



**UNIVERSITY OF NAIROBI  
DEPARTMENT OF COMPUTER SCIENCE  
FACULTY OF SCIENCE AND TECHNOLOGY**

**An mHealth Intervention for Sexual Reproductive Health  
Information and Services by Young People in Kenya**

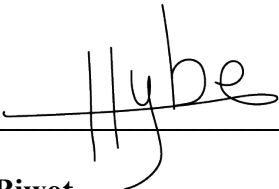
**Betty Chebet Biwot  
(P51/6411/2017)**

**Supervisor  
Christopher Moturi**

**A Project Report Submitted in Partial Fulfilment of the Requirement for the Award of  
Master of Science in Applied Computing of the University of Nairobi  
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## DECLARATION AND APPROVAL

This project is my original work, and, to the best of my knowledge, this research work has not been submitted for any other award in any university.

Signature:  \_\_\_\_\_ Date: August 19, 2021

**Betty Chebet Biwot**

**P51/6411/2017**

This project report has been submitted for examination with my approval as the University of Nairobi Supervisor.

Signature



Last modified: 21:46

Signature: \_\_\_\_\_ Date: August 19, 2021

**Christopher A. Moturi**

**Department of Computer Science**

**University of Nairobi**

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## **ABSTRACT**

Accessibility to Sexual Reproductive Health (SRH) information and services among young people has been poor over the years. Lack of quality SRH information, services, and tools among young people has resulted in adverse effects such as early unplanned pregnancies, sexually transmitted infections, HIV/AIDS, and poor sanitation.

This research was aimed at identifying the sources of SRH information available, the factors that influence SRH accessibility by the young people and developing a mobile-based solution that would enable access to SRH information and services conveniently.

Considering that mobile penetration in Kenya stood at 119.7% as at 2020, mHealth is an effective mode of providing SRH information and services which grants confidentiality and accessibility to young people (CA, 2020). This research sought to demonstrate how a mobile-based prototype can be used as a key intervention to enable young people to access SRH information and services conveniently. A review was conducted among 157 participants. Results from the analysis revealed that the common sources of SRH information and services were internet (30.6%), media (15.9%), home (6.2%) and school (15.1%). 86.5% of the respondents thought that an mHealth intervention would improve accessibility to SRH information and services.

This study can be exercised with more participants in diverse parts of the country to understand the full potential of mHealth in bearing SRH outcomes. COVID-19 limited the researcher to have better engagement with study participants, which would have surfaced more insights. This study was aimed at providing a solution towards improving lives and mitigating the short and long-term consequences of poor access to SRH services and information for young people.

This study has presented a case for mHealth as an innovation to facilitate better SRH information and services access for young people. A feasible mHealth solution incorporating a wearable, mobile and web technologies was developed which was then tested by sampled young people and healthcare professionals to assess its usability. The usability scoring of 75.3% demonstrated that mHealth can be used to improve access to SRH information and services by the young people.

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## ABBREVIATIONS

AHF	AIDS Healthcare Foundation
API	Application Programming Interface
ASRH	Adolescent Sexual and Reproductive Health
CA	Communications Authority
CEDAW	Convention on Elimination of all Forms of Discrimination against Women
COVID-19	Coronavirus Disease 2019
CRC	Convention on the Rights of the Child
FP	Family Planning
HIV	Human Immunodeficiency Virus
ID	Identity Document
JSON	JavaScript Object Notation
KDHS	Kenya Demographic Health Survey
KNHCR	Kenya National Commission on Human Rights
KPHC	Kenya Population and Housing Census
LMICs	Low and Middle-Income Countries
mHealth	Mobile Health
NGO	Non-governmental organization
RAD	Rapid Application Development
SDG	Sustainable Development Goal
SMS	Short Message Service
SRH	Sexual Reproductive Health
STI	Sexually transmitted infections
UNICEF	United Nations Children's Fund
URL	Uniform Resource Locator
YPP	Young People's Program
WHO	World Health Organization



# CHAPTER 1: INTRODUCTION

This chapter covers the background of the research problem, problem statement, research objectives, research questions, scope, and the significance of the study.

## 1.1. Background

Sustainable Development Goal (SDG) 3 is focused on guaranteeing healthy lives and advocating the welfare of people at all ages (<https://sdgs.un.org/goals/goal3>). SDG 3.7 specifically targets to attain worldwide access to sexual and reproductive health-care services such as family planning, information, and education, and to incorporate reproductive health into national strategies and programs. According to a report by the United Nations (2018), Sexual and Reproductive Health (SRH) for young people is considered an important public health issue worldwide. This is because globally, there is 1 young person in every 6 people which translates to roughly 16% of the world's population.

The World Health Organization (WHO) (<https://www.who.int/>) defines adolescents as “individuals in the 10-19 years age bracket” and youth as “the 15–24 years age bracket”. These two age groups are included in the ‘young people’ group (WHO, 2017). A series of major physical and psychological changes occur on the outset of adolescence which gradually affects their SRH. This occurs as the slow transition from childhood to adulthood with notable changes in social interaction and relationships.

Kenya’s population constitutes 66% of young people aged below 25 years. More specifically, adolescents account for roughly 24% (9.2 million) of the country’s population (Kenya Population and Housing Census (KPHC), 2019). A series of major physical and psychological changes occur on the outset of adolescence which gradually affects young people’s SRH. This occurs as the slow transition from childhood to adulthood with notable changes in social interaction and relationships.

Young women have very poor SRH outcomes in the country compared to men, some of which are poor menstrual hygiene, early pregnancies, dropping out of school or acquiring STIs (Chandra-Mouli, et al., 2013). More male students aged 15 years and older attend school than female students in the same age category. 11% of females in the 15-19 age bracket were already married as compared to just 1% of the males in the same age category. Most women aged 15-24 years got married at the age of 20 years. 15% of women and 22% of men aged 20-49 had their first sexual

intercourse at 15 years, 50% of women and 56% of men by age 18, while 71% of women and 76% had their first encounter at age 20 years. The average age of first sexual intercourse among men was 17.4 years while for women was 18.0 years. This shows that young men have an early sexual debut as compared to women. The survey also showed that 11.4% of women and 9.6% of men aged 15-19 years had had a sexual activity in the last 4 weeks. More women (49.2%) than men (34.8%) aged 20-24 years had had a sexual activity in the last 4 weeks. The survey also reported that 15% of women aged 15-19 years had already had a birth while 3% were currently pregnant at the time of the survey. 98.2% of women aged 15-19 and 98.7% of women aged 20-24 years had heard about modern or traditional methods of contraceptives. This is compared to 99.7% of men aged 20-24 years. 10.1% of women aged 15-19 years and 42.0% of women aged 20-24 years were using contraceptives. 23.01% of women aged 15-19 years had unmet needs for family planning for either spacing their childbirth or for reducing their chances of getting pregnant. 62.5% of those in the age 15-19 years while 73.8% of 20-24 years demanding for contraception were satisfied (Kenya Demographic Health Survey (KDHS), 2014).

SRH problems are common among young people worldwide, which include, but are not limited to: early unplanned pregnancies, Sexually Transmitted Infections (STIs), HIV (Chandra-Mouli, *et al.*, 2013), poor sanitation (Belayneh, *et al.*, 2019), and lack of access to quality SRH information and services. Barbara Frost of Water Aid (cited in Melik, 2011) outlined several adverse effects of poor access to SRH services, specifically sanitation. Precisely, Barbara said: “you cannot achieve universal primary education, you cannot promote gender equality and empower women, and you cannot reduce child mortality.” This is evident in the challenges young people in Kenya face in accessing sanitary towels (Mason, *et al.*, 2013). These challenges subsequently lead to young people missing school when faced with SRH issues.

SRH problems can majorly be blamed on the insufficient education and guidance young people receive prior to their transformation into adolescence from their families, communities, or the education system (Sommer, *et al.*, 2020). This is evident in KDHS (2014): 27.9% of women and 23.7% of men aged 15-19 and 16.1% of women and 10.1% of men aged 20-24 years had not heard or seen any family planning message on radio, TV, newspaper, or magazine. 92.3% of women aged 15-19 and 79.1% of women aged 20-24 years who did not use contraceptives had never

discussed contraceptives with either field worker or at the health facility in the last 12 months prior to the survey.

Other barriers to access to SRH information for young women arise from stigma and cultural taboos relating to menstruation. Sommer, *et al.* (2020) noted that these barriers actuate the need for secrecy and silence on menstrual management in young women. These women then become subject to behavioral restrictions around social activities, household chores and school participation (Tuli, *et al.*, 2019).

Belayneh, *et al.* (2019) found that many adolescent schoolgirls have poor knowledge regarding menstruation and their hygienic practices. This poor access to SRH services can partly be attributed to guardians, teachers and healthcare workers failing to discuss SRH issues with adolescents from the outset of the developmental stage (Hindin, *et al.*, 2009). Several social and cultural practices such as taboos and stigma relating to menstruation are the cause of this failure.

Belayneh *et al.* (2019) concluded that there is a need to design acceptable awareness and advocacy programs to improve the knowledge of safe hygienic practices of adolescent girls during menstruation. As such, interventions providing SRH information to increase knowledge in the subject would be of use to the young population (Omondi, 2015).

According to the Communications Authority of Kenya (2020), mobile penetration in Kenya stood at 119.7% (CA, 2020). The potential of mHealth has propelled the development of different mobile-based solutions tackling health issues such as SRH. Mobile health (mHealth) provides a great opportunity to support public health through its application in SRH interventions for young people. MHealth particularly grants confidentiality and accessibility to young people which provides an effective mode to provide SRH information and services (Ippoliti, *et al.*, 2017). In developing nations, the penetration of mobile devices is increasingly paving way for feasible solutions to reach out and engage young people on SRH issues.

## **1.2. Problem Statement**

It is imperative to empower young people with the necessary SRH information and tools that will enable them to easily access SRH services (PRB, 2016). Different organizations have come up with ways of facilitating access to SRH services (e.g., sanitary towels and contraceptives) to vulnerable young people living in marginalized communities. However, even with such initiatives, young people are still not able to access SRH services due to shortages, lack of privacy and confidentiality, discrimination, stigma, inconvenient access locations, parental disapproval, or sheer lack of awareness.

Due to the high penetration of mobile devices among the youth (Lenhart, 2015), an opportunity is evident for their use in SRH interventions

## **1.3. Research Objectives**

The overall objective of this study was to develop an mHealth based intervention for access to Sexual and Reproductive Health (SRH) information and services by young people.

The Specific Objectives were:

1. To analyze the current programs that provide SRH services to young people in Kenya.
2. To establish the factors that influence accessibility of SRH information and services by young people.
3. To review the sources of SRH Information to young people.
4. To design a prototype MHealth-based application for SRH information and services for young people.

## **1.4. Research Questions**

1. What are the current SRH initiatives for young people?
2. What are the achievements of the current SRH initiatives for young people?
3. What factors influence accessibility of SRH information and services?
4. How do these factors affect accessibility of SRH services and information?
5. What are the sources of SRH information to young people?
6. How can mHealth be applied as an intervention to improve accessibility to SRH services?

### **1.5. Scope**

This research project was limited to young people aged between 10-24 years. The participants were sampled from the Young People Program under the AIDS Healthcare Foundation (AHF) in Nairobi and Coast counties.

### **1.6. Significance**

There is a need to intervene and ensure that SRH information and services become available and accessible, when, where and how young people need them. This study was aimed at providing a solution towards improving lives and mitigating the short and long-term consequences of poor access to SRH services and information for young people.

## **CHAPTER 2: LITERATURE REVIEW**

This chapter covers the different literature reviewed on sexual reproductive health, application of mobile health, existing studies, systems and programs, the gaps, and the proposed solution to the problem.

### **2.1. Sexual Reproductive Health**

Sexual Reproductive Health and SRH) focus on efforts to alleviate maternal and infant mortality and morbidity, to ensure quality SRH services, (such as contraceptives, menstrual hygiene), and to address sexually transmitted infections (STI), reproductive diseases (such as cervical cancer), violence against girls and women, and the SRH needs of adolescents (KNHCR, 2012). Universal access to SRH is essential not only as an SDG but also to ensure that the SRH needs, rights and aspirations of people worldwide are achieved.

SRH rights of adolescents and the youth are guaranteed in various human rights instruments. These include the Convention on the Rights of the Child (CRC) and the Convention on Elimination of all Forms of Discrimination against Women (CEDAW) and any other treaty that protects the right to health including reproductive rights of women. According to the CRC, SRH services should be availed to all people irrespective of age and gender including those who belong to marginalized and vulnerable groups. Regarding SRH, the youth have a right to access information, a right to health and development, and a right to privacy and confidentiality. As party to various international and regional human rights programs, Kenya strives to ensure that adolescents and the youth are provided with quality reproductive health treatment and information (KNHCR, 2012). These programs aim to enable the youth to take full charge of their lives while avoiding the risks of negative SRH-related outcomes.

Kenya has implemented policies and legal frameworks to protect ASRH and rights. The Constitution of Kenya (2010) guarantees the right to health to all Kenyans. It also stipulates that all international treaties related to health that Kenya gets into become part of Kenyan law. Kenya developed the National ASRH Policy (2015) to guide responsible stakeholders (such as national and county governments, nongovernmental organizations) on how to approach ASRH issues. In support of this policy, the National Adolescent Sexual Reproductive Health Policy Implementation Framework (2017 - 2021) was formulated. This framework came with schemes and interventions aimed at achieving specific goals outlined in the National ASRH Policy (2015). The interventions

outlined in the policy were to be mainly adapted to developing ways to “equip adolescents with the right knowledge, attitudes and skills to make informed decisions about their sexual reproductive health and to protect themselves against SRH risks” (KNHCR, 2012).

## **2.2. SRH Needs and Challenges for Young People**

### **a) Contraceptives**

Adolescents from many developing countries experience the highest number of unmet needs for family planning. They face varying challenges accessing quality contraceptive products, (Marshal *et al.*, 2012; NFPA, 2013; Finer *et al.*, 2011) which include marginalization from access to SRH information and services; healthcare inequities like unintended pregnancy rates; knowledge deficits such the safety of contraceptive methods; and wrong beliefs imposed on young people.

### **b) SRH information**

Adolescents encounter major challenges in accessing accurate SRH information. For instance, the Kenya Demographic and Health Survey (KDHS) in 2014 noted that only 58% of adolescent boys and 52% of adolescent girls had comprehensive knowledge of HIV/AIDS. Several policies in the National SRH Policy (2015) emphasize the need for the availability of accurate SRH information, sexuality education and life skills to adolescents in and out of school. This will help to improve their ability to make informed SRH-related decisions and to protect themselves against SRH risks.

### **c) Access to SRH as Human Right**

For teen-age girls and young females, gender inequality and violation of their rights remain to be the major cause for health inequities, and as such poor access to SRH services and information as a right. It is important to prioritize the specific actions required to achieve a comprehensive and integrated approach to young people’ SRH. Failure to do this will not only undermine health and human rights but also efforts to curb other problems facing nations at large (Hunt, *et al.*, 2013) e.g. poverty, lack of education, social, economic and environmental development.

### **d) Equitable Access to Quality Healthcare**

Many SRH inequities are rooted in gender inequality that place girls at increased risk of grave SRH outcomes, such as gender-based violence. This comes from increased vulnerability due to decreased access to quality healthcare and education and less decision-making power for young people (WHO, 2015).

Vulnerable and marginalized young people are often excluded from SRH service provision. They lack easy access to quality and friendly SRH such as safe abortion services, STI services, antenatal care, and skilled attendance during delivery, which result in complications such as maternal and perinatal mortality. To turn this around, policymakers should emphasize on increased availability and use of integrated SRH services (including contraceptives, sanitary towels, maternal health, and HIV education) that are gender-responsive and meet the human rights standards for equitable access to healthcare.

#### **e) Comprehensive Sexuality Education**

Comprehensive sexuality education does not only teach about sexual activities, but also helps the youth to understand their bodies during the developmental stages and who they will become as unique individuals, including information about sex roles, sexual hygiene, and rules of social interactions (Wilson, *et al.*, 2010).

Generally young people lack comprehensive sexuality education and SRH services. Parents are mostly reluctant to openly engage in a discussion with their children on matters relating to their sexuality (WHO, 2015). According to Stein, *et al.* (2017), this reluctance comes from the perceived threat of sexual complications, parents not being well-informed in many areas regarding adolescent sexuality (Wilson, *et al.*, 2010), children's immaturity and their inability to understand the information. Health care providers may also lack adequate knowledge on sexuality, leading to them offering inappropriate SRH services to adolescent patients (Luchowski, *et al.*, 2014).

#### **f) STI-Related Issues**

The WHO classifies STI incidence as most prevalent among adolescents compared with any other age bracket. This is caused by adolescents having the wrong perspective of HIV risks or ignoring these risks altogether, engaging in unsafe sex while also indulging in alcohol and drug abuse (WHO, 2019).

This exposes a critical opportunity for governments, especially from Low and Middle-Income Countries (LMICs), to implement policy reforms and innovative approaches to adequately handle STI prevention for adolescents.



### **g) Protection from Sexual Abuse and Violence**

Sexual abuse and violence against young people result in grave psychological, physical, and social harm including unsafe abortions, unintended pregnancies and STIs. Statistics from UNICEF indicate that, globally, every 1 in 10 girls (roughly 120 million) under the age of 20 has encountered sexual coercion. These figures could as well be much higher. KDHS (2014) reported that 7% girls aged between 15-19 years experienced sexual violence. 32% girls reported cases of physical violence while 33% of girls reported the cases of sexual and physical violence.

UNICEF urges governments and relevant prevention programs to develop and reinforce rules and policies against sexual abuse and violence, and improve on health accessibility, justice, social services, and education that will aid teen-age survivors recover from the effects of such violence. New resources should also be directed towards changing social customs that encourage sexual violence and continue a culture of not speaking out among adolescents.

### **h) Role of men in Reproductive Health**

Kabagenyi et al. (2014) have provided the rationale for the limited part that men play in reproductive health. This includes limited knowledge and awareness concerning the specific roles played by men in reproductive health, supposed side effects of feminine contraceptive methods that interferes with sexual activity, unavailability of adequate options for male contraceptives, assumptions that reproductive health was a woman's domain owing to old beliefs, and preference for large family sizes. Onyango et al. (2010) have identified the factors that influence male participation in reproductive health as gender customs and the old methods used to implement reproductive health and family planning programs. Considering that decision-making on reproductive health a shared responsibility of men and women, any effective system must involve both males and females. The range of strategies suggested by Davis et al. (2016) that would enhance men's participation in reproductive health include engaging boys and men early in the life cycle, in community and clinical settings, and making health services that are more male-friendly.

## **2.3. Application of Mobile Health (MHealth) to SRH**

According to Källander et al., (2013), mHealth is “the use of portable electronic devices with software applications to provide health services and manage patient information.” WHO categorizes mHealth as a constituent of electronic health (e-health) that provides information and health services through mobile technologies such as cell phones and Personal Digital Assistants

(PDAs). An approximate 5 billion people use mobile phones globally, which means that there are numerous opportunities for mHealth to formally adjust health services, mainly in low and middle-income countries.

Mhealth is considered appealing owing to its far reach and low setup costs and ability to convey appropriate health information to users (Rokicki, *et al.*, 2017). According to Mehl, *et al.*, (2014) mHealth offers many benefits, including: easier provision of health information to people; timely health reporting, hence improving disease prevention; better aggregation of health data for research and disease surveillance; decision-making support for healthcare professionals thus improving healthcare service delivery; better management of health conditions, treatment, and outcomes; and easier access to healthcare services.

Adolescents report cases of discrimination, stigma, lack of privacy and confidentiality, cost constraints and transport challenges while seeking SRH services. (Chandra-Mouli, *et al.*, 2014). This provides an opportunity for mHealth to enable adolescents to access SRH services discreetly, and in confidence (Ahmed, 2020). Using mobile phones to deliver SRH services is highly attractive to adolescents and results in better SRH outcomes. A few studies conducted in Kenya and Tanzania have established the feasibility of delivering SRH services to adolescents through mobile phones (Ippoliti, *et al.*, 2017). Mhealth depends on prevailing health programs such as health education to fill the void on inaccessibility of quality SRH education, behavioral change communication and SRH services information (Mehl, *et al.*, 2014).

## 2.4. A Review of Existing Studies

Researchers and IT professionals from different parts of Sub-Saharan Africa have developed various kinds of interventions aimed at promoting SRH. This review focused on web and mobile based interventions as summarized below:

Table 1: Existing studies summary

	Document/Program	Summary	Focus	Take-away
1	Potential for Using Online and Mobile Education with Parents and Adolescents to Impact Sexual and Reproductive Health (Guilamo-Ramos, <i>et al.</i> , 2015)	This study examined the viability and appropriateness of online and mobile-based adolescent sexual health interventions for African American and Latino families.	SRH engagement between adolescents and parents (Empirical literature)	The study encouraged parents and adolescents were encouraged to get information on sexual health using the online and mobile technologies because of their accessibility, extensive use, and capability to deliver large quantities of information.
2	Integrating Mobile Phones into Medical Abortion Provision: Intervention Development, Use, and Lessons Learned from a Randomized Controlled Trial, South Africa (De Tolly, <i>et al.</i> , 2014).	Mobile-based intervention to facilitate access to SRH services (e.g., medical abortions, family planning, contraceptives) to youth aged 18–29 years.	Accessibility to SRH services (Mobile intervention)	The study findings and conclusion suggested that mobile technology would greatly contribute to better accessibility and provision of SRH services.
3	Using Technology, New Media, and Mobile for Sexual and Reproductive Health, USA (Levine, 2011)	The article describes some of the popular technologies used by youth currently, plus case examples that demonstrate ways in which that technology is being used for sexual and reproductive health.	SRH technologies for the youth (Study explored some of the technologies that are popular with young people, demonstrating how technology is being used in SRH)	The study encourages professionals and stakeholders in the SRH field to stay well-informed of new media and online and mobile technology to communicate well with the youth on how to sustain lifelong sexual health.
4	Sexual and Reproductive Health for Young Adults in Colombia: Teleconsultation Using Mobile Devices, Colombia (Lopez, <i>et al.</i> , 2014).	Developed a mobile solution that allowed the youth to enquire about SRH issues.	Mobile-based SRH solutions for the youth (Mobile intervention to provide SRH education and services to university students)	Focus on promoting educational strategies for SRH and provide adolescents and young adult with easily available tools that have reliable information on SRH irrespective of their socioeconomic position.

## 2.5. Review of Existing Systems

In Kenya and across Sub-Saharan Africa various apps and tools have developed as interventions aimed at promoting. They include the following, most of which are available in Google Play:

**m4RH:** This is an app by FHI 360 that aims at promoting SRH and family planning information service for ages 29 years or younger. It also offers links to SRH services. The app uses SMS programs that include role model stories of FP use (<https://www.fhi360.org/projects/mobile-reproductive-health-m4rh>).

**Ma3looma:** This is an app developed in Egypt that addresses concerns raised on SRH by young people in the 10–29 age bracket in and out of schools. Qualified counselors from local organizations offer swift, precise, and non-judgmental responses. Health promotion is done through a mobile and web-based question-and-answer service, and Facebook chat.

Ma3looma advocates for the use of social media to expose the Egyptian youth to the digital era to address SRH issues (<https://www.oneworld.org/2013/09/19/ma3looma/>)

**InfoAdoJeunes:** This is an educational and information sharing tool ,on sexual and reproductive health, that was developed in Togo for the young people that is aimed at improving the young person’s sexual and reproductive health during COVID-19 (<https://www.ippfar.org/blogs/new-mobile-app-thats-helping-improve-young-peoples-sexual-and-reproductive-health-togo>).

**Info Ado Senegal:** This is a mobile-based tool that offers a platform where youth, in and out of school, aged 11-34 years, can ask questions on SRH issues to trained counselors from the local organizations and receive answers that are rapid, accurate, and non-judgmental. It serves to promote health using SMS and web-based question-and-answer service for the youth (<https://www.infoado.org/qui-sommes-nous>).

**Nishauri:** An app that employs a USSD platform, complemented by SMS to provide confidential, reliable, and timely information, when there is no one else to ask. Nishauri offers a platform for mobile counseling services aimed at connecting counselors who are skilled in HIV/AIDS and STI prevention to hundreds of youths looking for answers from safe and private sources.

Nishauri was developed by Stanford University in partnership with Mathare Youth Sports Association (<https://hci.stanford.edu/courses/cs379l/2011/projects/nishuuri.html>).

**RADA:** An innovative mobile application developed by the University of Nairobi in partnership with UNESCO and SRHR Alliance to provide a safe space for students to access information on sexual and reproductive health, dating tips, HIV and AIDS, alcohol and drug abuse, mental health, general health, safety of campus students and career guidance. It aims to empower university students and other young people in Kenya and beyond with correct information so that they can make informed decisions. <https://www.uonbi.ac.ke/rada-app>

**Ushauri:** This app provides a simple user interface using a chat bot application embedded in Facebook messenger to enable adolescents to seek and acquire healthcare information. The platform provides information about wellness, peer support and access, as well as follow-up to medical support ([https://make-it-initiative.org/africa/cpt\\_startup/ushauri/](https://make-it-initiative.org/africa/cpt_startup/ushauri/)).

**Reprodutiva:** Developed in Timor-Leste by Plan International to curb high rates of teenage pregnancies, this application offers a safe and private space for young people where they can get answers to their SRH questions by professionals. <https://plan-international.org/sexual-health/app-helps-avoid-teenage-pregnancy>.

**Free to Be:** This is an interactive map of the city that allows girls and women to share locations that they love, avoid, feel safe in and think can be improved and answer few questions about their experiences there, as well as leave comments through a short survey. This solution is currently being implemented in 8 cities in different countries. <https://plan-international.org/sexual-health/app-helps-avoid-teenage-pregnancy>

**Age Verification:** This is an age-verification application that was developed by Plan International in collaboration with the Bangladesh government aimed at averting child marriages. The solution allows matchmakers, priests and officers who register marriages to verify the bride and groom's ages through a digital database. The bride and groom will be given a greenlight to proceed with the marriage if they are over 18 years of age, else the marriage will be terminated. <https://plan-international.org/sexual-health/app-helps-avoid-teenage-pregnancy>

## 2.6. The Gaps

The different studies and applications identified for this review aimed to promote better accessibility to SRH information and services (Guilamo-Ramos, *et al.*, 2015, Lopez, *et al.*, 2014, De Tolly, *et al.*, 2014), while also providing psychosocial support to young people (Levine, 2011).

These studies and programs advocated for the use of mHealth to address SRH issues for the youth. In some interventions, young people were able to consult health professionals on SRH issues and access SRH-related content. These interventions also ensured that the youth received SRH content on their mobile devices via SMS on a regular basis ([Info Ado: Apprendre a Vivre Senegal](#)).

Accessibility of SRH services (e.g., contraceptives, sanitary towels) was severally highlighted as a major challenge for young people. In a few of the interventions, mHealth was applied to connect the young people with SRH services. Mobile based interventions were found to be relatively cheap and have a farther reach specifically amongst the youth (Lopez, *et al.*, 2014).

Though interventions that use SMS have recorded positive outcomes amongst the participants, they are not the best intervention mode when it comes to reaching young people. Additionally, SMS based solutions require that users subscribe with their phone numbers. This may compromise the privacy needs of young people. For interventions that apply technologies such as smartphones and wearables, young people can access SRH information anonymously without necessarily providing personal information.

Though some smartphone-based apps have been developed to promote SRH (Feroz, 2021), there is little evidence on the outcome of these interventions due to limited studies on the same. Smartphones and wearables can be used to deliver SRH solutions, but there is little literature covering the same.

## **2.7. Proposed Solution**

The proposed intervention combined a mobile app, a web-based platform, and a wearable to enable young people to link with nearby SRH access points, monitor their SRH, and actively engage with SRH-related information like menstrual hygiene, contraceptives, and sexuality content and send alerts in case of emergencies to their listed emergency contacts. The mobile application provides the young people with a platform to see the available products and services by the different providers. They are also able to compare the prices for the different products or services from the different providers. It also allows them to book appointments for different services in their preferred service points with ease and hence help reduce the waiting time in the hospitals. It also gives the users the flexibility of cancelling appointments when they cannot honor them. The list of service providers in the app also allows the users to find providers near them as it gives approximate distance between the app user and the service provider or location where the product

is located. There is a blog section on the app that allows the users to read information on various topics as posted by the healthcare providers. The application also has an SOS feature that allows the users to send an SOS alert anytime they are in danger or in an emergency. They can do this by first ensuring that they have enlisted one or two emergency contacts under their profile. The SOS has information regarding their last known location by giving the geocodes and name of the place. The application requires that one logs in before viewing any information hence providing the user with a safe platform of getting more information.

The web platform allows the healthcare providers to add products or services that they are offering, see their customers and the bookings that have been made and generate reports.

The smart wearable has one key function which is to enable the users initiate an SOS in case of an emergency without having to log into the system.

This solution is different from the existing ones as it gives the young person an opportunity to get correct information on SRH services and to seek them with ease. Stigma was cited as one of the biggest contributors as to why young people do not seek SRH services. This solution will help reduce this as it will allow the young people select providers that offer young people friendly SRH services. High cost of SRH services was also listed as a hinderance and this solution will be useful as it provided the ability to compare the costs of different products and services. This solution is very timely since there has been an increased number of early pregnancies among the young people in the recent years. UNICEF Press Release (2020) reported that one third of adolescent girls aged 15-19 years in Homabay County were mothers or pregnant as at the time of the publication. The report also showed that 13% of the new HIV infections in the country were youth aged between 15-24 years of age(<https://www.unicef.org/kenya/press-releases/action-urged-teenage-pregnancy-and-hiv-new-report-reveals-high-rates-homa-bay>).Fig1 depicts the conceptual system architecture of the proposed systems.

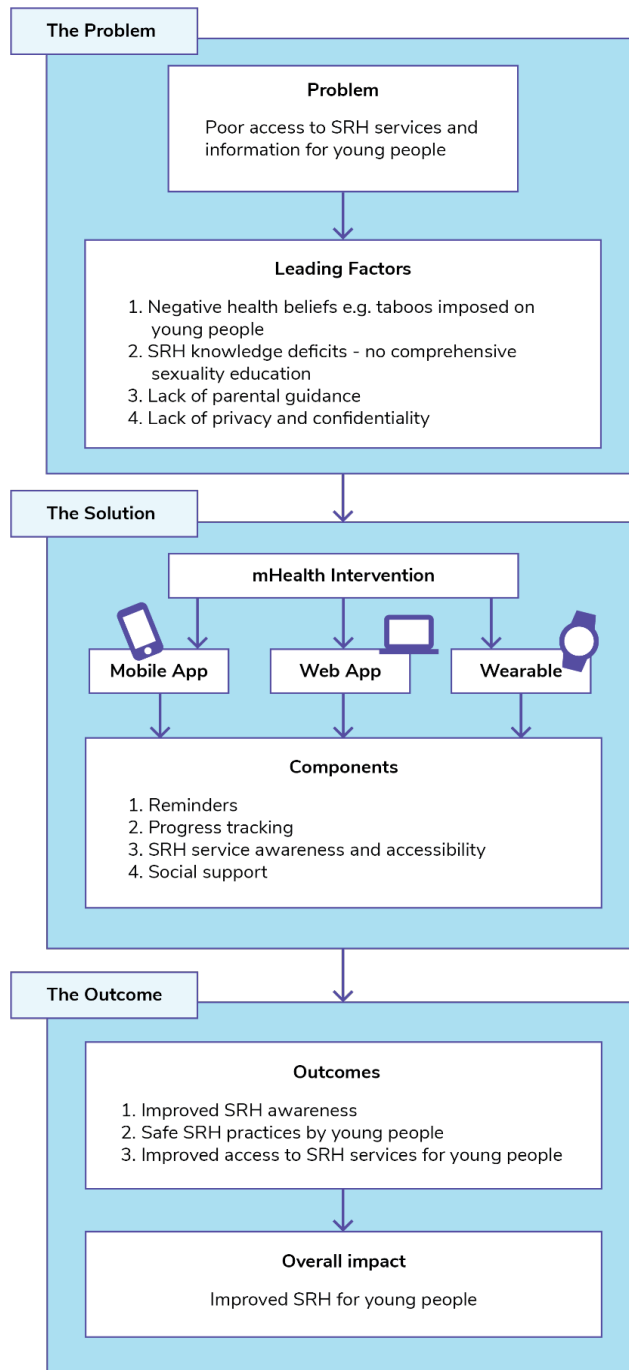


Figure 1: Conceptual architecture



## **CHAPTER 3: RESEARCH METHODOLOGY**

This chapter details the methodology used in this research to get the target population, sampling techniques, data collected from the field, analysis methods, design and develop the application and ethical concerns that were considered while conducting the research.

### **3.1. Research Design**

The study employed descriptive research which engaged a mix of both qualitative and quantitative approaches to successfully achieve its goals. This was done to enable the researcher to generalize the proposed solution's feasibility in health.

### **3.2. Proof of Concept**

The proof of concept was achieved by the development and testing of the prototype with young people and healthcare professionals. A System Usability Scale was administered to 15 respondents to measure the system's usability. Typically, evaluation was essential for us to derive if the prototype was feasible.

#### **3.2.1. Target Population**

The target population was a group of young people from the Young People Program under the AIDS Healthcare Foundation (AHF) (<https://www.aidshealth.org/global/Kenya/>). This is an initiative to foster leadership and confidence for young people by supporting each other, strengthening fundamental life skills, and developing community activism.

#### **3.2.2. Sample Size**

The target population involved young people and healthcare professionals. The sample size was 180 participants. A reasonable sample size should be in the range of 12 to 60 participants, though it may vary from one situation to another (Adler, 2012). Purposive sampling, which is a non-probability form of sampling, was employed since the research participants were individuals within subgroups of interests, these being: adolescent and young people and healthcare professionals.

#### **3.2.3. Data Collection**

##### **Questionnaires**

The study employed a structured approach, using both open-ended and closed-ended questions to collect data from respondents. Closed-ended questions were coded using a Likert scale to facilitate

efficient analysis. Open-ended questions allowed the respondent to freely elaborate their opinions where applicable and with an open mind. These questionnaires were distributed to the main stakeholders of the study. The advantage of questionnaires is that they are simple to administer and further ease the data analysis process. The participants consented to allowing their data to be used in the analysis of the research results. The questionnaire contained (Appendix 2) the following key questions:

1. What factors influence accessibility of SRH information and services?
2. What are the sources of SRH information and services to young people?
3. What SRH information and services do young people seek/need?
4. How important is privacy and confidentiality to young people while accessing SRH services?
5. What if a mobile-based system were to be introduced to enhance the accessibility of SRH services to young people, how useful would it be?
6. How do young people find it when talking with their parents/teachers/peers about SRH?

#### **3.2.4. Data Analysis**

Data analysis helps to make sense of collected data. Data analysis is categorized into qualitative and quantitative analysis.

##### **Qualitative Analysis**

This type of analysis involves unquantifiable data such as raw data collected through interviews and questionnaires. In this research, data gathered from the main respondents were analyzed systematically to draw meaningful and useful conclusions and make recommendations. To establish a pattern, responses from different respondents were studied to identify similarities and differences.

##### **Quantitative Analysis**

This was done when studying closed-ended questions that had preset responses and were assigned numerical values. It helped in acquiring definitive statistics and eventually informed conclusions and recommendations.

### **3.3. Research Ethics and Authorization**

Permission was sought from the relevant authorities including from the School of Computing, University of Nairobi, and the target population. Ethical concerns, such as confidentiality and avoidance of harm, were addressed through a form of consent, which was willingly signed by

voluntary research participants. They were informed of the envisioned purpose and type of the research. All responses and information from participants were regarded as confidential and were solely used in this research.

### 3.4. System Development Methodology

Rapid Application Development (RAD) process, which was used in developing the prototype (Fig. 3.1), is a form of Agile Software Development Methodology. RAD is an elaborate process that allows the software developer to prototype and perform rapid cycles of iterative development to expedite the development process. It is organized to understand user needs (through focus groups or workshops) and allows the re-use of software components, thus helping the developer to work more efficiently.

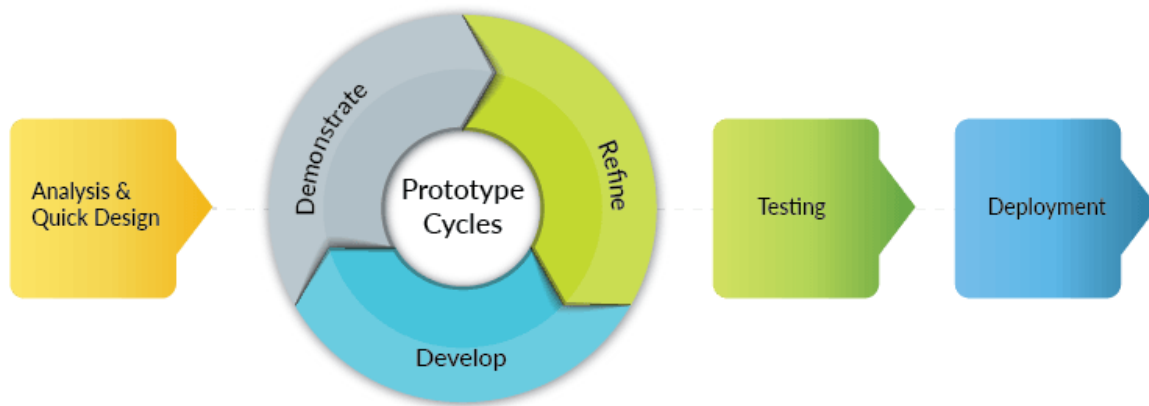


Figure 2: RAD Process. (Source: wavemaker.com)

RAD was adopted due to its simplicity, ease of use and allowing a breakdown into smaller, manageable, and achievable tasks. Its iterative aspect allows for time-to-time alterations to application features that may not have been keenly perceived during the analysis & quick design stage. The development followed the following steps:

**Analysis and Design** - This step involved figuring out the system requirements and what the project was supposed to accomplish. The researcher needed to understand who the users of the system were, how they would use the system, and what data would be pertinent to the system in terms of input and output. They also needed to come up with the estimated project's budget and timeline.

**Prototyping** - This process allowed the developer to refine and adjust the prototype through iterative efforts. System design specifications from the first step assist the researcher in determining the appropriate input for implementation and coding.

**Testing** - The system was tested to ensure that it was performing as desired. Testing was done with young people from the target population to assess the system's functionality.

**Deployment** - This stage initiates after successful testing, where the implemented model is delivered to the users for first use. Users are also trained on how to use the system. However, since this is a prototype, full deployment will not be undertaken.

## CHAPTER 4: RESULTS AND DISCUSSION

This chapter show cases the results, findings from data analysis, data presentation, and discussions.

### 4.1. Key Findings

The data was gathered, analyzed, and interpreted based on the research objectives and questions. Research and data collection was done prior to prototype development because we needed to fully understand the SRH context of young people based on the study's objectives.

#### 4.1.1. Sociodemographic

The total sample population for the data collection reached 157 (96 young people and 61 Healthcare Professional).

*Table 2:Healthcare Professional Education*

Age group * The highest level of education Cross-tabulation					
		Highest level of education			Total
		Primary	Secondary	Tertiary	
Age group	18 – 24	0	0	6	6
	25 – 34	0	1	24	25
	35 – 44	1	0	22	23
	Over 45 years	0	0	7	7
Total		1	1	59	61

96.7% of the healthcare professionals had reached tertiary education levels. 24 were male while 37 were female (Table 2).

*Table 3:Healthcare Professional Practice*

Sex * Practice Cross-tabulation							
		Practice					Total
		General practitioner	Clinical officer	Social worker	Nurse	Counselor	
Sex	Male	0	8	0	11	5	24
	Female	2	5	5	18	7	37
Total		2	13	5	29	12	61

Nurses and clinical officers made 47.5% and 21.3% of the population, respectively (Table 3).

Table 4: Young People age group and sex

Age group * Sex				
		Sex		Total
		Male	Female	
Age group	10 - 14	1 (5.26%)	1 (1.30%)	2 (2.08%)
	15 - 19	9 (47.37%)	28 (36.36%)	37 (38.54%)
	20 - 24	9 (47.37%)	48 (62.34%)	57 (59.38%)
Total		19 (100%)	77 (100%)	96 (100%)

Out of the 96 participants in the young people target group, 19 were male, while 77 were female. 65.6% of this population was in secondary level education. 57 out of the 96 (59.38%) young people fell under the 20 – 24 years age group (Table 4).

Table 5: Young people cohorts

Cohort				
		Frequency	Percent	Valid Percent
Valid	No response	3	3.1	3.1
	Mathare	18	18.8	18.8
	Mukuru	16	16.7	16.7
	Utena	15	15.6	15.6
	MYSA	16	16.7	16.7
	Junda	13	13.5	13.5
	Kisauni	15	15.6	15.6
	Total	96	100.0	100.0

There was an almost even distribution of participants among the 6 cohorts in Nairobi and Mombasa (Table 5).

#### 4.1.2. SRH Information

Of the 258 responses recorded by the 96 young people respondents, 30.6% indicated that the most common source of education on SRH topics was through the internet. Young people also

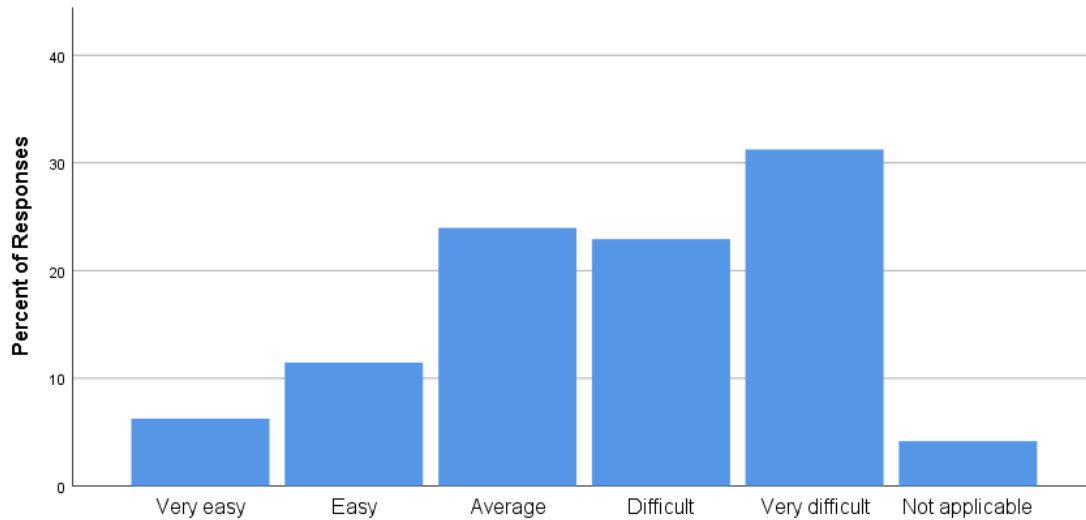
highlighted their interest in SRH information being delivered through media. 15.9% out of the 258 recorded responses acknowledged that they received or came across SRH information on media. The youth in the 21<sup>st</sup> century have grown up with technology, and it has become an embedded part of their lives hence they do not consider the internet or cell phones as tools. They feel they cannot do without either (Levine, 2011). These results give further insight into the accessibility needs of young people regarding SRH education through their mobile devices.

Table 6: Sources of SRH education

Sources of SRH education				
		Responses		Percent of Cases
		N	Percent	
Where do you learn about SRH? ( <i>n</i> =258)	Home	16	6.2%	16.8%
	School	39	15.1%	41.1%
	Church/mosque/temple	12	4.7%	12.6%
	Internet e.g. YouTube	79	30.6%	83.2%
	Media e.g. TV, radio	41	15.9%	43.2%
	Peers	27	10.5%	28.4%
	Health facilities	35	13.6%	36.8%
	Other. Please specify	9	3.5%	9.5%
Total		258	100.0%	271.6%

Home education was distinctively low, with only 6.18% of the total responses indicating that they received SRH information from their home environments, either from their parents or siblings (Table 6). According to Wamoyi, *et al.* (2010), although young people discuss SRH issues with their parents, they lack the confidence to freely engage them for fear of punishment (Figure 3). Parents also have inadequate knowledge on SRH and are limited by the cultural norms that restrict interactions between opposite sex thereby limiting on what they communicate with the young people.

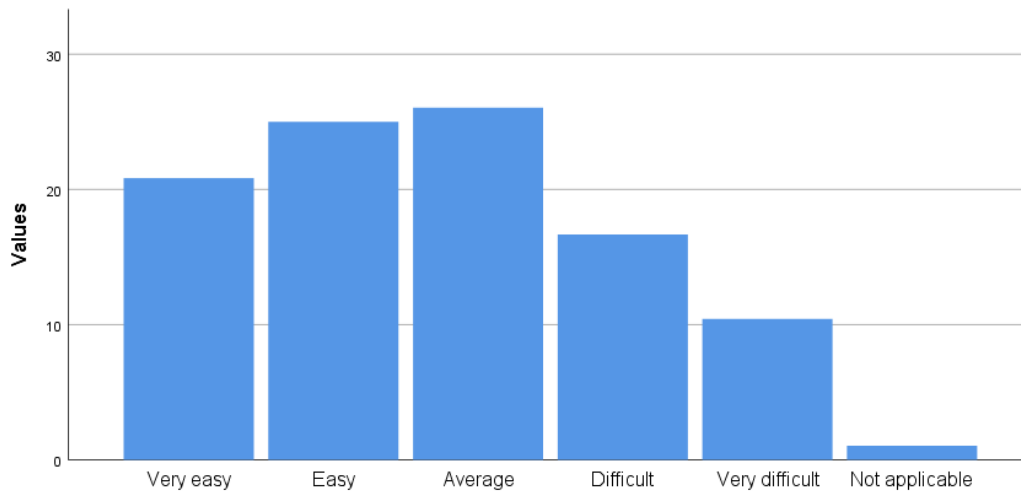
**How do you find it talking with your parents about SRH?**



*Figure 3: Young people find it very difficult to discuss SRH with their parents*

SRH education at school was also in the lower percentiles (15.06% of 258 responses). According to Hakim (2012), teachers are generally uncomfortable teaching SRH topics. Most of them either skip the topic or teach it at a superficial level, leaving out a lot of crucial information. Consequently, such discomfort among teachers could invariably form a distinct lack of confidence in students to approach them on SRH matters.

**How do you find it talking with your teachers about SRH?**



*Figure 4: Young people are more at ease discussing SRH with their teachers*

However, for this study, young people were more disposed to speak to their teachers than parents about SRH as seen in *Figure 4* above. Only a small number (10.4% out of 96 respondents) found it very difficult to talk with their teachers about SRH.



Table 7: Preferred type of health facility

Choice of facility and reasons for such preference						
		What reasons influenced your choice?				Total
		No response	More accessible	Private, personalized services	Cheap/free/better services	
Government, NGO, or private health facility? (n=96)	No response	6	0	1	0	7
	Government	15	5	1	36	57
	Private	6	3	12	1	22
	NGO	5	2	1	2	10
Total		32	10	15	39	96

59.4% of the 96 respondents mentioned that their last SRH-related visit was to a government facility. The most common cited reason for this was that government facilities offer cheaper/free or better services and were more accessible compared to other kinds of facilities. Those who visited private facilities ,22.9%, indicated that these facilities offer more private and personalized services and that it took less time to be attended to (Table 7). NGO facilities were least preferred, mainly because they are not quite as many.

### 4.1.3. Service-Seeking Trends

Table 8: Service seeking trends of young people (Responses from young people)

Cross-tabulation									
		How often have you sought SRH services or information from a doctor or nurse in the last twelve months?							Total
		No response	Weekly	Bi-weekly	Monthly	Quarterly	Twice yearly	Annually	
Visited a health facility or doctor to receive SRH services or information? (n=96)	No response	1	0	0	0	0	0	0	1
	Yes	1	1	0	42	8	9	10	71
	No	8	1	1	4	3	5	2	24
Total		10	2	1	46	11	14	12	96

Table 8 shows that 74% of the young people had previously sought SRH services and information on contraception, pregnancy, abortion, or sexually transmitted diseases. 59.1% of the 71 young people, who had previously sought SRH services and information, said that they mostly sought

SRH services or information from a doctor or nurse monthly in the past one year. This was corroborated by 41% of the healthcare professionals' responses.

According to Thongmixay, *et al.*, (2019), a common reason for adolescents not regularly communicating with or seeking SRH services from doctors and nurses or even is because of concerns about confidentiality resulting in lost opportunities for these adolescents to receive needed healthcare.

Table 9: Awareness of contraception

<b>Sex * Are you aware of contraception? Cross-tabulation</b>					
		Are you aware of contraception?			Total
		No response	Yes	No	
Sex	Male	0 (0%)	17 (89.47%)	2 (10.53%)	19 (100%)
	Female	2 (2.60%)	68 (88.31%)	7 (9.09%)	77 (100%)
Total		2 (2.08%)	85 (88.54%)	9 (9.38%)	96 (100%)

88.5% responded positively to awareness of contraception (Table 9).

Table 10: Contraception awareness

<b>Which of these contraceptive methods have you heard of?</b>				
		Responses		Percent of Cases
		N	Percent	
Which contraceptive methods do you know?	Condoms	85	25.9%	93.4%
	Contraceptive implants	44	13.4%	48.4%
	Contraceptive pills e.g., FemiPlan	65	19.8%	71.4%
	Contraceptive injection	65	19.8%	71.4%
	Emergency Contraception Pill	46	14.0%	50.5%
	Vasectomy	23	7.0%	25.3%
Total		328	100.0%	360.4%

Most young people were aware of contraception such as condoms, contraceptive implants, contraceptive pills e.g., FemiPlan, contraceptive injection, and emergency contraception pills. Condoms were the most previously used method of contraception among young people (35.8% of

123 recorded responses) (Table 10). At least 8.1% of the responses had used emergency contraceptives before (Table 11).

Table 11: Contraception usage

<b>Which of those contraceptive methods have you used before?</b>				
		Responses		Percent of Cases
		N	Percent	
Which contraception have you used before?	Condoms	44	35.8%	49.4%
	Contraceptive implants	8	6.5%	9.0%
	Contraceptive pills e.g., FemiPlan	9	7.3%	10.1%
	Contraceptive injection	5	4.1%	5.6%
	Emergency Contraception Pill	10	8.1%	11.2%
	Traditional Contraception (Withdrawal)	11	8.9%	12.4%
	None of the above	36	29.3%	40.4%
Total		123	100.0%	138.2%

#### 4.1.4. Perceived barriers in accessing SRH services.

Table 12: Importance of privacy and confidentiality – young people responses

<b>How important is privacy and confidentiality to you while accessing SRH services?</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	76	79.2	79.2	79.2
	Moderately important	5	5.2	5.2	84.4
	Important	10	10.4	10.4	94.8
	Slightly important	4	4.2	4.2	99.0
	Not important	1	1.0	1.0	100.0
	Total	96	100.0	100.0	

Table 13: Importance of privacy and confidentiality – Healthcare Professional responses

**How important is privacy and confidentiality to young people while accessing SRH services?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No response	1	1.6	1.6	1.6
	Very important	52	85.2	85.2	86.9
	Moderately important	5	8.2	8.2	95.1
	Important	2	3.3	3.3	98.4
	Slightly important	1	1.6	1.6	100.0
	Total	61	100.0	100.0	

23.4% of 197 responses by the young people cited lack of privacy and confidentiality as a major barrier for them while seeking SRH services (Figure 5) while 79.2% of them commented that privacy and confidentiality was very important to them while accessing these services (Table 12). This was supported by an 85.2% response rate by healthcare professionals which further substantiates that young people highly valued privacy and confidentiality as a primary factor while seeking SRH care (Table 13).

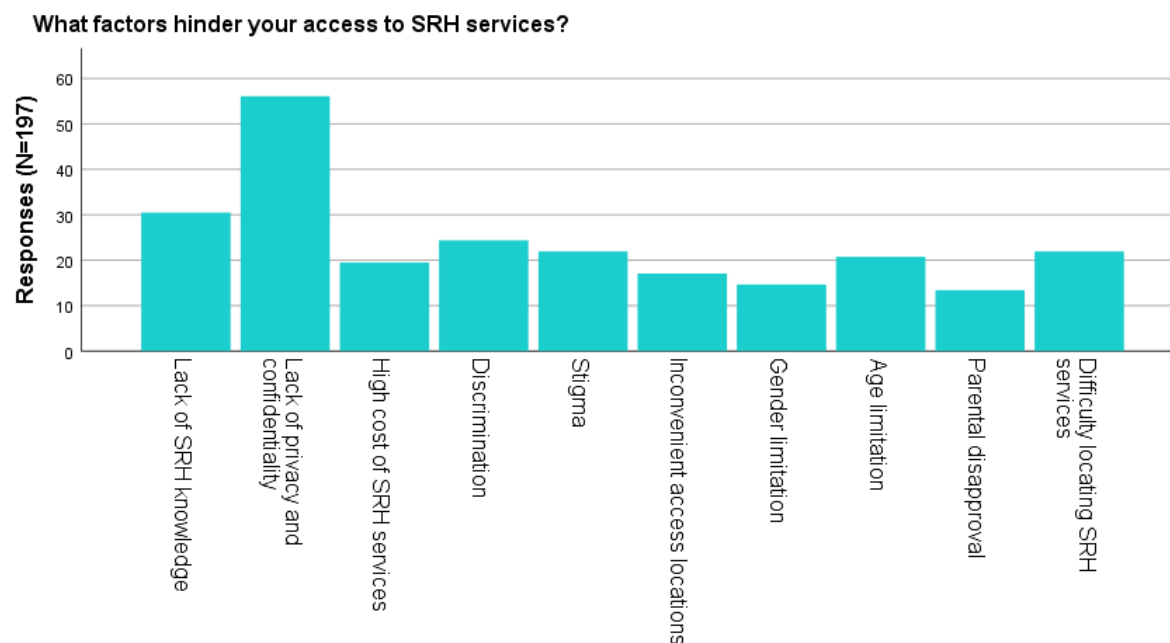


Figure 5: Perceived barriers in accessing SRH services – Young people responses

What factors do you think affect adolescents' access to SRH services?

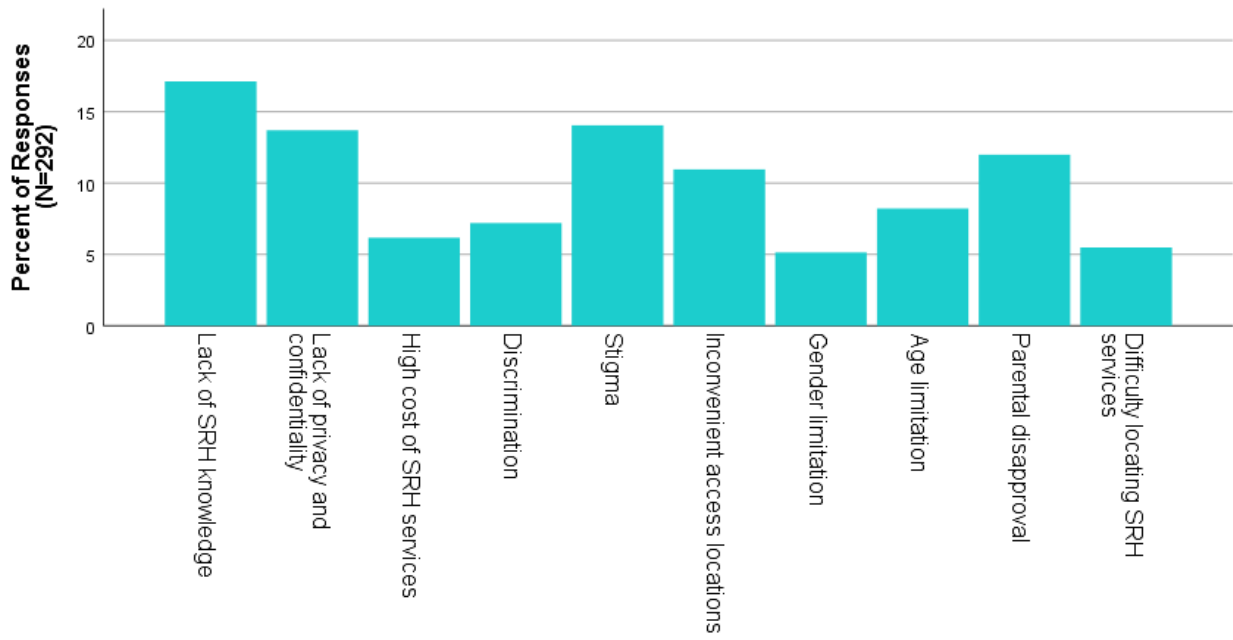


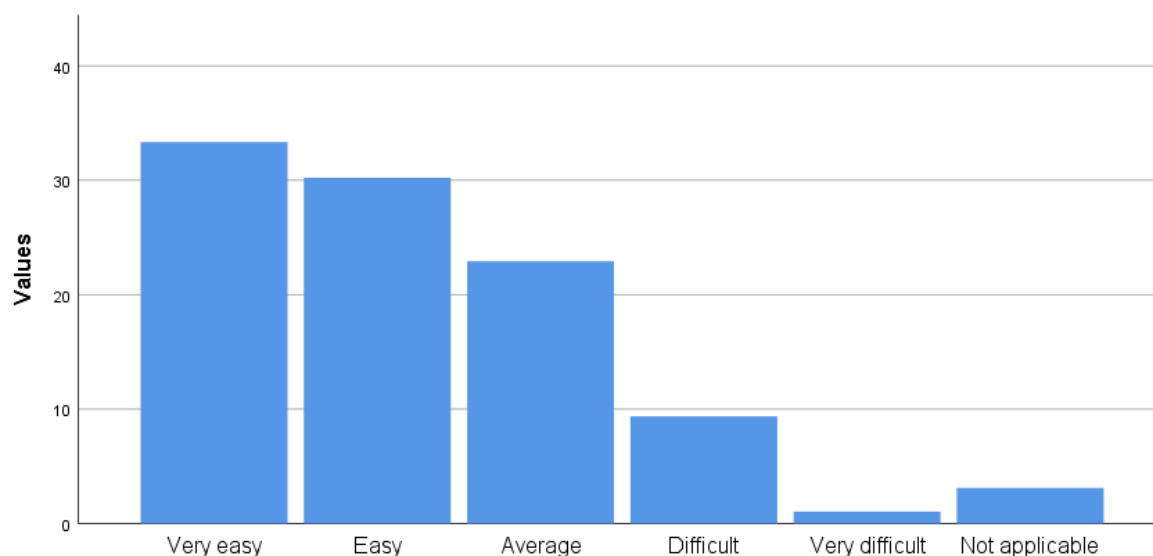
Figure 6: Perceived barriers in accessing SRH services – Healthcare professionals' responses

Another common factor hindering access to SRH services was lack of comprehensive SRH knowledge (Figure 5). 17.1% of recorded responses from healthcare professionals cited this as a highly possible factor influencing the youth's access to SRH services (Figure 6). Young people experience poor accessibility to SRH information and services, and discriminatory gender customs that results in poor SRH knowledge. This may result in grave consequences on young people's SRH and wellbeing (Cortez, *et al.*, 2014).

Other factors were also identified which included: high cost of services, discrimination, stigma, inconvenient access location, parental disapproval, age limitation and difficulty locating SRH services (Figure 5&6).

Majority of the young people admitted that accessing these services was relatively easy. They however indicated that their concern for privacy and confidentiality, high cost of services, little SRH knowledge and sometimes parental disapproval caused them to disregard seeking these services, even for their wellbeing (Figure 7).

**How difficult/easy is it for you to access SRH services?**



*Figure 7: Young people do not feel challenged accessing SRH services*

These results compound the importance of mHealth that will assist the young people to overcome most of the barriers that include stigmatization, discrimination, and parental disapproval, lack of privacy and confidentiality, embarrassment in seeking SRH education and services on highly sensitive topics, cost inhibitions, and transportation challenges, by providing accurate, safe, cost-effective, timely and tailored SRH services to young people.

#### **4.1.5. Importance of SRH education**

*Table 14: Importance of SRH education*

**How important is SRH education to you?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	83	86.5	86.5	86.5
	Moderately important	5	5.2	5.2	91.7
	Important	8	8.3	8.3	100.0
	Slightly important	0	0	0	100.0
	Not important	0	0	0	100.0
	Total	96	100.0	100.0	

Asked how important they felt SRH education was to them, 86.5% of young people said that it was very important (Table 14). They further indicated that it would be very important for both boys and girls to have equal access and knowledge on SRH. 88.5% of 61 Healthcare Professional agreed that SRH education towards young people’ well-being is very important. They also thought SRH education mattered to both boys and girls equally.

However, around 32.79% healthcare professionals found it averagely challenging discussing SRH with young people, 27.87% found it difficult while 14.57% felt that it was very easy connecting with young people on matters SRH (Table 15).

*Table 15: Discussing SRH with young people- Healthcare Professional*

**How do you find it talking with young people about SRH?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No response	1	1.6	1.6	1.6
	Very easy	9	14.8	14.8	16.4
	Easy	14	23.0	23.0	39.3
	Average	20	32.8	32.8	72.1
	Difficult	17	27.9	27.9	100.0
	Very difficult	0	0	0	100.0
	Total	61	100.0	100.0	

#### **4.1.6. Perceived Importance of a Mobile –Based SRH Intervention**

For both young people and Healthcare Professional, introducing a mobile-based SRH intervention would be very useful. One of the insights from Healthcare Professional was for any SRH intervention being rolled out to be young people responsive and have meaningful involvement in SRH services. This way, there will be a positive uptake of the solution by the young people and a consequent positive impact on the SRH wellbeing of young people.

What if a mobile-based system were to be introduced to enhance the accessibility of SRH services to adolescents and young adults, how would you rate it by usefulness?

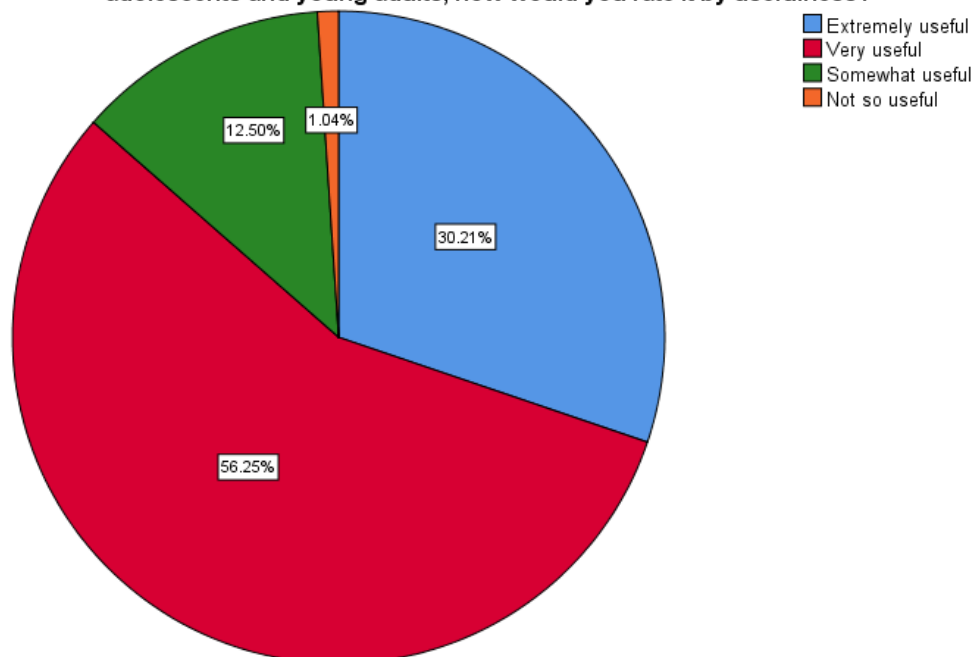


Figure 8: Perceived Importance of a Mobile –Based SRH Intervention

If barriers that would enhance the uptake of mHealth interventions, are adequately addressed, then there would be an increase in the potential use of mobile phones to improve access to SRH awareness and services for young people.

65.6% of the young people from the study already had smart phones or tablets. This is an indicator that the youth have an increasing engagement with smart technologies which accords them growing opportunities to learn and access SRH wherever they are, whenever they need, and as often as possible (Table 16).

Table 16: Devices owned by young people

**What kind of mobile device do you use?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Smartphone	61	63.5	63.5	63.5
	Feature phone	23	24.0	24.0	87.5
	Tablet	2	2.1	2.1	89.6
	No phone	10	10.4	10.4	100.0
	Total	96	100.0	100.0	



## **4.2. Suggestions for Improvement**

Both the healthcare workers and the young people pointed out that stigma and discrimination to service provision for young people was still a huge concern and if addressed, would greatly improve the context of SRH for young people. Below is a sample comment by a nurse on discrimination.

*“If discrimination is done away with and the healthy seeking behavior towards SRH among adolescents are sensitized, then we can help reduce the STD/STI/Unintended pregnancies among the adolescents and teenagers.” – Nurse.*

Stigmatized young people are most likely to be subjected to discrimination. Together, stigma and discrimination were recognized as major barriers to accessing quality SRH care and treatment services for young people.

In addition, respondents mentioned that besides building an SRH intervention, doing community outreach to bring the services to the young people would greatly improve their knowledge on SRH.

*“The mobile intervention is a great solution, but also starting youth friendly services which involve both sexes (male and female) would be a plus. Doing community outreaches such as in schools and churches to bring the services to young people will greatly improve their knowledge of SRH.” – Clinical Officer.*

Finally, policy gaps were identified and described as another factor which affected access and utilization of SRH services and education. The legal provisions to offer SRH services to young people need to be strengthened and highly considered ensuring that young people can enjoy the highest attainable standard of SRH and wellbeing.

## **4.3. Discussion Based on the Research Questions**

The findings demonstrated: the sources of SRH information; the service seeking trends of young people; and the key barriers among young people in accessing SRH information, and services in Kenya. The key takeaway from the study was that young people need frequent access to SRH services and education that efficiently address the growing, social, and personal needs.

### **4.3.1. Factors affecting accessibility of SRH information and services.**

Despite accessible services in health facilities and pharmacies, most young people thought the services did not exactly address their needs and were rather biased or their privacy and

confidentiality were wanting. lack of SRH knowledge was also identified as a common factor that hindered accessibility to SRH services was identified as. This made young people unwilling to seek care due to poor understanding of their changing bodies and insufficient awareness of risks that result from poor SRH practices such as early sexual debut, unhygienic menstrual health, and early pregnancy. The findings also indicated that young people do not think they adequately have access to materials talking about SRH services. Some suggestions from respondents included having youth-friendly forums and workshops that share and discuss ways to improve accessibility to and availability of SRH services. The 2010 - 2012 Reproductive Health Communication Strategy emphasizes the need to provide comprehensive SRH education and accessibility as a priority for young people for the purpose of improving their SRH.

All health care professionals who participated in the research reported that they provided health services to young people who visited them at the health facilities. The services offered included: fertility services; STI and HIV related services; prevention and treatment of unsafe abortion; menstrual hygiene; counseling and treatment; and condoms and lubricants provision. Health education, guidance and counseling, social support, and access to friendly SRH services and information were identified as the key SRH needs of young people. They also suggested that extending these services to schools and churches with the aim of reaching younger people and setting up young-people-friendly SRH clinics would help address the factors hindering access to SRH services and information,

#### **4.3.2. Sources of SRH information to young people**

Results indicated that young people received SRH education through different sources, with the most cited source being the internet. The reason for this preference was because the internet granted young people anonymity, and thus they felt confident to search for anything SRH-related.

The findings also showed that young people had very little SRH knowledge. Young people felt that they did not receive adequate SRH education either at home, school or when they visited health facilities. The reason for this was that teachers generally feel uncomfortable teaching SRH topics, and that some topics at school are covered more adequately than others. It was also common for parents to shy away from talking with their children about SRH which caused the young people to view the topic with doubt and shyness. This in turn influenced how these young people found the topics significant for them.

Healthcare professionals mentioned that many parents and teachers lacked enough skills and knowledge regarding the SRH needs of their children. This was emphasized by some of the research respondents on the importance of parents and teachers to learn and discuss SRH matters with the young people which will further help to create a friendly and healthy environment for them.

#### **4.4. Overview of Prototype Components**

The prototype developed (Fig. 9) was built as both a mobile app for use by young people, and a web-based system for service providers to view and process bookings and add or remove products and services they provide. These two applications accessed a common server to exchange user, services, and product information. All functionality of the prototype required an active data connection.

##### **4.4.1. Implementation**

###### **Database**

The database technology used was MongoDB which has the following advantages: -

- **Flexible document schemas:** A collection can contain documents with different properties, making it easy to embed documents together without creating relationships between them.
- **Code-native data access:** MongoDB can be accessed using multiple programming languages. Different modules can use different programming language but still have access to the same database.
- **Change-friendly design:** When a model changes it does not affect the documents which are already in the database. This makes it easy to add properties to the document without breaking the application.
- **Easy horizontal scale-out:** MongoDB is a distributed database. It allows the creation of clusters with real-time replication and shared high-throughput collections on several clusters to enhance performance and scale horizontally.

MongoDB indexes provider, services and products based on their geolocations, which enables querying of services, products and providers that are on a specific radius from the user's location.

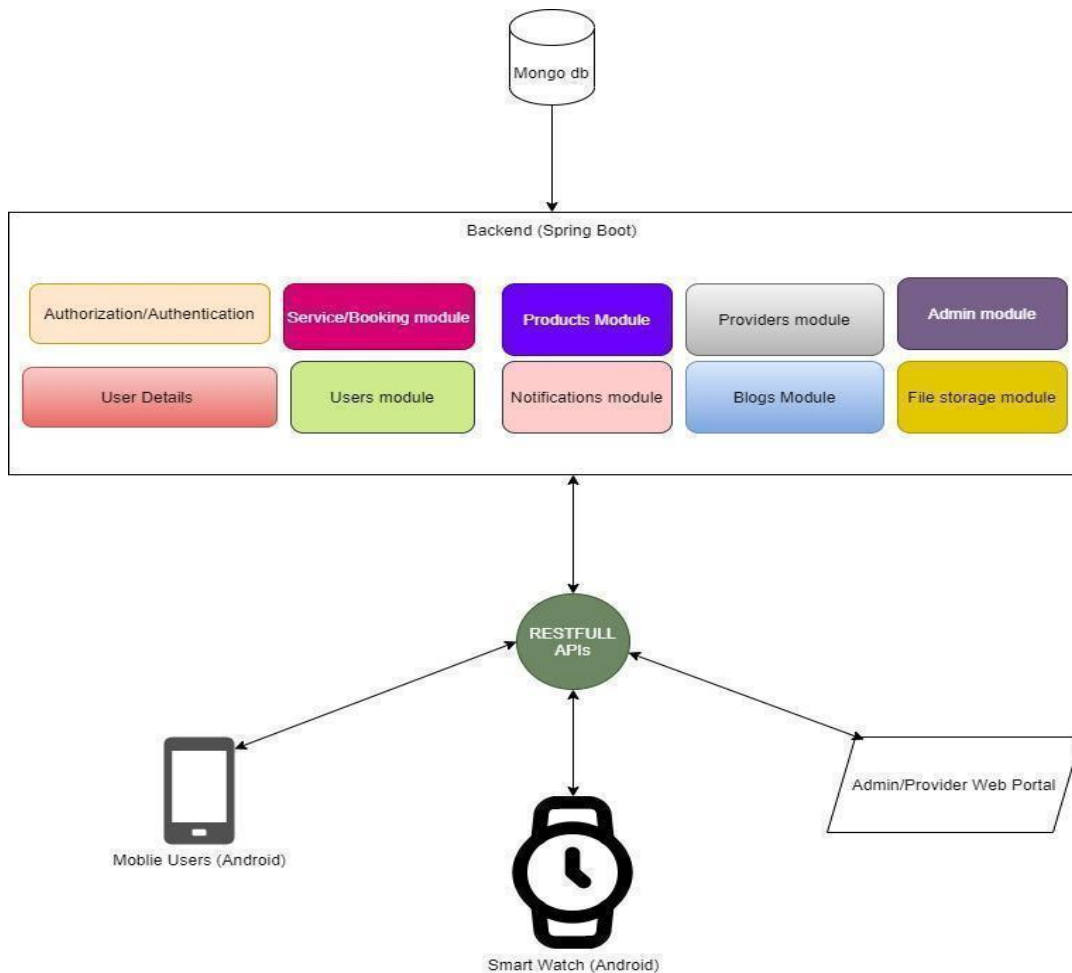


Figure 9: High Level Design

## Backend

The backend was implemented using Java programming language. Spring boot framework was used to create the restful APIs which are consumed by the frontend clients. The application has an embedded tomcat server that handles the http requests from the client.

The backend consists of the following modules:

### 1. User Details Module

This module manages the information about all the entities in the application. The user details include phone number, usernames, and passwords (hashed), use roles etc. The data is stored in a database that has an exposed module as a service with methods that can be used to manage the user details i.e., create, add, update, and delete user details.

## **2. Authorization and Authentication**

The authentication and authorization were implemented using spring security. Users are authenticated using their phone number and password/pin. The authentication filter is used to verify the user credentials by ensuring the password provided by the user matches the hashed password contained in the database. This is done with the help of Bcrypt Password Encoder that can generate and compare hashed passwords. When the user is successfully authenticated a JSON web token is returned as Authorization header on the response. The token contains this User ID as the subject. The token can be decoded by the authorization filter to identify the user making the request.

The authorization filter is used to intercept all the requests. Each request must be authorized which is done by decoding the JWT Bear token that is added to the Authorization request header to get the User ID. The User ID is then used to get the user roles assigned to the user. Each endpoint is protected by only allowing requests with specific authorities to access the endpoint. If the user does not have the required authority, then a 403 unauthorized http response is returned.

## **3. User Module**

This module handles the request for mobile users (young people). It includes methods to edit details that are specific to mobile users i.e., update emergency contact details, change PIN. All the requests to this module must be authenticated and have a USER role.

## **4. Notification Module**

The notification module is responsible for sending email and SMS to the users. The module uses Java Mail API to send notifications to the users i.e., sending service booking notification to the user and provider when a service is booked.

This module also integrates with Uwazii SMS gateway to send SMS to users' phone numbers. This is done by calling the rest API exposed by Uwazii API to send messages. The messages sent include the following.

- SOS signal messages sent to emergency contacts when a user is in danger or emergency.
- One time password sent when a user register.
- Change pin token sent to reset user account pin.

## **5. Products Module**

This module is responsible for storing the product details and provides the APIs to add, delete and edit the product details. The module can only be accessed by users with the Admin or Provider role.

## **6. Services/Bookings Module**

The module contains the APIs that are used to edit, add, and delete services which can only be done by users with the Admin or Provider role. The module is also used to keep track of the bookings made by users for each service. The bookings are unique to each service, date, and time i.e., 2 different users cannot book the same service at the same time. When a user books a service, a notification is sent to both the user and the service provider. Users can also cancel a booking.

## **7. Providers' Module**

This module exposes the APIs that are used on the providers' web portal to retrieve and manipulate the number of products and services that belong to a specific provider. This module can only be accessed by users with the Admin or Provider role. It is also responsible for generating daily booking metrics for the last 30 days. This information is represented as a line graph on the web portal.

## **8. Admin Module**

This module exposes information that can only be manipulated by the Admin. It is used to generate admin metrics such as monthly user count and daily bookings. The admin can also add, edit and delete service, product and provider details. The module also has APIs to add the main and subcategories for products and services.

## **9. Blogs Module**

This module exposed endpoints for adding blogs that are viewed on the mobile app. The blogs can only be added by the Admin. Users will only be able to view the blogs. The module also exposed additional APIs for the admin to add post category, add post, edit post, and delete post.

## **10. File Storage Module**

This module is responsible for adding and retrieving images of products and services. The module contains the endpoint for adding Multipart files, which are then stored on the file system and a link to retrieve the file is sent as response. Only the URL to retrieve the files are added to the database.

#### **4.4.2. Web Fronted.**

When a user logs in, the user is redirected to the dashboard based on their account type. The admin dashboard has the following operations: viewing the number of providers, products, bookings, providers, and services; tracking daily bookings count and monthly users count; adding, deleting and editing providers, services, products, categories and blogs.

The providers' dashboard has the following operations: adding, deleting, and editing services, products, profile; changing password; and viewing number of services, bookings and products.

The dashboard also integrates to google maps to allow picking the locations of providers, services and products. When a service or product is added, the location can be picked from a map shown on the web page. Both dashboards use fetch API to make requests to the backend APIs. The frontend was written in HTML, CSS3 and JavaScript.

#### **4.4.3. Deployment**

The application is deployed on the cloud, using Linode as the cloud provider. The Linux virtual machine is used to host both backend and frontend. The domain name *healthprisim.com* is pointed to the virtual machine public address. The following software was used to host both frontend and backend:

**Nginx:** used to serve the web pages on port 443. All the http requests on port 80 are then redirected to https on port 443. It also serves static assets such as JavaScript and CSS files.

**Maven:** used to build the backed application and generate the .jar file containing the compiled source code and all other dependencies.

**Java:** used to run the .jar file generated and start the application on port 8081. The applications only accept https traffic.

### **4.5. Mobile App Technical Documentation**

The mobile application allows a user on the app to browse through listed SRH products and services that they might be interested in. The user is also able to view nearby SRH service providers (such as chemists and health facilities) within their area.

A user is also able to book services as an appointment offered by different providers. As a bonus, there is a Blog section where young people can read through SRH-related articles.

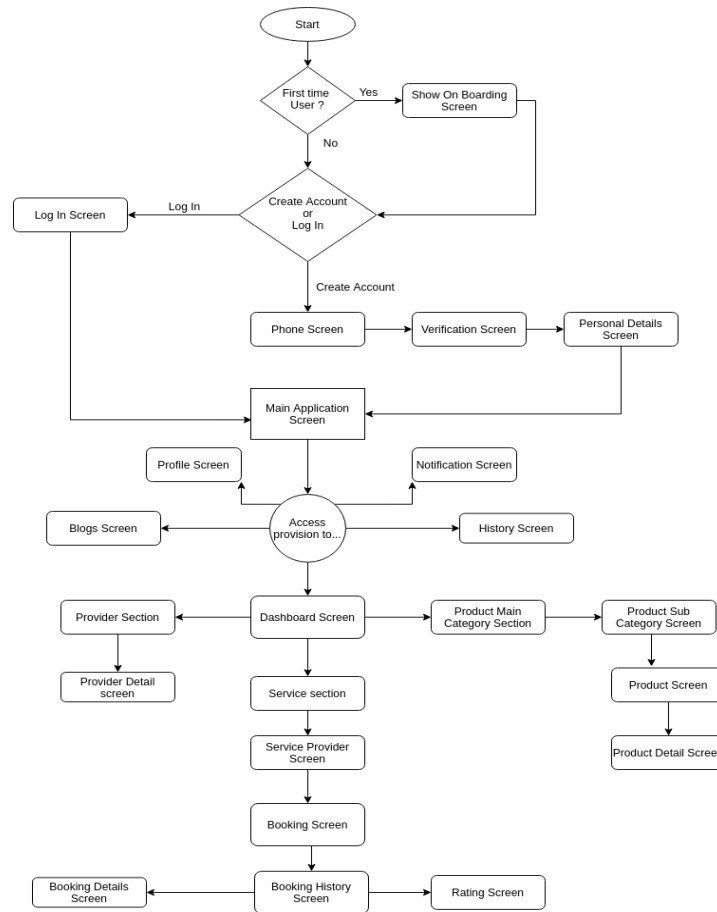


Figure 10: Application flow process

#### 4.5.1. Code Base Structure and Implementation.

The code base structure was designed in per-folder basis where related screens are contained in a specific folder. The code base had 10 folders: auth, model, network, onboarding, provider, screens, services, storage, util, and widget folders.

The entire code base was implemented using Riverpod library which is the state management tool utilized for the maintenance of the application at different screens of the application state.

#### 4.5.2. State Management

Generally, the entire app was designed to use Riverpod as the only state Management tool to preserve and maintain the application state at different screens and levels within the application. Riverpod offers a clear and cleaner way of handling states within an entire application without constant and frequent links which can result in app under-performance or deep links that cause screens to be tightly coupled.



### 4.5.3. Services

**Registration service:** This service uses the **sign-up user endpoint (/accounts/signUp)**, which is a **post method** that has a body of user object with the following parameters which are phoneNumber, firstname, lastname, gender, and date of birth while email is optional.

**Verification Service:** This service is applied during the creation of an account where a One Time Password (OTP) is sent to a first time-user's phone number to allow them to proceed with registration.

**Log in Service:** For this service, an endpoint is also consumed to verify if the user is registered and retrieve their user details before proceeding to the next screen.

**Product service:** This service displays the products to the user interacting with the application.

**Provider Service:** This service consumes a get request that retrieves all providers that are within the platform.

**Place Service Booking:** Service booking allows the user to book services with available providers.

**Service Booking days and hours:** For each service offered by a provider this service returns true or false according to the service bookings for the next 30 days and also checks on hours which have a status of true or false for hours between 7 AM and 5 PM.

**Bookings History service:** This service keeps track of all the service bookings done by the user.

**Rating Service:** This service allows the user to give feedback and rank providers based on quality of service.

**Cancel Booking Service:** This is a service to allow a user to cancel a service appointment they had made before.

**Emergency Services:** This service allows the initiation of an SOS message to the user's emergency contact list after a user taps the SOS button on the bottom navigation bar.

**Notification Service:** Through this service, a user can receive SRH updates and notifications of successful bookings and new services/products.

## 4.6. System Evaluation Results

Following development of the prototype, a system evaluation was conducted using the System Usability Scale (SUS) with 15 respondents (8 young people and 7 healthcare) from the original 157. The SUS is a reliable tool for measuring the perceived usability of a system. It comprises 10 statements, where participants rate their degree of agreement with each statement on a scale of 1 - 5 where 1 is "Strongly Disagree" and 5 is "Strongly Agree".

The respondents were required to first familiarize themselves with the entire prototype and then fill in the SUS questionnaire. The SUS returned a score of 75.3 out of 100, which meant that the system was satisfactory and potentially useful (Fig. 11).

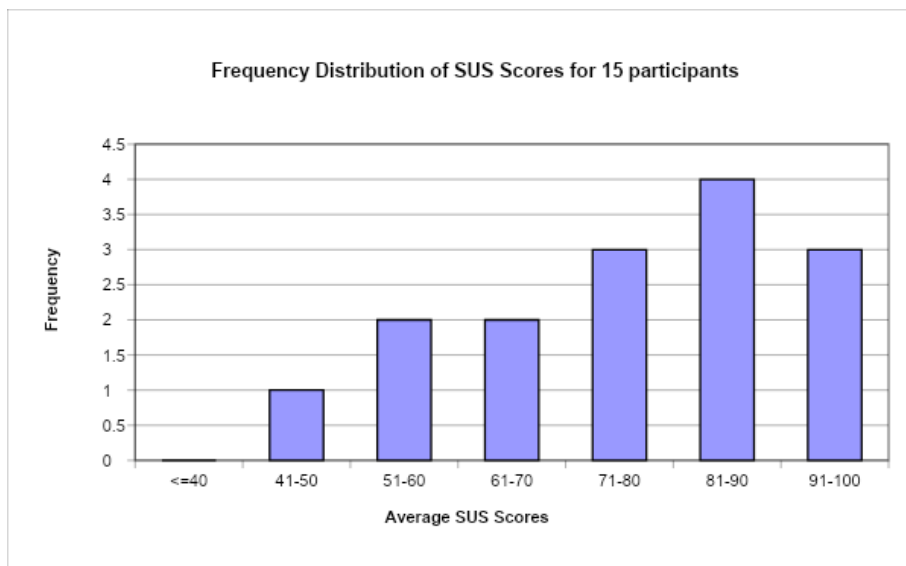


Figure 11: Frequency Distribution of SUS Scores for 15 participants

To design a suitability score, we had to compile the scores from each question by each respondent. For each odd-numbered question (1, 3, 5, 7, or 9), we subtracted 1 from the given score. For instance, if a respondent gave a score of 1 point for either question 1, each of these scores would be adjusted by deducting 1 from 5 which equals 4.

For each even-numbered question (2, 4, 6, 8, 10), the score had to be deducted from 5. For example, if a respondent gave a score of 4 points for question 2, we would deduct 4 from 5 which equals 1. The scores from all the even and odd numbered questions were then summed up and the result multiplied by 2.5 to give the final usability score (out of 100).

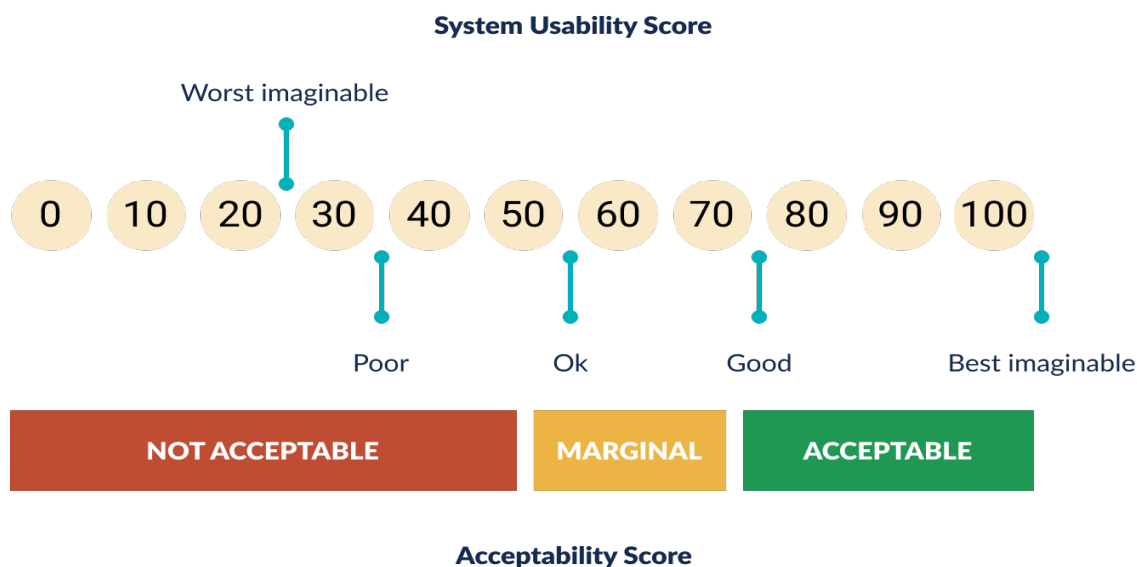


Figure 12: The System Usability Scale (SUS)

The suggestions made by some of the respondents include provision of a button to help share the application with friends, having the application translated to more languages such as Swahili, having the contents on the blog diversified for example having information on the rights of the young people.

#### 4.7. Socio-cultural Impact of mHealth

A well-functioning health system is one that has health workers who are trained and motivated and an infrastructure that is well maintained with reliable medicines and supply of technologies together with enough funding, solid health plans and evidence-based policies (WHO, 2018). It is estimated that by 2035, there will be a shortage of health workers of about 12.9 million. There is therefore a need for innovative solutions to healthcare; self-care interventions that are accessible, affordable, increase choice and opportunities to make informed decisions are becoming promising (WHO, 2018).

Williamson (2013) classified SRH barriers into 4 different categories which includes: Accessibility, Information, Socio-cultural and Provider based. These barriers were further broken down into cost, location, SRH information, location information, embarrassment and fear, social pressure and cultural norms, provider bias, provider training, provider bias and service delivery. All these barriers limit the young people's in access to SRH Information and services.

The developed solution has tried to address some of the above barriers as shown in Table 17.

Table 17: Addressing Barriers to SRH

<b>Barrier</b>	<b>Barrier Sub-Category</b>	<b>Proposed Solution</b>
<b>Accessibility</b>	Cost	Application helps reduce cost as it enables users to select a facility that is closest.
	Location	The solution has a feature that looks at the proximity of the user from a selected provider. This helps the young people to conveniently reach service or product delivery points.
<b>Information</b>	SRH Information	The blog section of the solution allows the users to have access to quality information as provided by accredited service providers.
	Location Information	The solution provides details of the service or product providers including their name, the distance in kilometers from them to the user, the county, and the service/s that they offer.  The solution provides an SOS functionality that enables the listed emergency contacts to locate the person who initiated the SOS.
<b>Social cultural</b>	Embarrassment and Fear	The solution provides an opportunity for the young person to book appointments with their preferred healthcare providers. It allows visits to the facilities at preferred times. The solution ensures that the information that has been shared or filled in is confidential.
	Social pressure and cultural norms	Social pressure from incorrect information can be eased from the young people when they access the blog section that has verified information on SRH information required.
<b>Provider</b>	Provider Bias	The solution allows the young people to have access to different providers offering the same services.
	Service Delivery	The young person can rate the quality of the services being provided by different service providers hence helping to improve the quality of the services being offered.

## CHAPTER 5: SUMMARY AND CONCLUSION

This chapter presents a summary of the research findings, conclusions, and the recommendations for future work.

### 5.1. Achievements

*Objective 1: To analyze the current programs that provide SRH services to young people in Kenya.*

The research established that there were several existing interventions and activities in Sub-Saharan Africa which aimed at promoting SRH information and services by leveraging on mobile technology as listed in Section 2.4.

*Objective 2: To establish the factors that influence accessibility of SRH information and services by young people.*

The study findings indicated that young people felt that the SRH information and services they received did not meet their needs and were relatively biased or lacked privacy and confidentiality. Lack of SRH knowledge was also found to be a huge gap in quality SRH for young people. The findings indicated that young people do not think they adequately have access to materials talking about SRH services. There were recommendations to come up youth-friendly interventions to improve accessibility to and availability of SRH information and services.

*Objective 3: To review the sources of SRH Information to young people.*

Results indicated that young people received SRH education through different sources, the internet being the most prevalent. The internet granted young people anonymity, which made them feel confident to look up SRH topics. However, the findings showed that young people from the study had very little SRH knowledge, and they felt that they did not receive adequate SRH education either at home, school or when they visited health facilities. It was common for parents and teachers to overlook discussing SRH with young people which led to young people not adequately being informed on SRH.

*Objective 4: To design a prototype MHealth-based application for SRH information and services for young people.*

The desired mHealth prototype was developed to incorporate web, mobile and wearable technology. We believe that when fully implemented and used, this prototype will practically facilitate improved accessibility to SRH information and services to young people.

## **5.2. Limitations**

Some respondents may have been biased, dishonest or omitted responses in their participation. However, the researcher was keen to look for inconsistencies and contradictions in the data collected and omitted such instances from the analysis.

COVID-19 limited the researcher to have better engagement with study participants, such as in person interviews and focus group discussions which would have surfaced more insights for the study. However, results gathered were sufficient to validate previous studies and assumptions about young people's SRH and inform the development of the mHealth prototype. The consistency of our results with other similar studies confirms the validity of this study.

## **5.3. Conclusion**

This study has presented a case for mHealth as an innovation to facilitate better SRH information and services access for young people. We explored the possibility of developing a feasible mHealth prototype resulting in the incorporation of wearable, mobile and web technologies. The final prototype was tested by sampled young people and healthcare professionals to assess the usability. The usability scoring of 75.3% out of 100% demonstrated that mHealth can be used to enhance accessibility to SRH information and services by young people.

However, to better understand the underlying SRH issues, methods used to deploy such mHealth interventions should be realistic and suitable to the requirements and expectations of young people and SRH professionals. This means that young people, as the key mHealth end users, should be involved all through the development and deployment of the intervention to reach optimum functionality.

## **5.4. Further Work**

Future studies could administer the intervention to a large sample over a period to properly conduct usability evaluations and identify any pending gaps with respect to young people's SRH. Future researchers could also explore the possibility of providing a gamified intervention to make it more interesting for young people.

Since this study employed quantitative surveys and very little qualitative exploration, new studies could apply more precise research methods and multiple approaches of mHealth besides wearables, smartphones, and web technologies.

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# APPENDICES

## Appendix 1: Consent Form

My name is Biwot Betty, a master's Student in Applied Computing at the University of Nairobi. I am conducting research on how mobile-health (mHealth) can be used to enhance accessibility to SRH information and services to young people. The study targets young people currently in the Young People's Program (YPP) under AHF. You have been selected to assist in this research by responding to the questionnaire intended for this research. Please note: do not indicate your name anywhere throughout this research. The information you provide will be handled as confidential and will solely be used for the purpose of this study.

It is anticipated that filling in the questionnaires will not take much of your time and the research questions include those related to the current SRH information and services available and the challenges in accessing them. The questionnaire is divided into sections which addresses the above issues, including socio-demographic characteristics, SRH sources of information and challenges in accessing these services.

Kindly note that it is required of you to fill all the questions for reasons of gathering valid, complete, and reliable data. However, you may skip any questions you are not comfortable with. You are allowed to quit participating in this research at your discretion. There are no risks associated with taking part nor are there any financial benefits afforded to you during this study. Findings from the study will be vital in designing and testing the proposed mHealth intervention and assist me in making conclusions and recommendations for further study.

### **Respondent Agreement**

The researcher has explained to me the purpose of this study and I voluntarily consent to participate.

\_\_\_\_\_

Respondent signature

\_\_\_\_\_

Date

\_\_\_\_\_

Interviewer signature

\_\_\_\_\_

Date

## Appendix 2: Adolescents and Young Adults Questionnaire

I am a Masters' student at the University of Nairobi, registration number P51/6411/2017. I kindly ask you to participate in my study on the use of mobile health (m-health) to facilitate accessible Sexual Reproductive Health services to adolescents and young adults in Kenya. Below is a questionnaire which seeks information purely related to the objectives of my research. Please fill it in to the best of your knowledge. Thank you.

### Instructions:

1. Please answer the following questions only if you fall within the range of 10–24 years.
2. Be brief, clear, and specific in your answers.
3. Please, do not identify yourself on this material.

### Key:

- Tick only that which applies (once)
- Tick all that apply.

### Section A: Socio-Demographic Characteristics

#### 1. Age group

- 10 – 14 (1)
- 15 – 19 (2)
- 20 – 24 (3)

#### 2. Sex

- Male (1)
- Female (2)

#### 3. Highest level of education

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

#### 4. Cohort

- Mathare (1)
- Mukuru (2)
- UTENA (3)
- MYSA (4)
- Junda (5)
- Kisauni (6)

**Section B: Use and Perception of SRH Services**

5. Have you received any SRH information in the last twelve months?
- Yes (1)
  - No (2)
6. What SRH services are you aware of?
- Family Planning e.g., family planning (1)
  - Prenatal, antenatal, and postnatal care (2)
  - STI and HIV related services (3)
  - Prevention and treatment of unsafe abortion (4)
  - Menstrual hygiene (5)
  - Sexual dysfunction (6)
  - Cervical Cancer Screening (7)
  - Infertility (8)
  - Other. Please specify ..... (9)
7. Which of these SRH services have you used before?
- Family planning (1)
  - Prenatal, antenatal, and postnatal care (2)
  - STI and HIV related services (3)
  - Prevention and treatment of unsafe abortion (4)
  - Menstrual hygiene (5)
  - Sexual dysfunction (6)
  - Cervical Cancer Screening (7)
  - Infertility (8)
  - Other. Please specify ..... (9)
8. Where do you learn about SRH?
- Home (1)
  - School (2)
  - Church/mosque/temple (3)
  - Health facilities (4)
  - Peers (5)
  - Media e.g., TV, radio (6)
  - Internet e.g., YouTube (7)
  - Other. Please specify ..... (8)
9. Have you ever visited a health facility or doctor of any kind to receive services or information on contraception, pregnancy, abortion, or sexually transmitted diseases?
- Yes (1)

- No (2)
10. How often have you sought SRH services or information from a doctor or nurse in the last twelve months?
- Weekly (1)
  - Bi-Weekly (2)
  - Monthly (3)
  - Quarterly (4)
  - Twice yearly (5)
  - Annually (6)
11. Thinking about your last visit, did you go to a government or private health facility?
- Government (1)
  - Private (2)
- Other. Please specify..... (3)  
 What reasons influenced your choice above.....?
12. When you last saw a doctor or a nurse, what was your reason for going? Suggestion when you last visited a health facility, which services did you want/need?
- Contraception e.g., condoms, injection (1)
  - HIV/STD examination (2)
  - Gynecological exam (3)
  - Pregnancy test (4)
  - Pregnancy termination (5)
  - Mother and child healthcare (MCH) (6)
  - Cervical Cancer screening (7)
  - Sexual Dysfunction examination (8)
  - Infertility treatment (9)
  - None of the above (10)
13. Which Service/Services did you receive in your last visit to a health facility?
- Contraception e.g., condoms, injection (1)
  - HIV/STD treatment (2)
  - Gynecological exam (3)
  - Pregnancy test (4)
  - Pregnancy termination (5)
  - Mother and child healthcare (MCH) (6)
  - Cervical Cancer Screening (7)
  - Sexual Dysfunction examination (8)
  - Infertility treatment (9)
  - None of the above (10)

14. Are you aware of contraception?

- Yes (1)
- No (2)

*If you answered 'Yes', go to the next question. If 'No', skip to question 15.*

15. Which of these contraceptive methods have you heard of?

- Condoms (1)
- Contraceptive implants (2)
- Contraceptive pills e.g., FemiPlan (3)
- Contraceptive injection (4)
- Emergency Contraception Pill (5)
- Vasectomy (6)

Other. Please specify ..... (7)

16. Which of those contraceptive methods have you used before?

- Condoms (1)
- Contraceptive implants (2)
- Contraceptive pills e.g., FemiPlan (3)
- Contraceptive injection (4)
- Emergency Contraception Pill (5)
- Traditional Contraception (Withdrawal) (6)
- Vasectomy (7)
- None of the above (8)

Other. Please specify ..... (9)

17. Where did you access contraceptives?

- Local chemist (1)
- Local health center (2)
- Peers (3)

Other. Please specify ..... (4)

18. Based on your own evaluation, please rate the importance for each of the statements below?

	Very important (1)	Moderately important (2)	Important (3)	Slightly important (4)	Not important (5)	Not Applicable (6)
a) How important is privacy and confidentiality to you while accessing SRH services?	●	●	●	●	●	●
b) How important is SRH education to you?	●	●	●	●	●	●



c) Do you think it's important for both boys and girls to have equal access and knowledge on SRH?	●	●	●	●	●	●
---	---	---	---	---	---	---

19. Please give a rating on difficulty/ease for each statement below?

	Very easy (1)	Easy (2)	Average (3)	Difficult (4)	Very Difficult (5)	Not Applicable (6)
d) How do you find it when talking with your parents about SRH?	●	●	●	●	●	●
e) How do you find it talking with your peers about SRH?	●	●	●	●	●	●
f) How do you find it talking with your teachers about SRH?	●	●	●	●	●	●
g) How difficult/easy is it for you to access SRH services?	●	●	●	●	●	●

20. What factors hinder your access to SRH services?

- Lack of SRH knowledge (1)
- Lack of privacy and confidentiality (2)
- High cost of SRH services (3)
- Discrimination (4)
- Stigma (5)
- Inconvenient access locations (6)
- Gender limitation (7)
- Age limitation (8)
- Parental disapproval (9)
- Difficulty locating SRH services (10)
- Other. Please specify ..... (11)

**Section C: Mobile use**

21. Do you have access to a mobile device?

- Yes (1)

- No (2)

22. If yes, what kind of mobile device is it?

- Smartphone (1)
- Feature phone (*mulika mwizi*) (2)
- Tablet (3)

23. Which of these bests describe what you mostly do on your mobile device?

- Education e.g., online classes, reading material (1)
- Playing games (2)
- Social media e.g., Facebook, Instagram, YouTube (3)
- Communication e.g., calling friends and family (4)
- Other. Please specify..... (5)

24. What if a mobile-based system were to be introduced to enhance the accessibility of SRH services to adolescents and young adults, how would you rate it by usefulness?

- Extremely useful (1)
- Very useful (2)
- Somewhat useful (3)
- Not so useful (4)
- Not at all useful (5)

25. Do you have any suggestions or general comments on how the access to SRH services could be improved for adolescent and young adults?

.....  
.....  
.....

Thanks for your time. Cheers

## Appendix 3: Healthcare Professionals Questionnaire

I am a Masters' student at the University of Nairobi, registration number P51/6411/2017. I kindly ask you to participate in my study on the use of mobile health (m-health) to facilitate accessible Sexual Reproductive Health services to adolescents and young adults in Kenya. Below is a questionnaire which seeks information purely related to the objectives of my research. Please fill it in to the best of your knowledge. Thank you.

Instructions:

4. Please answer the following questions only if you are a healthcare professional.
5. Be brief, clear, and specific in your answers.
6. Please, do not identify yourself on this material.

Key:

- Tick only that which applies (once)
- Tick all that apply.

### Section A: Socio-Demographic Characteristics

1. Age group
  - 18 – 24 (1)
  - 25 – 34 (2)
  - 35 – 44 (3)
  - Over 45 years (4)
2. Sex
  - Male (1)
  - Female (2)
3. Highest level of education
  - None (1)
  - Primary (2)
  - Secondary (3)
  - Tertiary (4)
4. Practice
  - General practitioner (1)
  - Clinical officer (2)
  - Obstetrician/Gynecologist (3)
  - Social worker (4)
  - Nurse (5)
  - Counselor (6)
  - Other. Please specify ..... (7)
5. Experience
  - 1 - 5 years (1)

- 6 - 10 years (2)
- 11 - 15 years (3)

More than 15 years (4)

**Section B: Administration of ASRH Services**

6. Do you think that adolescents and young adults receive enough SRH information?

- Yes (1)
- No (2)

7. What SRH services do you administer to adolescents and young adults (ages 10-24)?

- Fertility services e.g., family planning (1)
- Prenatal, antenatal, and postnatal care (2)
- STI and HIV related services (3)
- Prevention and treatment of unsafe abortion (4)
- Menstrual hygiene (5)
- Counseling (6)

Other. Please specify ..... (7)

8. How often do adolescents and young adults visit you to receive services or information on contraception, pregnancy, abortion, or sexually transmitted diseases?

- Daily (1)
- Twice weekly (2)
- Weekly (3)
- Bi-weekly (4)
- Monthly (5)
- Semi-Annually (6)
- Annually (7)
- Never (8)

9. When you last saw an adolescent or young adult, what was their reason for visiting?

- Contraception e.g., condoms, injection (1)
- HIV/STD examination (2)
- Gynecological exam (3)
- Pregnancy test (4)
- Counseling (5)
- Pregnancy termination (6)
- Mother and child healthcare (MCH) (7)
- Infertility examination (8)

- Sexual dysfunction treatment (9)
- None of the above (10)

10. From your own observation, which of these contraceptive methods do adolescents and young adults mostly seek?

- Condoms (1)
- Contraceptive implants (2)
- Contraceptive pills e.g., Femi Plan (3)
- Contraceptive injection (4)
- Emergency Contraception Pill (5)
- Vasectomy (6)

Other. Please specify ..... (7)

11. Based on your own evaluation, please rate the importance for each of the statements below?

	Very important (1)	Moderately important (2)	Important (3)	Slightly important (4)	Not important (5)	Not Applicable (6)
h) How important is privacy and confidentiality to adolescents and young adults while accessing SRH services?	●	●	●	●	●	●
i) How important do you think SRH education is towards better sexual health for adolescents and young adults?	●	●	●	●	●	●
j) How important do you think it is for both boys and girls to have equal access and knowledge on SRH?	●	●	●	●	●	●

12. Please rate the difficulty/ease for each statement below?

	Very easy (1)	Easy (2)	Average (3)	Difficult (4)	Very Difficult (5)	Not Applicable (6)
k) How do you find it talking with adolescents and young adults about SRH?	●	●	●	●	●	●

1) How do you find it educating and reaching out to adolescent and young adults on matters SRH?	●	●	●	●	●	●
---	---	---	---	---	---	---

13. What factors do you think affect how adolescents and young adults' access SRH services and information?

- Lack of SRH knowledge (1)
- Lack of privacy and confidentiality (2)
- High cost of SRH services (3)
- Discrimination (4)
- Stigma (5)
- Inconvenient access locations (6)
- Gender limitation (7)
- Age limitation (8)
- Parental disapproval (9)
- Difficulty location SRH (10)
- Other. Please specify ..... (11)

**Section C: Technology use**

14. What kind of mobile device do you use?

- Smartphone (1)
- Feature phone (*mulika mwizi*) (2)
- Tablet (3)

15. Please rate the level of your computer literacy.

- Poor (1)
- Adequate (2)
- Good (3)
- Excellent (4)

16. Frequency of computer use (for work or other)

- Every day or continuously (1)
- Only when needed (2)
- Never (3)
- What if a mobile- and web-based system were to be introduced to enhance the accessibility of SRH services to adolescents and young adults, how useful do you think it would be? Extremely useful (1)
- Very useful (2)
- Somewhat useful (3)
- Not so useful (4)
- Not at all useful (5)

17. Do you have any suggestions or general comments on how the access to SRH services could be improved for adolescent and young adults?

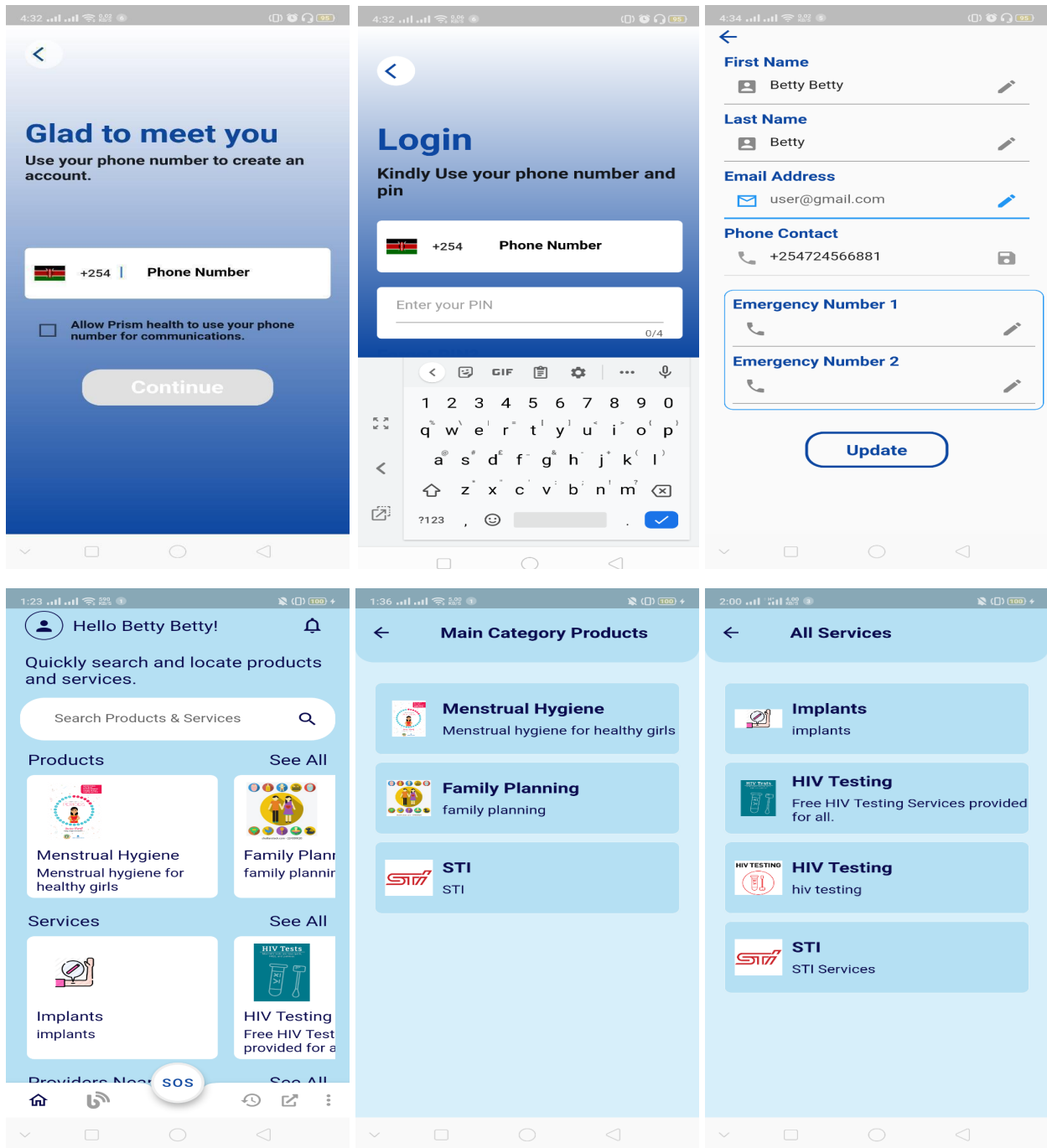
.....

Thanks for your time. Cheers!

## Appendix 4: System Usability Scale Questionnaire

Questionnaire Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I think that I would like to use this application frequently					
I found this application unnecessarily complex					
I thought this mobile application was easy to use					
I think that I would need assistance to be able to use this application					
I found the various functions in this application were well integrated					
I thought there was too much inconsistency in this application					
I would imagine that most people would learn to use this application very quickly					
I found the application very cumbersome to use					
I felt very confident using the application					
I needed to learn a lot of things before I could get going with this application					

## Appendix 5: Mobile App Screenshots





11:11



**Service** HIV Testing  
Distance 10km away  
Service Description  
Free HIV Testing Services provided for all.

**Provider**  
Hospital One  
★★★★★  
Location Nairobi County

Select Appointment Date

< July 2021 Week >

Mon	Tue	Wed	Thu	Fri	Sat	Sun
					12	13

Select Time

7:00 8:00 9:00

Book Now

2:16

**My Bookings**

03 Jul, Saturday 2:16 AM  
Service HIV Testing  
Provider Dennis  
Location Nairobi County  
[More Details](#) [Rate Provider](#)

03 Jul, Saturday 3:09 PM  
Service HIV Testing  
Provider Pumwani Hospital  
Location Nairobi County  
[More Details](#) [Rate Provider](#)

02 Jul, Friday 3:05 PM  
Service HIV Testing  
Provider Pumwani Hospital  
Location Nairobi County

SOS

4:35

**Notification Center**

Service Booking  
Saturday 26 Jun, 2021 2:44 PM

Service Booking  
Saturday 26 Jun, 2021 2:48 PM

Service Booking  
Saturday 26 Jun, 2021 2:50 PM

Service Booking  
Saturday 26 Jun, 2021 3:05 PM

Service Booking  
Saturday 26 Jun, 2021 3:05 PM

Service Booking  
Saturday 26 Jun, 2021 3:09 PM

11:11

**Providers Available**

Hospital One  
Nairobi County  
8km away  
★★★★★

Hospital Two  
Nairobi County  
16km away  
★★★★★

Hospital Three  
Muranga County  
47km away  
★★★★★

Hospital 5  
Garissa County  
323km away  
★★★★★


Hospital 6  
Kwale County  
444km away  
★★★★★

Hospital 7  
Kwale County


11:37

**Blogs**


HIV Self-Testing



Voluntary Medical  
VMMC




Child Marriage



Voluntary Counselling and Testing

11:37

**Voluntary Counselling and Testing**

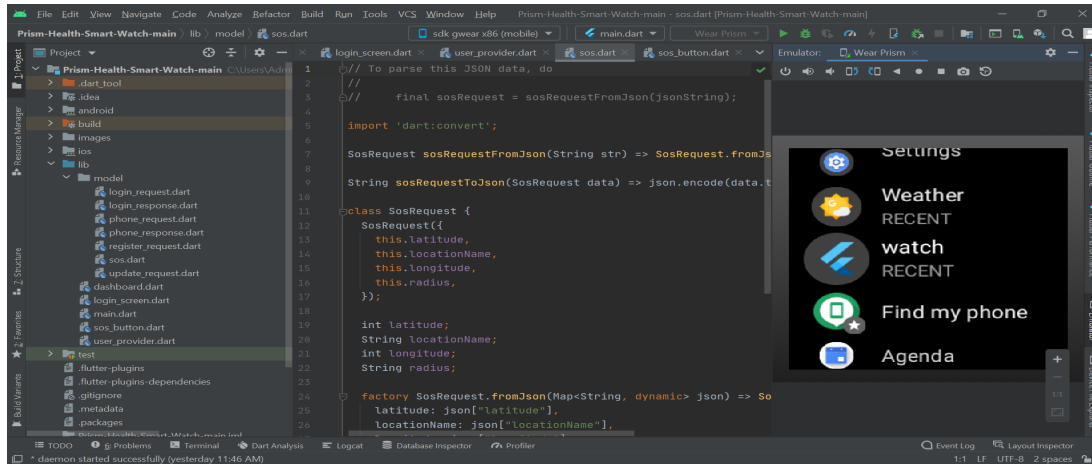


Category HIV Testing

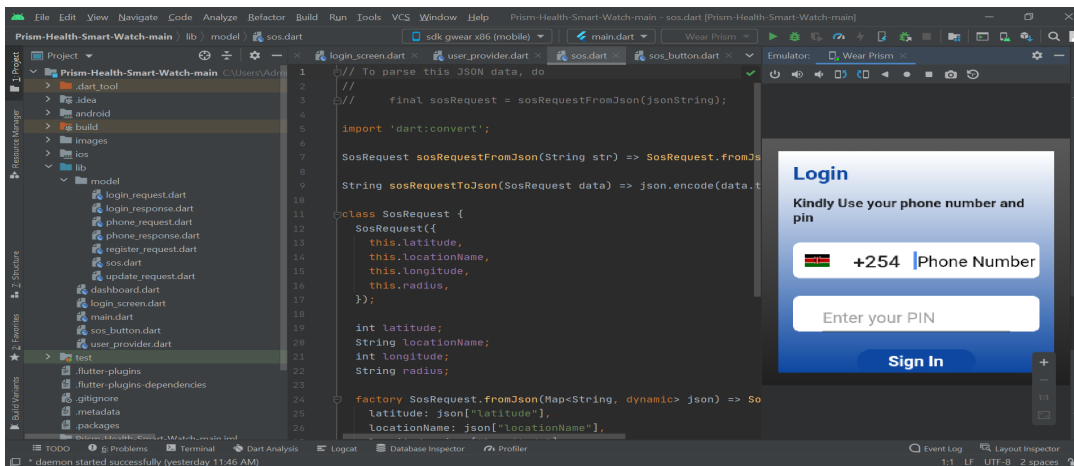
Content  
Testing done at VCT is done to clients who voluntarily wish to be tested for HIV. Pre-test and Post-test counseling is done during this testing.

## Appendix 6: Smart Watch screenshot

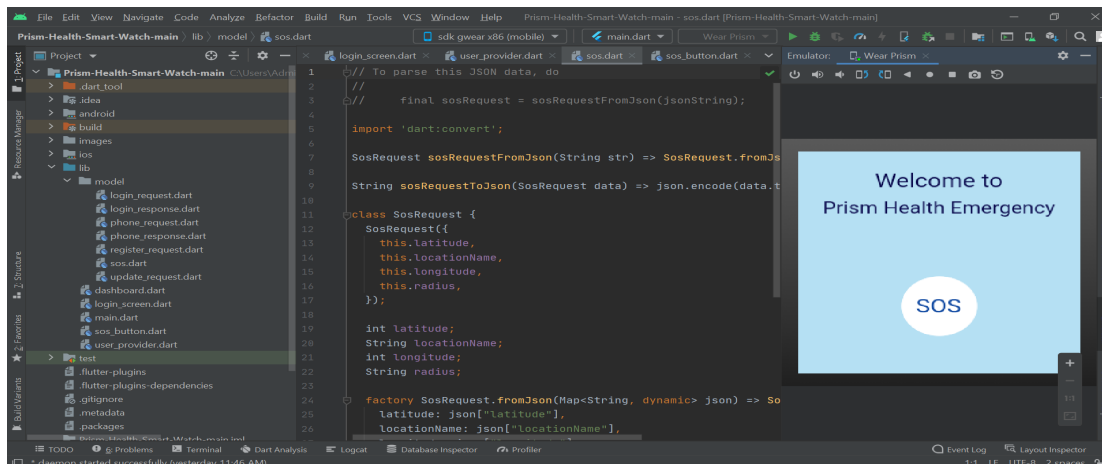
### Smart watch Simulator



### Login Screen

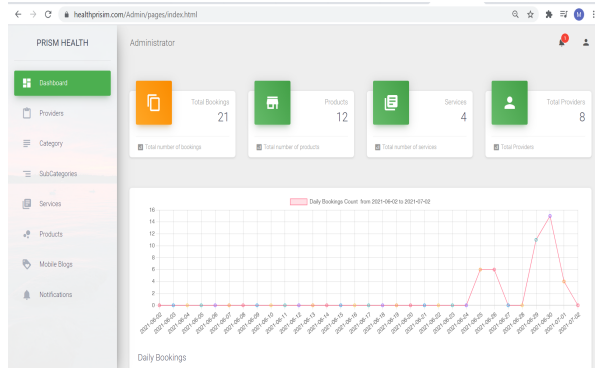


### SOS Functionality

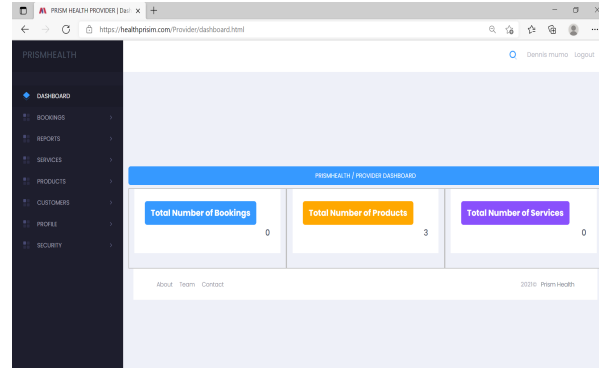


# Appendix 7: Web System Screenshots

## Administrator dashboard



## Provider's list view



## Category View

ID	Name	Description	Action
1	Menstrual Hygiene	Menstrual hygiene for healthy girls	[Edit] [Delete]
2	Family Planning	family planning	[Edit] [Delete]

## Sub-Category View

ID	Name	Category	Description	Action
1	Sanitary Towels	Menstrual Hygiene	Sanitary towels	[Edit] [Delete]
2	Contraceptives	Family Planning	contraceptives	[Edit] [Delete]
3	Condoms	Family Planning	Condoms	[Edit] [Delete]

## Services View

ID	Name	cost	Provider Number	Action
1	Implants	500	+2547102008	[Edit] [Delete]
2	HIV Testing	500	+2547102008	[Edit] [Delete]
3	HIV Testing	500	+25472225960	[Edit] [Delete]

## Products View

ID	Name	sub Category	Description	price	provider Number	Action
1	Always Sanitary Pads	Sanitary Towels	Sanitary pads	70	+25411111111	[Edit] [Delete]
2	Kotex	Sanitary Towels	kotex	100	+2547102008	[Edit] [Delete]
3	KONN	Condoms	Free condoms given out by AHF	0	+25411111111	[Edit] [Delete]
4	LOVE Condoms	Condoms	Free condoms distributed by AHF	0	+25411111111	[Edit] [Delete]
5	FemPlan Pills	Contraceptives	Pills to prevent pregnancy	150	+25411111111	[Edit] [Delete]

## Mobile blogs

ID	Title	Category	Content	Action
1	HIV Self-Testing	Menstrual Hygiene	A Rapid Self-Test is done entirely at home or in a private location and can produce results within 20 minutes. You can buy a rapid self-test kit at a pharmacy. OraQuick is an FDA-approved rapid self-test that is available in pharmacies. For this test, you must save your gums to collect an oral fluid sample and use the materials in the kit to test your oral fluid sample. You will be able to get a result within 20 minutes. It is important to follow the directions as described in the instructions or the kit will not work. There is a phone number included with the HIV self-test for anyone to call to get help with conducting the test.	[Edit] [Delete]
2	IMBIC	HIV Prevention	Circumcised men and their female partners experience lower rates of several sexually transmitted infections (STIs), including human papillomavirus, herpes simplex virus-2, bacterial vaginosis, and Trichomonas vaginalis. Women benefit indirectly from the lower risk of HIV infection in circumcised men as IMBIC programmes expand, and their men acquire HIV. Women may be less likely to acquire HIV infection from an HIV-positive man who is circumcised than from one who is not, except when the man is recently circumcised and healing.	[Edit] [Delete]