and their maternal experience which play a central role in the choice of the delivery assistant (Cheboi et al., 2020). Adapting maternity care to meet the contextualized individual

and community needs may have a positive effect on maternal health seeking behaviours including skilled deliveries among adolescent girls and young women. Both mHealth and community outreach programs can therefore create demand for maternal services like institutional deliveries if health care providers are professionally trained to handle community dynamics including being culturally tolerant and appropriate delivery of appropriate and timely health messages during both outreaches and facility-based primary care (Bang et al., 2018) using mHealth technologies.

In Tanzania, a cluster randomized pragmatic trial comparing the community outreaches with standard maternal care at the health facilities found that women who were contacted during outreaches were significantly less likely to deliver at home (Geldsetzer et al., 2019). Clinical community outreach programs have the potential to improve maternal and child health. These outreaches can be effectively implemented if health workers and the larger public health fraternity understand the dynamics which influence uptake and retention to services. These can be achieved by balancing communities' expectation around the improvement of maternal integrated outreaches with HCPs trainings and capacity building (Defar et al., 2021). Specifically, for Kenya, county governments need to embrace community health as part of the health system and thereby make systematic efforts to integrate community health units with other higher tiers of the health system. Additionally, a variety of interventions and alternative models including educational mHealth platforms and integrated community outreaches can be used to create more demand for maternal services including skilled deliveries among adolescents and young women. Implementing the text messaging alone might not be very effective in achieving positive maternal results including skilled deliveries, instead mHealth interventions should be supplemented with adequate HCP training, community outreaches and equipment provision (Ruton et al., 2018). Furthermore, there is need to address the individual

and systemic factors related to non-uptake of skilled deliveries. Emphasis by policy makers should also be towards improving the education access for young girls and women to build their confidence for their improved decision making and autonomy regarding their SRH. Undoubtedly, educated women are more likely to have knowledge about the benefits of skilled maternity care and ultimately able to make sound health decisions for a positive health outcome. Last but not least, despite the low proportion of unskilled deliveries in this study, there is an urgent need to design interventions that will address the systemic and sociocultural barriers preventing young women form seeking skilled care at birth in Kenya in general.

5.7 Effect of text message and outreach interventions on infants' birthweight

Overall in this study, 6.5% of the participants had babies with low birthweights, <2500 grams. Inadequate knowledge in maternal nutrition and poor dietary intake during pregnancy are among the key determinants of low birth weight (Nyamasege et al., 2018). The mHealth text message intervention for this study provided educational content on nutrition and balanced-diet feeding during pregnancy. Contrary to positive maternal outcomes related to ANC contacts and institutional deliveries as a result of mHealth and outreach interventions, babies born to control participants had significantly lower odds of delivering low birthweights' babies compared to those born to the mHealth intervention and outreach arms' participants. One possible explanation to this finding could be that control participants might have had favourable biological characteristics including physiological factors like maternal height and pregnancy weight gains which have been associated with infants' birthweights (Desta et al., 2020; Girma et al., 2019). This study did not compare any of these biological/physiological factors.

Consistent to these unanticipated findings is a systematic review on the effectiveness of an mHealth application in gestational diabetes mellitus; studies in this review showed a trend towards lower birth weights in the intervention groups although the differences were not statistically significant (Eberle et al., 2021). Undeniably, this finding departs from other studies

which have associated text message based maternal interventions with lower risk of delivering a low birthweight infant (Coleman et al., 2017; Fedha, 2014; Saronga et al., 2019). Having access to antenatal clinical services at the facility level or during community clinical outreaches can positively influence birth outcomes including the reduction of risks related to low birthweights (Coleman et al., 2020; Dearden et al., 2021). This is because, studies have shown that nutritional education and counselling during pregnancy provided as part of the ANC standard care contributes to a healthy pregnancy, delivery and infant (Desta et al., 2020; Girma et al., 2019; Waltmann et al., 2022). Conversely, this was not the case for this study.

This study acknowledges that several factors are associated with infants' low birthweight including lack of nutrition counselling during pregnancy, lack of iron/folic acid supplementation during pregnancy, and maternal under-nutrition and maternal anemia (Girma et al., 2019). Additionally, use of Sulfadoxine-pyrimethamine (SP) to prevent malaria, maternal height, pregnancy weight gain and maternal age of less than 20 years have also been found to be predictors of low birthweights (Desta et al., 2020). That said, the unexpected findings in this study should be interpreted with caution because the mHealth intervention for this study only gave nutritional messages and was not meant to influence any other physiological factors known to be influencing infants' birthweights. Also, this study did not compare any biological characteristics or clinical (patient) factors between study participants like maternal height and pregnancy weight gain which have been associated with infants' birthweights. Given the unexpected nature of these findings, it is critical to qualitatively explore valuable insights into the experiences and perspectives of the study participants. This will help to shed more light on factors that may not have been captured through quantitative measures alone as well as uncover nuances and potential explanations for the observed unexpected relationships between the mHealth and outreach interventions and low birthweight.

No associations were observed between low birthweights and most of the background characteristics apart from parity, whether participants received any ANC information since becoming pregnant and participants' knowledge on when to start ANC clinic. Specifically, participants who reported a parity of three or more had significant lower odds of delivering low birth-weight babies compared to nulliparous participants. This finding compares to a previous study done in Kenya which also found parity to have had similar significant association with birth weight (Nyamasege et al., 2018). Nulliparity has been associated with low birthweights; low birthweight risks associated with nulliparous women have been associated with factors related to immaturity of the mother: incomplete growth, small size of the uterus and fetal competition for nutrients (Garces et al., 2020). Although it has been shown that inadequate knowledge in maternal nutrition is one of the determinants of low birthweight (Nyamasege et al., 2018), findings from this study found that participants who received some ANC information after getting pregnant had significantly higher odds of delivering low birth weight babies compared to those who did not receive any ANC information after getting pregnant. This study did not seek to establish the type of ANC information participants had received prior to enrolment to this study. Contrasting findings with existing evidence and previous research related to birthweights as observed in this study calls for more research to reconcile these differences.

5.8 Feasibility and acceptability of integrating mHealth within the ANC clinics

This study also explored the experiences of young mothers and HCPs to get their viewpoints regarding the mHealth-text messaging intervention. Generally, this study found that mHealth text messaging intervention was acceptable to the young mothers; while HCPs were cautious not to accept the intervention in its entireness. The initial study plan was to integrate the mHealth platform within the antenatal clinics in the intervention facilities, however industrial actions of health care providers during the COVID-19 pandemic coupled with technological

challenges like computer systems' breakdowns made the integration difficult. Messages were therefore later sent by the researcher who was the custodian of the platform. Regular text message was considered basic and simple to interact with by the intervention participants. This was an important finding for this study because as shown in other studies perceived ease of use of technology is one of the key determinants of technological effectiveness and acceptability (Degroote et al., 2020; Manyazewal et al., 2021). Also, using technology that young people are unfamiliar with can be a barrier to its uptake and use (Stowell et al., 2018). As reported by study participants, user-friendliness and an interactive interface of mHealth platform was an important enabling factor for general mHealth adoption. This finding supports other mHealth studies done in SSA (Aamir et al., 2018) which have reported that the less complicated mHealth applications provided more usability for users especially those with low literacy levels as observed in this study.

mHealth intervention participants also liked the interactive nature of the mHealth platform and they expressed their willingness and that of their peers to interact with the platform. Consistent to this finding is the results of a study done in Ethiopia which found that pregnant women including young mothers in antenatal clinics were willing to receive educational and reminder text messages for their clinical appointment (Endehabtu et al., 2018). Further, intervention participants in this study reported that they could easily relate with the text messages because they were already familiar with some of the information they received at the antenatal clinics. Anecdotally, this could imply that indeed the health care providers were providing gestational age appropriate messages to the study participants and the mHealth messages complemented the clinical information received from the HCPs.

As expected, some participants reported to have ignored the very first messages because they didn't know the sender and had thought they were scam messages or the usual promotional messages sent by various service providers in Kenya. For health interventions targeting young people, personalized text messages have been shown to be a feasible and acceptable intervention to positively change individual behaviours (Partridge & Redfern, 2018). To retain active participation of the targeted group in mHealth communication, there is need to sensitize the target group on the platform's name which they will be interacting with to avoid the suspicious tendencies observed in this study. Similar to a text messaging study done in Burkina Faso (Sawadogo et al., 2021), a few participants in this study reported about technological challenges like network issues and power outages sometimes leading to their lack of interaction with the mHealth platform. Despite the broaden penetration of mobile network and the ubiquity of mobile phones among young people in Kwale county, the study established that steady connectivity was not evenly distributed. This could also be confirmed by the mHealth platform's non-delivery alerts of messages sent to the study participants. A few messages took longer to be delivered meaning the phones were off either due to power or network challenges. Despite the few reported network challenges, this study found that text messages can be a feasible and an acceptable approach to provide antenatal education and reminder care to expectant adolescents and young women.

Healthcare providers interviewed in this study reported experiencing huge workloads and that having them interact and work on a mHealth platform without additional staff was something they weren't looking up to. Seemingly, the text messaging intervention didn't align with the HCPs workflow largely due to apprehension about workload. mHealth integration was therefore seen as an additional responsibility. Similar to what other studies have observed, integrating technological interventions like mHealth have been regarded as extra burdens to

the HCPs, an added responsibility that draws them away from their core mandates (Kiberu et al., 2017; Wallis et al., 2017). Despite some initial hesitation, the interviewed HCPs responded well to the mHealth integration initiative terming technological interventions as 'inevitable' especially with the current high-tech developments. For HCPs, ease of integration with their daily workflow was highlighted as a critical factor to mHealth adoption.

HCPs were also cautious with their responses and stated that mHealth text messages if unregulated might interfere with the standard in-person clinical care which is essential for a positive pregnancy outcome. They reported that sending educational messages and reminders to expectant young women is acceptable but were against diagnosis of any complications through a text inquiry from a pregnant woman. This speaks to the ethics of mHealth and confirms the potential risks and challenges that must be addressed before and during the use of mHealth interventions (Cvrkel, 2018). The consequences of these challenges can be significant; administering effective treatment plans requires proper diagnosis of both biological and behavioural factors which might have contributed to the reported ailment. Relying on reported texts from expectant young women without a physical diagnosis can lead to inaccurate treatment posing more danger to the already vulnerable expectant adolescent girls and young women. It is therefore important to encourage expectant young women to seek clinical care throughout their pregnancy period and adhere to their clinical appointments.

Further, this study also sought to determine if the HCPs were tech-savvy should the relevant authorities address the staffing challenges and decide to integrate mHealth into their daily routines. All the four HCPs reported to be not-so tech-savvy but expressed their willingness to learn and improve their proficiency in the use of modern technology. Similar to previous research (Brown et al., 2020), this study also determined that despite the HCPs willingness to

accept mHealth interventions, their willingness did not equate to immediate uptake of technological interventions thereby calling for systemic preparedness by policy makers and county heads specifically in the creation of appetite for positive technological disruptions in the health sector. Indisputably, in most mHealth initiatives, HCPs have been regarded as an important success factor because of their interaction with the community and the nature of their work relating to the provision of effective healthcare services (Aamir et al., 2018). Alignment of mHealth initiatives with the HCPs workloads has the potential to increase the utilization of mHealth applications.

Moreover, mHealth interventions have been considered as acceptable solutions towards health-related challenges particularly within maternal and neonatal health (Mukami et al., 2021). Despite this acceptance, mHealth interventions in sub-Saharan Africa have mostly not been scaled up beyond the pilot implementations and have remained proof of concept activities (Kiberu et al., 2017). This could be due to the interventions' perceived impracticableness or the purported complexities surrounding technological innovations. The adoption and use of mobile health interventions by HCPs could face challenges including motivation relating to user acceptance and adoption (Maiga & Namagembe, 2014). From the qualitative interviews with HCPs, the researcher confirmed that performance expectancy (belief that the mHealth intervention will help them improve their performance), effort expectancy (ease of use associated with the technology) attitude and additional responsibilities concerns as explained in the unified theory for the acceptance and use of technology (Dwivedi et al., 2019) are vital issues for HCPs to adopt any mHealth intervention. Further, maternal clients including expectant young women may fail to adopt or utilize the mHealth text messaging intervention if they don't find any relevance in the content being sent from the mHealth platforms (Maliwichi et al., 2021).

Lastly, to gain some insights about the perceptions of caregivers regarding the monthly messages they were receiving, we found mixed reactions with some caregivers appearing to be discussing with the young mothers, others were unbothered while some opined that the messages were not useful to them and should instead be directed to the young mothers. At one point, the researcher also received a message from the caregiver who seemed like they had reminded the young mother of their clinical appointment, but their efforts were not convincing enough. The caregiver stated,

> *"I have tried but she does not want to come, so I'll leave her alone until when she wants to …"*

This finding, albeit subtly, suggest that primary caregiver text messaging has the potential to increase other household's members' positive involvement in pregnancy related care thereby increasing spousal/caregiver involvement. Caregivers' and partners' involvement should however be carefully designed so as not to be seen as information overload which was insinuated as one of the concern that bothered the household members. Additionally, any interventions should not interfere with young women's autonomy to make their own sexual and reproductive health decisions.

5.9 Limitations of the study

This study was not without limitations. As generally expected of quasi experimental studies where participants have not been randomly assigned to conditions (Cook & Campbell, 1979) as in this study, we observed differences in most of the background characteristics across the three groups (i.e., the control, mHealth-text message intervention, and outreach). However, significance test of baseline characteristic does not provide an appropriate criterion to assess the effect of imbalance on outcome or the decision to adjust for baseline variables (Roberts & Torgerson, 1999; Senn, 1989). This is typical of non-equivalent groups' designs under the

quasi-experimental design where the resulting groups are likely to be dissimilar in some ways. It is worthy of note that even under complete randomized controlled trials, it is possible to observe some differences in the background characteristics of the control and the intervention groups.

Another limitation is that this study was conducted in four out of the eleven health centres in Kwale County providing maternal and child health care, findings in this study are therefore not representative of Kwale and hence limited in the extent to which they can be generalized.

5.10 Chapter summary

This chapter focused on exploring and discussing the underlying meanings of the findings of this study. Background characteristics of the study participants relevant to this study have been discussed. This was then followed by interpreting and describing the significances of findings related to the study outcomes of interest. The next chapter will focus on conclusion and recommendations based on the findings of the study.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The final chapter of this study provides a summary of the main findings, conclusions related to the findings and some recommendations to policy makers, research and the scientific community and other relevant public health stakeholders specifically in the field of maternal health care.

6.2 Summary of findings

This study was designed to be a quasi-experimental trial with two arms, mHealth-text message intervention arm and a comparison arm aimed at determining the effect of mHealth intervention on antenatal care outcomes amongst expectant adolescents and young women in Kwale County, Coastal Kenya. However midway through the study, one control facility (Mkongani Health Centre) introduced community clinical outreaches thereby interfering with the planned two-arm study design. With these developments, the study was modified in the analysis to incorporate the new outreach intervention arm. The final analysis therefore had three arms, control, mHealth-text messaging and the outreach intervention arms. This study utilized messages from Mission Motherhood (Babycentre, 2017) and translated them into Swahili to suit and relate to the targeted expectant young women in Kwale County, Coastal Kenya. All the study participants were provided with their respective health facility's mobile phone numbers to communicate directly with their health care providers. The trial ended when the last enrolled participant got her last set of messages at week 38. This was then followed by qualitative endline assessments with selected mHealth-text message intervention participants and health care providers to gather their insights about the intervention processes and contents. Other clinical study outcomes were then measured quantitatively as recorded in the clinical antenatal and maternity registers. Findings from this study are as follows:

- A total of 128 messages from Mission Motherhood were vetted, tested and translated into Swahili to fit the study context
- Overall, 273 (33.4%) participants had less than four antenatal contacts; 31 (3.9%) were delivered by unskilled birth attendants and 51 (6.5%) had low birthweight babies
- Participants in the mHealth-text message intervention and outreach arms had a significantly lower prevalence of low ANC contacts compared to the control arm participants.
- Compared to participants in the control arm, those from the mHealth-text message intervention and outreach arms had significantly lower prevalence of unskilled deliveries
- Disparately, compared to babies born to participants from the control arm, those born to participants from the mHealth intervention and outreach arms had a significantly higher prevalence of low (<2500 grams) birth weight
- Findings from this study also revealed that some sociodemographic factors were potential predictors of antenatal health outcomes among expectant young women in Kwale County in the Coastal, Kenya. They included whether the pregnancy was planned, gestation at first ANC visit, level of education and parity.
- The qualitative component of this study revealed that mHealth-text messaging intervention is a feasible and acceptable intervention by both young mothers and cautiously by the healthcare providers.

6.3 Conclusions

This study concludes the following:

- Employing mHealth-text messaging interventions and community-based clinical outreaches can improve expectant adolescents' and young women's maternal health seeking behaviours including increased antenatal contacts and deliveries by a skilled health practitioner.
- mHealth text messaging is a feasible and acceptable intervention in improving ANC service uptake. However, before any technological integration is effected at the health facilities' level, some potential challenges will need to be addressed including adequate staffing of healthcare providers, equipping health facilities with technological equipment like computers and training providers on basic information and communication technology.
- Combining mHealth interventions with community-based clinical outreaches can maximize the strengths of each model in improving expectant young women's antenatal health outcomes while addressing the recognized shortcomings of each.
- Policy makers and the research community should therefore explore the effects of combining the two in the contexts of expectant young women in rural and semi-urban areas, in Kenya and sub-Saharan Africa in general.
- On infants' birthweights, contrasting findings with existing evidence as determined in this study calls for more research to help reconcile these differences.

6.4 Implications of the study findings and contribution to new knowledge

The policy implication for this study is that community oriented primary care outreaches implemented jointly with mHealth interventions can improve antenatal uptake and pregnancy care among expectant adolescents and young women. Certainly, building the continuum of care for positive maternal health among expectant adolescents and young women in Kenya will need systemic improvements in several social and health systems. Emphasis should be put

towards increased enrolment and retention of young girls in formal schooling, adequate staffing at the health facilities and policy support for community sensitization and outreaches as well as technological integration at the national, county and health facilities' levels.

6.4.1 Study contribution to knowledge

- This study is the first to test the effectiveness of a mHealth text message intervention to improve antenatal health outcomes among expectant adolescents and young women in Kenya.
- Findings have shown that the two interventions (mHealth-text message and Outreaches) can improve antenatal contacts and skilled deliveries among expectant adolescents and young women. Outreaches had a marginal higher effect on antenatal contacts compared to the mHealth-text message intervention.
- Methodologically, this study has confirmed that, in any research, we should safely expect unanticipated encounters which might lead to unplanned design deviations. The unexpected outreaches in one control facility led to a somewhat serendipitous discovery of the positive effects of community-based outreaches on antenatal health outcomes of expectant adolescents and young women. These findings provide a unique opportunity to test the impact of blending community-based outreaches and mHealth interventions in settings where antenatal uptake is low.
- In addition, findings from health care providers on the feasibility and acceptability of integrating mHealth interventions provide a good guide for County heads at the department of health and policy makers to plan ahead of any technological introduction and adoption at the facility levels.

6.5 Recommendations

Based on the findings of this study, the researcher provides the following recommendations for effective interventions and future research:

- To improve ANC uptake and skilled deliveries among expectant young women, this study recommends the public health community, particularly the national and sub-national health directors to adopt and use a blended approach, combining mHealth and community based clinical outreaches in routine service delivery.
- Prior to any planned introduction of mHealth intervention at the facility levels, health departments at the county levels should consider several key factors including development of mHealth regulatory policies, sufficient staffing, development of protocols and training programs for healthcare workers to effectively use technology as well as putting in place incentives to motivate mHealth adoption and use by providers.
- To increase early ANC contacts among expectant young women, there is a need for effective interventions at the community level (by the community health promoters) to identify and link young women to clinical care early in their pregnancy. Pregnancy related case-findings model and community sensitizations by trained community health promoters in Kenya on the importance of early ANC uptake is one potential approach that needs to be enhanced and effectively implemented at the sub-national levels.
- In order to reconcile the unexpected results related to infants' birthweights, this study recommends further research trials on the effect of mHealth text messaging intervention and clinical community outreaches on infants' birthweights. This can be an exploratory qualitative study supported by the Kwale County Government to understand unmeasured factors that might have influenced these findings.
- There is also need for future researchers to compare findings with facilities' baseline parameters of interests (ANC uptake, Skilled deliveries & infants' birth-weight) and for health economists to do a comprehensive economic evaluations of mHealth-text

messaging evaluations and outreaches designed for expectant adolescents and young women over a more extended time-period as opposed to shorter trials.

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APPENDICES

APPENDIX 1: PARTICIPANT INFORMATION AND ADULT CONSENT FORM

Introduction:

I would like to tell you about an academic study being conducted by the above listed researcher. The purpose of this consent form is to give you the information you will need to help you decide whether or not to be a participant in this study. Feel free to ask any questions about the purpose of the research, what happens if you participate in the study, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions to your satisfaction, you may decide to be in the study or not. This process is called 'informed consent'. Once you understand and agree to be in the study, I will request you to sign your name on this form. You should understand the general principles which apply to all participants in a medical research: i) Your decision to participate is entirely voluntary ii) You may withdraw from the study at any time without necessarily giving a reason for your withdrawal

iii) Refusal to participate in the research will not affect the services you are entitled to in this health facility or other facilities. We will give you a copy of this form for your records.

May I continue? YES / NO

This study has approval by The Kenyatta National Hospital-University of Nairobi Ethics and Research Committee Protocol No. _____

Purpose of the study

You might have heard about antenatal care and its importance for a positive pregnancy. Studies and country data have shown that expectant young women's uptake of antenatal coverage is below average in most parts of the country and Kwale in particular. This lack of or inadequate clinical contacts prevent the early detection of any pregnancy related complications. Access to comprehensive antenatal care (ANC) and utilization of skilled delivery services can help detect and prevent these complications. However poor referral channels and lack of knowledge on the importance of ANC often impede expectant young women from attending antenatal clinics. It is evident that young women possess mobile phones which present the potential to improve ANC knowledge through educational messages as well as reminder prompts for clinical appointments. This study therefore seeks to determine whether mHealth (mobile phones) integrated within an existing ANC system would improve expectant young women antenatal coverage thereby safeguarding their pregnancies for positive pregnancy outcomes.

Study procedure

The researcher listed above with support of other research assistants will therefore interview expectant young women aged 24 years and below who came for their first ANC in this health facility. The purpose of this interview is to find out what expectant young women know about maternal health and their source of this information. Additional questions will include perceived benefits of ANC and perceived receptive tendencies of the healthcare providers when young women seek antenatal care. Both sets of data will be electronically collected using mobile phones as shown by the data collector, there are no right or wrong answers as we are only interested in your opinion. You will also be asked about your demographic details such as age, educational level, religion, marital status, your spouse age and educational status, occupation and male partner if available and type of pregnancy, that is, whether the pregnancy is wanted or not. Other questions will include number of children alive and young women's autonomy regarding their reproductive health service utilization. The discussions will also include how best we can design a mHealth system to reach out to young mothers as well as test the messages with expectant young women like you to test the messages' relevance to the targeted group. Messages will be tested in either English or Swahili depending on one's language of choice. With your consent, we shall record the discussions but will not attach any responses to any voice, we shall also take notes during the discussions. The recordings will be deleted after two years. There will be approximately 856 participants in this study from selected facilities with highest burdens of teenage pregnancies. We are therefore asking for your consent to consider participating in this study.

WHAT WILL HAPPEN IF YOU DECIDE TO BE IN THIS RESEARCH STUDY?

If you agree to participate in this study, the following things will happen:

You will be interviewed by a trained interviewer in a private area where you feel comfortable answering questions. The interview will last approximately 30 - 60 minutes. The interview will cover topics such as contraceptives use among young women, ANC basic knowledge, services and information offered at the health facilities, young women's autonomy in clinical decision making and parental support.

After the interview has finished, you will be enrolled to either the intervention arm (to receive study messages) or the control arm (where no messages will be sent). This is a random selection based on your health facility and will not interfere in any way with the antenatal services you are entitled to.

We will ask for a telephone number where we can contact you if necessary. If you agree to provide your contact information, it will be used only by people working for this study and will never be shared with others. The reasons why we may need to contact you include: sending educational messages and reminder prompts as is the objective of this study as well communicating to you about any changes that may arise. We shall also give you our number and the facility's number so you may get in touch should you experience any unforeseen challenges/complications.

ARE THERE ANY BENEFITS BEING IN THIS STUDY?

Although there are no direct tangible benefits related to this study, you may benefit by receiving free health information related to your pregnancy as well as some small airtime to communicate to the health facility in case of any pregnancy or study-related complications. The study will benefit from your responses which will help improve service provision for adolescent girls and young women. Additionally, your participation will be key in answering the research questions which aim at determining the effectiveness of mHealth in improving antenatal coverage among expectant young women in Kwale County. This is information is a contribution to public health as it will contribute to the body of mHealth knowledge currently being explored by the public health community.

RISKS, HARMS DISCOMFORTS ASSOCIATED WITH THIS STUDY?

One potential risk of being in this study is loss of privacy. We will keep everything you tell us as confidential as possible. Also, answering questions in the interview may be uncomfortable for you. If there are any questions you do not want to answer, you can skip them. You have the right to refuse the interview or any questions asked during the interview. Furthermore, all study staff and interviewers are professionals with special training in these interviews. Also, some questions might evoke emotions that might be stressful, if this happens, we shall stop the interview and link you up with a professional counsellor at no cost at your respective facility.

CONFIDENTIALITY

We will use a code number given at the ANC clinic to identify you in a password-protected computer database and will keep all of our paper records in a locked file cabinet. However, no system of protecting your confidentiality can be absolutely secure, so it is still possible that someone could find out you were in this study and could find out information about you. The mobile phones used to collect data will not use any personal identifiers and will only be linked to your clinical data after the study for analysis purposes.

WILL BEING IN THIS STUDY COST YOU ANYTHING?

This study will not cost you anything, all study related expenses will be taken care of by the researcher.

WILL YOU GET REFUND FOR ANY MONEY SPENT AS PART OF THIS STUDY?

We do not anticipate any expenditure from your end, however if any arises, the study will communicate in good time for a refund.

WHAT IF YOU HAVE QUESTIONS IN FUTURE?

If you have further questions or concerns about participating in this study, please call or send a text message to the study staff at the number provided at the bottom of this page.

For more information about your rights as a research participant you may contact the Secretary/Chairperson, Kenyatta National Hospital-University of Nairobi Ethics and Research Committee Telephone No. 2726300 Ext. 44102 email uonknh_erc@uonbi.ac.ke.

The study staff will pay you back for your charges to these numbers if the call is for study-related communication.

VOLUNTARY PARTICIPATION

Your decision to participate in research is voluntary. You are free to decline participation in the study and you can withdraw from the study at any time without injustice or loss of any benefits.

CONSENT FORM (STATEMENT OF CONSENT)

Participant's statement

I have read this consent form or had the information read to me. I have had the chance to discuss this research study with the study team. I have had my questions answered in a language that I understand. The risks and benefits have been explained to me. I understand that my participation in this study is voluntary and that I may choose to withdraw any time. I freely agree to participate in this research study.

I understand that all efforts will be made to keep information regarding my personal identity confidential.

By signing this consent form, I have not given up any of the legal rights that I have as a participant in a research study.

I agree to participate in this research study: **Yes** **No**

I agree to provide contact information for follow-up: Yes No

Participant printed name:

_____

Participant signature / Thumb stamp _____ **Date**

_____

Researcher's statement

I, the undersigned, have fully explained the relevant details of this research study to the participant named above and believe that the participant has understood and has willingly and freely given his/her consent.

Researcher's Name: _____ **Date**: _____

Signature

_____

Role in the study: _____ *[i.e. study staff who explained informed consent form.]*

For more information, contact **Jefferson Mwaisaka** at **0723206132** anytime of the day.

Witness Printed Name (*If witness is necessary, a witness is a person mutually acceptable to both the researcher and participant*)

Name _____ **Contact information** _____

Signature /Thumb stamp: _____ **Date**; _____

APPENDIX 2: SWAHILI CONSENT FORM

Utangulizi:
Ningependa kuwaeleza kuhusu utafiti wa kitaaluma ambao umefanywa na mtafiti. Madhumuni ya fomu hii ya idhini ni kupeana maelezo utakayohitaji kuamua ikiwa utakuwa mshirika katika utafiti huu. Jiskie huru kuuliza maswali kuhusu madhumuni ya utafiti, ni nini kitatokea utakapojihusisha na utafiti huu, hatari na faida, haki zako kwa kujitolea, na kitu chochote kile kuhusu utafiti na lolote lisilo wazi katika hii fomu. Wakati tumejibu maswali yako na yamekuridhisha, unaweza kuamua kujihusisha katika utafiti huu ama ukatae. Mchakato huu unaitwa 'idhini ya habari'. Unapoelewa na kukubali kuhusika katika utafiti huu, ningependa ueke sahihi kwa jina lako katika fomu hii. Unafaa kuelewa kanuni za jumla zinazotumika na washiriki wote wa utafiti wa matibabu: i) Uamuzi wako wa kushiriki ni wa hiari ii) Unaweza kujiondoa kwa utafiti wakati wowote bila kupeana sababu.
iv) Kukataa kushiriki katika ufiti hautaathiri huduma unazopata katika kituo cha afya au vituo vingine. Tutawapatia nakala ya fomu ya rekodi zako.

Nitaendelea? NDIO / LA

Utafiti huu umeidhinishwa na Hospitali Kuu ya Kenyatta-Chuo Kikuu cha Nairobi
Maadili na Kamati ya Utafiti na Itifaki nambari _____

Madhumuni ya utafiti
Labda umesikia kuhusu huduma za wajawazito na umuhimu wa ujauzito mzuri. Utafiti na data za nchi zimeonyesha kuwa matumizi ya chanjo ya wasichana wajawazito iko chini ya wastani katika sehemu nyingi za nchi na hasa Kwale. Upungufu wa mawasiliano katika kliniki umezuia ugunduaji wa matatizo yanayohusiana na mimba mapema. Upatikanaji wa kina za huduma za wajawazito na matumizi ya wenye ujuzi wa kutoa huduma zinaweza kusaidia kugundua na kuzuia matatizo hayo. Hata hivyo njia za rufaa duni na ukosefu wa maarifa wa umuhimu wa huduma za ujauzito mara nyingi huzuia wasichana wajawazito kuhudhuria huduma za ujauzito. Ni dhahiri kuwa wasichana wadogo wanamiliki simu ambazo zina uwezo wa kuboresha maarifa ya huduma za wajawazito kupitia mafunzo na hata kusababisha kuwakumbusha miadi ya kliniki. Kwa hivyo utafiti huu unataka kuamua iwapo afya ya simu imejumuishwa ndani ya mfumo wa huduma za ujauzito na kuboresha huduma za chanjo za ujauzito kwa wasichana wajawazito hivyo kulinda mimba kwa matokeo mema.

Utaratibu wa Utafiti
Mtafiti pamoja na msaada wa wasaidizi wa utafiti watawahoji wanawake wajawazito wa umri wa miaka ishirini na minne kurudi chini waliohudhuria huduma za ujauzito kwa mara ya kwanza katika kituo hiki cha afya. Madhumuni ya mahojiano haya ni kutaka kujua ni nini wasichana wajawazito wanachokijua kuhusu afya ya wamama na chanzo cha maelezo haya. Maswali zaidi yatahusu faida zilizoonekanakatika huduma za ujauzito na kutambulika na kupokolewa kwa mielekeo ya wahudumu wa afya wakati wasichana wadogo wanatafuta huduma za ujauzito. Seti zote za data zitakusanywa kieletroniki kupitia simu kama ilivyoonyeshwa na mkusanyaji wa data, hakuna majibu yaliyosahihi na yasiyosahihi kwani nia yetu ni maoni yako. Utaulizwa pia kuhusu idadi yako kama vile umri, kiwango cha elimu, dini, ndoa, umri wa mwenzi na hadhi ya elimu, kazi na mume kama yuko na aina ya ujauzito, na kama mimba imekubalika au la. Maswali mengine yatahusu idadi ya watoto waliohai na uhuru wa wanawake wadogo kuhusu matumizi ya huduma ya afya ya uzazi. Mjadala pia utahusu vile tutakavyobuni mfumo wa afya ya simu ili kufikia akina mama wachanga na pia kujaribu ujumbe huo na wanawake wajawazito na wewe kujaribu umuhimu wa ujumbe huo kwa

waliolengwa. Ujumbe utajaribiwa kwa lugha ya kiingereza na Kiswahili kulingana na uchaguzi wako. Kupitia kwa idhini yako, tutanakili majadiliano lakini hatutaambatanisha majibu kwa sauti yoyot, tutachukua pia maelezo wakati wa majadiliano. Rekodi zitafutwa baada ya miaka miwili. Kutakuwa na takriban washiriki mia nane ishirini na sita (856) kwa utafiti huu nasibu uliochaguliwa kutoka kwa vituo vilivyo na wingi wa wasichana wajawazito. Kwa hivyo tunaomba idhini yako kwa kushiriki katika utafiti huu.

Ni nini kitatokea nitakapoamua kujiunga katika utafiti huu?
Utakapoamua kushiriki katika utafiti huu, yafwatavyo yatatokea:

Utahojiwa na mhojiwa aliyefunzwa katika eneo la kibinafsi ambalo utahisi vizuri kujibu maswali. Mahojiano yatachukua takriban muda wa dakika thelathini hadi sitini. Mahojiano yatahusu mada kama vile upangaji uzazi kwa wanawake wachanga, maarifa ya huduma za ujauzito, huduma na maelezo yatakayotelewa katika vituo vya afya, uhuru wa wanawake wachanga kufanya maamuzi ya kliniki na msaada wa wazazi.

Baada ya mahojiano kumalizika, waliojiandikisha watapokea ujumbe wa utafiti ama kutopokea ujumbe. Uteuzi huu ni wa nasibu kulingana na kituo cha afya na haitaingilia kati kwa njia yoyote na huduma za ujauzito ulizoekewa.

Tutauliza nambari ya simu ambayo tutawasiliana nawe ikiwa ya lazima. Ukikubali kupeana nambari ya mawasiliano, itatumika na watu wanaofanya kazi kwa utafiti huu na haitawahi tumika na wengine. Sababu za kuwasiliana nawe ni: kutuma ujumbe wa mafunzo na kusababisha ukumbusho kama ilivyo lengo la utafiti na pia kuwasiliana nawe kuhusu mabadiliko yatakayotokea. Tutapeana nambari yetu ili uweze kuwasiliana nasi utakapopitia changamoto zozote.

Kuwapo kwa utafiti huu kuna faida zozote?
Ingawa hakuna faida inayoonekana moja kwa moja inayohusiana na utafiti huu, unaweza kufaidi kwa kupokea maelezo ya kiafya bure yanayohusiana na ujauzito na hata muda wa maongezi ili kuwasiliana na kituo cha afya iwapo kutakuwa na ujauzito ama changamoto zinazohusiana na utafiti. Utafiti utafaidi upokezi wako ambao utasaidia kuimarisha utoaji wa huduma kwa wasichana na wanawake wachanga. Zaidi, ushirikiano wako utakuwa kiini cha kujibu maswali ya utafiti ambao lengo lake ni kuamua athari ya afya ya simu ili kuboresha ujauzito kati ya wanawake wajawazito katika kaunti ya Kwale. Habari hii ni mchango kwa afya ya umma kwani itachangia ushirika katika maarifa ya afya ya simu unaotumika sasa katika afya ya umma kwa jamii.

Hatari, Madhara na Usumbufu unaohusiana na utafiti huu
Uwezekano wa hatari ya mmoja kuwa katika utafiti huu ni upungufu wa siri. Chochote utakachotuambia tutakiweka siri inavyowezekana. Na pia, kujibu maswali ya mahojiano yanaweza kuwa ya wasiwasi kwako. Iwapo kuna maswali yoyote usingependa kuyajibu, unaweza yawacha. Uko na haki ya kukataa mahojiano au maswali yoyote utakayoulizwa wakati wa mahojiano. Zaidi ya hapo, wafanyakazi wa utafiti na wahoji ni wataalamu walio na taaluma maalum kwa mahojiano haya. Na pia maswali mengine yanaweza kuudhi hisia ambayo yatakusumbua, haya yakitokea, tutakatiza mahojiano na kukuunganisha na mtaalam wa ushauri bila gharama inayohusika na kituo.

Usiri
Tutatumia nambari ya msimbo iliopeanwa kwa kliniki ya huduma ya ujauzito kukutambua kwa nywila za kompyuta za data ya msingi na tutaweka rekodi kwa kufunga katika faili ya chumba kidogo. Walakini hakuna mfumo wa kulinda usiri wako unaeza kuwa salama, kwa hivyo kuna uwezekano wa mtu kujua kuwa ulikuwa katika utafiti huu na anaweza kupata maelezo kukuhusu. Simu za mkono zitakazotumika kukusanya data hazitatumia vitambulisho binafsi na zitaunganishwa na data ya kliniki yako baada ya utafiti kwa madhumuni ya uchambuzi.

Kushiriki kwenye utafiti utakugharimu chochote?
Utafiti huu hautakugharimu chochote, gharama zote zinazohusiana na utafiti zitashughulikiwa na mtafiti.

Je, utarejeshewa pesa zozote utakazotumia kwenye utafiti huu?

Hatutarajii gharama kwa upande wako, bali zozote zitakapotokea, utafiti utawasiliana kwa wakati mzuri kwa marejesho.

Ikiwa utakuwa na maswali siku zijazo?
Ukiwa na maswali zaidi ama wasiwasi kuhusu kushiriki kwa utafiti huu, tafadhali piga simu ama tuma taarifa kwa mfanyikazi wa utafiti kwa nambari uliyopewa mwishoni mwa ukurasa.

Kwa maelezo zaidi kuhusu haki kama mshiriki wa utafiti wasiliana na katibu/mwenyekiti, Hospitali Kuu ya Kenyatta-Chuo Kikuu cha Nairobi cha Kamati ya Maadili na Utafiti nambari ya simu 2726300 nambari ya upanuzi 44102 barua pepe uonknh_erc@uonbi.ac.ke.

Mfanyikazi wa utafiti atakulipa gharama kutumia hizo nambari kama simu inahusiana na utafiti.

Ushiriki wa hiari
Uamuzi wako wa kushiriki kwa utafiti ni wa hiari. Uko huru kukataa kushiriki kwa utafiti na unaweza kujiondoa kutoka kwa utafiti wakati wowote bila udhalimu au upungufu wa faida yoyote.

Fomu ya idhini (kauli ya idhini)
Kauli ya mshiriki

Nimesoma fomu ya idhini hii au nimesomewa maelezo haya. I have read this consent form or had the information read to me. Nimekuwa na nafasi ya kujadili utafiti na timu ya utafiti. Nimekuwa na maswali yangu yakijibiwa kwa lugha ninayoelewa. Nimeelezwa hatari na faida. Naelewa ya kuwa ushiriki wangu katika utafiti huu ni wa hiari na naeza chugua kujiondoa wakati wowote. Nimekubali kushiriki katika utafiti huu.

Naelewa kuwa juhudi zote zitafanywa kuhusu maelezo haya ya binafsi kuwa siri.

Kwa kutia sahihi katika fomu ya idhini hii, Sijakatalia haki za kisheria nilizo nazo kama mshiriki wa utafiti huu.

Nakubali kushiriki katika utafiti huu: **Ndio** **La**
Nakubali kufwatilia kwa kupeana maelezo ya mawasiliano: Ndio La

Uchapishaji wa jina la mshirika:
_____

Sahihi ya Mshirika / Muhuri _____ **Tarehe**
_____

Kauli ya mtafiti

Mimi niliyechaguliwa nimeeleza maelezo husika ya utafiti huu kwa mshiriki aliyetajwa na ninaamini ya kuwa mshirika ameelewa na yuko huru kupeana idhini yake.

Jina la Mtafiti: _____ **Tarehe**:
_____

Sahihi_____
__

Jukumu kwenye utafiti: _____ *[i.e. mfanyakazi wa utafiti ambaye alieleza taarifa ya fomu ya idhini.]*

Kwa maelezo zaidi, wasiliana na **Jefferson Mwaisaka** kwa nambari **0723206132** wakati wowote.

Uchapishaji wa jina la mshahidi (*kama mshahidi ni lazima, mshahidi ni mtu anayekubalika na pande zote za mtafiti na mshiriki*)

Jina _____ **Maelezo ya mawasiliano**_____

Sahihi /Muhuri wa kidole: _____ **Tarehe**;
_____

APPENDIX 3: EXPECTANT YOUNG WOMEN'S BACKGROUND SURVEY QUESTIONNAIRE

INTERVIEW INFORMATION			
Respondent unique ID **RESPONDENT'S LOCATION DETAILS AND INFORMATION**			
Sub-county Name [_____]		Sub-county	Sub-county Code [____]
Ward Name [_____]		Ward	Ward Code [____]
Village Name [_____]		Village	Village Code [____|____]
Interview Details	Date	Time	Facility
Comments *(including reason for refusal, if given)*			

RESPONDENT INFORMATION SHEET

Hello, my name is _____. I am an interviewer representing the University of Ghana, School of Public Health. We are conducting a baseline survey about antenatal coverage in readiness for a mHealth intervention study targeting expectant young women aged 24 years and below in Kwale County. We are doing this study in four public health facilities providing maternal care services. I would like to invite you to this study so you may provide some basic information regarding sexual and reproductive health services in general and maternal services in particular.

Read to the participant: We will ask about access to health service utilization; source and access of SRH information, adolescent and young mothers' autonomy in making SRH decisions; interaction with reproductive health mobilizers in the community, community factors that influence adolescent sexual and reproductive health (SRH) and antenatal referral strategies you've experienced or heard about. This information will be completely confidential to help improve the quality of maternal services in Kwale. The questions will take about 20-30 minutes to complete. All of your answers will be put into my smart phone (show the participant the device). Your unique ID is what will be used during analysis and, all other details will remain with the health facility. Please let me know if you are not comfortable with the question at any one point; you may refuse

to answer any question that you do not feel comfortable with. If you have questions about this survey, please contact the Principal Investigator any time on this number (0723206132).

Do you agree to continue with the interview?

Please tick one box: ☐ The client declines to be interviewed
☐ The client agrees to be interviewed

Thank you for agreeing to take part in the survey.

Name of interviewer: _____	Date of interview _____ Start time and end time _____

SECTION 1: BACKGROUND INFORMATION
READ TO THE PARTICIPANT: Thank you for agreeing to participate in the interview. I'd like to start by asking some background questions about yourself.

Q101	In what month and year were you born?	☐☐ MONTH DON'T KNOW MONTH ……..98 YEAR ☐☐☐☐ DON'T KNOW YEAR ……..98	
Q102	How old were you on your last birthday?	Age in complete years ☐☐	
Q103	How old is the father of your child? (Mark 98 if age is not known)	Age in complete years ☐☐	
Q104	Have you ever attended school?	Yes..... 1 No..... 2	If 2 go to Q109

Q105	What is the highest level of school you attended: primary, vocational, secondary, or higher	Primary incomplete ……...1 Primary complete …….. .2 Secondary incomplete ……3 Secondary Complete ……4 Vocational …… …….5 College (middle level) ……...6 University …… ……..7	
Q106	Are you currently attending school?	Yes..... ... 1 No 2	If 2 go to Q109
Q107	If yes, what level are you in?	Primary..... .....1 Secondary..... ..... 2 Vocational …… …….3 College (middle level) …… 4 University..... 5	
Q108	What is the highest level of school attended by the father of your child?:	Primary incomplete ……...1 Primary complete …….. .2 Secondary incomplete ……3 Secondary Complete ……4 Vocational …… …….5	

		College (middle level) ……...6 University …… …….7 Don't know …… ……98	
Q109	What is your religion?	Christian Catholic..... ..... 1 Protestant/other Christian..... 2 Islam..... .. 3 Traditional religion.....4 Hindu..... ...5 No Religion..... 6 Other (specify)..... 98	
Q110	Who do you currently live with Mark all possible options (Code 1 cannot be marked with any other)	I live alone …… ……1 Husband/Male partner (Father of the unborn) …2 Male Partner (not the father of the unborn) …….3 Father/Step father …… ……..4 Mother/Step mother …….. ..5 Siblings …… ……6 Grandparents …… ……7 Other relatives …… ……...8 Friends …… ……9	

		Others specify …… ……10	
Q111	What is your current relationship status	Single …… …….1 Dating …… ……2 Cohabiting …….3 Engaged …….. .4 Married…… …….5 Others specify ……...6	
Q112	Who is your primary caregiver, that is, the person who takes care of you or assists you at home? (Code 0 cannot be marked with any other)	No one …… …….0 Male partner …… ……...1 Mother/Step mother …… 2 Father/step father ……3 Siblings …… …….4 Grandparents …… ……...5 Other relatives …… ……6 Other (Specify _____) …….. 98	
Q113	Is this your first pregnancy?	Yes ……1 No …… 2	If 1, go to Q115

Q114	How many births have you had in total during your life? How many of them are male and female births?	Total Births Male Births …… Female Births …….	
Q115	How old were you when you had your first child/pregnancy? Give the current age if that's the first pregnancy	Age in complete years ☐☐	
Q116	Do you have a cell phone?	Yes ……1 No ……2	If 2, go to Q121
Q117	If yes, insert the cell phone number	Insert cell phone number	
Q118	What type of cell phone do you have?	Basic phone (Only for calls and texts) …….1 Multimedia phone (Has a camera and MP3 but no internet or applications ……2 Smartphone (Has internet and applications) …..3	
Q119	Is the cell phone shared or for you only?	Only for me ……1 Shared with someone ……..2	If 1, go to Q121
Q120	Who do you normally share with?	Parents …….....1 Husband/male partner……..2 Siblings ……...3 Friends……4 Other relatives ……5	

		Others (specify) …… ……..6	
Q121	Are you employed or engaged in any business that generates money?	Yes..... ... 1 No 2	If 2 go to Q123
Q122	What types of work/business are you currently engaged in? **SELECT ALL THAT APPLY**	Office work..... 1 Full time profession ……2 Selling vegetables.....3 Agribusiness work..... 4 Washing clothes/house chores for pay…5 Selling fish…… ……6 Other *(specify)*..... 7	
Q123	Is the father of your child employed or engaged in any business that generates money?	Yes..... ... 1 No 2	If 2, go to Q201
Q124	What types of work/business is he currently engaged in? **SELECT ALL THAT APPLY**	Office work..... 1 Full time profession ……2 Selling vegetables.....3 Agribusiness work..... 4 Washing clothes/house chores for pay…5	

		Selling fish……6 Fishing ……7 Motor cycle rider (Boda boda) ……8 Other *(specify)*..... 98	

SECTION 2: INFORMATION ON SEXUAL AND REPRODUCTIVE HEALTH AND SERVICES:

Now I would like to ask you some questions about your reproductive life and your knowledge about sexual and reproductive health as well as about programs you have seen and/or have been part of in your community, where you learned about sexual and reproductive health, pregnancy, and family planning.

Q201	What sources of information do you normally RELY on to know about sexual and reproductive systems of women - for example how pregnancy occurs, how to prevent it? **SELECT ALL THAT APPLY**	School teacher ……1 Mother ……2 Father ……3 Brother ……4 Sister ……5 Other family members …6 Friends ……7 Doctors/health care workers ……8 Community Health Volunteers ……9 Radio programs ……10	

		Books/magazines ………………………………………………………………11 Internet …………………………………………………………………………12 Other (Specify………) …………………………………………………..13 None that I know ………………………………………………………………0	
Q202	Have you ever discussed about SRH including pregnancy related topics with anyone?	Yes …………………………………………………………..….1 No ………………………………………….………………………….2	If 2 go to Q204
Q203	With whom did you discuss with? **SELECT ALL THAT APPLY**	Mother or female caregiver ………….…..……………….…..1 Father or male caregiver ……………………………………… 2 Husband /Male partner ………………………………...……...3 Sister……………………………………………………….……….………4 Brother ……………………………………………………………….…..… 5 Other family member ………………………………………...….... 6 Friend or other peer ……………………………………….…… 7 Health care workers ……………………………………...…...8 Community health volunteer ……………………………….......9 Teachers ………………………………………………………………10 Other (Specify_________________) …....................11	
Q204	Have you received any information in the past six months about pregnancy?	Yes 1	If 2 go to

		No 2	Q207
Q205	What information did you receive about pregnancy?	How to avoid pregnancy……..…… ….1 What to do if you found out that you are pregnant ……. …….2 Clinical pregnancy care (ANC) …….3 Nutritional advise …… ….4 Delivering in a health facility ……...5 Other (Specify_____) ……..… .6	
Q206	What was the <u>main</u> source of pregnancy information? **SELECT ONLY ONE RESPONSE**	Parents …… ……1 Internet..... ..... 2 Community health volunteer ……3 Peer educator…… ……4 Religious leader ……. …..5 Teacher …… …….6 Friends …… …….7 Male partner/Husband ……...8 Other Relatives ……... ……9 Books/Magazines ……. 10 Others specify …… …….11	

Q207	Have you ever received information about contraception in the past six months	Yes .... 1 No 2	If 2 go to Q209
Q208	What was the <u>main</u> source of information? **SELECT ONLY ONE RESPONSE**	Parents ……1 Internet..... ..... 2 Community health volunteer ……3 Peer educator……4 Religious leader …….5 Teacher ……6 Friends ……7 Male partner/Husband ……...8 Other Relatives ….9 Books/Magazines ……1 0 Others specify ….98	
Q209	Since you first became pregnant, have you ever received any information about the importance of ANC care	Yes ……1 No ……..2	If 2, go to Q211
Q210	What was the <u>main</u> source of information? **SELECT ONLY ONE RESPONSE**	Parents ……1 Internet..... ..... 2 Community health volunteer ……3	

		Peer educator……4 Religious leader …….5 Teacher ……6 Friends …….7 Male partner/Husband ……...8 Other Relatives …….9 Books/Magazines ……10 Others specify ….98	
Q211	Do you think it is important for a pregnant woman to get pregnancy care at the clinic	Yes ……...1 No ……2 Not sure ……3	If 2, go to Q213
Q212	Why do you think it's important for a pregnant woman to visit a health facility? **SELECT ALL THAT APPLY**	Screening to detect complications ……...1 For the good health of the baby and mother ……...2 Monitoring pregnancy progress ……3 Get nutritional advise …….4 Get ANC card ……...5 Get mosquito nets ……...6	

		I don't know …… …….7 Others, specify …… ……..8	
Q213	When should a pregnant woman start her ANC clinics	Immediately when she misses her periods ……1 1st trimester (week 1 to week 12) …….....2 2nd trimester (week 13 to week 26) ……...3 3rd trimester (week 27 onwards) …….4 I don't know ……..…… ……5	
Q214	How many visits should a pregnant woman make to health facility before delivery?	Insert the number mentioned or write if she says 'none' or 'as many as possible'	

	SECTION 3. SEXUAL ACTIVITY, FAMILY PLANNING KNOWLEDGE AND ACCESS **READ TO PARTICIPANT: In this section I am going to ask you questions about your sex life, family planning methods, including where to get them and how they work. As I mentioned earlier, if you feel uncomfortable we can skip a question or move on to the next section.**		
Q301	**Please tell me all the family planning methods you have heard of?** **Do not read the explanation in brackets when asking the question. For methods not mentioned spontaneously, probe using the information in brackets.**		
	Methods	Mentioned spontaneously	Mentioned by probing
A	**IUD** (Women can have a loop or coil placed inside them by a health provider)	Yes ..... 1 No 2	Yes ..... 1 No 2
B	**Male condom** (Men can put a rubber sheath on their penis before sexual intercourse	Yes ..... 1 No 2	Yes ..... 1 No 2
C	**Female condom** (Women can place a sheath in their vagina before sexual intercourse)	Yes ..... 1 No 2	Yes ..... 1 No 2
D	**Daily pill** (Women can take a pill every day to avoid becoming pregnant)	Yes ..... 1 No 2	Yes ..... 1 No 2
E	**Implant** (Women can have a small rod placed in their upper arm by a health provider, which can prevent pregnancy for one to three years)	Yes ..... 1 No 2	Yes ..... 1 No 2
F	**Injectable or injections** (Women can have an injection by a health provider that stops them for becoming pregnant for one or more months)	Yes ..... 1 No 2	Yes ..... 1 No 2
G	**Emergency contraception/morning after pill** (Women can take pills up to five days after sexual intercourse to avoid becoming pregnant)	Yes ..... 1 No 2	Yes ..... 1 No 2
K	**Standard days/safe days'/cycle beads** (Every month that a woman is sexually active she can avoid pregnancy by not having sexual intercourse on the days of	Yes ..... 1 No 2	Yes ..... 1 No 2

	the months she is most likely to get pregnant)		
L	**Withdrawal** (Men can be careful and pull out before ejaculation)	Yes ..... 1 No 2	Yes ..... 1 No 2
M	**Other (Specify) 1** _____ _____ _____ _____	Yes ..... 1 No 2	Yes ..... 1 No 2
Q302	Do you know of a place where you can obtain a method of family planning?	Yes ..... 1 No 2	If 2 go to Q304
Q303	What are the places where you can obtain family planning services/methods? SELECT ALL THAT APPLY	Government hospital ..... 1 Private hospital ..... 2 Pharmacy/chemist ..... 3 Mobile clinic (outreaches)..... 4 Community-based distributor ..... 5 Shop/ supermarkets ..... 6 Friend/relative..... 8 Other(specify)..... 9	
Q304	I will now read the list of family planning methods, please tell me which one you think is the most effective in preventing pregnancy?	IUD ..... 1 Male condom ..... 2 Female condom ..... 3 Daily pill ..... 4 Implant..... 5	

	TICK ONLY ONE ANSWER	Injectable or injections .....6 Emergency contraception .....7 Standard days/safe days.....8 Withdrawal .....9 Don't know.....10 Other(specify).....98	
Q305	**Now I will read you some statements about family planning methods and infections that may be transmitted by having sex. As I read each statement, please tell me if you agree or disagree.**		
Q305 a	Some family planning methods can cause women to become infertile	Agree .....1 Disagree.....2 Don't know.....3	
Q305 b	Using a condom can protect you from sexually transmitted infections	Agree .....1 Disagree.....2 Don't know.....3	
Q305 c	Condom use reduces sexual satisfaction	Agree .....1 Disagree.....2 Don't know.....3	
Q305 d	A person can be infected with HIV even if he/she looks healthy	Agree .....1 Disagree.....2 Don't know.....3	

READ TO PARTICIPANT: Now I would like to ask some questions about your sexual activity. Please be assured that your responses are absolutely confidential. If any question makes you uncomfortable, please let me know and we shall move to the next question.

Q306	How old were you when you first had sexual intercourse?	AGE IN YEARS	
Q307	When was the last time you had sexual intercourse? **IF LESS THAN YEAR, RECORD THE NUMBER OF DAYS, WEEKS OR MONTHS MENTIONED.**	DAYS AGO . . . . . . WEEKS AGO . . . . MONTHS AGO	

		YEARS AGO . . . . ☐☐	
Q308	In total, with how many different people have you had sexual intercourse in your lifetime? **IF NON-NUMERIC ANSWER, PROBE TO GET AN ESTIMATE.**	Number of partners in lifetime . . .... ☐☐ Don't know . . . . …….98	
Q309	Was this pregnancy planned? (Probe if the pregnancy was intended or not)	Yes ……. …….1 No ……. ……2 Not sure ……. ……..3	If 1, go to Q311
Q310	If not planned, what was the **main** reason for not using any FP method to prevent the current pregnancy? **SELECT ONE ANSWER**	Preferred method was not available ……..…1 Didn't know where to get the FP services ……...2 I was told I was not eligible ……3 Method was too expensive ……4 My partner refused ……. ..5 I didn't know about FP then ……...6 I didn't think I could get pregnant ……7 Others, specify ……. ……..8	

Q311	After delivery, do you think you will use any family planning method?	Yes ..... 1 No ..... 2 Not sure …… …….3	If 2, go to 401
Q312	Which FP method will you consider using? **SELECT ONE RESPONSE**	IUD ..... 1 Male condom ..... 2 Female condom..... 3 Daily pill ..... 4 Implant..... 5 Injectable or injections..... 6 Emergency contraception ..... 7 Standard days/safe days..... 8 Female sterilization ……9 Withdrawal ..... 10 Undecided …… .11 Other (specify)..... 12	

SECTION 4: RESPONDENT'S CONFIDENCE IN DISCUSSING SRH ISSUES

READ TO PARTICIPANT: Now I want to ask you how confident you are that you could do certain things. As I read each statement, please tell me if you think you definitely could, probably could, probably could not or definitely could not do each of the things listed below. How confident are you that you would be able to:

Q401	Attend all the required ANC clinics	Definitely could ..... 1 Probably could ..... 2 Probably could not..... 3 Definitely could not..... 4	
Q402	Talk about pregnancy care with your boyfriend/husband/partner?	Definitely could ..... 1 Probably could ..... 2 Probably could not..... 3 Definitely could not..... 4 Do not have a partner 5	
Q403	Ask a health provider questions about your pregnancy?	Definitely could ..... 1 Probably could ..... 2 Probably could not..... 3 Definitely could not..... 4	

Q404	Ask a health provider questions about STIs/HIV and AIDS?	Definitely could .....1 Probably could .....2 Probably could not.....3 Definitely could not.....4	
Q405	Discuss pregnancy and related problems with a health provider?	Definitely could .....1 Probably could .....2 Probably could not.....3 Definitely could not.....4	
Q406	Use contraceptives in the future	Definitely could .....1 Probably could .....2 Probably could not.....3 Definitely could not.....4	
SECTION 5: ACCESS TO SRH INFORMATION AND SERVICES **Now I would like to ask you about your recent visit to health facilities**.			
Q501	In the last 3 months, were you visited by a community health volunteer who talked to you about pregnancy care?	Yes .....1 No 2	
Q502	In the last 3 months, have you visited a health facility for any health care service for yourself?	Yes .....1 No 2	If 2, go to Q504
Q503	During any of that (those) visit (s), did any staff member at the health facility also speak to you about family planning methods and pregnancy care?	Yes .....1 No 2	
Q504	How long does it usually take you to get from your house to the nearest health center/facility? If over 60 minutes, provide answer in hour and minutes	Hours ☐☐ Minutes ☐☐ Don't know …….….. 98	

I would now like to talk to you about ANC services, a clinical service that aims to provide maternal and child health information and services for expectant mothers in Kenya. For each item, please tell me whether you have been told or referred for such services.			
Q505	Have you ever been contacted by any health care provider, organizations/programme or community health agents who teach about SRH services in the last six months?	Yes……1 No …….2	
Q506	Have you ever been contacted by peer educators who teach about ANC in the last six months?	Yes……1	

		No ……..2	
Q507	Have you ever received an SMS message from anywhere on contraception and pregnancy care?	Yes……1 No ……..2	
Q508	Have you ever been told about using mobile SMS or Facebook or WhatsApp to connect to youth friendly sexual and reproductive health providers (including pregnancy care?	Yes……1 No ……..2	
Q509	If you were to receive health messages concerning pregnancy care, which one will be your preferred language?	Swahili ……1 English ……2 Both ……3 Not sure ……4 Others specify ……98	

Now, I would like to ask you a few questions on your experience and other girls your age when seeking SRH services including ANC clinics

Q510	Many different factors can prevent girls from seeking SRH services or going for antenatal care. Which ones do you agree/disagree are the factors preventing young women from seeking SRH services including ANC at the health facilities?	Yes / No	
	A. Getting permission to go	1 2	
	B. Getting money for treatment	1 2	
	C. The distance to the health facility	1 2	
	D. Having to take transport	1 2	
	E. Not wanting to go alone	1 2	
	F. Concern that there may not be female health provider	1 2	
	G. Concern that there may not be a friendly and respectful service provider	1 2	
	H. Concern that there may not be a provider	1 2	
	I. Concern that other adults can see you at the clinic	1 2	
	J. Others specify	98	

Q511	Are you planning to deliver at a health facility?	Yes ……1 No ……..2	If 2, go to Q513
Q512	If Yes, where will you prefer?	Public health facility ……1 Private health facility ……2	
Q513	If No, why?	Partner will not allow ……..1 Parents/In laws won't allow ……2 It's against our culture ……....3 Distance to health facility ……4 Transport cost ……5 Poor quality of care ……6 Previous experience was bad ……7 Other specify ……98	

SECTION 6: PARENTAL SRH SUPPORT AND RESPONDENT DECISION MAKING
I will now read statements about parental support for adolescents' sexual and reproductive health. Please tell us if you strongly agree, disagree, strongly disagree or disagree.

Q601	Parents in my community support unmarried girls using contraception	Strong agree…… 1 Agree …… 2 Neither agree nor disagree …… 3 Disagree …… 4 Strongly Disagree …… 5	

Q602	Parents in my community disapprove adolescent girls having a child before finishing high school	Strong agree…… …. 1 Agree ……..…… ……. 2 Neither agree nor disagree ……..… 3 Disagree ……. … 4 Strongly Disagree ……..… 5	
Q603	Parents in my community disapprove adolescent girls marriage before finishing high school	Strong agree…… …. 1 Agree ……..…… ……. 2 Neither agree nor disagree ……..… 3 Disagree ……. … 4 Strongly Disagree ……..… 5	
Q604	Parents in my community support expectant young girls and young mothers to attend ANC clinics	Strong agree…… …. 1 Agree ……..…… ……. 2 Neither agree nor disagree ……..… 3 Disagree ……. … 4 Strongly Disagree ……..…5	
Q605	Parents in my community support expectant young women to deliver at a health facility	Strong agree…… …. 1 Agree ……..…… ……. 2 Neither agree nor disagree ……..… 3 Disagree ……. … 4	

		Strongly Disagree ……..…5	

Q606: Now I would like to know who mostly makes decisions about the following matters in your household – you, your parents, other relatives, and whether you take part in the decision making or not. **(USE CODES)**

CODES: 1=Self 2=Partner /Husband 3=In laws 4=Parents/guardian 5=Other relatives 6=N/A

		A. CODE	**B. Do you take part in making the decision?**
A	How to spend money		Yes …….1 No …….2
B	Whether or not you work for pay		Yes …….1 No …….2
C	Whether or not you go to a hospital		Yes …….1 No …….2
D	Who decides/decided *when* you would get married		Yes …….1 No …….2
E	Who I can have as friends		Yes …….1 No …….2

END OF INTERVIEW

THANK THE PARTICPANT FOR HER TIME AND REMIND THEM THAT DATA COLLECTED IS PURLEY FOR ACADEMIC PURPOSES AND THAT CONFIDETIALITY WILL BE HIGHLY MAINTAINED.

APPENDIX 4: IN-DEPTH INTERVIEW GUIDE FOR MHEALTH – TEXT MESSAGE INTERVENTION PARTICIPANTS

IDI Identification	
Name/Initials of Facilitator	
Date of IDI *(dd/mm/yyyy)*	
Start Time *(00:00 am/pm)*	
Stop Time *(00:00 am/pm)*	
Tape Check Performed by	
Transcriber	
Transcription Date *(dd/mm/yyyy)*	

INTRODUCTION AND CONSENTING

Hello and thank you for accepting the invitation to participate in this in-depth interview (IDI). My name is _____, and I will moderate this interview.

The purpose of this IDI is to gain insights regarding your experiences while interacting with the mHealth platform as well as get your views about the relevance of the mHealth content. We shall also wish to discuss your experiences interacting with the health care providers while seeking ANC services and whether you encountered any challenges throughout the study period.

This interview will last approximately one and half hours and will be recorded so that the views collected may be documented and used during analysis. Your participation is voluntary. You are free to stop the interview at any time. If you decide to stop the interview at any time, your decision will in no way affect the services that you receive at the health facilities. Your experiences or thoughts will not be shared with anyone, and all data collected will be de-identified.

INTERVIEW GUIDE

Warm-up

Please tell me how your experience was like while interacting with the mHealth platform?

Probe: general views, whether it should be part of the ANC package?

Was there anything that you had expected from the platform but you didn't get? If any, please tell me what you expected?

Probe: if they expected particular information or any incentives

What suggestions do you have on how we can improve the mHealth platform?

Probe: what they will change to make it more appealing to expectant young women

mHealth content

What are your general views about the messages/information during the entire study period?

Probe: was the information new, useful and acceptable to them.

Tell me what you liked about the messages and why?

Tell me what you disliked about the messages and why?

Were the messages easy to understand? What was easy and/or difficult?

Is there anything you would like to change and/or add about the messages?

Probe: language used, length of the message

Do you think expectant young women will be interested to receive the messages in the future? Why?

Did you share these messages with anyone? If yes, with who and why? If no, why?

Antenatal experience

Were there any clinical and/or technical challenges that you encountered during the study period?

Probe: that which might have made her miss a clinical appointment

We have come to the end of our interview. Thank you so much for your time. Could you be having any questions, or is there anything that you would like to add or seek clarification?

Should you be having any concerns regarding the study or what we've discussed today, please call Jefferson Mwaisaka, the principal investigator on +254 723 206 132

APPENDIX 5: IN-DEPTH INTERVIEW GUIDE FOR HEALTH CARE PROVIDERS

IDI Identification	
Name/Initials of Facilitator	
Date of IDI *(dd/mm/yyyy)*	
Start Time *(00:00 am/pm)*	
Stop Time *(00:00 am/pm)*	
Tape Check Performed by	
Transcriber	
Transcription Date *(dd/mm/yyyy)*	

Introduction and consenting

Hello and thank you for accepting the invitation to participate in this in-depth interview (IDI). My name is _____, and I will moderate this interview.

The purpose of this IDI is to gain insights regarding your experiences while interacting with the mHealth platform as well as to get your views about the relevance, challenges, motivating factors and perspectives regarding mHealth-ANC integration approach. We shall also wish to discuss your experiences while interacting with expectant young women who sought ANC services at the health facility.

This interview will last approximately one and half hours and will be recorded so that the views collected may be documented and used during analysis. Your participation is voluntary. You are free to stop the interview at any time. Your experiences or thoughts will not be shared with anyone, and all data collected will be de-identified.

INTERVIEW GUIDE

A. Warm-up

1. Please tell me how your experience was like the few times you interacted with the mHealth platform?

   Probe for general views

2. Did the platform work as per your expectations? If yes, how? If no, why?

3. What suggestions do you have on how we can improve the mHealth platform?

   Probe: what they will change to make it more appealing to expectant young women

4. What are your thoughts regarding integrating mHealth within an existing ANC setting?

   Probe for barriers, challenges and motivating factors

B. mHealth content

1 What are your general views about the messages/information during the entire study period?

   Probe: was the information understood, new, useful and acceptable to expectant young women.

2 What did you like/dislike about the messages and the entire platform?

3 Is there anything you would like to change and/or add about the messages or the intervention in general?

   Probe: language used, length of the message, time of sending the messages

4 Did any intervention participant share any message with you or ask for their meaning/sought clarification?

   Probe: which messages and what the discussion was about

C. Antenatal experience

1 How would you describe your relationship with the expectant young women when they sought ANC services?

   Probe whether they were open to ask questions or they were shy

2 What do you think should be done so as to encourage expectant young women seek and adhere to their antenatal appointments?

Probe: what needs to be done at the family/community and health facility levels?

We have come to the end of our interview. Thank you so much for your time. Could you be having any questions, or is there anything that you would like to add or seek clarification?

Should you be having any concerns regarding the study or what we've discussed today, please call Jefferson Mwaisaka, the principal investigator on +254 723 206 132

APPENDIX 6: STUDY MESSAGES FOR EXPECTANT YOUNG WOMEN

Mission Motherhood® Messages for Pregnancy

Pregnancy SMS messages for Expectant Adolescents and Young Women

Month	Week	SMS Message	Swahili Version
2	6	Regular clinic visits in pregnancy help detect problems before they happen. Find out where your nearest clinic is for a healthy pregnancy.	Utembeleaji cliniki mara Kwa mara wakati wa uja uzito huwezesha kutambulika matatizo mapema. Tambua kliniki iliyo karibu kuhakikisha usalama wa uja uzito wako.
	6	Spotting or light bleeding is worrying but very common in pregnancy. If you have bleeding with pain, contact the clinic immediately.	Hutokea Sana Kutokwa na doa au damu nyepesi unapokua na ujauzito hivyo unatakiwa kutembelea kliniki mara moja unapotokwa na damu yenye maumivu.
	7	Eat well, so your baby will grow well. Try to eat some meat, eggs, bean or lentils every day and green vegetables and milk, yoghurt or soya.	Kula lishe Bora kama vile nyama,mayai, maharagwe au ndengu,maziwa,mboga kijani na maziwa ya mtindi maharagwe au soya kila siku ili kuwezesha mtoto kua vizuri.
	7	Calcium-rich foods such as milk, yoghurt and soya, will help your baby to grow strong bones. Make sure you get some every day.	Hakikisha unapata baadhi ya vyakula vyenye madini ya calcium kama vile maziwa, maziwa ya mtindi na soya kila siku ili kuwezesha mtoto kua na mifupa yenye nguvu.
2	8	Your baby is the size of a grape and his bones are developing. You may feel sick or vomit. Eat when you can and drink plenty of clean water.	Mtoto wako ni sawia na ukubwa wa zabibu na mifupa yake inakua hivyo inaeza sababisha ujihisi mgonjwa au kutapika. Kula ikiwezekana, unywe maji Safi Kwa wingi.
	8	Some medicines can harm your baby. If your friends and family suggest a medicine, check with your health worker first before taking it.	Baadhi ya madawa yanaweza kudhuru mtoto.Iwapo marafiki na familia watapendekeza dawa hakikisha umewasiliana na mhudumu wa afya kabla yakuitumia dawa hio.
	8	Plan how to get to the clinic for your first visit. Go as soon as you	Panga jinsi ya kutembelea kliniki siku yako ikifikia hata kama hujihisi vibaya. Ni vyema kwa afya yako na ya mtoto.

		can, even if you feel well. Ask your family for help to get there.	
3			
	9	Protect yourself from infections. Wash your hands with soap before you prepare meals, after using the toilet and after handling animals.	Hakikisha unanawa mikono yako Kwa kutumia sabuni kabla yakuandaa vyakula,baada ya kutoka msalani na baada ya kushughulikia mifugo ili ku zuia maambukizi.
	9	Bad or stale food can make you ill. Make sure that all your food is fresh. Cook fresh meals every day. Store food in a cool, dry place.	Hakikisha vyakula vyote ni safi.chakula kibaya kinaweza kukudhuru.Pika vyakula Safi kila siku,hifadhi mahali penye baridi na pakavu.
3	10	Your baby is now the size of a date. Arrange to go the clinic for a check-up and for your iron and folic acid pills. Take these each day.	Mtoto wako anaendelea kukua, usikose kutembelea kliniki kujiangalia na kuchukua dawa za madini ya iron na follic acid.Meza kila siku.
	10	Giving birth puts you and your baby at risk of tetanus. The Tetanus vaccine can protect you both. Ask your health worker about it.	Unapojifungua unakua katika hatari ya maambukizi ya ugonjwa wa Pepo punda, chanjo ya ugonjwa huo itawalinda nyote. Ulizia mhudumu wa kituo cha afya.
	10	Iodine helps your baby's brain develop. Salt often has iodine added to it. Ask at the clinic where you can buy iodised salt.	Chumvi hua na madini ya iodine husaidia kukuza ubongo wa mtoto wako. Ulizia kliniki mahali unaeza nunua chumvi hizo.
	10	Keep in touch with family and friends. Being surrounded by people who love you and care about you will make you feel happier.	Ni Bora zaidi kuwa karibu na wanao kupenda na kukujali, itakupa furaha zaidi. Boresha mawasiliano na jamaa na marafiki zako.
3	11	You may be feeling less sick about now. Your baby is the size of your thumb and is protected by the water he floats in, inside your womb.	Mtoto anandelea kukua na analindwa na maji yanayo elea ndani ya tumbo lako. Ukiskia kisunzi, keti hadi kitulie

	11	At the clinic, a blood test will check your iron levels. You will also be offered an ultrasound scan and a test for HIV and syphilis.	Utapimwa damu kuona kiwango chako cha iron, virusi vya ukimwi,kaswende na kufanyiwa scan katika kliniki.
	11	Feeling dizzy? Sit down, eat and drink something, until you feel better. Get up slowly. Try to eat little and often.	Unapohisi kisunzi keti chini, kula na kunywa kitu hadi utakapojihisi vizuri, jiinue polepole.Jaribu kula kidogo kidogo mara kwa mara.
	11	You need to eat well. Make sure you have some oily fish, nuts, seeds, eggs and chicken whenever you can.	Unafaa kula vizuri. Hakikisha unapata samaki,mbegu,karanga na kuku pale unapoweza.
3	12	Drinking alcohol is bad for you and your baby. It could make your baby weak and ill. Don't drink in pregnancy.	Unywaji pombe ni vibaya kwako na kwa mtoto wako.Inaweza kufanya mtoto kua dhaifu na mgonjwa.usinywe unapokua na uja uzito.
	12	If you have a fever, or start shaking and feeling sick, go to the clinic. A fever can affect your baby as well as you, and needs treating.	Ukiwa na mwili moto au kutetemeka na kujihisi mgonjwa tembelea kliniki. mwili joto unaweza kuhatarisha maisha yako nayale ya mtoto,inahitaji matibabu.
	12	Drink plenty of clean water throughout the day. It can help wash away germs in your body. If you have pain urinating, go to the clinic.	Kunywa maji safi ya kutosha kila siku, husaidia kusafisha mwili wako. Iwapo unahisi uchungu unapokojoa tembelea kliniki.
	12	Gently massage your growing stomach. It is safe to do so now. It's also a great way to relax and wind down.	Ni salama kukanda tumbo lako polepole kwa wakati huu,na pia husaidia kujihisi vizuri.
3	13	Your baby is as big as half a banana! She is growing sucking muscles in her mouth. Get deworming pills at the clinic to keep your blood healthy.	Mtoto wako anatoshana na ukubwa wa nusu ya ndizi,amekua akimumunya mdomo wake.pata dawa ya minyoo kliniki,kusafisha damu yako.
	13	Take your iron pills every day, even if you	Meza tembe za iron kila siku hata kama umechoka au kupata choo kigumu. Unaweza kuona mstari

		feel tired or constipated. You may see a dark line on your stomach. This will fade after birth.	mweusi kwa tumbo lako. Utapotea utakapojifungua.
	13	Smoking harms you and your baby. If you smoke, your baby could be born weak and catch infections easily. Stop smoking and avoid smoky places.	Usivute sigara wala kukaa maeneo ya wavutaji sigara.Ni hatari kwa afya yako naile ya mtoto,huenda akazaliwa akiwa mdhaifu na mrahisi wa kuambukizwa magonjwa.
4	14	Your baby is growing hair, and he can also grasp, frown and even suck his thumb! Try to eat an extra mouthful of food at each meal and extra snacks.	Jaribu kula chakula Zaidi,wakati huu mtoto hua ameanza kumea nywele,kushika vitu na hata kunyonya kidole chake.
	14	Many women begin to feel less sick now and get hungry instead. Eat fruit, vegetables, and meat or lentils, peas, and beans.	Wanawake wengi huanza kuhisi ugonjwa kiasi sasa na badala yake kuhisi njaa. Kula matunda,mboga na nyama au dengu,mbaazi na maharagwe.
	14	It's very common for pregnant women to crave non-foods such as soil. Some non-foods can harm your baby. Talk to a health worker about it.	Ni kawaida kwa wanawake wengi wajawazito kupenda kula vitu visivyo vyakula kama vile udongo. vyengine huleta madhara kwa mtoto. Ongea na mhudumu wa afya.
4	15	Inside you, your baby will just fit in the palm of your hand. He even has tiny fingernails and eye lashes.	Mtoto anaweza toshea kwa kiganja cha mkono wako na pia hua na kucha ndogo na kope ndogo.
	15	Drinking alcohol can harm your baby. It can affect her growth. It's best not to have any alcohol. Drink plenty of clean water.	Ni vyema Kunywa maji safi yakutosha na kukosa kunywa pombe. Unywaji pombe unaweza ukadhuru mtoto wako. Inaweza kuathiri ukuaji wa mtoto.
	15	Open windows if your house is very smoky. Try to give up smoking while you are pregnant, as it can harm your baby.	Fungua madisrisha moshi unapozidi. Jaribu kuachana na uvutaji sigara unapokua na ujauzito.Unaweza ukadhuru afya ya mtoto.
	15	If you're not getting enough exercise, try to go for a walk every day. It is good for your	Iwapo hupati mazoezi ya kutosha, jaribu kutembea kila siku. Nivizuri kwa afya ya mwili na pia hukufanya kua mchangamfu.

		body and it can also improve your mood!	
	16	Your baby is now the size of a pear. He may have found his first toy - the umbilical cord! After the birth, keep the cord stump clean.	Mtoto wako anatoshana na peari. Anaeza kua ashagundua sesere yake ya kwanza-kitovu. Weka Kamba ya kitovu safi baada ya kujifungua.
	16	Mosquitoes can cause illnesses like malaria. Always sleep under an insecticide-treated net to prevent mosquitoes from biting you.	Mbu husababisha malaria,Hakikisha unalala ndani ya neti iliotibiwa kujichunga dhidi ya ugonjwa wa malaria.
	16	Iron pills help you stay well for your baby. Taking them will not make bleeding worse during birth. Get them for free at the clinic.	Pata vidonge vya ion bure katika kliniki. Kunywa vidonge hivyo kila siku; husaidia kuishi vizuri.
	16	Your bump is beginning to show. Take some time every day to remind yourself that you're becoming more beautiful every day!	Tumbo limeanza kuonekana. Chukua mda wako kujikumbusha jinsi unavyozidi kurembeka kila siku.
4			
	17	Keeping clean helps protect you and your baby from infections. Wash your hands with soap after the toilet and before meals.	Kuzingatia usafi husaidia kujikinga kutokana na magonjwa yanayoatharisha afya yako na mtoto. Nawa mikono na sabuni kabla ya kula na baada ya kutoka masalani.
	17	You may need extra money during pregnancy, for travel to the clinic and for when your baby arrives. Start saving a little bit every day.	Weka pesa kidogo kila siku za akiba, ili kushughulikia mtoto anapozaliwa na pia unapotaka kuenda kliniki.
5	18	Your baby is twice the size he was last week. He's moving more and you will feel him soon. He can hear your heartbeat now.	Mtoto wako ana ukubwa wa mara mbili ya alivyokua wiki jana. ameanza kuzunguka Zaidi, utamhisi karibuni. Ameanza kuhisi mpigo wa moyo wako.
	18	Tired with headaches and dizziness? You may need iron. Remember to take your	Kila siku kumbuka kumeza tembe za iron na asidi ya folic, ili kuzuia kupata uchovu na maumivu ya kichwa. Pata zengine kutoka kwa kliniki.

		daily iron and folic acid pills. Get more from the clinic.	
	18	It is common to have backache in pregnancy. Lift heavy things carefully. Divide loads evenly between both hands. Ask your partner for help.	Unapokua mjamzito ni kawaida kuumwa na mgongo. Beba vitu vizito kwa makini, gawa mizigo kwa usawa mikono yote miwili. Omba usaidizi kwa familia.
	18	If something makes you upset, talk about it. Sharing your feelings with someone you trust can help. You can speak to a health worker too.	Iwapo kuna kitu kinakukwaza. i bora ukikiongelea. Utakapomueleza mtu unayemuamini ama mhudumu wa afya utasaisaidika.
5	19	Your baby has all her major organs now - the heart, liver and kidneys. She's even started developing taste buds on her tongue!	Mtoto ana viungo vyote muhimu sasa- moyo, ini na figo. Ameanza kuhisi ladha kwenye mdomo. Usikose kutembelea kliniki siku yako ikifika
	19	Ask about your blood group at the clinic. Check if relatives have the same blood group. Ask them if they will donate blood if you need it.	Uliza kuhusu aina ya damu yako na uulize familia na jamaa yako kama damu zao ni aina moja na yako na kama wataweza kusaidia unapohitaji damu.
	19	Make a plan with your family to put your new baby to the breast in the first hour. Your creamy first milk will protect him from illness.	Maziwa ya kwanza ya mama ni mazuri zaidi, yanakinga mtoto dhidi ya kupata magonjwa. Hakikisha ananyonya kati ya saa moja anapozaliwa.
	19	Do something enjoyable every day. A gentle walk with your friends or your partner will help you relax and remain healthy for your baby.	Fanya jambo la furaha kila siku itasaidia kuhisi mtulivu na kua mwenye afya kwa mtoto wako. Kutembea na mpenzi wako au rafiki.
5	20	You're halfway through pregnancy! Your baby floats in fluid. This keeps him warm and protected. You may see	Wakati huu uko katikati ya safari ya Kujifungua, mtoto huelea kwa maji ya uzazi ambayo humpa joto na kumkinga. Unaweza ona hivo ukienda kufanyiwa scan.

		him at your scan. Get it soon.	
	20	You'll start feeling your baby kicking soon. Take time every day to feel him move. Tell your health worker of any changes.	Mtoto ataanza kucheza, kila siku jaribu kuskiza anavyocheza. Iwapo kuna mabadiliko yeyote ongea na muuguzi wa afya kliniki
	20	Feeling out of breath when you walk? Your womb is squashing your lungs now. Go to the clinic if you find you are breathless all the time.	Enda kliniki iwapo unapatashida ya kupumua vizuri kila wakati unapotembea. Maana kizazi chako hua kimeanza kufinya mapafu yako.
	20	This might sound strange, but your baby can hear you talk. Talk to her every day. She will recognise your voice when she is born.	Jaribu kumuongelesha mtoto kila siku hivyo basi unapojifungua atakumbuka sauti yako.
5	21	Your baby can hear your heartbeat and other noises from inside your body. He can hear your voice as well, so talk and sing to him.	Jaribu kumuongelesha na kumuimbia mtoto maana huskia suati yako, sauti ya mdundo wa moyo wako na sauti zingine kwa mwili wako.
	21	Wash your hands with soap and water to help prevent infections. Wash them after handling animals, using the latrine and before cooking.	Hakikisha unaosha mikono yako kwa sabuni na maji baada ya kushika wanyama, kutumia choo na kabla ya kupika, ili kusaidia kutosabaza ugonjwa.
	21	Go to the clinic if you have a fever, vomiting, bleeding or pain when you pass urine. Make sure your family know these signs, too.	Hakikisha unaenda kliniki unapojihisi mwenye homa, unatapika, kuvuja damu au maumivu unapokojoa. Familia yako inapaswa kujua dalili hizi.
6	22	Your baby can turn over as well as kick. This is a good sign. Tell your health worker if you notice your baby moving much less than usual.	Unaweza kuhisi mtoto anajigeuza au kurusha mateke na hio hua ishara nzuri. Kama utahisi mtoto hafanyi hivyo kama kawaida yake basi mweleze muhudumu wa afya.
	22	As your baby grows inside you, he will need more food. Slowly increase the amount of	Ongeza polepole kiwango cha chakula unachokula maana mtoto anapokua tumboni atahitaji chakula zaidi na tumbo huendelea kua kubwa.

		food you eat as your stomach grows.	
	22	Growing a baby can make you feel very tired. Get as much rest as you can. Ask your family to help with shopping, cooking and cleaning.	Ulezi Unaweza kufanya uhisi uchovu. Hakikisha unapata usaidizi wa kupika, kufanya usafi na kuenda dukani kutoka kwa familia ili upate nasafi ya kupumzika.
	22	Try to relax and have a warm drink before bed. This might help you sleep better and feel less tired during the day.	Kabla ulale jitahidi unywe maji vuguvugu. Husaidia kupata usingizi vizuri na kua mchangamfu siku itakayofuata.
6	23	Your baby now has definite times of sleeping and waking. He may wake you with his kicks. Go to the clinic if the kicks slow down or stop.	Mtoto hua na masaa yake ya kulala na kuamka, huweza kuamsha kwa kukugonga. Hakikisha unaenda kliniki anapopunguza au kuacha kufanya hivyo.
	23	If a family member has TB, they need treatment at the clinic. It will help protect you against TB too. You need to be healthy for your baby.	Ni muhimu uwe na afya bora kwa ajili ya mtoto. Hakikisha mtu yeyote wa familia kama anaugua w kifua kikuu, anapata matibabu kuzuilia usipatwe na ugonjwa huo.
	23	The area around your nipples may become darker and your breasts may feel heavier now. Your body is preparing to breastfeed your baby.	Maeneo karibu na chuchu zako huweza kuanza kua nyeusi na matiti kuhisi ni mazito. Mwili wako unajitayarisha kuanza kunyoyesha.
6	24	Your baby's sense of taste is developing, ready to enjoy your milk! Your breastmilk will make your baby grow strong. It's the perfect food.	Ladha ya mtoto wako inabadilika tayari kufurahiaa maziwa yako. Maziwa yako ndio chakula bora na yatamsaidia mtoto kukuwa.
	24	Your first milk is best for your baby. Let your partner know you want to breastfeed your baby within the first hour. He can support you.	kumnyonyesha mtoto kwa mara ya kwanza ni muhimu sana, hakikisha uamueleza mwenzako kuwa unahitaji kunyonyesha mtoto kwa lisaa moja.kwa ushirikiano zaidi.
	24	As your baby grows, taking up more room in the womb, you may find it hard to eat big	Mtoto anapoendelea kukua unaweza shindwa kula chakula kingi, hakikisha unakula mara kwa mara.

		meals. Eat little and often to get enough food.	
6	25	Your baby is gaining fat. This fat will help keep him warm when he is born. You can help him by eating a few extra mouthfuls at each meal.	Mtoto wako anahitaji mafuta mwili ili kumpa joto anapozaliwa. Unaweza kumsaida kwa kuongeza maji yako.
	25	Your growing baby needs plenty of iron. Try to eat meat, lentils, beans or chickpeas every day, and take your iron pill.	Mtoto wako anaitaji ayani, ulaji wa nyama, lenti , maharagwe na dengu huongeza ayani mwilini.hakikisha unameza tembe zako za ayani.
	25	A burning sensation at the top of your stomach is heartburn. Spicy and oily foods can make it worse. A glass of milk may help soothe it.	Epuka vyakula vilivyo na viungo na mafuta ili kuepukaa kiungulia. Unywaji wa maziwa hupunguza kiungulia.
	25	It is healthy to put on weight in pregnancy. Your body needs to change to grow your lovely baby. Be proud of yourself, mother!	Kuongeza kilo wakati wa ujauzito ni afya, mwili wako unahitaji kukua ili kukuza mtoto aliye na afya. Jivunie kuwa mama.
6			
	26	Complications sometimes occur when giving birth. It's best to try and have your baby at a clinic; that way there'll be help at hand.	Shida hutokea wakati wa kujifungua, ni vyema kujifungulia kwenye cliniki ili kupata msaada wa haraka.
	26	It's time for your next clinic visit. Get more iron and folic-acid tablets. If the clinic is out of stock, ask when to go back for them.	Ni wakati wako wa kutembelea kituo cha afya hakikisha unapewa tembe za iron na folic. Iwapo zimeisha uliza ni lini unaweza kuzipata.
7	27	Babies dream at this stage in pregnancy. Perhaps he's dreaming about being born! If he's not as active as usual, tell your health worker.	Kipindi hiki cha ujazito watoto huota, hakikisha unamueleza mhudumu wako wa afya endapo mtoto hachezi kama kawaida.
	27	Calcium helps your baby's bones and teeth grow strong. Drink milk and eat dried figs,	Kalsiamu husuadia kukua kwa mifupa na meno ya mtoto wako, ulaji wa maharagwe, mboga na kunywa maziwa husaidia kuongeza kalsiamu mwilini.

		beans or vegetables to get plenty of calcium.	
	27	Slightly swollen hands and feet are common in pregnancy. But if you have sudden swelling and headaches, go to the clinic.	Uvimbe kiasi wa miguu na mikono ni kawaida wakati wa ujauzito. Inapofura ghafla na kupata maumivu ya kichwa ,tembelea kituo cha afya.
	27	Spend some time with other people who have a little baby. You can talk about birth and babies and get plenty of tips on how to cope.	Tumiaa muda wako na watu walio na watoto, mnaweza kuzungumza kuhusu watoto
7	28	Your baby responds to change - she may move when you undress! Feel thirsty and need to urinate a lot? Tell clinic staff, it may be diabetes.	Mtoto wako hugundua mabadiliko haraka hasa unapo badilisha nguo. Unapohisi kiu na mkojo kila mara eleza mhudumu wa afya ili kubaini kama ni ugonjwa wa sukari.
	28	Drink plenty of water and eat fruit to keep your stools soft. If you have itching around the anus, wash the area after you open your bowels.	Kunywa maji mengi na kula matunda ili kua na afya nzuri.
7			
	29	Eat two extra mouthfuls of food at each meal and a healthy snack between meals. Eat something extra before you go to bed, too.	Kula chakula zaidi na kupata vitafunio mara kwa mara kabla ya kulala.
	29	If you need a blood transfusion, your friends & family can donate. Ask them to find out if their blood group matches yours.	Iwapo utahitaji kuongezwa damu, marafiki na familia yako wanaweza kutolea damu. Wsihi wajue aina ya damu zao kama inafanana na yako.
	29	Most couples argue sometimes. But it is never acceptable for your partner to use violence. If he does, speak to someone you trust.	Wapenzi hukosana, ila sio sawa kupigana. Basi ikitokea hivyo hakikisha unaongea na mtu unayemuamini kwa ushauri.

7	30	Your baby can open and close his eyes. Inside your womb, he can tell day from night by the way the light changes.	Mtoto wako akona uwezo wa kufungua na kufungua macho akiwa tumboni. Anaweza kubaini mchana na usiku kwa kutofautisha aina ya mianga.
	30	It's time for your next clinic visit. Make plans to put your baby to the breast as soon as he is born. Do not give honey or anything else.	Ni wakati wa kutembelea kliniki, panga mikakati ya kunyonyesha mtoto wako anapozaliwa bila kumpa asali wala kitu kingine mile.
	30	Give birth in a clinic. If it is far away, stay with a friend close to the clinic 2-3 weeks before your due date so you can be on time.	Jifungulie hospitali, iwapo iko mbali kaa na jamaa walio karibu na hospitali wiki 2-3 kabla ya siku yako ya kujifungua ili usichelewe.
8			
	31	Have a trained birth attendant present during birth. She will know how to deliver the placenta safely and can stop you bleeding too much.	Kuwa na mkunga aliye na ujuzi wakati wa kujifungua. Atajua jinsi ya kuutoa mji wa mtoto salama na kusitisha kuvuja kwa damu.
	31	Have you felt your belly tighten suddenly, then relax? This was a practice contraction. Your body is getting ready for labour.	Usihofu unapohisi tumbo lako ni gumu. Ni ishara mwili unajitayarisha kwa kujifungua. Hongera na furahia kua mama
	31	Worried about the future? Talk to your family about what you wish for this baby. Remember you are the perfect mother for your baby	Unapohofu kuhusu maisha ya badae, ongea na familia kuhusu matamanio na mtoto wako na ukumbuke wewe ndio mamabora zaidi.
8	32	Your baby is getting plump! This body fat will keep him warm when he is born. Have 2 cloths ready. One to dry him and one to wrap him in.	Mtoto wako anakuwa, mafuta mafuta yatamsaidia kupata joto mwilini anapozaliwa.tayarisha nguo mbili, moja ya kumfuta na moja ya kumfunika.
	32	Have a hat or small cloth ready to cover your new baby's head. Babies lose lots of heat from their heads. Hold	Kuwa na kofia au nguo ndogo utakayotumiaa kumfunikia mtoto wako kichwani anapozaliwa, watoto hupoteza joto mwilini kupitia kichwa.mueke karibu yako.

		him close to keep him warm.	
	32	It's time for your next clinic visit. Make plans to put your baby to the breast as soon as he is born. Do not give honey or anything else.	Usikose kutembelea kliniki kwa wakati. Panga mikakati ya kujifungulia hospitalini na kunyonyesha mtoto anapozaliwa. Usimpe kitu kingine.
8	33	Your baby may settle head down now, the best position to be born! You may find it harder to walk. It's time to slow down.	Mtoto wako anapopindua kichwa chini, yukoo tayari kwa kuzaliwa. Tembea pole pole kwani unaweza kulemeewa na mwendo. Pana mikakati ya kujifungulia hospitalini
	33	If the bag of waters your baby is in breaks, go to the clinic. Your baby is at risk of infection. It may be a trickle or a gush.	Iwapo mfuko utapasuka na maji kumwagika tembelea kituo cha afya kwa haraka maana mtoto wako yuko katika hatari ya kupata maambukizi.
	33	Leg cramps may wake you up at night. Stretch your leg, walk around and stand on something cold to ease the cramps.	Iwapo utapa maumivu ya mguu, nyoosha miguu yako ama utembee ama usimame ,pia unaeza kukanyaga kitu kilicho baridi ili kupunguza maumivu.
8	34	A baby born early needs extra care and warmth. If he is too weak to breastfeed, give him expressed milk. Clinic staff can show you how.	Mtoto anapozaliwa mapema anahitaji joto mwilini na matunzo zaidi, iwapo hataweza kunyonya mpatie maziwa yaliokamuliwa. wahudumu wa afya watakuonyesha jinsi ya kufanya hivyo.
	34	Sudden swelling of hands, face and feet is a sign of a problem. Tell your family, and ask them to take you to the clinic if they see this.	Kuvimba kwa mikono,uso na miguu ni dalili mbaya,elezea familia waweze kukupeleka kituo cha afya,unapopatwa na dalili hizi.
	34	Your baby will drop lower now ready to be born. You will breathe more easily, but may also have to urinate more frequently.	Mtoto wako atateremka chini kidogo tayari kwa kuzaliwa; wanawake wengi huenda haja ndogo mara kwa mara. Usikose kutembelea kliniki na pia panga kujifungulia hospitalini.
8	35	Your body is designed to give birth. It will stretch and open with each contraction in labour, making space for your baby to be born.	Mwili wako una maumbile ya kupanuka na kufunguka kila uchungu unapokuja ili kukuwezesha kutengeneza njia ya mtoto kuzaliwa.

	35	Breastfeeding is the best way. It is safe, prevents illness, and helps your baby grow strong. Let your baby suckle whenever he wants.	Unyonyeshaji wa mtoto ndio njia bora Zaidi na salama hukinga magonjwa na husaidia mtoto kuwa na afya. Nyonyesha mtoto wako wakati wowote.
	35	Sometimes an operation is the safest way to have your baby. Choose a clinic where you trust the staff just in case you need an operation.	Mara nyengine njia ya upasuaji huwa bora Zaidi.chagua kliniki unayoamini wahudumu wake iwapo utafanyiwa upasuaji.
	35	Your body helps your baby grow inside you. Once he is born you can help him grow and develop by giving him your love and attention	Mwili wako humsaidia mtoto kukuwa anapokuwa tumboni. Upendo wako husaidia kumkuza pindi anapozaliwa.
9	36	Your newborn baby will need help to stay warm when he's born. Have some cloths ready to wrap and dry him with, and hold him close to you.	Mtoto wako atahitaji usaidizi ili kupata joto anapozaliwa,hakikisha uko na nguo tayari kumfinikia na kumfutia alafu mbebe karibu nawe.
	36	To cut the cord, you need a new razor blade or sterile knife and two pieces of string about the length of your hand. Get these ready now.	Utahitaji kuwa na wembe mpya, kisu kilichosafishwa na nyuzi mbili zilizo na urefu wa mkono wako ili kukata kitovu.
	36	You may need to continue taking iron pills for 3 months after your baby's birth. Go to the clinic for your next checkup and your iron pills.	Utahitajika kuendelea kumeza tembe zenye madini ya iron kwa muda wa miezi mitatu baada ya Kujifungua. Tembelea kiliniki kwa uchunguzi na kupata vidonge vya iron.
	36	Talk to your partner about helping you care for the baby. It will help him feel more involved, and help your baby develop	Shirikiana na mwenzako jinsi ya kusaidiana na malezi ya mtoto,ili kumhusisha na pia husaidia kukuza mtoto.
	37	Don't bathe your baby for the first 6 hours of her life. Keep her well	Usimuoshe mtoto kwa masaa sita baada ya kuzaliwa, hakikisha unamfunika vizuri hadi kichwani. kitovu kitaachana baada ya wiki moja.

		wrapped up and her head covered. The cord will drop off after a week.	
	37	Communication is important in every relationship. If something your partner does upsets you, talk to him so he knows how you feel.	Mawasiliano ni muhimu katika kila uhusiano,iwapo mwenzako atafanya jambo la kukuudhi mwambie ajue unavyohisi.
9	38	Your baby is curled up inside you all ready to be born. Talk to your health worker about the vaccinations your baby needs when she is born.	Mtoto wako ameshaumbika tayari kwa kuzaliwa,wasiliana na mhudumu wa afya kuhusu chanjo anazostahili kupewa atakapozaliwa.
	38	A jelly-like substance on your underwear is a sign that labour will start soon. If you have bleeding like a period, go to the clinic.	Unapoanza kupata ute kwenye suruali yako hiyo ni dalili ya uchungu kuanza wakati wowote. Iwapo utavuja damu kama hedhi tembelea kliniki.
	38	Low back pain is a sign that the baby is low down, ready to get born. Make sure you can get to the clinic in time.	Maumivu ya kiuno ni dalili ya kuwa mtoto ameteremka tayari kwa kuzaliwa. Hakikisha unafika kliniki kwa wakati unaofaa.
9	39	It is natural to worry with the birth so close, but you don't have to do it alone. Talk to your health worker, she can guide you.	Ni kawaida kupata wasiwasi unapokaribia kujifungua, unaweza kuzungumza na wahudumu wako wa afya ili wakufahamishe Zaidi.
	39	Your baby needs nothing else apart from breastmilk for the first 6 months. Your milk will contain all the water and goodness he needs.	Mtoto wako anahitaji maziwa ya mama pekee kwa muda wa miezi sita,maziwa hayo yana maji na virutubisho ambavyo mtoto anahitaji.
	39	Your baby will need the first dose of vaccines against polio and TB at birth. Make sure you baby gets them as soon as he is born.	Hakikisha mtoto wako anapewa dozi ya kwanza ya chanjo ya polio na kifua kikuu pindi tu anapozaliwa.

9	40	Your baby can hear, see, and suck. He is snug and warm curled up inside you. He is ready to be born and will be able to feed straight away.	Mtoto wako ashajigeuza juu chini na anaweza kusikia, kuona na kunyonya. Tayari kuzaliwa na anauwezo wa kula.
	40	Life turns upside down when a baby arrives. So take your time today simply to do something you love. Enjoy it!	Maisha hubadilika pindi mtoto anapozaliwa hakikisha unachukua muda wako kufanya kitu unachokipenda na kufurahia.
9	41	Like you, your baby is waiting for labour. You do this together! Make sure you have everything ready for labour.	Unaposubiri subiri kujifungua hakikisha umetayarisha kila kitu kinachohitajika.
	41	After birth, you will bleed like a heavy period, so be prepared. Change pads every 4-6 hours. Don't insert anything into your vagina.	Baada ya kujifungua utapata mvujo wa damu kama hedhi. Hakikisha unabadilisha sodo yako baada ya masaa manne hadi sita. Usiingize chochote.
	41	Breastfeeding helps to reduce your bleeding after birth. Go to the clinic if your bleeding becomes heavy, clotted, smelly or you feel faint.	Kunyonyesha hupunguza kuvuja kwa damu baada ya kujifungua. Tembelea kliniki pindi damu inapoongezeka au kutokwa kwa madonge, kutoa harufu au unapohisi kusunzi.
	41	After birth, your body will need time to heal. Plan to get plenty of rest and eat well. Ask your family for support. Mothers need nurturing!	Baada ya kujifungua mwili wako huhitaji muda kupona,hakikisha una pumzika yakutosha, kula vizuri, zungumza na familia yako kuhusu kushirikiana Wazazi wanahitaji kukuzwa.
9	42	If your baby is still not here by next week, visit the clinic. Make sure you can get to the clinic when labour does start.	Hakikisha unauwezo wa kufika kliniki pindi tu uchungu unapoanza.Iwapo hujajifungua kufikia wiki ijayo,tembelea kliniki.
	42	Regular, strong contractions are a sign of labour. If you feel	Maumivu ya tumbo ya mara kwa mara ni dalili ya uchungu. Fika cliniki au kuita mkunga pindi unapohisi hivyo.

		them, go to the clinic or fetch your birth attendant. Don't wait.	
	42	Your baby will feel hungry often as she has a small stomach. Breastfeed her every 2-3 hours even at night. Wake her up if she's asleep.	Mtoto wako atahisi njaa mara kwa mara sababu bado tumbo lake ni dogo, hakikisha unamnyonyesha baada ya masaa mawili au matatu usiku pia, muamshe hata kama amelala.
	42	By now, you may be fed up. So, put your feet up and enjoy the remarkable work you've done: grown a whole new person!	Kufikia sasa utakuwa umechoshwa. Weka miguu juu na ifurahie kazi nzuri ulioifanya. Kukuza mtoto.

APPENDIX 7: STUDY MESSAGES FOR HOUSEHOLD MEMBERS

Mission Motherhood® Messages for Household Members, Pregnancy

SMS Messages for Pregnancy

Month	Week No.	SMS Message	Swahili version
2	5	Congratulations, there's a baby on the way! You can help the mother make sure her baby is healthy. Encourage her to visit the clinic often.	Hongera, mtoto yuko karibu! Unaeza msaidia mama mtoto kuhakikisha mtoto wake ana afya bora. Mhimize kutembelea kliniki mara kwa mara.
2	6	Remind the mother to take iron and folic-acid pills every day. She can get them free at the clinic. A healthy mother grows a healthy	Mama mwenye afya hukuza mtoto Mwenye afya bora. Mkumbushe mama Kunywa vidonge vyenye madini ion na folic-acid kila siku.Anaweza kupata bure katika kliniki.
2	7	Check the mother eats meat, beans, fruits and vegetables daily. She needs iodised salt, too. Eating well will help her have a healthy baby.	Hakikisha mama anakula nyama, maharagwe, matunda na mboga kila siku. Anahitaji chumvi iliyo na madini yaliyo na iodine pia. Kula vizuri kutamwezesha kua na mtoto mwenye afya.
2	7	Your partner may be tired, nauseous and feeling unwell This is common in early pregnancy. Support her and let her share any worries with you.	Mwenzako anaeza akawa amechoka, kujihisi kichefuchefu na kutojihisi vyema, hii ni kawaida kwa mimba ya mapema. Msaidie na mwezeshe kuzieleza shida zake kwako.
2	8	Help your partner so she can rest. Take on a few extra chores like washing the dishes. Raising a child is teamwork after all.	Msaidie mwenzako ili aweze kupumzika. Chukua majukumu Zaidi kama kuosha vyombo. Kukuza mtoto ni kazi inayohitaji umoja hata hivyo.
3	9	Mosquitoes cause illnesses like malaria. Make sure the mother sleeps under an insecticide-treated bednet to prevent mosquito bites.	Umbu husababisha magonjwa kama vile malaria,hakikisha mama analala ndani ya neti iliyotibiwa ili kujikinga kutoumwa na umbu.
3	10	Make sure the mother goes to the clinic for a check-up this week. Staff will do tests to check if she is well. She can go with a friend.	Hakikisha mama anaenda cliniki kuangaliwa wiki hii. Wahudumu watampima iwapo yuko sawa. Anaweza kuandamana na rafiki.
3	10	Pregnancy can make your partner's moods go up and down now. Try not to take it personally. Just being there for her will make her happy.	Ujauzito unaweza kufanya mwenzako kua na mihemko/hali tofauti tofauti, jaribu usiichukulie kwa ubinafsi. Kua na ukaribu nae itamfurahisha.

3	11	Make sure the mother eats well. She needs some oily fish, nuts, seeds, eggs and chicken whenever she can.	Hakikisha mama anakula vizuri. Anahitaji samaki,karanga,mbegu,mayai na kuku anapoweza.
3	12	Make sure the family washes their hands after using the toilet and before eating. This will keep germs away and keep the mother healthy.	Hakikisha familia ina nawa mikono baada ya kutoka msalani na kabla ya kula. Hii itafukuza wadudu na kumfanya mama kua na afya.
3	13	See that the mother drinks plenty of clean boiled water every day and eats an extra mouthful of food at each meal. This will keep her strong.	Hakikisha mama anakunywa maji safi yaliyochemshwa na ya kutosha kila siku na kula chakula Zaidi kila anapokula. Hii itamfanya kua na nguvu.
3	13	Smoke harms your baby. Try to smoke outside the house so the mother is not affected. It's a good habit for when the baby comes too.	Moshi hudhuru mtoto wako, jaribu kuvuta nje ya nyumba ndio mama asidhurike. Ni tabia nzuri hata kwa mtoto anapokuja.
4	14	Make sure the mother doesn't eat non-foods such as soil. They may harm the baby. Many pregnant women crave non-foods during pregnancy.	Hakikisha mama hatakula vitu visivyo stahili kuliwa kama vile mchanga. Vinaweza kumdhuru mtoto. Wamama wengi wajawazito hutamani vitu hivyo wanapokua wajawazito.
4	14	The mother needs to feel safe at home. Don't let anyone treat her badly, shout at her, beat her or make her do things she doesn't want.	Mama anafaa kujihisi salama nyumbani. Usimruhusu mtu yeyote kumfanyia ubaya,kumpigia kelele,kumpiga au kumfanyisha vitu asivyovitaka.
4	15	Encourage the mother not to smoke or drink alcohol while pregnant. It could harm her baby. Ask her family to smoke outside, too.	Mhimize mama kutovuta sigara au kutokunywa pombe anapokua mjamzito. Inaweza kudhuru mtoto. Ambia familia pia kuvuta sigara nje.
4	16	Keep the mother healthy by making sure she only eats fresh, well-cooked food. Food that is left out or raw is full of germs. It could make her sick.	Hakikisha mama anakua na afya kwa kula chakula kilichopikwa siku hio na vizuri. Chakula kilicho lala au kibichi hua na wadudu. Kinaweza kumfanya mgonjwa
4	17	Being pregnant makes the mother tired. She needs extra care. Make sure the family members share her work and give her time to rest.	Kua mjamzito hufanya mama kuchoka. Anahitaji uangalifu Zaidi. Hakikisha familia inajigawa majukumu yake na kumpa mda wa kupumzika.
5	20	Encourage the mother to pay attention to her baby's movements. Take her to the clinic if the movements slow or stop.	Mshawishi mama kutilia maanani kucheza kwa mtoto. Iwapo kucheza kutapungua au kusimama mpeleke kliniki.

5	21	If the mother is ill or in pain, get to the clinic. She may need treatment. Vomiting, fever, pain and bleeding are signs of a problem.	Fika kwenye kliniki iwapo mama ni mgonjwa au anahisi maumivu, huenda akahitaji matibabu. Kutapika, joto, maumivu na kuvuja damu ni dalili ya matatizo.
5	21	Always treat the mother with respect. Never use violence. This can harm the mother and the baby. It may cause her to be born too early or weak.	Usitumie njia ya vita kumuongelesha mama. Inaweza mdhuru mama na mtoto. Inaweza sababisha kuzaliwa kwa mtoto mapema kabla ya siku zake au kuzaliwa dhaifu.
6	23	Make sure anyone in the family with TB gets treated. TB can make pregnant women very sick. A cough that lasts and chest pain are signs of TB.	Kohozi linokawia na maumivu kifuani ni dalili ya kifua kikuu. Hakikisha mtu yeyote katika familia mwenye ugonjwa huo anatibiwa. Kifua kikuu kinaweza kufanya mama mja mzito kua mgonjwa zaidi.
6	24	Make plans now for the mother to have her baby at a clinic or with a trained birth attendant. It is the safest way.	Anza mipango sasa ya mama kupata mtoto wake katika kliniki au kupitia kwa mkunga. Ndio njia bora Zaidi.
6	26	Make sure the mother gets to her next check-up this week. Suggest the family starts saving money for other check-ups and the birth, too.	Hakikisha mama anaenda kwa kliniki yake ya mara kwa mara wiki hii. Shawishi familia kuanza kuchanga pesa za kliniki ya mara kwa mara na za kujifungulia pia.
6	27	If the mother has swollen hands and feet, encourage her to rest with her feet up. Swelling is caused by the weight of the baby.	Iwapo mama atakua na kufura kwa mikono na miguu, mhimize kuweka miguu juu anapopumzika. Kufura husababishwa na uzito wa mtoto.
7	28	Look out for signs of diabetes. Tiredness, thirst and blurred vision are signs. Take the mother to the clinic if you spot them.	Tambua iwapo kuna dalili za ugonjwa wa sukari. Kuchoka, kiu na kutoona vizuri ndizo dalili. Mpeleke mama kliniki pindi unapoziona.
7	29	Look out for sudden swelling in the mother's hands, feet and face. These are signs of a problem. Get her to a clinic fast if you spot them.	Tambua iwapo kutakua na kufura kwa ghafla kwenye mikono ya mama, miguu na uso. Hizi na dalili ya tatizo,mpeleke kliniki haraka pindi unapoziona.
7	30	Clinic birth is safest. Find out the fastest way to get there when it's time. Organise transport, money, and have enough airtime on phones.	Kujifungua katika kliniki ni salama Zaidi.Tambua njia ya haraka Zaidi ya kufika hapo wakati ukifika. Jipange kwa usafiri,pesa na salio la kutosha kwenye simu.

8	31	Living far away from the clinic? Get the mother to stay with a friend close to the clinic 2-3 weeks before due date so she is not late.	Iwapo unaishi mbali na kliniki mpeleke mama kuishi kwa rafiki anayeishi karibu na kliniki,wiki mbili au tatu kabla ya tarehe ya kujifungua ili asichelewe.
8	32	Encourage the mother to breastfeed straight away. The first milk isn't dirty, but is creamy with goodness. It's the best food for the baby.	Maziwa ya kwanza hayana uchafu, lakini ni laini na mazuri, ndio chakula bora cha mtoto. Himiza mama kunyonyesha kwa wakati huo.
8	34	Remind the mother to go to her next check-up. Prepare for an emergency birth. Get clean water, soap, string and a sharp tool to cut the cord.	Mkumbushe mama kuenda kliniki inayofuata ya mara kwa mara. Jipange kwa uzalishaji wa ghafla, weka maji safi, sabuni,uzi na kifaa cha makali ya kukata kitovu.
8	35	You and the family need to know danger signs of birth: fever, bleeding, fitting and difficult breathing mean the mother needs clinic help.	Familia na wewe mnapaswa kujua dalili hatari za kujifungua: joto, kuvuja damu, kifafa na kupumua kwa shida humaanisha mama anahitaji usaidizi katika kliniki.
9	36	This week, get the mother to her check-up and prepare for the birth. She may need to continue taking iron pills after the baby's birth.	Mpeleke mama kwa kliniki zake hii wiki na matayarisho ya kujifungua. Huenda akahitaji kuendelea kutumia vidonge vya madini ya ion baada ya kujifungua.
9	37	Talk to the mother about the importance of vaccines. They will protect her baby from disease. Her baby will need vaccines after the birth.	Muelezee mama umuhimu wa chanjo. Mtoto atazihitaji baada ya kuzaliwa. Zitamkinga mtoto kutokana na magonjwa.
9	39	Support the mother in breastfeeding straight after the birth. Her first, creamy milk is the best food for the baby. He needs nothing else.	Himiza mama kunyonyehsa pindi anapojifungua. Maziwa yake ya kwanza laini ndio Chakula bora cha mtoto. Hahitaji kitu chengine .
9	40	You and the family need to know the signs of early illness: a fever, unresponsiveness and vomiting mean the baby needs help at the clinic.	Wewe na familia munahitaji kujua Mapema dalili za ugonjwa: joto, mwili Kutulia na kutapika kumaanisha mtoto Anahitaji usaidizi kwenye kliniki.
9	41	Make sure the mother gets a check-up after the birth. Staff will check her health and give the baby vaccines to protect against disease.	Hakikisha mama anapata matibabu ya mara kwa mara baada ya kujifungua. Wahudumu wataangalia afya yake Na mtoto apewe chanjo ya kumkinga Kutokana na magonjwa.

9	42	Make sure the mother rests and eats well after the birth. This will help her heal. If she is faint or dizzy, get her help at the clinic.	Hakikisha mama anapumzika na kula vizuri baada ya kujifungua, itamsaidia kupona. Iwepo atazimia au kuhisi kisunzi Pata usaidizi kutoka kwa kliniki.
9	42	If you already have a child, she may feel jealous of the new baby. Give a toy or book to your older child as a present from the new baby.	Iwapo una mtoto mwengine, anaeza kuhisi wivu kwa mtoto mgeni, mpe kitu cha kuchezea au kitabu Kama zawadi kutoka kwa mtoto mgeni.

APPENDIX 8: ANTENATAL (ANC) REGISTER MOH 405

Republic of Kenya – Ministry of Health

AnteNatal (ANC) Register MOH 405

County:			
Sub-County:			
Health Facility:			
KMHFL Code:			
Type:		**Man. Agency:**	
Start date:		**End date:**	

Edition: April 2019

Column ID	Column Label			Column Description
A	Date of visit			Enter the date when the client visits the health facility either as a new client or a re-visit in the format DD/MM/YY
B	ANC Number(New client)			Enter Antenatal clinic number which has been given to the client for this pregnancy at her first antenatal visit. Fill-out the Antenatal Clinic Number in the format YYYY-MM-NNNN. Where YYYY is the year, MM is the month and NNNN is the sequential visit order number for this client. For example, a client who makes the initial visit in February 2019 and is the 8th client of the month should be given the number: 2019-02-0008.
C	ANC Number(Revisit)			If this is a subsequent visit for this particular pregnancy, enter in this column the Antenatal clinic number which was given to the client at her first antenatal visit.
D	No. of ANC Visits (1,2,3,4 ….)			Indicate the client's visit number during this particular pregnancy by indicating, 2, 3, 4 …. For second, third, fourth visit etc.
E	Full Names			Enter the client's full names in the order first name, middle and surname.
F	Date of Birth/Age			Enter the date when the patient was born in the format 'dd/mm/yyyy'. Enter the client's age in completed years as at last birthday on the first visit; Note: Do not update this field on subsequent visit should the client's age change but just use the age at first visit.
G	Subcounty/County			Enter the name of the subcounty if client resides within the county where facility is located. Else, enter name of County if the client resides in a different county from where the facility is located
H	Village/Estate/Landmark/ Telephone Number			Enter the name of the village or estate or landmark where the patient is currently staying. Manadatory to fill in the telephone number
I	Marital Status: (Codes 1-5)			Enter one of the options in the cell 1-Married, 2-Widowed, 3-Single, 4-Divorced, 5-Separated
J	Parity			Format X+Y: First part (X): Enter the number of previous deliveries that occurred at a gestation beyond 24 weeks (6 months) regardless of outcome. Second part(Y): enter the number of terminations or miscarriages that have occurred at a gestation less than 24 weeks prior to this pregnancy.
K	Gravidae			Enter the number of pregnancies that the woman has had including the current pregnancy. For example in her third pregnancy, a woman is said to be gravida three (3) regardless of outcome of the previous pregnancies.
L	Date of Last Menstrual Period(LMP)		*(dd/mm/yy)*	Record the date of the last menstrual period in the format DD/MM/YY.
M	Expected Date of Delivery(EDD)		*(dd/mm/yy)*	Record the Estimated Date of Delivery in the format DD/MM/YY
N	Gestation in weeks			Record the duration of pregnancy expressed in weeks. This should be updated on each visit.
O	MUAC: (Codes 1-3)			Record 1= Green, 2=Yellow, 3=Red
P	Height (Centimeters)			Record the measured height in centimeters
R	Blood Pressure			Record the blood pressure reading
S	Breast Exam		(Y/N)	Record 'Y' if Breast examination has been done OR 'N' if Not done
T	FGM associated complications			Record Complications associated with FGM 1=scarring, 2=Keloids, 3=Dyspaneuria, 4=UTI
U		Haemoglobin	(Level/ND/NA)	Record the haemoglobin level. Record ND if not done and NA if not applicable.
V		Blood Sugar Testing for Diabetes		Record 1=RBS<11.1 mmol/L, No Diabetes, 2=RBS>11.1 mmol/L, Has Diabetes, 3=No RBS done
W		Blood group and rhesus		Record Yes if done/No if not done
X		Urinalysis		Record Yes if done/No if not done
Y		RPR/VDRL — Y/N/ND	RPR/VDRL/Dual Testing/NA	This is the routine test for syphilis/VDRL that is carried out for pregnant women. Record whether the results are Positive or Negative. If tests were not done on this visit, write ND for "Not Done" ND= "Test not done" on this visit. This should also be recorded for those who were tested on a previous visit and are not tested at this visit even if treatment is given at this visit. In the lower cell record the type of test done: RPR or VDRL or NA if test is not done.
Z		RPR/VDRL — Results (P/N/NA)	Treated (Y/N/NA)	In the upper cell: Indicate results using "P" if positive "N" if Negative and "NA" if not applicable. In the lower cell: Record "Y" If the client tests positive and is started on treatment at this visit, and "N", if not started on treatment. Otherwise if the client is not tested at this visit or tests Negative, write "NA" for not applicable. Since this is a visit-based register, if the client tested positive on a previous visit, write "Y" against the visit on which treatment is started.
AA		TB Screening: Codes (1-4)		Enter the following: 1 = Presumed TB if a patient is clinically or radiologically suspected to have TB but not confirmed through laboratory tests. 2 = if no signs TB from previous assessment. 3 = if patient is already on treatment. 4=Not done

AB	Laboratory	HIV Status	HIV status before 1st ANC	(KP/U/ Revisit)	Record HIV status for this visit. Enter 'P' for Positive, 'N' for Negative 'U' for Unknown and 'KP' for Known Positive results at first ANC visit in this pregnant; Note: Do not record "KP" on subsequent visits if the positive status was known during or after the 1st ANC Visit.
AC			HIV testing (Initial or Retest)	(I/R/ND)	This records whether the client is tested during this visit. If client is tested during this visit and it is an initial test, record "I', If it is a retest , record "R" If testing is not done at this visit, record ND. Retesting only applies to those women who were tested during the first trimester and their tests were negative. It is recommended that such women are tested again in their last trimester or in maternity.
AD			HIV Testing 1	(N,P,I,NA)	**Kit Name**: Write the name of the first HIV rapid test kit which you have used. **Lot No**: Write lot number of the test kit. If the lot number changes in the middle of the page, skip one row and write the new lot number on the next row **Expiry Date**: Write expiry date of the test kit. **Test Result**: Write either of the following initials; N: Negative (non-reactive) P: Positive (Reactive) I: Invalid NA for KPs and those not due for a test In case of invalid results, the same test should be done again. The repeat test results should be captured on the following row.
AE			HIV Testing 2	(N,P,I,NA)	
AF			HIV Results	(P/N/NA/ PrevP/PrevN)	Indicate HIV status of the client. P for Positive, N for Negative and NA for Known Positive. If the test was not done during this visit, record NA. On subsequent visits, if the mother tested positive in an earlier visit (during the current pregnancy) write Prev P. If she tested negative in an earlier visit (during the current pregnancy) and she is not due for a retest write Prev N.
AG	ART Eligibility	Client Monitoring	WHO Stage		If the client has been assessed for ART eligibility using WHO staging, record the stage under this column using the notation: I, II, III or IV.
AH			Viral Load		If the client has been assessed for ART eligibility using CD4, record Y to indicate that the sample has been taken on this visit and N if not. When the results are ready, enter CD4 value against the visit (subsequent) the patient has made. There is no need to go and update the visit on which the blood was drawn. Note: For the purpose of reporting data on the indicator on assessment for eligibility, please count all the "Y"s even before the results have been known as long as the reporting date is due.
AI		Maternal HAART	On ARV before 1st ANC visit	Y/ Revisit/N/NA)	On 1st visit: If client was a KP and already on ARVs before first ANC visit for current pregnancy enter Y. On subsequent visits, enter Revisit. If client was a KP and not on ARVs before first ANC visit for current pregnancy, enter N. For clients with unknown HIV status at first ANC enter NA.
AJ			Started HAART in ANC	Y/Revisit/N/NA	Enter Y on date of visit when the client was started on HAART within the ANC setting. On subsequent visits after being started on HAART, write Revisit. If the client is HIV positive and they have not been started on HAART during the visit, enter N If a client was already on ARVs before 1st ANC visit, enter NA If a client is HIV negative, enter NA
AK			CTX	(Y/N)	Write Y if Cotrimoxazole has been given or N if not given. This is recorded for HIV positive mothers who are commenced on Cotrimoxazole. If the woman is not eligible, record NA for "Not Applicable"
AL		Infant Prophylaxis issued	AZT for Baby	(Y/N/NA/R)	Enter Y if infant AZT drugs have been dispensed to the mother or N, if not given, and NA if HIV negative. On subsequent visits if you had already given baby AZT, enter R for Revisit.
AM			NVP for Baby	(Y/N/NA/R)	Enter Y if NVP Drugs have been dispensed to the mother for the baby or N, if not given and NA if HIV negative. On subsequent visits if you had already given baby NVP , enter R for Revisit.
AN	Partner HIV C&T	Partner HIV testing		(Y/N/NA/KP)	Record Y if the client' s partner was tested for HIV during this ANC visit or N if he was not tested. Record NA if the partner did not accompany the client.
AO		Partner Test Result		(P/N/KP/NA)	Indicate HIV test result for the partner, P for Positive or N if Negative U for unknown or KP for known positive results.
AP	PPFP Counselling				Record the method of Immediate PostPartum Family Planning Consented after Counselling 1- IUD, 2- Implants, 3- BTL
AQ	Other Conditions (Codes 1-6)				Use the codes to record the other conditions observed during the visit i.e. 1=Hypertension; 2=Diabetes; 3=Epilepsy; 4=Malaria in Pregnancy; 5=STIs/RTI; 6=Others (Specify) 7=None
AR	Treatment	Deworming		(Y/N)	Indicate YES if Deworming medication has been given and NO if not given
AS		IPT 1-3		(1,2,3,NA)	Intermittent Presumptive Treatment first, second or third dose. Write the dose which has been given or NO if not given. If the woman is not eligible, record NA for "Not Applicable"
AT		TT Dose		(1 to 5)	This refers to the Tetanus Toxoid Vaccine given to the woman during the visit. Record which number of dose was given.
AU	Supplementation	Given supplementation		1,2,3,4,5	Indicate in this column the code according to the Supplementation given. i.e. 1= Combined IFAs 2= Iron 3=Folate 4 = Iron+Folate Separately 5=Calcium
AV	LLITN	Received LLITN		(Y/N)	Record :Y=Yes if an LLITN was issued to the client during this visit, or N=No if not given. Indicate the visit number when the net was given
AW	Referrals: From (Codes 1-4)				Record as per provided codes: 1=From Community Unit, 2=Another Health Facility, 3=Not Applicable
AX	Referrals: To (Codes 1-4)				Record as per provided codes: 1=To Community Unit, 2=Another Health Facility, 3=Not Applicable
AY	Reason for referral …specify				Record reasons for referral
AZ	Remarks				Any other comments that will be beneficial to the client and service

Date of visit	ANC Number (New Client)	ANC Number (Re Visit)	Number of ANC Visits	Full Name (First, Middle, Last)	Date of Birth (DD/MM/yyyy) / Age	Subcounty /County	Village/Estate/ Landmark / Phone Number	Marital Status 1=Married 2=Widowed 3=Single 4=Divorced 5=Separated	Parity	Gravidae	Date of Last Menstrual Period (LMP) (dd/mm/yyyy)	Expected Date of Delivery (EDD) (dd/mm/yyyy)	Gestation in Weeks
		(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k	(l)	(m)	(n

Adolescent with HIV	Number
Adolescents (10-19 yrs) 1st ANC KP (g) & (x)	
Adolescents (10-19 yrs) tested positive in ANC (g) & (aa)	
Adolescents (10-19 yrs) started HAART in ANC (g) & (ae)	

Blood Sugar Testing for Diabetes (u)	Number of clients
1=RBS<11.1 mmol/L, No Diabetes	
2=RBS>11.1 mmol/L, Has Diabetes	
3=No RBS done	

HIV Test 1 (ac)	Number	HIV Test 2 (ad)	Number
N: Negative		N: Negative	
P: Positive		P: Positive	
I: Invalid		I: Invalid	
Wastage:		Wastage:	

APPENDIX 9: MATERNITY REGISTER_MOH-333

Maternity Services

Health Facility Register (MoH 333)

Service Delivery Point:
SDP Number:
Facility Name:
KMHFL Code:
Sub-County:
County:
Start date: End date:

Edition April 2019

Column ID	Column Label				Column Description
A	Date of Admission				Write the date when the patient is admitted in the format 'dd/mm/yyyy'
B	Admission Number				Enter the unique identification number given to the mother on admission to maternity in the format 'yyyy-mm-nnnn'. Initialise every month e.g 2019-07-0001 for the first client in July 2019. Only pregnant with viable pregnancies i.e (>24 weeks gestation) admitted for delivery are enrolled in this register.
C	Full Names				Enter the client's full names in this cell. (first name, middle name, surname)
D	Data of birth/Age				Enter the data when the patient was born in the format 'dd/mm/yyyy'. Enter the client's age in completed years as at last birthday
E	Subcounty/County				Enter the name of the subcounty if client resides within the county where facility is located. Else, enter name of County if the client resides in a different county from where the facility is located
F	Village/Estate/Land mark				Enter the name of the village/estate where the client resides.
G	Marital status (Codes 1-5)				Enter one of the options in the cell (1-Married, 2-Widowed, 3-Single, 4-Divorced, 5-Separated
H	Parity				Format X+Y: First part (X): Enter the number of previous deliveries that occurred at a gestation beyond 24 weeks (6 months) regardless of outcome. Second part(Y): enter the number of terminations or miscarriages that have occurred at a gestation less than 24 weeks prior to this pregnancy.
I	Gravidae				Enter the number of pregnancies that the woman has had including the current pregnancy. For example in her third pregnancy, a woman is said to be gravida three (3).
J	No. of ANC Visits				Record the number of antenatal visits the client made to the clinic, prior to admission, as indicated on the Mother Child Health Handbook (1,2,3,4.....)
K	Date of Last Menstrual Period (LMP)				Record the date of the last menstrual period in the format dd/mm/yyyy
L	Expected Date of Delivery (EDD)				Record the Estimated Date of Delivery in the format dd/mm/yyyy
M	Diagnosis				Write the final diagnosis made by the clinician. If the patient suffers from more than 1 condition, record all diagnosis in this column.
N	Delivery / Mother	Duration of labour			Record the time count from onset of labour to actual delivery
O		Date of Delivery			Record the date the mother delivers in the format dd/mm/yyyy
P		Time of Delivery			Indicate the time the baby(ies) was delivered
Q		Gestation at Birth (Weeks)			Record the duration of pregnancy expressed in weeks at birth
R		Mode of delivery			Record the birth form,Record using key: 1=Normal delivery; 2= Caeserean Section; 3= Breech; 4= Assisted vaginal delivery
S		No. of Babies delivered			Record number of babies delivered in multiple pregnancy (e.g 2 in the case of twins) Name of mother should appear once in one row, details of babies in separate rows
T		Placenta Complete			Write "Y" for Yes if placenta is complete and "N" for No if not complete,BBA if baby is born before arrival and placenta expelled and not available to be examined
U		Uterotonic given			Record uterotoxin given 1=oxytocin 2=Carbetocin 3= None
V		Vaginal Examination			Record using the codes as follows: 1= Normal 2=Episiotomy 3=Vaginal tear 4=FGM 5=Vaginal warts
W		Blood loss		(in mls)	Indicate the amount of blood loss during delivery in millilitres (mls)
X		Mother's Status after Delivery		(Alive/Dead)	Write the condition of the mother after delivery
Y		Date Maternal death notified			Record the date the Maternal Death was notified in the format dd/mm/yyyy
Z		Delivery complications (Codes)		(1 - 6)	Record using the Codes as follows: 1=A.P.H. (Ante Partum Haemorrhage); 2=P.P.H. (Post Partum Haemorrhage); 3= Eclampsia; 4=Ruptured Uterus;5=Obstructed labour; 6=Sepsis
AA	Baby	APGAR Score			**Low APGAR SCORE is 6 and below at 5 min. See APGAR score table at the bottom of these instructions:**
AB		Birth outcome			Enter "LB" for Live Birth, "FSB" for Fresh Still Birth and "MSB" for Macerated Still Birth
AC		Birth Weight		(in grams)	Enter the weight of the baby in grams
AD		Sex			Enter the sex of the baby "M" for Male or "F" for Female
AE		Initiation of BF < 1 Hour (Y/N) Kangaroo Mother Care (Y/N)			Indicate 'Y' for Yes if Breastfeeding was initiated in less than one hour and 'N' if not Indicate 'Y' for Yes if baby initiated on Kangaroo Mother Care and "N" if not
AF		Tetracycline at birth (Y/N)			Indicate 'Y' for Yes if Tetracycline was given at birth and 'N' if not
AG		Chlorhexidine applied on cord stump (Y/N)			Indicate 'Y' for Yes if Chlorhexidine was given at birth and 'N' if not
AH		Birth with deformities (Y/N)			Indicate 'Y' for Yes if the baby had birth deformities and 'N' if not
AI		Given Vitamin K			Indicate 'Y' for Yes if the baby was given vitamin K and 'N' if not
AJ	VDRL/ RPR Results			(P/N)	Indicate RPR/VDRL test result, P for Positive or N if Negative.
AK	HIV Status	AT ANC		(P/N/KP/U)	Record HIV status from the last ANC visit. This can be copied from the Mother-Baby booklet. Enter P for Positive, N for Negative KP for known positive at 1st ANC visit and U for Unknown.
AL		HIV Test 1 & HIV Test 2		(N/P/I/NA)	Kit Name: Write the name of the first HIV rapid test kit which you have used. Lot No: Write lot number of the test kit. If the lot number changes in the middle of the page, skip one row and write the new lot number on the next row Expiry Date: Write expiry date of the test kit. Test Result: Write either of the following initials; N: Negative (non-reactive)
AM		HIV Results (Maternity)		(P/N/U/NA)	Record HIV status: Enter 'P' for Positive, 'N' for Negative 'U' for Unknown and 'KP' for known positive. **Note 1:** Only results for tests done in the maternity should be recorded here.
AN	ARV Prophylaxis	Mother	Issued From ANC	(Y/N/NA)	Enter Y if the mother was on HAART during ANC, N if she wasn't and NA if the mother was negative or had unknown status.
AO			Issued at Maternity	(Y/N/NA)	Only for women tested at Maternity: Indicate Y if started on HAART, N if not and NA if negative or had already been started from ANC.
AP		Baby		(Y/N/NA)	Only for babies of mothers tested at Maternity. Indicate Y if provided with infant ARV prophylaxis, N if not provided and NA if negative or had already been issued from ANC. Note: For mothers issued with infant ARV prophylaxis at ANC but never carried to the maternity, issue the prophylaxis but record NA.
AQ	Cotrimoxazole (CTX)		To mother in MAT	(Y/N/NA)	Write Y if Cotrimoxazole has been given or N if not given and NA if HIV negative.
AR	Partner Involvement		Tested for HIV		Enter "Y" for Yes or "N" for NO if the partner to the client has tested for HIV in the maternity, NA if partner was not available for testing
AS			Partner HIV status		Record the partner's results as follows: 'P' for Positive, 'N' for Negative 'U' for Unknown or "KP" for known positives
AT	Counselled on infant feeding			(Y/N)	Indicate Y if counselling occurred and N if not counselled
AU	Delivery Conducted by	(Write Name)			Indicate the name of the person who conducted the delivery
AV	Birth Notification Number				Indicate the serial number from the birth notification sheet
AW	Discharge		Date (dd/mm/yyyy)		Indicate the date when the mother is discharged
AX			Status of Baby (Dead/Alive)		Enter D for dead or A for alive.
AY	Referrals: From (Codes 1-4)				Record as per provided codes: 1= From Community Unit, 2=Another Health Facility, 3=Not Applicable
AZ	Referrals: To (Codes 1-4)				Record as per provided codes: 1= To Community Unit, 2=Another Health Facility, 3=Not Applicable
BA	Reasons for refferal				Record reason for referral
BB	Comments				Any other remarks that may be beneficial to the mother, child or facility e.g

APGAR SCORING(AA)

A score is given for each sign at one minute and five minutes after the birth. If there are problems with the baby an additional score is given at 10 minutes. A score at 5 min of 7-10 is considered normal, while 4-6 is low and requires continued resuscitative measures. A baby with apgars of 3 and below requires immediate resuscitation.

	Score of 0	Score of 1	Score of 2	Acronym
Skin color	blue all over	blue at extremities	normal	Appearance
Heart rate	absent	<100	>100	pulse
Reflex irritability	no response to stimulation	grimance/feeble cry when stimulated	sneeze/cough/pulls away when stimulated	Grimance
Muscle tone	none	some flexion	active movement	Activity
Respiration	absent	weak or irregular	strong	Respiration

Date of Admission	Admission number	Full Name (First, Middle, Last)	Date of Birth (dd/mm/yyyy) / Age	Subcounty/ County	Village/Estate/Land mark / Phone number	Marital Status 1=Married 2=Widowed 3=Single 4=Divorced 5=Separated	Parity (X+Y)	Gravidae	No. of ANC visits	Date of Last Menstrual Period (LMP) (dd/mm/yyyy)	Estimated Date of Delivery (EDD) (dd/mm/yyyy)	Diagnosis	Delivery: Duration of labour (h)	Date of Delivery (c)	Time of Delivery (p)	Gestation at Birth (wks) (q)	Mode of Delivery 1) SVD 2) CS 3) Breech 4) AVD (r)	No.of babies delivered Number (s)	Placenta Complete 1=Yes 2=No 3=BBA (t)	Uterotonic given 1=oxytocin 2=Carbetocin 3= None (u)	Vaginal Examination 1= Normal 2=Episiotomy 3=Vaginal tear 4=FGM 5=Vaginal warts (v)	Blood loss (ml/s) (w)	Mothers status after Delivery (Alive/Dead) (x)	Maternal deaths Notified (Y/N) Date Death notified (y)	Delivery Complications (z)
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)	(w)	(x)	(y)	(z)

AGE (d)	Number
10-14 years	
15-19years	
20-24 years	
Above 25 years	
Totals	

No of mothers given Uterotonics (u)	

Maternal complications (y):	Alive	Dead
No. with APH (y):		
No. with PPH (y):		
No. with Eclampsia (y):		
No. with rutpured Uterus (y):		
No. with obstructed labour (y):		
No. with sepsis (y):		

No. of babies discharged alive (aw):	
Early Neonatal deaths (aw) (0-7days	
Late Neonatal deaths (aw) (8-28days	

Pre Term Babies (q):	
Underweight Babies (ah):	
Live Birth (aa):	
Birth with Deformities (ag):	
Fresh Still Births (aa):	
Macerated Still Births (aa):	

10-14 years	
15-19 years	
Above 25 years	
Totals	

No. of mothers given Oxytocics (u)	
Oxytocin	
Carbetocin	

No. Started HAART_L&D (an):	
Infant ARV prophylaxis_L&D(ap):	

APGAR Score	Baby: Birth Outcome	Birth Weight	Sex	Initiated on BF in < 1hr (Y/N) Kangaroo Mother Care (Y/N)	TEO given at birth?	Chlorhexidine applied on cord (Y/N)	Birth with deformity(Y /N)	Given Vitamin K	VDRL/ RPR Results	HIV Status: AT ANC	HIV Test 1: Kit Name: / Lot No. / Expiry	HIV Test 2: Kit Name: / Lot No. / Expiry	HIV Results Maternity	ART Prophylaxis: Mother: Issued from ANC	Mother: Issued at Maternity	To Baby in MAT	CTX To Mother	Partner involvement: Tested for HIV	Partner involvement: HIV Test Results	Counselled on infant feeding	Delivery Conducted by	Birth Notification	Discharge: Date	Discharge: Status of Baby	Referrals: From (1= Community Unit, 2=Another Health Facility 3=Not Applicable)	Referrals: To (1= Community Unit, 2=Another Health Facility 3=Not Applicable)	Reasons for referral	Comments
(aa)	(ab)	(ac)	(ad)	(ae)	(af)	(ag)	(ah)	(ai)	(aj)	(ak)	(al)	(am)	(an)	(ao)	(ap)	(aq)	(ar)	(as)	(at)	(au)	(av)	(aw)	(ax)	(ay)	(az)	(ba)	(bb)
	(LB/FSB/ MSB)	(grams)	(M/F)		(Y/N)	(Y/N)	(Y/N)	(Y/N)	(P/N/IND)	(P/N/KP/U)	(N/P/I/NA)	(N/P/I/NA)	(P/N/U/NA)	(Y/N/NA)	(Y/N/NA)	(Y/N/NA)	(Y/N/NA)	(Y/N/NA)	(P/N/KP/U)	(Y/N)	(Enter Name)	Birth Notification Number	(dd/mm/yyyy)	A= Alive D= Dead				

Mode of delivery (r)	Number
No. Normal deliveries (r)	
No. Caesarean Sections (r)	
No. Breech Delivery (r)	
No. Assisted vaginal delivery (r)	

Initial test at L&D (ak):	
Positive Results L&D (al):	
No. HIV positive deliveries (aa)(ak)	

No. of babies applied chlorhexidine for cord care (af)	
No. of babies given tetracycline at birth (ae)	
No. of Infants intiatied on breastfeeding within 1 hour after birth (ad)	
No. of neonates given Vit "K" (ah)	

Code.(e)	
Maternal deaths 10-14Years (w)	
Maternal deaths 15-19Years (w)	
Maternal deaths 20 years plus (w)	
Maternal deaths audited	

Adolescents (10-19 yrs) New HIV+ maternity (al)(e)	
Adolescents (10-19 yrs) Started HAART maternity (an)(e)	

APPENDIX 10: KNH-UON-ERC ETHICAL APPROVAL

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/234

21st July 2020

Jefferson Mtongolo Mwaisaka
PhD Candidate
Dept. of Population, Family and Reproductive Health
School of Public Health
University of Ghana
email; jefmwaisaka@gmail.com/jmmwaisaka@st.ug.edu.gh

Dear Jefferson

RESEARCH PROPOSAL – THE EFFECT OF mHEALTH INTEGRATION ON THE HEALTH OUTCOMES OF EXPECTANT ADOLESCENTS AND YOUNG MOTHERS – A QUASI-EXPERIMENTAL STUDY IN KWALE COUNTY, KENYA (P11/01/2020)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 21st July 2020 – 20th July 2021.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

APPENDIX 11: NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH ETHICAL APPROVAL

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH
Established 1979A Constituent of the College of Health Sciences

University of Ghana

INSTITUTIONAL REVIEW BOARD

Phone: +233-302-916438 (Direct)
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Telex No: 2556 UGL GH

Post Office Box LG 581
Legon, Accra
Ghana

My Ref No: DF22
Your Ref. No:

6th May, 2020

ETHICAL CLEARANCE

FEDERALWIDE ASSURANCE FWA 00001824 **IRB 00001276**

NMIMR-IRB CPN 066/19-20 **IORG 0000908**

On 6th May 2020, the Noguchi Memorial Institute for Medical Research (NMIMR) Institutional Review Board (IRB) at a full board meeting reviewed and approved your protocol titled:

TITLE OF PROTOCOL : **The effect of mHealth integration on the health outcomes of expectant adolescents and young mothers – A Quasi-experimental study in Kwale county, Kenya**

PRINCIPAL INVESTIGATOR : **Jefferson Mwaisaka Mtongolo, PhD Cand.**

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to NMIMR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till 5th May, 2021. You are to submit annual reports for continuing review.

Signature of Chair: .....

Mrs. Chris Dadzie
(NMIMR – IRB CHAIR)

APPENDIX 12: NACOSTI RESEARCH PERMIT

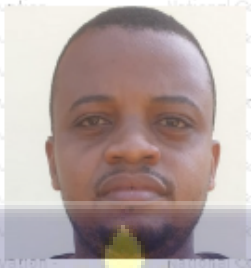
REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 975276

Date of Issue: 28/August/2020

RESEARCH LICENSE



This is to Certify that Mr.. Jefferson Mwaisaka of University of Ghana, has been licensed to conduct research in Kwale on the topic: The Effect of mHealth Integration on the Health Outcomes of Expectant Adolescents and Young Mothers – A Quasi-Experimental Study in Kwale County, Kenya for the period ending : 28/August/2021.

License No: NACOSTI/P/20/6389

975276

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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