The design, development and evaluation of an SMS contraceptive behaviour change intervention – a case study in Chikwawa, Malawi.

Rebecca Laidlaw

Department of Civil and Environmental Engineering

University of Strathclyde

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Declaration

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

Signed:

Date:

Abstract

This thesis aimed to determine the feasibility, acceptability and effectiveness of a behaviour change intervention delivered via mHealth in Chikwawa, Malawi. Three qualitative studies were executed to identify health needs in the area and to understand cultural practices which may influence intervention effectiveness. The Behaviour Change Wheel was then used to design an SMS intervention delivering contraceptive education to adolescents. This intervention was tested in two studies; a feasibility study and larger quasi-experimental study, to identify effectiveness in regards to contraceptive knowledge, attitudes to condoms and contraceptive behaviour. The SMS intervention was found to be feasible in terms of infrastructure, accessibility and participant acceptability. Intention-to-treat analysis found significant increases in attitudes at six months in the intervention group. However, 39% of the control group had access to the intervention, affecting results. Post-hoc analysis revealed significantly higher contraceptive knowledge and attitudes in those who received access to the intervention compared to those who did not, and this was sustained for six months. Additionally, contraceptive behaviour was more frequent in those who received access to the intervention at six months follow up. This thesis demonstrates the feasibility and acceptability of an SMS behaviour change intervention delivering contraceptive education to adolescents in Chikwawa and provides evidence of positive impact on contraceptive knowledge, attitudes and behaviour change. This thesis is the first to implement an mHealth intervention in a community setting in Malawi, and highlights the advantage it has in delivering health education in a relatively quick, simple and easy to access way, without negatively impacting health sector services. However study replication is required to build on the foundations of this research and conduct a large scale evaluation of intervention effectiveness, cost effectiveness and gender equality in mobile access to ensure it can be delivered across the country to those who need it most.

Publications

Laidlaw, R., Dixon, D., Morse, T., Beattie, T. K., Kumwenda, S., & Mpemberera, G. (2017). Using participatory methods to design an mHealth intervention for a low income country, a case study in Chikwawa, Malawi. *BMC Medical Informatics and Decision making, 17*: 98.

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Chapter 1: Background to Malawi and the potential for mHealth to enhance healthcare provision.

This thesis discusses the design, development and evaluation of an SMS contraceptive behaviour change intervention using a case study in Chikwawa, Malawi. This first chapter provides the background to Malawi and introduces the concept of mHealth (Mobile Health). It then presents research using mHealth methodology in low income countries and identifies mHealth as a potential solution to current healthcare challenges in low income countries such as infrastructure, accessibility and health literacy. The thesis aims and structure are then outlined.

1.1 What is mHealth?

Mobile Health (mHealth), defined as "medical and public health practice supported by mobile devices such as mobile phones, personal digital assistants and other wireless devices" (WHO, 2011; p. 6), is an example of this technology. mHealth applications can use both the phone's basic functionalities (e.g. voice call and short messaging service) and more complex functionalities (e.g. third generation mobile telecommunications (3G) or Bluetooth technology) to support health service delivery. mHealth interventions therefore, can range from simple call or text reminder services to personally tailored mobile applications, or apps, which focus on multiple aspects such as self-monitoring, educational input and integrated tasks.

mHealth programmes cover a wide array of functions both in communicating with, and monitoring the patient population, and for consultation, communication, training and development in healthcare professionals (Labrique et al., 2013). There has been a surge of evidence on the effectiveness of mHealth interventions for positive behaviour change in areas such as alcohol (Gustafson et al., 2014; Gonzalez & Dulin, 2015), diet (Carter et al., 2013), physical activity (van Het Reve et al., 2014; Rabbi et al., 2015), family planning (Gilliam et al., 2014) and medication adherence (Perera et al., 2014; Hammonds et al., 2015). As well as evidence for improvements in specific health conditions, including self-monitoring of diabetes (Kirwan et al., 2017) and hypertension (Moore et al., 2014). mHealth evidence not only exists for patients, but also for healthcare professional practice. Health professionals can use technology to improve information and time management, including

apps for dictating patient notes, storing information (Ventola, 2014), accessing patient medical records for quicker consultations (Choi et al., 2011), and improving communication between health professionals (Mosa, Yoo, & Sheets, 2012). mHealth has also been used for communicating with and monitoring patients. Appointment reminders by SMS have been found to significantly increase appointment attendance (Youssef, 2014; McLean et al., 2016) and apps such as iWander (Sposaro, Danielson, & Tyson, 2010) have been created using GPS to track Alzheimer's patients for their own safety. Sensor technology attached to clothing has also been used to get quick assistance to elderly patients in independent living if they slip or fall (Boulos et al., 2011).

This research is promising both for the self-management of conditions and for healthcare delivery, and uses technology which most individuals already use on a daily basis. However the majority of this research is utilising mobile applications which require both a smartphone or tablet and access to Wi-Fi. This instantly reduces accessibility to these types of interventions for those from more deprived backgrounds. However this is not the only mHealth intervention which can be used, it is also possible to create an effective mHealth intervention using only the phones basic functionalities, enabling the intervention to be used by any phone type with mobile signal. Short Message Service (SMS) or voice call based interventions are extremely popular for health research, particularly in low income countries, where mobile ownership rates are rapidly on the rise (GSMA, 2017), but predominately in basic phone ownership without reliable internet access.

In Malawi, 34% of the population own a personal mobile phone (29.1% in rural areas and 69.8% in urban areas), while 45.5% have a mobile phone in their household (40.2% in rural areas and 85.1% in urban areas) (NSO, 2014). These numbers have risen dramatically in the last few years with a 70% increase in subscribers in the last six years, and the number is still increasing (ITU, 2014). Mobile phone ownership has increased in line with advancements in cellular coverage; rates currently standing at 94% of the population having access to adequate mobile coverage, reaching 79% of the geographical area of Malawi (GSMA, 2012). The discrepancies between these figures are due to 83.5% of the population living in rural areas and thus are harder to reach (World Bank, 2016c). Even though mobile coverage is high, cost for owning a device is also high, but Malawi has the highest annual mobile phone

expenditure (out of a 166 country study) at 56.6% Gross National Income per capita (ITU, 2014).

The cost of the device handset has been found to be the biggest barrier to mobile phone ownership; 57.9% of individuals in rural Malawi are willing to pay between K2000-K5000 (equivalent of 3-7 US dollars) on a mobile handset (NSO, 2014), which would provide them with a basic mobile phone, as smartphones are much more expensive. Yet this does not always translate into buying a device, as it is difficult to access this amount of capital, considering 87.6% of working adults in Malawi live on less than $3.10 per day (UNDP, 2016). However, mobile ownership is on the rise in this country, and those without a device are willing to spend a significant proportion of their income on the use of a mobile phone, suggesting that mobile phone ownership is a priority to these individuals.

1.2 Aims of Thesis

It is the widespread network coverage, increasing rates in mobile ownership and individuals' perceptions of the priority of mHeath technology that make mHealth an appealing tool to improve healthcare delivery in Malawi. Therefore the overarching aim of this thesis is to determine the feasibility, acceptability and effectiveness of a behaviour change intervention delivered via mHealth in Chikwawa, Malawi.

1.3 mHealth research in low income countries

There is increasing evidence from mHealth research in low income countries as to the utility of mHealth in relation to improved service delivery, primarily through infrastructure and accessibility, two of the biggest barriers facing the health system in Malawi.

1.3.1 Infrastructure as a barrier to health service delivery

Eighty percent of the population of Malawi live in rural areas, which is a challenge for service provision. With such a high percentage of the population living in rural communities, it is no surprise that 80% of the population do not have access to grid electricity (GSMA, 2012), 2.4 million people do not have access to clean water and 14.2 million people do not have access to adequate sanitation (WaterAid, 2013). In addition, road infrastructure is heavily relied upon because the country is landlocked. Malawi has made significant

improvements to roads infrastructure through increased expenditure. This has led to 90% of paved roads to be in good or fair condition, which is high compared to other low income countries (Foster & Shkaratan, 2010). Yet road maintenance spending falls short of what is required to sustain the recent improvements and only 26% of the population live within 2km of an all-weather road (Foster & Shkaratan, 2010). Public transport also brings challenges, with no official local transport links, and the mini-bus culture resulting in long journey times, unreliable service and expensive fares if travelling long distances (Hine, Huizenga, & Willilo, 2015). These infrastructure inadequacies directly influence effectiveness of the health service across the country, particularly in rural areas. Even with dedicated health centres for rural villages, poor infrastructure affects health professionals' access to communities, the distribution of medication and emergency aid, as well as difficulty for individuals to reach their nearest health centre. There is also the issue of health staff being unwilling to relocate and work in remote areas as the infrastructure for living conditions is poorer compared to that of larger towns and cities.

mHealth could be used as a method to overcome some of these barriers caused by poor transport links and infrastructure, as it can facilitate remote data collection, patient monitoring or education services when access to patients is time consuming or difficult. Blaschke et al., (2009) conducted a pilot trial using mobile phone SMS (text messages) to monitor child nutrition in Malawi. Health workers in growth monitoring clinics were trained to submit data for each child through SMS. The message was received instantly by a central server and programmed to automatically analyse for indicators of child malnutrition. Feedback messages were received by the health workers instantly and contained additional direction if malnutrition was indicated. All the information received was made available online to provide real-time data for the government and relevant stakeholders to the project. The results of the pilot showed an increase in data quality, and data input error rate was 2.8% compared to 14.2% with the paper-based system. It eliminated manual data-entry, freeing up time for the health workers and it significantly reduced transport costs related to the movement of paper forms and manual data entry. Project Mwana (UNICEF, 2012b) used SMS messaging to deliver HIV test results of new-born infants. This method reduced delays in transmitting results by 50% on average, cutting the total time of receiving results from 66 days to 33 days via the SMS service. This has significant impact on new-born survival rates, which are up to 75% higher if treatment begins within the first 12 weeks of

life (Motswere-Chirwa et al., 2014). Therefore reducing time between testing and diagnosis positively impacts treatment and likelihood of survival. In addition SMS messaging eliminates journey time, which is significant when treatment has such a critical window, and delays due to poor roads conditions, weather or traffic congestion will not affect the dissemination of results.

1.3.2 Difficulties in healthcare accessibility

Access to health services in Malawi is extremely difficult, with government funding, a rapidly increasing population and extreme poverty playing their part, particularly in rural areas. Distance from healthcare facilities is often a serious problem with more than 50% of the population living in excess of 5km from their nearest formal health facility and only 20% of the population within 25km of a hospital (Lawson et al., 2008). In addition those in reach of facilities struggle to finance their need; the most recent available publication states that irrespective of the introduction of the Essential Health Package, only 9% of government and mission facilities provided free access to the full set of services outlined in government policy (Lawson et al., 2008).

mHealth can be introduced to help ease the pressure on healthcare resources and reduce costs. One of the simplest applications is using mobile communication to send reminders to patients regarding appointments. This was introduced in China and it was found that SMS and telephone reminders reduced non-attendance by 7% (Liew et al., 2009). Similarly a Randomised Controlled Trial (RCT) conducted in Malaysia found that SMS and telephone reminders increased attendance by around 40% compared to controls (Chen Fang, & Dai, 2008). There was no difference between the types of communication; however cost effectiveness evaluation showed that SMS messaging was cheaper than, and just as effective as, voicemail messages (Kahn, Yang, &, Kahn, 2010).

mHealth can also be utilised to remind patients to take medication. This is extremely important as it is critical in chronic diseases such as tuberculosis and HIV that patients adhere to their time sensitive treatment plan. In the simplest application this can take the form of a routine SMS reminder to the patient to encourage adherence. Txt Alert was set up in South Africa to do exactly that (Praekelt Foundation, 2007), as well as enabling health workers to monitor patients through tracking missed appointments and medication pickups.

More sophisticated technology can monitor treatment compliance more accurately through the use of a SIMpill bottle (SIMpill, 2012). This device is programmed with the treatment plan and when the bottle is opened an SMS message is sent to their clinic and records adherence. If the bottle is not opened in accordance with their treatment plan the patient receives a SMS reminder, further non-compliance results in a message being sent to a nominated family member. There are limitations to this type of technology, as patients need only open the bottle to avoid SMS reminders. However if used correctly this mHealth method alleviates pressure on health clinics monitoring adherence through distributing medication daily and observing compliance in person.

This type of technology can also be applied to preventative health services as well, such as using mHealth as a platform to provide information to at risk groups. Mobile for Reproductive Health (m4RH) set up in Kenya and Tanzania created a set of text messages providing information about eight family planning methods and directing users to their nearest family planning clinic where they could access contraception (AIDSTAR-Two Project, 2011). These free messages were available to anyone who signed up to the alerts, increasing awareness and education of family planning methods. This method of information provision is fairly common in preventative health interventions. Projects have been set up to inform individuals about HIV (Butcher, 2008; Hero's AIDS Project, 2004), malaria (IMF, 2008) and diarrhoea (Townsend, 2009) throughout low income countries. Other methods include interactive games which can educate users as they play (Africa Reach Program, 2008; ZMQ Development, 2009), interactive television programmes (Campbell, 2009) and interactive radio programmes (Farm Radio International, 2016). These developments increase access to health services through the use of methods which are relevant to the 21st century, reaching groups of individuals who do not normally engage in health services. Using mHealth interventions to reach these groups is encouraging as they will have the ability to access relevant health information, and interact with healthcare providers anonymously, without the cost of travelling a great distance.

1.3.3 mHealth and its impact on health literacy

Education has improved in Malawi in recent years, with youth (15-24 years) literacy rates for males and females at 74.3% and 70% respectively (UNICEF, 2013). However adult literacy, defined as persons aged 15 or over who can read and write, is lower at 61.3% (UNICEF,

2013), with the highest proportion of illiterate adults in rural areas. There are also gender inequalities, with the percentage of literate men in rural Malawi (80%) higher than their female counterparts (68%) (NSO, 2017). This means that traditional health promotion methods such as posters or leaflets may have little impact in these populations. mHealth can address these difficulties through the use of voice messages, video messages or podcasts detailing health issues to those who are unable to understand more conventional messages.

Health literacy is not just the ability to read and write it also conveys an individual's ability to understand and put into practice the information they have received (Nutbeam, 2000). Therefore there are a number of mHealth projects which assess how much the intervention content is being understood through the use of interactive question and answer sessions or quizzes, allowing projects to monitor correct answers from participants (Veldhuizen & Harmsen, 2009; Mitchell, Bull, Kiwanuka, & Ybarra, 2011). These interactive sessions are often incentivised through prize draws on radio shows to increase knowledge and awareness about important issues in Africa, and tend to be targeted at young people (Martin, 2011).

As well as improving health literacy for members of the public about their own health risks, programmes have been put in place to remotely train healthcare workers. High proportions of nurses in Africa are not fully qualified and cannot be deemed as a 'registered' nurse, a situation that prompted American Medical Research and Education Foundation (AMREF) (2005) to create a distance learning platform to allow nurses to complete modules online and therefore fulfil the requirements to becoming fully registered. Originating in Kenya this programme has approximately 2000 nurse graduates with expansion underway to introduce the course to Uganda and Tanzania (Nguku, 2009). In addition these programmes can be used on the job, to train community health workers within the community. Commcare (Treatman & Lesh, 2012) is a mobile platform aiding community health workers in their daily tasks. This system presents staff with audio, image and video prompts on their mobile device to guide them through their health visits. It also contains pre-recorded audio clips or 'jingles' to play to patients to initiate conversation on sensitive issues such as contraception use or living with HIV. These resources are extremely important, particularly providing preventative health messages to those who are illiterate and cannot understand written

methods of health education. In addition, the pre-recorded clips are often assumed to have come from a higher authority and are more respected than messages coming directly from community workers who some believe have no higher status in the community than the clients themselves (WHO, 2013). This is very positive as it means individuals have more access to accurate and trusted health information and advice, and provides a platform for future conversations on important preventative health topics.

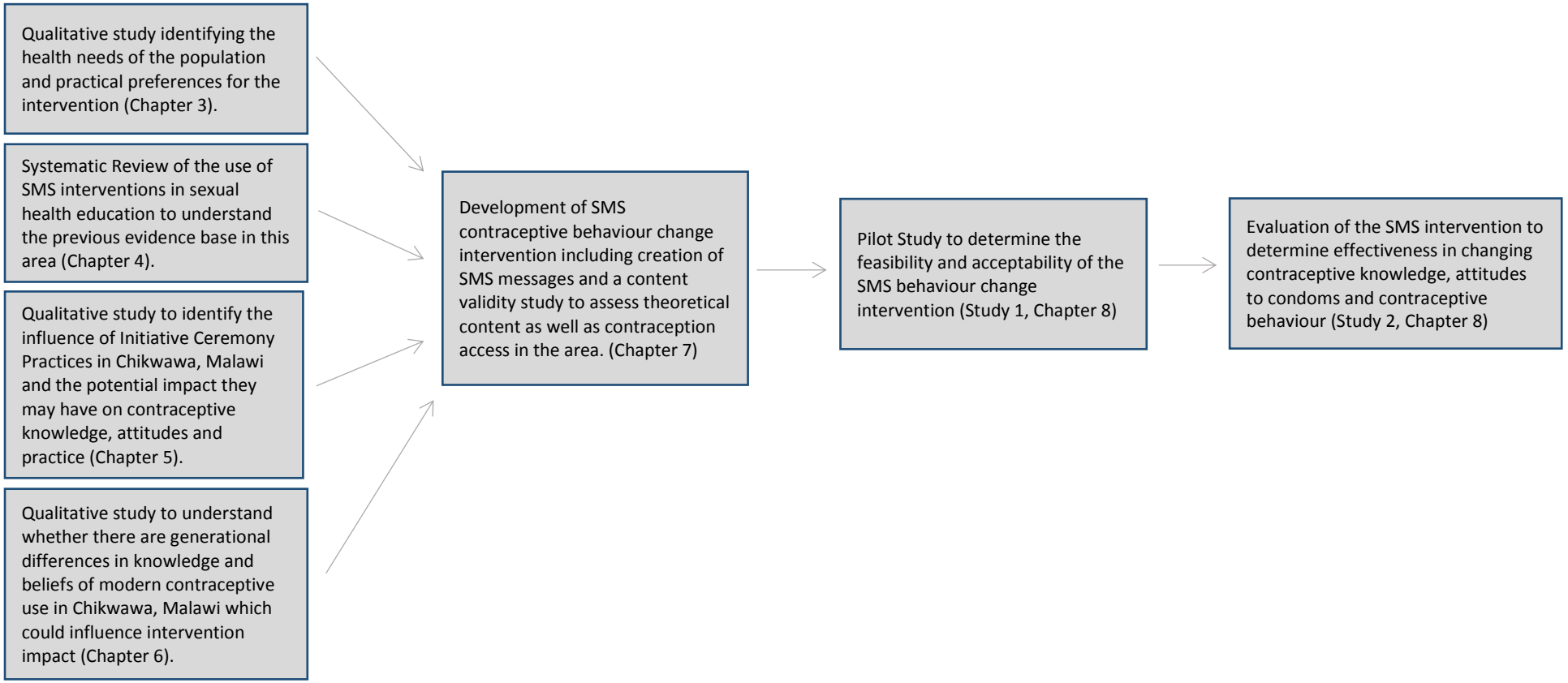
The use of mobile communication devices within health has the potential to overcome some of the barriers which make traditional health service delivery difficult. For individuals who already have access to a mobile phone, mHealth interventions are relatively cheap, simple to use and easy to access. More importantly, they utilise technology which individuals are already engaging with, providing a platform for increased health awareness and improved service delivery, on an accessible device.

1.4 Structure of Thesis

This thesis contains a general methodology chapter (Chapter 2) outlining the use of Malawi as a case study and the methodological considerations taken within the sequential studies in this thesis. There are four preliminary studies (Chapters 3-6) which inform the design and development of the mHealth behaviour change intervention (Chapter 7). Contraceptive knowledge, attitudes to condoms and contraceptive behaviour were the focus of the intervention and SMS messages were created using the Behaviour Change Wheel to guide the process. This identified relevant evidence based behaviour change techniques which were embedded within the SMS messages to encourage change in contraceptive behaviours i.e. increase in the regularity of modern contraceptive use including condoms and long acting contraceptive methods (see Chapter 7 for more detail). The four preliminary studies identified that there was a lack of knowledge surrounding modern contraceptive methods and as such education and persuasion was the primary focus of this intervention. Increasing knowledge about the benefits and side effects of modern contraception would allow participants to make an informed decision about their own use, and providing information about the opinions of peers would aim to help normalise this behaviour and encourage regular contraceptive use.

After the design of the intervention content, two sub-studies were implemented to assess the contraception access within the study area to ensure behaviour change was possible and to test the theoretical constructs embedded within the SMS messages. The intervention was then piloted within one village in Chikwawa to assess feasibility and acceptability (Study 1, Chapter 8). A larger evaluation was then conducted to identify the effectiveness of the intervention in regards to contraceptive knowledge, attitudes to condoms and contraceptive behaviour (Study 2, Chapter 8). Chapter 9 then discusses the implications of this thesis in regards to recommendations for future research and practice. Figure 1.1 visually depicts how each of the studies (Chapter 3-8) within this thesis feed into one another to answer the primary research question; to determine if an SMS behaviour change intervention is feasible, acceptable and effective in changing contraceptive behaviour in Chikwawa, Malawi.

Figure 1.1: Flow Diagram of the sequential studies in this thesis and how they relate to the overall research question.



1.5 Summary of Chapter 1

mHealth could provide a potential solution to improve the delivery of health services which the overburdened and under resourced health system in Malawi is struggling to do, due to ever increasing population numbers, increasing life expectancy and medical staff shortages. It has the capacity to overcome and support current issues in the health sector including poor infrastructure, difficulties in accessibility and issues around health literacy. This is particularly true in preventative healthcare, where using mHealth as a mode of delivery for behaviour change interventions, could deliver health education and encourage positive health behaviour change in a way which is relatively simple, cheap and easy to access. The structure of the thesis was then presented outlining how the four preliminary studies complement each other in providing contextual information for the design of the SMS behaviour change intervention. This then led to the subsequent pilot and evaluation of this intervention in regards to contraceptive knowledge, attitudes to condoms and contraceptive behaviour.

Chapter 2: Methodology and use of Malawi as a case study

This chapter provides a rationale for the study setting and outlines the background information to set the scene for the location of data collection in this thesis. The health sector is explained in detail, including challenges to deliver healthcare to the growing population such as staff shortages and under resourced health centres. Considerations for the methodology of mHealth behaviour change interventions are then detailed including design, use of theory and intervention content and delivery. Ethical considerations for all studies in the thesis are then discussed including a reflection of my own involvement in the research process.

2.1 Case study of Malawi

2.1.1 Justification for Chikwawa as the Study Setting

This research has been conducted as part of the Scotland Chikwawa Health Initiative (SCHI), a consortium led by the University of Strathclyde in partnership with the University of Malawi (Polytechnic), Ministry of Health in Malawi, Chikwawa District Health Office and funded by the Scottish Government (SCHI, 2014a). The SCHI have been working in the Chikwawa District of Malawi since 2006, implementing programmes on community health development including maternal and reproductive health access (SCHI, 2014a). SCHI have been implementing the 'Healthy Settings' approach (Whitelaw et al., 2001; Dooris 2006) in 18 communities in Chikwawa. 'Healthy Settings' is an approach where health promotion is implemented through a setting for health such as school, village or workplace (Dooris et al., 2007). It is a multidisciplinary method which aims to maximise disease prevention and identifies the need to invest in the social system of a community as well as working with individual, organisational and political stakeholders. The SCHI have spent considerable time in each of these communities educating individuals and empowering communities to take control of their local health issues, and be involved in the decision making process to ensure equity in healthcare. This thesis was embedded within the SCHI and utilised the relationships and links with the local health centre, schools and 18 communities involved in the 'Healthy Settings' project to collect the data required to fulfil the thesis aims.

2.1.2 Background to Malawi: Geography and Economy

Malawi is a landlocked country bordering Zambia, Mozambique and Tanzania in South East Africa. It has an area of 118, 484 sq km, of which 94, 276 sq km is land and the other 20%, (24, 404 sq km) is water in the form of Lake Malawi, which stretches 475 km down through the country (National Statistics Office (NSO), 2011). Malawi is split into three regions and 28 districts. The Northern region comprises of 6 districts, the Central region of 9 districts and the Southern region of 13 districts (Figure 2.1). Districts are divided into a number of traditional authorities, each led by their own Chief, and each traditional authority is composed of a number of villages, led by village headmen (NSO, 2011).

Figure 2.1: Map of Malawi showing the three regions (Northern, Central and Southern) and 28 districts. (Source: Ezlon maps, 2009).

In 2016, Malawi was ranked the 6th poorest country in the world with a Gross Domestic Product (GDP) per capita of $1393 (£929) (International Monetary Fund (IMF), 2016). The most recent IMF (2017) report on Malawi states that its growth rate over the last decade has been below the average for non-resourced African nations and that of equivalent countries by geography and demographics. This is likely down to the nation's high dependence on agriculture produce, which accounts for a third of its GDP and the source of income for two thirds of the population (IMF, 2017).

It is reported that in 2010, 70.9% of Malawians lived on less than $1.90 per day (World Bank, 2010) and the projected figure for 2016 is relatively unchanged at 69.6% (IMF, 2017). Malawi relies substantially on foreign aid, receiving $1.049 billion in 2015 (World Bank, 2015a) from countries such as the United Kingdom and global organisations such as the World Bank. However due to political and governance concerns, primarily the "cash gate" corruption scandal, foreign aid has previously been suspended to take a stand against such injustices. In 2000 (and again in 2009), the IMF stopped aid (reducing the development budget by approximately 80%) over corruption concerns of members of government which significantly impacted the economy (UNDP, n.d). Government actions are still detrimental to the economy today with corruption principles still embedded into local and national governance, reducing both the amount of spending for public services and the credibility of leadership of those in power (BTI, 2016).

2.1.3 Main characteristics of the population of Malawi

Malawi's population includes a diverse range of people with different backgrounds, ethnicity and religious beliefs. There are ten prominent ethnic groups; Chewa (34.7%), Lomwe (19.1%), Mang'anja (2.5%), Ngoni (11.8%), Nkhonde (0.8%), Nyanja (1.1%), Sena (3.6%), Tonga (1.8%), Tumbuka (9.4%) and Yao (13.4%) (NSO, 2017). The groups are spread out across the three regions (Figure 2.1) and the predominant, but not exclusive, ethnic groups in the Southern District are Yao, Sena, Mang'anja, and Lomwe (Malawi Human Rights Commission, 2006).

Religion is prominent within Malawi, with only 0.5% of women and 2.9% of men reporting not belonging to a religion (NSO, 2017). Christianity is the predominant faith, representing many different ethnic groups, with 86.9% of women and 86.3% of men reporting a Christian

denomination and 12.5% of women and 10.7% of men reporting a Muslin faith (NSO, 2017). The Muslim community in Malawi are largely made up of those with Yao ethnicity (72%) and Chewa ethnicity (16%), but this is not exclusive (NSO, 2011).

The population of Malawi in 2016 was estimated at 18, 091, 575 (World Bank, 2016a) and has increased at an average rate of 3.1% from 2010 to 2015 (United Nations Data, 2017). In 2015, 16.3% of the population lived in urban areas, an average increase of 3.8% per year from 2010-2015 (United Nations Data, 2017). Therefore even with a growing increase in urbanisation, the majority of the population live in rural parts of Malawi. This rapid urbanisation is positive for the development of the nation, however poses a great challenge on government spending to meet housing, health, education and other public services, despite little economic growth (African Development Bank, 2016).

Malawi's average life expectancy is 63.8 years (World Bank, 2015b), a 15 year improvement over a decade, when it was 48.3 years in 2005 (World Bank, 2005a). In addition there have been improvements in child mortality (measured per 1,000 live births) with 43.4 in 2015 compared to 70.7 in 2005 (World Bank, 2005b; 2015c). This positive progression in key health outcomes is noteworthy, however with rapid population increases still occurring year on year and the projected population estimate at 23 million people by 2025 and 37 million by 2050 (Government of Malawi, 2012), the population increase will continue to severely impact both services and spending unless it is addressed.

The Government of Malawi have put in place policies and programmes to encourage contraceptive use and smaller family sizes in order to tackle rising population issues. This includes introducing the campaign "Children by Choice" encouraging individuals to decide if they want children and plan when the right time this will be (Government of Malawi, 2012). One way to encourage this is by the use of contraception. Malawi has made marked improvements in the use of modern contraception with 43.2% of unmarried women aged 15-49 using modern methods compared to 13.2% in 2010, and 58.1% of equivalent married women now using these methods compared to 35.4% in 2010 (NSO, 2011; 2017). The fertility rate (total births per woman) has also been falling over the last few decades from 6.25 births per woman in 2000 to 5.05 in 2015 (World Bank, 2000; 2015d). Efforts to curb population growth are extremely important, as this has an impact on government resources, but also on the country's ability to meet the Sustainable Development Goals put

in place by the United Nations in 2016. However, population increase at current rates, even with improvement in family planning, will put pressure on all aspects of public services from housing and education to employment rates and economic growth (Government of Malawi, 2012). It will also put a strain on the health service, as a growing population coupled with longer predicted life expectancy, equates to significant extra demand and pressure for local and national health services.

2.1.4 Health Sector of Malawi

Healthcare in Malawi is delivered by a mixture of public sector services provided by the government and private sector services provided by not for profit, faith based, private practitioners and community-based organisations (African Health Observatory (AHO), 2014). It has been reported that 40% of health services are provided by private organisations (SHOPS Project, 2012), however these centres charge at point of service delivery and this is often a significant barrier among local residents in accessing this type of care (Lawson, Mazengera, & Nkhoma-Mbawa, 2008).

Public health facilities in Malawi have been free to the patient at point of service delivery since the adoption of the Essential Health Package by the Government of Malawi in 2002 (Lawson et al., 2008). This World Health Organisation (WHO) package is designed to direct low income countries towards the minimum required health services which must be provided and guide the planning and funding of such services (WHO, 2008). Malawi works under a three level system; primary health care (community care), secondary care (district hospitals) and tertiary care (highly specialised services) (AHO, 2014). Community care is set up to meet patients' immediate needs and consists of community initiatives, maternity units, health centres and rural hospitals. This would be the first point of care for individuals in a rural setting as it will be their closest health service. District hospitals are much larger health facilities and provide more specialised services to patients including in and out patient care, as well as community health services. These services have much more sophisticated equipment such as laboratories, blood banks, imaging and testing facilities (Ripple Africa, n.d). Highly specialised services are provided by central hospitals and other specialist hospitals and can be specific to a condition or population group (AHO, 2014).

The total expenditure for health per capita is 93 US dollars which equates to 11.4% of the country's GDP (World Bank, 2014) – however external organisations have reported that there is a gap between planned budget allocation and actual spending on service delivery (Lawson et al., 2008). Financial barriers exist to the daily running of health services, predominantly rural services, as larger hospitals are prioritised in resource allocation. Makuala et al. (2012) observed five rural health facilities and found community healthcare workers did not feel able to meet their governmental health targets. This was reported to be due to irregular resource distribution, inadequate equipment, poorly maintained buildings and insufficient storage and space for service delivery. Insufficient medication or drug shortages have been reported as a barrier to health service delivery both in research (Lawson et al., 2008; Lungu et al., 2016; Machira & Palamuleni, 2017) and in the national papers (Nyasa Times, 2017), as well as lack of funding for ambulance provision (Abiiro, Mbera, & de Allegri, 2014) and long distances to reach health facilities (Ewing et al., 2011; Ustrup et al., 2014; Munthali, Chimbiri, & Zulu, 2004).

Mueller, Lungu, Acharya, & Palmer (2011) conducted an evaluation of the introduction of the Essential Health Package in Malawi and found drug availability and poor human resource management were the two primary sources of failure in Malawi's healthcare system. Human resource management primarily consisted of staff shortages – where barely half of the expected medical staff positions were filled from the reviewed hospitals (n=9). Staff shortages in health centres is a huge problem in Malawi. Malawi has one of the lowest doctor to patient ratios in the world at 0.019 physicians per 1000 (World Bank, 2016b), which equates to approximately 1 physician per 50,000 people. In reality this means that doctors are only found in district hospitals and primary healthcare centres have few, if any, nurses and are primarily run by Healthcare Surveillance Assistants (HSAs). HSAs are the core staffing of community health services, and after a 12 week training programme reside in their assigned catchment areas (Government of Malawi, 2009). The recommended ratio for care is 1 HSA for 1000 people, however in reality catchment sizes are much greater than this (Chikaphupha et al., 2016) which puts pressure on community services and HSA workloads. Responsibilities of HSA's originally focused on preventative health including health education, immunization, disease surveillance and sanitation; however increasing staff shortages have broadened their role to include family planning, malaria and nutrition as well as curative work in HIV and Tuberculosis (K4Health, 2013). These increases, in both

patient populations and workload, undoubtedly affect job satisfaction and motivation. Research has found a number of barriers including lack of resources, limited opportunities in career development, inadequate supervision and low income (Kok & Muula, 2013; SCHI, 2014b; Chikaphupha et al., 2016) in relation to the negative perceptions of this role.

Research in healthcare employment has found that opportunities for promotion, better working and living conditions and increases in monthly pay are all important when looking for work in Malawi (Mangham & Hanson, 2008). Therefore it is not surprising that medical staff are choosing to accept positions in foreign countries which meet the criteria above. Migration of trained healthcare workers is an issue which contributes to staff shortages in Malawi (Record & Mohiddin, 2006), however it is only part of the problem and increased training, particularly for specialised services, is needed to fill the gaps in service provision (Muula, 2006). Efforts need to be made to make significant improvements to working conditions, resource provision and management structures (Chimwaza et al., 2014) both for current employees and to encourage future generations to use their skills at home. As without these improvements, the cycle of staff shortages will continue to negatively affect service delivery (McAuliffe et al., 2012).

2.2 mHealth as a mode of delivery for Behaviour Change Interventions

mHealth has been highlighted as a potential tool in delivering health services, where infrastructure and accessibility is a significant issue. This may be best served in the delivery of preventative healthcare, a service which is desperately needed in Malawi to avoid unnecessary deaths from preventable diseases, yet the under-resourced and over-burdened health sector is struggling to adequately provide it. Three of the top causes of mortality in Malawi are preventable; HIV, malaria and diarrhoea (AHO, 2014). Therefore education and targeted behaviour change interventions are urgently required to ensure individuals are aware of the dangers and what actions they can take to minimise the risk to them and their families. Health education is important, particularly in low income settings where the opportunity to learn is not as easy as it is in high income countries, however, education alone is not enough to encourage effective behaviour change (Kelly & Barker, 2016). Choosing to perform health behaviours is a complex decision and does not occur in isolation. Therefore understanding why individuals do, or do not, conduct important preventative health behaviours requires theoretical input to address what is involved in this

process (Sutton, 2004). Health Psychology theories provide rich information on the many factors involved in performing a behaviour, such as an individual's attitudes, beliefs, perceived ability and self-efficacy and the attitudes of others, societal norms and the socio-cultural context (Rosenstock, 1974; Ajzen, 1985; Bandura, 1986; Prochaska & Diclemente, 1982; Michie et al., 2005). Acting upon these aspects, using behaviour change techniques identified in the literature (Abraham & Michie, 2008) is required in addition to education, in order to successfully elicit positive health behaviour change.

Therefore, utilising mHealth as the mode of delivery for theory-based behaviour change interventions is an example of how this tool can be practically applied. However, it is extremely important to design the intervention with considerations of the specific geographical location and socio-cultural context, as well as ensuring rigorous methodology and evaluation processes throughout. The next section details essential aspects, from the literature, which must be embedded into the design and implementation of a behaviour change intervention, and focuses on the importance of these for mHealth as the mode of delivery.

2.2.1 Methodological Design

The field of mHealth has been criticised for 'pilotitis' – where the majority of mHealth literature originates from small scale pilot ventures which are rarely rigorously tested with little formal evaluation (Huang, Blaschke, & Lucas, 2017). Therefore new projects need to critically consider choice of methodological design to ensure interventions are effectively evaluated. This includes basic principles; ensuring there is a control group and adequate pre- and post- intervention measures for cross comparison with the intervention group. This allows conclusions to be inferred regarding intervention effectiveness compared to routine care. Reviews of mHealth research globally (Cole-Lewis & Kershaw, 2010; Free et al., 2013; Tomlinson et al., 2013) and specifically in low income countries (Gurman, Rubin, & Ross, 2012; Aranda-Jan, Mohutsiwa-Dibe, & Loukanova, 2014; Chigona et al., 2013; Hall et al., 2014) identify that this is not current practice, and is needed in order to effectively evaluate and scale up mHealth interventions.

As well as making the best decisions regarding what methodology to implement, it is also extremely important for consistency in evidence reporting across the field. Guidance for

reporting scientific evidence is well accepted within the literature and exists to standardise reporting of randomised trials, for example Consolidates Standards for Reporting Trials (CONSORT) (Schulz et al., 2010) and for systematic reviews, Preferred Reporting of Systematic Reviews and Meta-analyses (PRISMA) (Liberati et al., 2009). In this line, Agarwal and colleagues (2016) created a specific mHealth Evidence Reporting and Assessment tool (mERA). This is specific to mHealth research and aims to improve clarity of reporting, which allows for easier comparisons between different intervention designs and methodologies. The mERA stipulates that information on 16 essential criterion is included; infrastructure (population level), technology, health information system context, intervention delivery, intervention content, usability/context testing, user feedback, access of individual participants, cost assessment, programme entry, limitations for delivery at scale, contextual adaptability, replicability, data security, compliance with national guidelines and the fidelity of the intervention (Agarwal et al., 2016). The introduction of reporting guidelines for mHealth is extremely valuable, as it will encourage clearer transparency in mHealth evidence which will further aid the design and development of new interventions in the future. Therefore it is important for mHealth interventions to follow these guidelines in dissemination of results and project implementation, this will be discussed in more detail in Chapters 4 and 9.

As mentioned above, mHealth interventions aimed at changing behaviour, whether *preventing* harmful behaviour (e.g. smoking cessation) or *promoting* health behaviour (e.g. fruit and vegetable consumption) need to be designed to incorporate behaviour change theory. The Medical Research Council guidelines for complex interventions (Craig et al., 2008) describe the design process as beginning with a 'theoretical' phase. In this phase, a specific theory or multiple theories, are chosen to be built upon throughout the design to ground the intervention in a theoretical basis for behaviour change. Michie and colleagues (2008) discussed that interventions must be underpinned by theory in order to effectively target underlying causes of behaviour, so theory can be tested and evaluated and adapted for different situations and populations. In practice, choosing a specific theory for intervention development can be difficult as many behaviour change theories exist within the literature, with overlapping constructs and limited instruction on practical application; therefore it is extremely difficult to translate theoretical ideas into practical delivery (Lippke & Ziegelmann, 2008).

The Behaviour Change Wheel (**Error! Reference source not found.**.2), created by Michie, tkins & West (2014), was designed to overcome reliance on single theories and is a guide for researchers in intervention design and development. It begins with getting the researcher to concentrate on the theoretical understanding of the behaviour in question and then pin down what aspects of the behaviour needs to change and to focus on addressing these aspects to encourage change (Michie, van Stralen, & West, 2011). The researcher then decides on which intervention functions are appropriate for the target behaviour and population, before incorporating tried and tested behaviour change techniques (BCTs) which enhance behaviour change effectiveness (Abraham & Michie, 2008). Chapter 7 outlines this process in more detail.

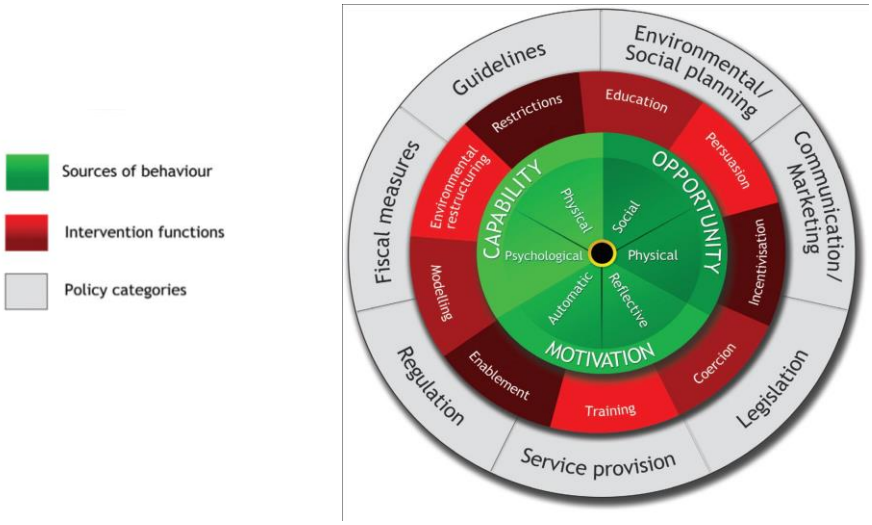


Figure 2.2: Behaviour Change Wheel (taken from Michie et al., 2014)

As previously mentioned, rigorous methodology and evaluation are required to test intervention effectiveness and inform future practice. In order to determine if mHealth interventions are able to be scaled up across larger populations, cost-benefit analysis must be completed in addition to intervention effectiveness (Gurman et al., 2012). This enables projects to identify the cost of the intervention and plan the financial resources needed to scale up the intervention to a larger population. Chen et al. (2008) conducted an SMS vs. telephone reminder service in China. Even though effectiveness did not differ between the groups, cost-effectiveness analysis revealed that the SMS service cost significantly less than the telephone service; this was quantified as a ratio of cost per attendance of SMS to

telephone being 0.65 (Chen et al., 2008). It is generally accepted sending a text will be cheaper than placing a call; it's quicker, easier, and simpler. However it is still important to quantify costs on mHealth projects in order to inform future funders of the financial implications of scaling up the project.

In addition to intervention evaluation pre- and post-delivery, experts have called for long term evaluation of intervention effectiveness and impact (Mecheal, 2009). There is a need to assess the long term effects of these behaviour change interventions; are they still being used 6 or 12 months after implementation or do they only have an effect for the first 3 months? These are the types of questions which need to be addressed to understand the full impact mHealth projects have and what implications that has for replication across health topics and populations. In addition it has been stated that the best way to 'entice donors' is through presenting long term analysis of behaviour change interventions (Gurman et al., 2012) to ensure future funding for this type of research.

2.2.2 Intervention Content and Delivery

2.2.2.1 Target Audience

Intervention content must be tailored to the specific target audience. This includes ensuring content is localised to the specific area in question, in order for the intervention to be trusted and acknowledged (Wood et al., 2012). For example, when discussing nutrition, only foods which are available in that region and which fit with specific cultural or religious beliefs should be recommended. This ensures the information is accessible and can be acted upon, increasing the likelihood of its adoption. It is also necessary to find out whether any local traditional health practices exist within the particular health topic and to address them within the intervention, as this may be a contradiction to what the target population believe to be true.

Translation of messages must also occur to be understood in the local language. It is important to consult local health experts in the translation process, as health issues may be commonly referred to by local slang terms rather than official medical definitions. Wood et al., (2012) overcame this issue by including both accurate medical terms and local slang in their message translations to keep the information relevant. The same group reported

difficulties in translation, as even after translating the messages from written English to the written local language, native speakers regardless of education could not read or make sense of the translation. To overcome this, they had the messages translated on the spot with help from local health workers to assure accuracy.

A final content consideration is the intended audiences' education level. It is extremely important to tailor messages towards participants' level of understanding, regarding language and literacy capabilities but also technology skills (Gurman et al., 2012). An mHealth intervention aimed at adults who are language literate, but technology illiterate will be as unsuccessful as aiming intervention content towards adults who cannot read. Therefore design considerations need to be made when developing mHealth interventions in areas where adult literacy is extremely low to overcome these barriers and ensure participants can understand and engage with the material. In order to overcome this, projects have integrated Interactive Voice Response (IVR) into mHealth projects. This is where messages are pre-recorded in the local language as an alternative to written SMS messages, and participants receive the voice messages in a phone call. This can prove problematic, as lost signal, battery depletion or participants not answering can all lead to the message not being received. However, the technology can redial the number if receiving difficulty getting through and can be programmed to automatically retry the following day if there is still no answer (Neumann, 2017).

A maternal health information service in Ghana found that 99% of women chose to receive IVR messages instead of SMS (Wood et al., 2012). The local language in question was predominately oral and rarely read or written down, this coupled with low literacy rates sheds some light on why IVR was the dominant choice in this study. However, every population group will have different preferences based on their demographics; therefore it is imperative to conduct extensive pre-intervention analysis to influence mHealth intervention design and the planning of data collection and evaluations.

2.2.2.2 Intervention Length

In the design of mHealth interventions, attention must be paid to intervention length. Rothman (2004, pg 3) stated "adequately testing basic principles [in a theory driven behaviour change intervention] depends on a well-timed assessment schedule." This is

difficult to achieve in practice as an intervention needs to be left for a period of time in order to have success in changing behaviour, but at the same time too much time will inhibit the effects found in the post-intervention assessments. mHealth projects in the literature vary considerably in length. A review of SMS interventions for behaviour change in disease prevention and management (Cole-Lewis & Kershaw, 2010) found that project length ranged from 1 month (feasibility study) to 12 months (with varying 3, 4, 6 months in between). All of these projects were Randomised Controlled Trials's (RCTs) conducted predominately in low income countries on health conditions such as weight management and diabetes management, both of which require monitoring over a longer period of time to see results in terms of behaviour change.

Research in middle and high income countries also shows varied intervention length, with examples of interventions completing a full study in 9 months (Lemaire, 2011), a 10 month pilot intervention (L'Engle et al., 2013), and a two year impact study (Crawford, Larsen-Cooper, Jezman, Cunningham, & Bancroft, 2014). However it is not clear in any of these studies how long the intervention was active and what proportion of time was initial data collection and follow up testing. It is also unknown how long participants engaged with each service as they are all opt-in study designs. mHealth projects in low income countries are rarely reported to the depth required for a peer reviewed journal, due in part to the popularity of mHealth in NGO's and small scale projects. Therefore it is difficult to ascertain best practice in terms of intervention length and follow up, as well as the average time participants stage engaged in such programmes, however this is likely to depend on the interventions target areas and the theoretical components involved.

2.2.2.3 Ethical Considerations

The majority of mHealth interventions are focused on changing specific behaviours, behaviours which in some cases can be very personal and require the exchange of sensitive information. Therefore ethical concerns such as privacy and confidentiality need to be addressed.

Although mobile phone ownership is increasing steadily in low income countries, not everyone has access to a personal phone. In Malawi, 45.5% of households own a mobile phone (NSO, 2014) therefore the potential for reach in terms of mHealth is promising.

However phone sharing brings concerns of intervention privacy. Sensitive information, particularly about one's own health, could prove problematic if accessed on a shared phone. Individuals may not want to disclose their involvement in the intervention to family members or may not be allowed to participate by the phone owner. This can be a problem in health topics such as maternal health, when a woman needs access to specific health information, but husbands or other family members refuse to allow them to participate in the mHealth programme. Wakadha and colleagues (2013) found this was a major barrier to their maternal health mHealth interventionin rural Kenya. As a significant proportion of mothers could not engage with the service because their husband owned the mobile phone and they would not receive the information, either they had no access or were prevented from participating. This barrier of intervention access has been found frequently in research in low income countries (Bullen, 2013; Chib et al., 2013), as it has been found participants are much less likely to receive the intervention content when they do not personally own the device.

Men are more likely than women to own a mobile phone, due in part to higher literacy and education levels, but also due to cultural norms and practices leading to gender inequality. As part of the 2010 Malawian Demographic and Health Survey in Malawi (NSO, 2011) it was found that 39% of households own a mobile phone, however it also stated that only 30% of women participate in decision making for household purchases and as such it is highly likely women will not have as much access to a purchased mobile phone as their husbands. It is therefore important to address these gender inequalities in mHealth research, otherwise these projects will inadvertently marginalise already vulnerable groups (Hall et al., 2014). This is especially important when the majority of mHealth initiatives in sub-Saharan Africa are based on female health issues such as maternal health and contraception. Women may be open to receive the health information, but not have the means to access it. In order to overcome this accessibility barrier, researchers have provided villages with mobile devices through the local community health workers (Larsen-Cooper, Bancroft, O'Toole, & Jezman, 2015). In doing this, members of the village who wish to receive health information can do so, receiving the information in private and without having to ask permission and rely on relatives to share their device.

Informed consent is another ethical concern which needs to be addressed. The majority of mHealth studies using basic functionalities of the phone are 'opt-in' whereby participants see the project advertised and make an informed choice to enter into the mHealth programme. This is the process for the vast majority of all health research. Participation is voluntary, consent is acknowledged in writing, and the participant can withdraw at any point (BPS, 2010). The same safeguard process needs to be addressed in mHealth interventions, creating a clear 'opt-out' strategy which is communicated to all participants (Wood et al., 2012). This could take place in the form of a SMS message at the beginning of the study, e.g. "to unsubscribe from this service text STOP to 45678 at any point". It is important to include this precaution in all mHealth interventions in order to allow participants to withdraw if they desire. They cannot physically walk away from the study, and protection needs to be included to give them the same right to withdraw at any point.

2.2.2.4 Cost of Delivery

mHealth interventions, especially when implemented in low income countries have financial implications to the participant. Mobile phones are one of the biggest and most widely available technology devices globally, and are embedded into everyday life. However they are expensive to purchase and run, particularly in countries like Malawi where the cost implication of travelling long distances to charge a phone is included in the expense (GSMA, 2012). Projects need to consider how this expense could impact participation in mHealth based studies.

The vast majority of mHealth projects in low income countries try to absorb this cost for the participant by using systems which route the cost of the SMS or IVR to the sender, ensuring that the end user is not charged for the service. Free open-sourced systems such as FrontlineSMS, Telerivet, and VOTO Mobile all enable projects to foot the bill for their messaging services (Morio et al., 2014). This has occurred in SMS campaigns such as Mobile for Reproductive Health in Kenya (FHI 360, 2013) and Sexual Health information service for youth in Mozambique (Pathfinder International, 2014). In addition to SMS, Village Reach (2014), an NGO in Malawi, implemented a free hotline for expectant mothers to ask health questions during their pregnancy, allowing users to receive SMS reminders and phone the hotline without any personal cost.

Including these features in the design enables participants to engage with the service for free. There can, however be a one off charge to enter the service, when the participant sends a SMS to register to the reminders or health information. This can be overcome by including 'flash to join' as an opt-in mechanism. Flashing is when a caller phones a recipient but hangs up after they hear the dial tone; this gets the attention of the recipient without costing the caller any credit. This mechanism has been included in projects such as maternal health service by the Grameen Foundation (Wood et al., 2012), where the system registers the participant to the SMS or IVR service after they have 'flashed' the advertised number. This can be an important aspect for participants, as if it is a 'flash to join' service instead of using SMS, participants are assured they will not be charged for their participation (Wood et al., 2012).

2.2.2.5 Involving participants in the research design

Finally, when designing interventions it is imperative to conduct participatory research in order to understand the needs, wants and experiences of the particular population in question. This is especially important in mHealth research in low income countries, as individuals may have never taken part or witnessed research using this mode of delivery and understanding the acceptability of this within specific populations is essential.

Community-Based Participatory research (CBPR) is defined as "a methodology that promotes active community involvement in the processes that shape research and intervention strategies, as well as in the conduct of research studies" (O'Fallon, Tyson, & Dearry, 2000, pg 10). The National Institute of Environmental Health Sciences state that 6 principles must occur for effective CBPR: promote active collaboration and participation at every stage of research; foster co-learning; ensure projects are community-driven; disseminate results in useful terms; ensure research and intervention strategies are culturally appropriate and define community as a unity of identify (O'Fallon & Dearry, 2002). In terms of intervention development, CBPR is effective in involving all stakeholders in the intervention design and implementation, and ultimately increasing the likelihood of its success (Wallerstein & Duran, 2010).

In mhealth projects, engaging the target group in the design process will help to improve understanding and engagement with the technology, as well as empowering the

community to get on board with the project. This process is especially important due to the technology involved. What the researcher may view as 'simple' technology or content may be quite the opposite in the targeted audience. Therefore asking these types of questions with the target audience is essential at the very early stages of design within mHealth interventions.

Therefore, there are a lot of considerations to weigh up when designing and implementing an mHealth behaviour change intervention in a low income country such as Malawi. Design decisions are heavily influenced by the project size and funding, however it is imperative to keep issues such as methodological rigour, ethical considerations of privacy and informed consent, audiences education level and evaluation methods in consideration throughout this process. In addition, it is important to target mHealth interventions to the relevant population and ensure that the theory based content and delivery method is relevant to the specific group. In order to do this, effort must be made to continuously liaise with participants, involving them in the research process, to gauge their opinion and ensure the final design is acceptable, engaging and appropriate to the target population.

2.3 Ethical considerations throughout the thesis

Full ethical approval for all studies within this thesis was granted by the National Committee on Research in the Social Sciences and Humanities in Malawi (NCST/RTT/2/6) (Appendix 1) and by the University of Strathclyde Ethics Committee in the UK (UEC16/03) (Appendix 2). Further to this, permission was sought from Chikwawa District Health Officer and District Commissioner and from relevant village headmen prior to data collection in all of the studies reported in this thesis.

Prior to any data collection in any of the reported studies, participants were read the information sheet and had the opportunity to ask questions. They were then asked to give their consent for participation, which was recorded on a consent form (see Appendices 3, 8, 9, 11, 13, 17 and 19 for consent forms for each of the studies involved in this thesis). For participants who were illiterate, a thumb print was taken as consent on the form instead of a signature.

All interviews in this thesis were audio-recoded and then transcribed verbatim. All responses were kept completely anonymous and participants were assigned an identification number for transcripts and no identifiable information was included in the transcripts or subsequent write up. All responses were kept confidential and stored on a password protected and encrypted laptop and then uploaded to Strathcloud (University secure cloud for data storage) after analysis was complete. Data will be kept digitally for 10 years after the last date it is accessed in line with University of Strathclyde regulations.

2.4 Reflexivity of author involvement

It is important to reflect on my own involvement in the research process, particularly in regards to the three qualitative studies (Chapter 3, 5 and 6) which were undertaken. In any qualitative study which analyses the meaning behind participant responses, acknowledgement that the interpretation process is influenced by the researcher's own beliefs, perceptions and socio-cultural identify must occur (Alzouebi, 2010). In this thesis, this is further complicated by the use of a translator in the research. The qualitative interviews and focus groups were facilitated and transcribed in Chichewa and then translated into English by a Malawian data collection assistant. It was this English version which was analysed by the author. This research process will have consequences on how the data was analysed and interpreted (Temple & Young, 2004), and opportunity exists for either individuals to influence, consciously or unconsciously, the data through their own interpretation of the participants responses.

The insider/outsider debate in reflexivity discusses the notion that a researcher sits on a continuum between being a member of the research group or 'insider', and having no membership of the research group or 'outsider' (Corbin-Dwyer & Buckle, 2009). Arguments exist for the costs and benefits for both approaches. 'Insider' researchers are more readily accepted and this can help promote honest discussion (Bonner & Tolhurst, 2002), however this can make it difficult to stay impartial and researchers may make unconscious assumptions about participants based on their own previous knowledge of the subject. (Hewitt-Taylor, 2002). 'Outsider' researchers are more able to objectively interpret the data, however their lack of understanding of the subject area may lead them to make faulty assumptions or interpretations of the data (Lewis, 1975). Regardless of opinion of where a

researcher should sit on the continuum, the overarching understanding is that researchers must be aware of their own role and subsequent influence (Unluer, 2012).

The author is a 26 year old female from Scotland, who prior to the commencement of this PhD, had no previous experience with the Malawian way of life, culture or language. Although endeavouring to learn as much as possible during her 6 month stay in the country, it was difficult to develop a clear understanding of the living conditions of the residents of Chikwawa. As well as the socio-cultural factors relevant to the study setting, the author was very much on the 'outsider' end of the continuum for the duration of the project. However, it was an awareness of this position which influenced decision-making regarding data collection procedures. Data collection assistants who were known in the study area and had previous experience, were recruited to conduct the focus groups and interviews. These were facilitated in Chichewa, rather than directly translating between the author and participants during discussions. This was to allow the participants a level or rapport with their facilitator and to encourage more discussion on the topics presented, as the data collection assistants would have been relatable to participants in their 'insider' role. This mixture of insider and outsider perspective allows this research to capture thoughts and opinions of the topic, as accurately as possible, particularly as it is of a sensitive nature. However also allows the data to be analysed as objectively as possible from an 'outsiders' perspective by the author.

On reflection, the author's position on the outsider/insider continuum is not clear cut, even with no prior experience of Malawian culture. Having experienced life in Malawi for a short, but significant period of time, taking part in local customs and embracing the way of living, there is a lived experience which is difficult to objectively forget during data analysis. This is particularly the case emotionally, as knowing the significant differences between living conditions from rural to urban Malawi, let alone Scotland, cannot just be put aside and will have implicitly impacted data analysis, themes and interpretation. This is recognised in the literature, with many researchers finding themselves somewhere in the middle, between the two (Breen, 2007; Corbin-Dwyer & Buckle, 2009; Kerstetter, 2012).

Literature on the involvement of translators in research details the impact this can have on the final dataset, including decisions regarding translation of nuances or word choices based on their experience of the situation (Murray & Wynne, 2001). Therefore there will

always be a level of bias with cross-cultural research, and it is important to acknowledge this limitation, but also include practical steps to limit this bias (Squires, 2008). The steps taken in this thesis, was to recruit data collection assistants who had previous experience of working with the SCHI and who were trained on the specifics of each study. The semi-structured interview guides were all translated into Chichewa prior to commencement, to ensure the same terminology of medical and cultural concepts were used and to minimise translation errors or ambiguity. The translators were also trained and understood the importance of transcribing the data in Chichewa and then translating this information into English, to ensure accurate representation of the data.

2.5 Summary of Chapter 2

This chapter has provided background information as to the study setting of Chikwawa, Malawi and provided justification for the need of an mHealth behaviour change intervention due to the ever increasing population size, medical staff shortages and overburdened health service. It also outlined the methodological requirements for the design, development and evaluation of an SMS behaviour change intervention including appropriate methodological design, ethical considerations and the need to include participants in the intervention design process.

Chapter 3: A qualitative study to design an mHealth intervention for a low income country, a case study in Chikwawa, Malawi.

Chapter 1 outlined the potential mHealth has, as a mode of delivery to implement health behaviour change information in low income countries and Chapter 2 detailed how this is required in Malawi due to the overburdened and under-resourced health sector. The proposed mHealth behaviour change intervention is the first example of this mode of intervention delivery in a community setting in Malawi, and involving the residents of Chikwawa to inform its design and development is imperative to creating a tailored intervention to their needs. This chapter outlines a two stage qualitative analysis, which includes secondary analysis of 108 focus groups to identify four potential health education topics, and 10 subsequent focus groups which explore the acceptability and feasibility of implementing an mHealth intervention within the community of Chikwawa, Malawi.

3.1 Introduction to the use of mHealth in low income countries

As outlined in Chapter 1, mHealth interventions have the potential to overcome major problems in preventative healthcare delivery in developing countries. However, it is essential that their development and implementation are carried out with scientific rigour. Reviews of mHealth research both globally (Cole-Lewis & Kershaw, 2010; Free et al., 2013; Tomlinson et al., 2013) and specific to developing countries (Gurman et al., 2012; Aranda-Jan et al., 2014; Hall et al., 2014) warn of the desperate need for adequately powered, rigorously tested and thoroughly evaluated scientific studies. In addition, intervention content must be tailored to the needs of the target population, for example, be sensitive to cultural context and demographic factors such as age and gender, in order to enhance intervention effectiveness (Kreuter et al.,, 2003). Furthermore, participant level of understanding, language and literacy capabilities and technology skills also need to be considered (Gurman et al., 2012). Therefore participants need to be involved in intervention design and development, as this is imperative to increase the likelihood of intervention success and engagement (Minkler & Wallerstein, 2008).

Previous public health campaigns in Malawi, with a mobile component, have included ‘Chipatala Cha Pa Foni’ a hotline for expectant mothers (Village Reach, 2014), ‘Youth Alert!’ a reproductive health radio programme predominantly accessed via mobile phone (PSI,

2014), and health education 'jingles' via mobile phone platforms in the Millennium Village Project (McCord, Liu, & Singh, 2012). mHealth appears to be a popular mode of public health campaign delivery in Malawi. However peer reviewed research in Malawi has had a predominant focus on up-skilling community health workers to deliver messages (Lemay et al., 2012; Mahmud, Rodrigeuz, & Nesbit, 2010; Millennium Promise, 2014), or implementing hotline or radio campaigns to specific groups of people (PSI, 2011; Village Reach, 2014). There is little evidence regarding the impact of mHealth public health campaigns at a community level.

Due to this gap in the current evidence base for community mHealth interventions, it is essential to involve participants in the design and development of an mHealth behaviour change intervention, which will provide health information to the community in Chikwawa, Malawi. This two stage qualitative study involved local residents to identify health topic priorities and used these topics to inform a more detailed discussion of health education need, and the acceptability and feasibility of implementing an mHealth intervention in this area.

3.2 Methods to understand feasibility and acceptability of mHealth

3.2.1 Study Setting

This study occurred in the Mfera catchment area of Chikwawa, Malawi (Figure 3.1).

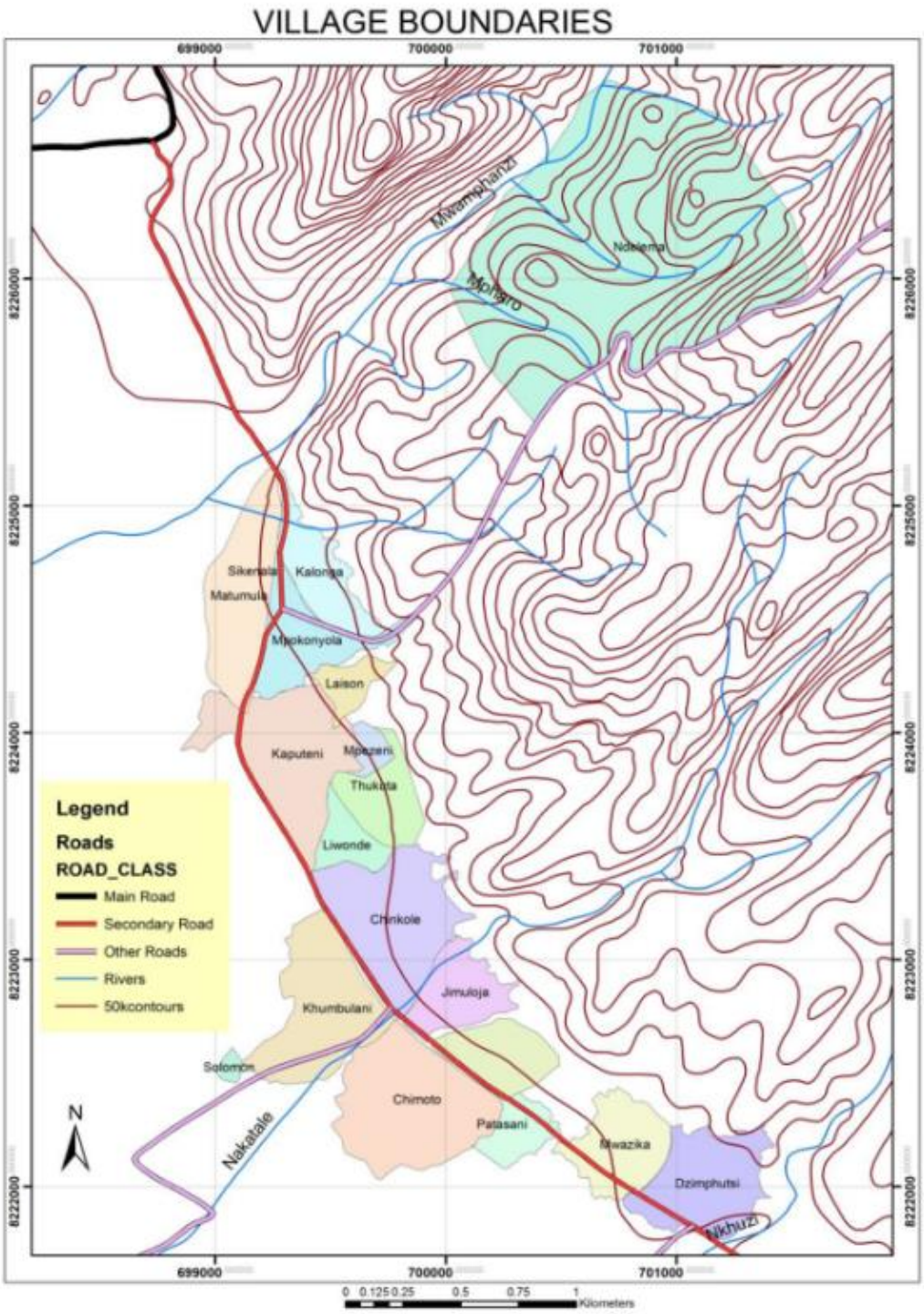


Figure 3.1: Map of Chikwawa District in Malawi and of the Study Setting of villages within Chikwawa (Map: created by the author September 2017).

3.2.2 Study Design

The aim of the study was to conduct qualitative research to involve participants in the design and development of a mHealth intervention, particularly intervention content, method of delivery and duration. This was achieved in two stages:

3.2.2.1 Stage 1: Secondary Analysis of Village Profiles

SCHI conducted 108 focus group discussions in 18 villages in Chikwawa (Figure 3.1) in 2013/14. In each village, focus groups were conducted with 6 representative groups; Leadership (mixed gender), Men, Women, Elderly/Marginalised (mixed gender), Male Youth (15–24 years) and Female Youth (15–24 years), with group sizes ranging from 6 to 12. The data from each village was combined by a SCHI team member and summarised to form individual village profiles (SCHI, 2014c). The 18 village profiles were used as secondary data to identify health education needs and the findings used to form the basis of Stage 2, this analysis was conducted in December 2014.

3.2.2.2 Stage 2: Intervention Development

Ten focus groups were conducted in two randomly selected villages, Sikenala (n=42), Chimoto (n=33) and one secondary school, Mfera Community Day Secondary School (CDSS) (n=16) in January 2015. Two focus groups were conducted with male adults, two with female adults, three with male youth and three with female youth.

The study instrument was a series of open-ended questions informed by the findings in Stage 1. Questions focused on 4 health topics (identified from Stage 1), Nutrition, Hygiene, Family Planning, HIV/AIDS, and included questions regarding mHealth intervention feasibility and acceptability. mHealth was presented to participants as the use of mobile phones to deliver health education via calls and text messages. Simple functionality was presented as observations in the communities indicated that the majority of residents only had access to basic mobile devices which could not access the internet. Questions addressed the relevance of each health topic, the perceived need for information about each topic, mobile phone ownership, intervention duration, mode of delivery and barriers to implementation. For adult focus groups there was additional discussion on parental

consent for intervention access. Demographic information including age, literacy and education level was also recorded.

3.2.3 Chapter 3 Procedure

For both stages participants were recruited through convenience sampling. For community based focus groups, the facilitators walked around the village with the village Headman identifying eligible candidates. After being read the information sheet and having the opportunity to ask questions, participants were asked to give their consent for participation, which was recorded on a consent form (Appendix 3). At the secondary school, permission to undertake the research was obtained by the Head teacher and participants over 15 were then invited to take part. If participants agreed to take part, they were asked to give their consent which was recorded on the consent form. Focus groups were conducted in Chichewa, the local language, by a trained facilitator and followed a pre-determined interview schedule (Appendix 4) created for this study. Additional probing questions were included to encourage expansion into discussion topics. Each focus group lasted between 45 and 60 minutes and were recorded using an audio recording device. All focus groups were transcribed verbatim and then translated into English by the facilitators.

3.2.4 Stage 1 Analysis

Secondary analysis of the 18 village profiles recorded references to health education needs and these were tabulated by village and focus group type (leadership, men, women, elderly, male youth and female youth). To include observations made by the original interviewers and in instances where a health topic was discussed, but no identification of focus group was given, an extra group entitled ‘General’ was included in the analysis.

3.2.5 Stage 2 Analysis

Thematic analysis was used to analyse the data, and followed the Braun & Clarke (2006) step-by-step guide. This process involved the author manually highlighting of sections of the transcripts which were relevant to the research objective and assigning an appropriate descriptive label which acted as a code. Similar coded sections were collated together to create themes which run throughout the data. Themes were refined by the author and discussed separately with two supervisors as to their relevance to the transcripts. Finally

each transcript was reread by the author to make sure the themes accurately represented the data collected.

3.2.5 Ethical considerations

Ethics were carried out as discussed in section 2.4.

3.3 Results of Stage 1

Fifteen of the village profiles referenced health education need in four health topics, Nutrition, Hygiene, Family Planning and HIV/AIDS (Figure 3.2).

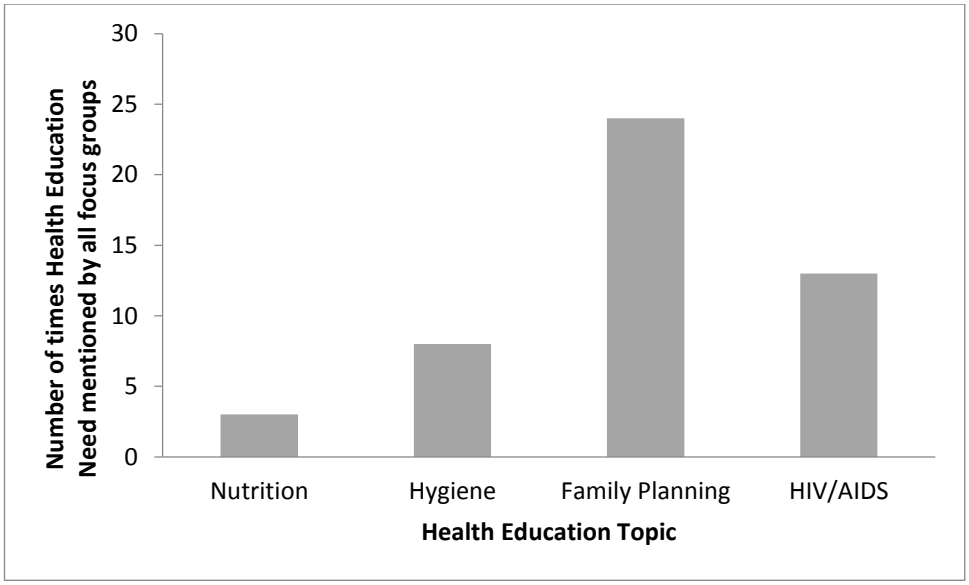


Figure 3.2: Health education need by health topic from secondary analysis of 108 focus groups which were conducted in 2013/2014 in Chikwawa, Malawi (Stage 1).

Family planning was most frequently raised as a need, followed by HIV/AIDS. Figure 3.3 shows the breakdown of health education need by focus group, showing a clear expression of need in female youth, women and male youth for family planning education. Male and female youth account for 52% of the references for all health education need (combined adults account for 36%, leadership 10%, elderly 2%) and were especially vocal in their need for youth friendly services, particularly surrounding family planning and HIV. For this reason youth were chosen by the researcher as the target group for the intervention.

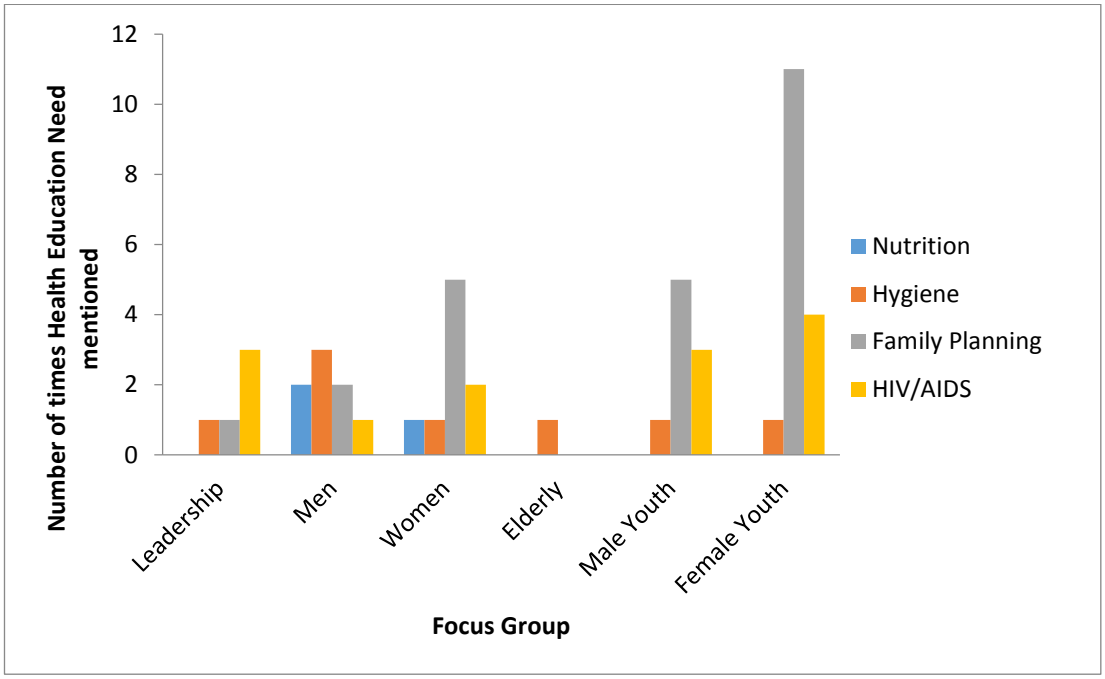


Figure 3.3: Health education need by health topic and represented population group from secondary analysis of 108 focus groups which were conducted in 2013/2014 in Chikwawa, Malawi (Stage 1).

3.4 Results of stage 2

Ten focus groups were facilitated, with a total of 91 participants. The demographic details of each group are displayed in Table 3.1

Table 3.1: Demographics of 10 focus groups by sample population conducted in Chikwawa Malawi in January 2015 (Stage 2)

Sample Population	Sample Size	Age Range (Years)	Literate (%)	Married (%)	With Children (%)	Education Level (mean number of years)
Male Adults	12	25-55	56	93	100	4.8
Female Adults	23	22-50	55	95	95	3.3
Male Youth	26	13-24	96	8	8	8.5
Female Youth	30	14-22	91	18	12	6.1

Five themes emerged from the transcripts encapsulating opinions and beliefs of the participants around the four health topics: Recognised Need for Health Education; Acceptability of an mHealth intervention; Barriers to Phone Access; Trust and Sustainability.

3.4.1. Recognised Need of Health Education

This theme depicts participants' self-reported need for health education and their prior knowledge of each health topic.

3.4.1.1 Need for Health Education

All focus groups recognised their need for health education. Amongst the four topics discussed, nutrition, hygiene, family planning and HIV, there was high concordance with the expressed health education needs at stage 1, with 80%, 60%, 100% and 90% of the groups describing a lack of information in these areas respectively. In six of the 10 focus groups participants highlighted a need to educate men on family planning methods. One female adult group and three focus groups with young people reported a need to increase knowledge of contraception methods in men, as it was suggested men do not always agree with their use. Similarly, two male adult and three focus groups with young people reported a need for men to be educated so that the decision on contraception uptake can be a joint one;

> "Contraception methods are perceived as for women in this village so if we receive these text messages in our homes we will be able to make an informed decision on which contraceptive method to use as a family." *Male Adult, Sikenala*

This concurs with the Stage 1 analysis, where four male youth and two male adult focus groups raised the need for family planning education for men.

Participants expressed more specific health education needs in relation to family planning than any other health issue discussed (see Table 3.2). Furthermore, the perceived family planning needs showed a high degree of consistency across all four represented populations.

Table 3.2: Specific requests for Health Education in four health topics from 10 focus groups conducted in Chikwawa, Malawi in January 2015 (Stage 2) (MA denotes Male Adults, FA - Female Adults, MY - Male Youth, FY - Female Youth).

Nutrition	Hygiene	Family Planning	HIV
Food groups [MA, FA, FY]	Hand Hygiene [MA, MY, FY]	Advantages to Family Planning [FA, MY, FY]	Prevention [MA,FA, MY, FY]
How to prepare a balanced meal [MA, MY, FY]	Toilet Practices [i] [MA, FA, MY]	Inclusion of Men in Family Planning Education [MA, FA, MY, FY]	HIV Testing [MY, FY]
Nutrition for people living with HIV [MA]	Kitchen Hygiene [MA, MY, FY]	Contraception methods and side effects [MA, FA, MY, FY]	Treatment [MA, FY]
	Personal Hygiene [ii] [MA, FY]	Child Spacing [MA, FA, MY, FY]	
	Disease prevention [MA, MY]	STI's [MY, FY]	
		Safe Motherhood/Early Pregnancy [FA, MY]	

[i] Toilet practices examples include washing hands after use, keeping the toilet clean and not practicing open defecation

[ii] Personal hygiene examples include taking a daily bath and general cleanliness

3.4.1.2 Prior Knowledge

Although there was high agreement about the need for health education in each topic, participants did demonstrate some prior knowledge. This was particularly the case in the areas of nutrition and hygiene, with seven groups (70%) able to describe the six food groups and eight groups able to explain toilet and household hygiene practices. There was less detailed knowledge of family planning and HIV. All of the focus groups mentioned the need for education on contraceptive methods; however only half of the groups (representing male and female youth and male and female adults) demonstrated any knowledge about specific methods. The three methods that were discussed by these groups were Norplant (contraceptive implant), contraceptive injection and condoms. Interestingly, out of the four focus groups who mentioned Norplant and the injection, all four stated that they knew the name, but did not understand how the method worked or why it benefited them over any other method;

> "We usually go for the injection, but some people say it is not good for our health…we do not know the advantages and disadvantages of these contraceptive methods…we use any of the methods without really knowing the side effects." *Female Adult, Sikenala*

In regards to HIV, four groups (representing male adults, female youth and male youth) were able to provide a link between sexual intercourse and the transmission of STI's, including HIV;

> "They say that we should stay faithful to a single partner to avoid contracting the disease [HIV]." *Male Adult, Sikenala*

> "We've to use condoms to prevent pregnancy and sexually transmitting diseases." *Male Youth, CDSS*

However beyond this link all the discussion surrounding HIV was around the need for information on how to prevent contracting the disease. Six focus groups (representing all four groups) mentioned the need for this information without demonstrating any further knowledge on the topic;

> "We need information on what can we do/use to protect ourselves from HIV and we also want to know how we can stop spreading the virus." *Male Youth, Chimoto*

3.4.2 Acceptability of an mHealth Intervention

This theme represents participants' views on the acceptability of an mHealth intervention including message type, message volume and frequency.

3.4.2.1. Message Delivery

Participants were asked their opinion of receiving health information on their mobile phone through a Short Message Service (SMS) text format or through a voice call format, Interactive Voice Response (IVR). Eight focus groups noted a general preference to receiving this information through SMS;

> "The text messages because you can read them several times while a call you can get the health messages once." *Male Youth, CDSS*

> "…because we can read the messages while in automated calls you can miss the instructions you are being told." *Female Youth, Sikenala*

> "…you can read a text message whilst doing other things right at home." *Male Adults, Sikenala*

Participants felt that written texts were advantageous as the messages could be stored and referred back to whenever convenient and without time pressures of a one off call format.

However, two focus groups (male adults and female youth) opted for IVR technology over SMS as the group's general consensus;

> "We prefer text messages because we will feel comfortable reading it…but others prefer voice messages since some may not know how to read and we need to accommodate them too so IVR would be best." *Female Youth, Chimoto*

Both focus groups had some members who preferred SMS but the overall consensus was that IVR was advantageous due to illiteracy levels and this method would allow more people to receive the intervention content.

Participants were also asked whether they would prefer to receive messages at set times (1 way messaging) or to access the information at their leisure through a text and reply service (2 way messaging). Male and female adults (4 focus groups) stated a preference for 1 way messages due to the messages being sent at fixed times. This appears to be due, in part, to difficulties surrounding the use of a mobile phone;

> "Do it at set times to help those who feel they cannot use a phone confidently." *Female Adult, Chimoto*

Confidence in using a mobile phone, and technical ability is imperative to gaining access to mHealth intervention. Both male and female adults mentioned a lack of confidence in their own ability to use a mobile phone and they believe knowing in advance when the messages would come would help them. Young people did not mention user confidence as an issue, however 4 youth focus groups also noted a preference for getting the messages at set times;

> "We should receive notice of when the messages will come so that we should easily remember to go and read them." *Male Youth, Sikenala*

Reliance on shared mobile phones was mentioned throughout the discussions and appears to influence preferences for a one-way messaging service. Prior notice of when the messages would be delivered would allow for the individual to plan access to the device. The two final focus groups discussed both methods and were happy to receive messages at set times or at their leisure.

3.4.2.2. Time/frequency

Participants were asked to identify their preferred time and frequency of message delivery. While all ten focus groups were in agreement that they supported this method of mHealth delivery and would be willing to receive messages, there was no such agreement on specific

timings for message delivery. Four focus groups (two female adult groups, female youth and male adults) stated that they had no preference;

> ”…to some of us it doesn’t matter how many times we receive the messages, as long as we get the information.” *Female Youth, Sikenala*

> “The time doesn’t matter…even if you receive a message when you are asleep you can always check the message when you wake up.” *Male Adult, Sikenala*

A further four focus groups (two male youth groups, female youth and male adults) stated a preference for the afternoon, one stating 4pm and the other 6pm (two didn’t state a time). The final two focus groups requested messages to be sent out with school hours;

> “You should send the messages after school hour; you should make sure they don’t affect our studies.” *Male Youth, CDSS*

In addition to being out with school hours, participants also noted the importance of message timing in shared phone access, requesting messages to be sent at a time convenient for message sharing;

> “…12 midnight cannot work because we will use borrowed phones.” *Female Youth, CDSS*

Participants were also asked as to the frequency of message delivery. Four focus groups (representing each sample population) requested the messages to be sent at least twice per week, two focus groups (male and female youth) opted for three times per week, and two focus groups (female youth and female adults) for five times per week. The final two focus groups (male youth and male adults) did not state a preference and were willing to leave it up to the researchers;

> “…it’s up to you to decide that, we will always receive the messages.” *Male Adult, Sikenala*

3.4.3. Barriers to Phone Access

Access to mobile phones to receive the health messages was a major discussion point in all focus groups, primarily barriers preventing access, including parental consent, mobile phone ownership and mobile sharing.

3.4.3.1. Phone Ownership

Participants who owned a mobile phone were all in favour of the intervention and stated they would use the service upon implementation; this was however, only 24% of the sample. For those with only shared access to a mobile (60%), concerns arose around message service access;

> "…for us who use borrowed phones it won't be easy to access the messages sometimes because the owners of the phones may be away." *Male Youth, CDSS*

Participants without mobile ownership have little control of when they get access to the phone. This may prevent consistent access to intervention content and is a significant barrier to intervention accessibility.

Participants were asked if they felt comfortable receiving health information through a phone which they did not own. Adult participants did not appear to find this an issue and were willing to use a shared phone;

> "We are all close so when one of us gets the message she would communicate…yes even if sharing husband's phone that is no problem." *Female Adult, Sikenala*

Only one male youth expressed apprehension regarding the sensitive content which would be delivered to a shared phone;

> "…to us who share with our relatives, we may not be that comfortable receiving reproductive health on a shared phone." *Male Youth, Chimoto*

3.4.3.2. Parental Consent

Young people were vocal in their need for health education, especially regarding reproductive health. Focusing the intervention on 15-24 year olds, requires parental consent for those under 16, therefore adult participants were asked their views on providing adolescents with this information;

> "Facilitator: What do you think of adolescents receiving this information on their mobile phone?
>
> Participant: With this generation, it really has to be so." *Male Adult, Chimoto*

All adult focus groups agreed to the need for adolescents to receive reproductive health information, and stated they would not prevent their own children from accessing the messages.

In contrast, two female youth focus groups and one male youth focus group showed concern towards their parents' reaction to their involvement in the study, especially if they were to access sensitive information on their parents' phone.

> "…for me the parents would not like the [family planning] messages they would think that it's a boyfriend giving me some advice." *Female Youth, CDSS*

> "Facilitator: Is it because you use a borrowed phone so you are afraid?
> Participant: Yes sometimes the parents may not be that friendly."
> *Male Youth, CDSS*

3.4.4. Trust of the intervention

This theme encompasses participants' expectations of an mHealth intervention.

3.4.4.1 Involvement in Intervention Design

All focus groups stated that they would trust the messages they were given, and this appears to be due, in part, to their involvement in the process of intervention development;

> "Yes we will, because what we are discussing here is exactly what we want so we will trust you to give us the right messages." *Male Youth, Chimoto*

Participants understood that their suggestions for health topics could become the basis for the message content, and liked that they were consulted about the practical issues surrounding the mHealth intervention. This appears to have positively impacted their perceived trust of the service.

Practically, it was noted that message content would be trusted if it was clear where the messages came from;

> "Participant: Yes, we will believe after seeing the phone number of the sender.
> Facilitator: So that means we should have a unique number for project?
> Participant: Yes." *Female Youth, Sikenala*

Belief in message content appears to stem from the trustworthiness of the sender. Participants stated they would believe the message content if they could be assured the messages came from SCHI through an identifiable phone number or short code.

3.4.4.2 Prior Knowledge of Service

In addition to recognising the sender, participants believed that prior knowledge of the service would impact their belief in the content;

> "…only the people who are here would trust the messages because we would know it's you when you send the messages." *Female Youth, CDSS*

Therefore it is perceived that involvement in this study will increase the likelihood of participants trusting the SMS message content.

3.4.5. Sustainability

Sustainability refers to the participants views on the long term implication of the messaging service.

3.4.5.1. Follow up post intervention

Four focus groups expressed a request for the implementation of the SMS intervention to be followed up throughout the research;

> "…plead to the authorities that they should not just make false promises but launch this programme." *Male Adult, Sikenala*

> "Are you going to be doing some follow up visits to check on how the services will be conducted?" *Male Youth, Chimoto*

This emphasises that participants are eager to see the SMS messaging service implemented in their area.

3.4.5.2 Face to Face Communication

Four focus groups (female adult, male youth and both male adult groups) requested face to face communication in addition to the messaging service;

> "…it will really be helpful if we had a club where the youth can meet and discuss about HIV and family planning." *Male Youth, Chimoto*

> "…apart from sending the messages you should come to conduct awareness campaigns to encourage us to use the health information." *Female Adult, Sikenala*

This was to provide opportunities to discuss message content and to act as a reminder for continued use of the messaging service.

3.4.6 Intervention Development

Themes from Stage 2 informed the design and development of the mHealth intervention in terms of target population, intervention content, delivery method, and time and frequency of the intervention (Figure 3.4).

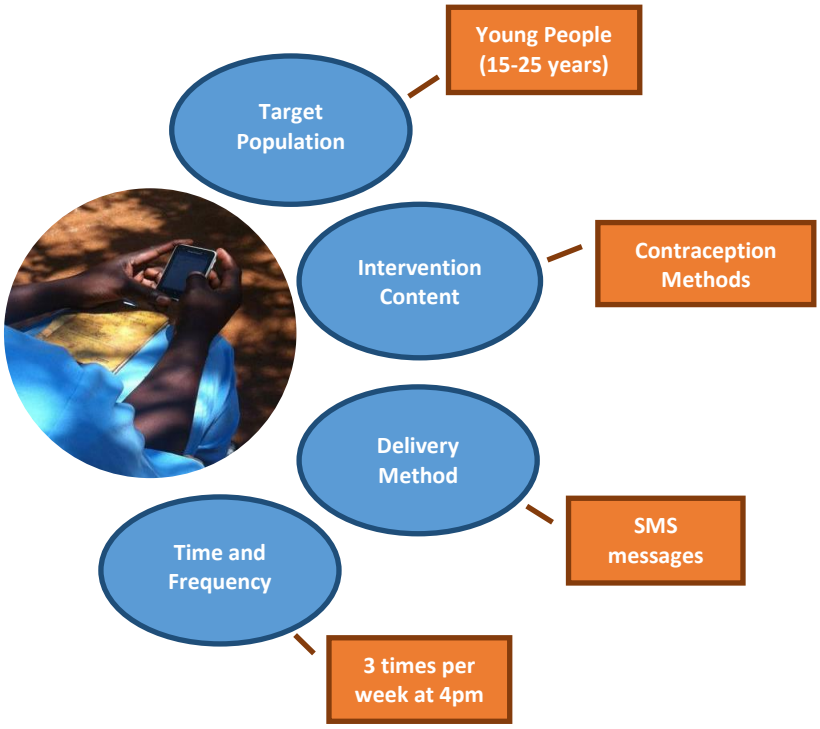


Figure 3.4 mHealth intervention development from focus group themes identified in 10 focus groups conducted in February 2015 in Chikwawa, Malawi.

3.5 Discussion of the acceptability and feasibility of delivering an mHealth intervention in Chikwawa, Malawi.

This aim of this chapter was to use qualitative methods and involve participants in the design and development of an mHealth preventative health intervention, as it is essential to tailor the intervention to participants needs to increase effectiveness in bringing about increased knowledge and behaviour change (Kreuter et al., 2003; Hall et al., 2014).

3.5.1 Target Population

Of the four health education need topics (Nutrition, Hygiene, Family Planning and HIV) identified in Stage 1 and taken forward for further discussion in Stage 2, male and female youth accounted for the majority (52%) of references, and were particularly vocal about their need for youth friendly health services (YFHS) in Chikwawa. Providing access to YFHS has been a priority for the Government of Malawi (Health Policy Project, 2015), however

accessibility to these services is challenging for young people therefore attendance is poor (Evidence to Action, 2014).

Previous global research has targeted mHealth interventions towards young people to increase engagement with health services and introduce healthcare delivery via technology that is familiar and accessible to them (Pathfinder International, 2014; Gonsalves et al., 2015). These studies have found promising results, with adolescents actively participating in pilot interventions delivering sexual health information and showing increased awareness of sexual health issues (Levine et al., 2008). mHealth interventions therefore provide an attractive, novel and engaging method of information provision which could be used to provide adolescents with a tailored preventative health service, relevant to their needs. Although adults also expressed need for health education (36% of the references), the great need identified among youth for services specific to them and the technological appeal this mode of delivery has among this group were the key drivers in selecting young people as the target population for this intervention. This will support local YFHS in the area without adding extra pressure to overburdened local health centres that are not sufficiently staffed to run face-to-face interventions to this population group.

3.5.2 Intervention content

Participants cited the need for more knowledge in each of the four health topics discussed in Stage 2. However, this was especially the case for family planning as all ten focus groups expressed a need for this information. In addition, there was a direct request from 6 focus groups on how to prevent HIV which is in line with contraceptive education. This finding is in line with data from Stage 1, where family planning was also the most frequently requested topic, particularly by young people and women. These findings guided the decision to develop an mHealth intervention targeted towards family planning, where messages will describe contraceptive methods, their benefits and side effects as requested in the focus group discussions. In addition, information on where participants can receive the contraception will be included so to refer them to their nearest health centre. Family planning is a high priority in Malawi, and in line with the Health Sector Strategic Plan II 2017 – 2022 in Malawi (Government of Malawi, 2017). There are a number of key benefits to increasing access and uptake of family planning including:

(1) Reduction of sexually transmitted diseases as the consequences of unsafe sex are contributing significantly to the burden of disease in the country.

(2) Reducing fertility rates due to the rapid increase in population is another government priority; the national population is estimated to triple by 2040 if fertility rates continue (Government of Malawi, 2012). Therefore contraception education is an urgent necessity to help slow this rapid population growth.

(3) Teenage pregnancy is common in Malawi, (Munthali et al., 2004) and often leads to poor educational attainment in teenage girls, as they are forced out of school and seldom return (Munthali, 2004). It is imperative for family planning education to be provided to these teenage girls so that they can make an informed decision.

It is also important for this education to be delivered to male adults and adolescent boys, and this has been called for as a priority in low income countries (Greene et al., 2006). Results of the current study concur with this, identifying a perceived need to encourage males to use contraception and be involved in the decision making process for contraception uptake. This has been recognised by previous research, and family planning interventions have been created to target males specifically (Shattuck et al., 2011; Kululanga et al., 2011; Kabagenyi et al., 2014). The inclusion of male youth in this intervention is important, as although current long-acting contraceptives target women, improvement in continuous use will require joint decision making of both partners (Vouking, Evina, & Tadefok, 2014). Additionally, it is crucial to provide young people with correct medical information from a source they trust. SCHI has been working in this area for over a decade and the current study found the project as a trusted source of information. Individuals stated they would trust the messages because of their affiliation with the SCHI and also due to their own involvement in this study. Therefore it is important to advertise the intervention appropriately to increase awareness of the intervention throughout the entire Mfera community.

3.5.3 Intervention Delivery Method

Participants were encouraged to state their preference in delivery method of the intervention, either SMS messages or using IVR. The majority of focus groups opted for SMS

messages over IVR as they can be stored, read again and have no time pressure regarding message delivery. This is contrary to previous research in Malawi which found preference for IVR when given the choice between the two (Crawford et al., 2014). However SMS messages were more likely to be successfully delivered due to the need for greater technical support and user participation involved with IVR (Crawford et al., 2014). IVR has been used to combat high illiteracy levels (Sapur, Chinnusamy, & Vadlamudi, 2014) and even though two focus groups stated a preference for IVR due to concerns of illiteracy, our target population for this intervention has literacy rates of 91% for female and 96% for male youth respectively. However this preference may be specific to this sample, and if the intervention was to be delivered on a widespread scale, the intervention delivery method would need to be continually reassessed to ensure equality of access for all.

In addition, participants in four focus groups cited a desire for face-to-face communication, with some unsure if messages alone were enough. This is the first study looking at perceptions of mHealth in Chikwawa, Malawi; therefore lack of experience with SMS may have favoured their opinion towards face-to-face knowledge exchange which is the norm. Evidence shows mobile-based behaviour change interventions are more effective with additional delivery methods, i.e. mHealth plus face-to-face or telephone calls (Lau et al, 2011); however individual SMS interventions have also produced greater behaviour change than routine healthcare (Okorodudu, Bosworth, & Corsino, 2015). The inclusion of health behaviour change theory in the design of the intervention and including behaviour change techniques (Michie et al., 2013) in the SMS messages will encourage contraceptive behaviour change throughout. However, consideration for future face-to-face additions to the intervention, particularly the creation of youth groups at the local health centre, will need to be assessed throughout the research process. Face to face additional support would provide a platform for peers to discuss the mobile content and ask questions to a trained facilitator. This would encourage social support and reinforce intervention content which could help adolescents in making consistent decisions regarding their contraception use.

3.5.4 Timing and Frequency of the Intervention

Gurman and colleagues (2012), in their review of mHealth behaviour change interventions, found that formative research into the preferred timing of health communication is seldom undertaken, yet important in order to understand the target population's preferences. In

addition, mHealth interventions will likely be more effective if message content, frequency and style are relevant to the needs and preferences of the target population (Tomlinson et al., 2013).

Adults stated a preference for messages to be sent at set times (one-way messaging) due to low user confidence in mobile phones, and the majority of youth noted a preference for receiving messages at set times due to the ability to plan shared access of mobile phones. Specific preferences for message frequency and timings were mixed in the sample with no majority for either. Message frequency suggestions ranged from twice per week to five times per week, and participants emphasised the need for messages to be delivered after school hours and at times which allowed for message sharing, with a consensus for afternoon hours. References to message sharing are important, as in this sample 24% of participants owned a mobile phone and 60% cited at least one relative or friend with ownership. This is in line with the national statistics stating household mobile phone access (46%) as higher than individual level access (34%) (NSO, 2014). The proportion of participants with frequent access to the shared or borrowed devices was unclear, however, there is potential to reach 84% of the participants sampled.

Due to the reliance on shared mobile phones, it is important to design the intervention to be as accessible as possible. Therefore the intervention will use a one-way messaging system to allow messages to be sent to everyone at the same time. SMS messages will be sent three times per week at 4pm, to allow for shared phones to be accessed after school and before dark when it is more difficult to travel. The timings and frequency will be further evaluated and refined after the next phase of research to ensure it continues to suit the target population.

From this sample, the majority of participants would rely on others for information, so it is imperative to prioritise ways to encourage phone owners to share message content. This will be considered in the design of the intervention, and will include informing the owner of shared devices about the intervention during recruitment, to increase likelihood of participants receiving permission to borrow the device. There is no publication known to the author addressing the use of shared mobile devices for sensitive health education such as contraception. However previous studies have identified SMS interventions for family planning education as an acceptable method in low income countries (FHI 360, 2013;

Vadhat et al., 2013), but do not separate opinion against phone access. The current study highlights that although adolescents worried about their own parents' reaction to them receiving information on a sensitive health topic like contraception, all adult focus groups expressed the view that young people need to receive this information. Even though parents of the adolescent participants were not directly targeted, it appears adult participants who have adolescent children support the delivery method and educational content; the young people's concerns about their parents' perceptions may therefore be misplaced.

It was important to take into consideration the views of both adults and young people to ensure that both parties agree with the mHealth intervention, particularly in cases where adolescents may register their parents' phone and a lack of inclusion in this study could make them wary of the research. This was identified in the current study, as involvement in the process of intervention development, and knowledge of its existence were stated as reasons for trust in the information received. Therefore involving parents at this stage creates awareness of the intervention, and as SCHI has a long standing relationship with residents in the area, will also provide reassurance as to the planned mHealth intervention.

3.5.5 Limitations to this study

Due to the recruitment of participants being led by directions from village headman and the head teacher's recommendations there is potential selection bias in the sample. However there is still a diverse age range and education level within the groups and care was taken to include students currently in education.

3.6 Summary of Chapter 3

This chapter presented a two phase study which has established that the sampled participants support the idea on an mHealth messaging service in Chikwawa, and the discussions have led to the design of an intervention tailored to their needs. Focus group discussions identified a need for contraception education in adolescents, which is both a national priority and a requirement in order to prevent disease, curb population growth and reduce teenage pregnancy. Discussions have also informed practical considerations for intervention delivery, including a preference for SMS messages over IVR. This preference

has been significantly influenced by the high proportion of users who share mobile devices and this needs to be taken into consideration in the design and development phases, such as encouraging message sharing within participants to increase intervention reach. This chapter has outlined targeted intervention content and delivery methods to this population leading to a SMS behaviour change intervention providing education on contraceptive methods to adolescents. A detailed review of the current evidence base of SMS interventions for sexual and reproductive health is now needed, in order to identify what is effective and the implications this has for the design and development of the proposed SMS intervention. Therefore, the next chapter presents a systematic review of this evidence.

Chapter 4: Harnessing the potential of 160 characters; are SMS based sexual health education interventions effective? A Systematic Review.

In Chapter 3 the participants in the Mfera catchment area of Chikwawa identified a need for contraceptive health education, and SMS technology was the preferred route over IVR. However, before initiating the development of such a service, a review of SMS interventions for behaviour change research was required. Therefore this chapter presents a systematic review of the current evidence base using SMS interventions to deliver sexual health information. Eleven relevant articles were compared, using the mHealth evidence reporting and assessment tool for guidance (Agarwal et al., 2016; see Section 1.4.1). Implications for the design and implementation of an SMS intervention in Chikwawa, Malawi are then discussed.

4.1 Introduction to the use of SMS interventions for sexual health

The use of Short Message Service (SMS) or texting, mHealth in its simplest form, is a widely researched tool for public health campaigns due to its ability to interact with any mobile phone handset. This is particularly important when working in low income countries, such as Malawi, as although mobile phone ownership has dramatically increased in recent years, with a current 63% mobile penetration rate (GSMA, 2016a), the proportion of smartphones is much lower than that of high income countries; though that too is increasing from a smartphone ownership median of 21% in 2013 to 37% in 2015 (Poushter, 2016).

Utilising mobile phones to promote health education can increase intervention reach as it allows for the delivery of health information to a large number of mobile phones simultaneously. It is also a relatively cheap and straightforward method to deliver interventions designed to encourage health behaviour change. This is particularly important in low income areas, where access to preventative healthcare is not as widely available due to low staffing levels and limited resources. In addition to increased reach, there is also an added layer of confidentiality when engaging with mHealth interventions. Participants can access health information without face-to-face interactions with a health professional and without the knowledge of relatives or peers. This is especially advantageous when dealing with sensitive subject areas, such as sexual and reproductive health, as young people frequently report needing this type of health education but are either too shy or worried

about the perceptions of others, if they were to publically request it (Santa-Maria et al., 2017).

Unsafe sex is the second major risk factor for young people of both sexes aged 15-19 (Mokdad et al., 2016) and is among the top ten risk factors in regards to the global burden of disease (WHO, 2009). It is consequently a high priority in the Sustainable Development Goals, where the UN include the aim to provide ubiquitous access to sexual and reproductive health services including family planning resources, information and education (UNDP, 2017). Health education is a key priority to promote safe sex and reduce the disease burden caused by the consequences of unsafe sexual behaviours. This is particularly the case for adolescents, and many countries have utilised mHealth as a means to deliver this information on a platform which is easily accessible and relevant to young people (Cole-Lewis & Kershaw, 2010; L'Engle et al., 2016).

It is the aim of this thesis to develop an SMS based intervention to deliver contraceptive health information to individuals aged 15-25, in accordance with the results from Chapter 2. However before this can be developed it is necessary to understand the effectiveness of the current global evidence based of SMS interventions for sexual health. Therefore this chapter presents a systematic review which will examine mHealth health education interventions aimed to improve outcomes in sexual health.

4.2 Systematic review methodology

4.2.1 Search Strategy

In September 2016, eight databases were searched; PsychInfo, PubMed, Web of Science, EMBASE, Popline, mhealthevidence.org and Google Scholar. Search terms 'SMS' or 'text messaging' and 'health education' and 'sexual health' were used. In addition, 11 relevant systematic reviews were hand-searched for additional relevant references.

4.2.2 Inclusion Criteria

Studies were included in the analysis if they used an SMS component to deliver sexual health information to any population and included at least one outcome measure of knowledge or behaviour change to test effectiveness. Research was not limited to peer-

reviewed literature, grey literature was also included if it met the relevant criteria. Systematic reviews and research published before 2006 were excluded from the analysis. The full inclusion criteria are presented in Table 4.1.

Table 4.1: Inclusion criteria for screening process in the systematic review

	Inclusion criteria	**Exclusion criteria**
Study design	All quantitative study and mixed method designs reporting original research will be considered.	Qualitative studies, letters, commentaries, protocols, feasibility studies or review papers.
Source	Peer-reviewed and non-peer reviewed journal articles, reports, working papers or extended conference abstracts.	Posters, dissertations or book chapters, conference abstracts with no detailed information.
Language	English only	Non-English language
Timeframe	2006 to 2016	Published < 2006
Participants	Humans (any)	Non-Humans
Intervention delivery	SMS component	Interactive Voice Messaging, application based or web based mHealth interventions. Any face to face or group interventions.
Intervention Content	Sexual health only	Any educational content not related to sexual health.
Outcome Measures	At least one measure of Knowledge or behaviour change	Studies which did not have any outcome measures related to knowledge or behaviour change.

4.2.3 Literature Search Results

The inclusion criteria was applied by the author using the screening tool presented in Appendix 5 and a total of 2277 articles were identified through database (n=2268) and hand searching of systematic reviews identified a further 9 pieces of grey literature. After duplicates were removed (n=168), 2109 abstracts were screened for eligibility, and 2069 records were excluded primarily because they targeted non-sexual health behaviours (n=996), or did not employ SMS as the mode of intervention delivery (n=1073). Full text assessment of 40 articles indicated 11 articles met the inclusion criteria and were included in the review. Reasons for articles being excluded at full text screening was due to the study having no SMS component, no outcome measured being included in the study, the study only describing a feasibility study, the study reporting on evaluation of a specific component of the intervention, study protocol only, a review paper and not an original piece of research and conference abstract with minimal detail regarding the intervention. Figure 4.1 shows the search strategy and results according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) flow diagram (Moher et al., 2009).

4.2.4 Data extraction

Data extraction for each of the 11 articles included author and country of research origin, study design, target population and sample size, sexual health topic and underlying theory for intervention content, intervention delivery method (e.g. one way messaging, two way messaging or question and answer format) and outcome measures including both SRH measures and participant experience. The results of the outcome measures were recorded including odds ratio, relative risk ratios and t-tests. Percentages were used when no statistical test was employed and to describe qualitative and self-report data. The data extraction tool is presented in Appendix 6.

4.2.5 Assessment Criteria

The research was assessed against the mHealth evidence reporting and assessment (mERA) checklist (Agarwal et al., 2016), see Table 4.2. This 16 item checklist provides guidance on the essential criteria for reporting mHealth based studies by assessing intervention content, implementation and replicability, as well as clear reporting of the research context,

stakeholder involvement and intervention adaptability. Each study was graded according to the mERA checklist which produced a percentage as to the number of items which had been adequately reported (Agarwal et al., 2016). No specific information was provided on the scoring protocol, therefore it is assumed that each sub-component of an item must be reported for it to be scored as present.

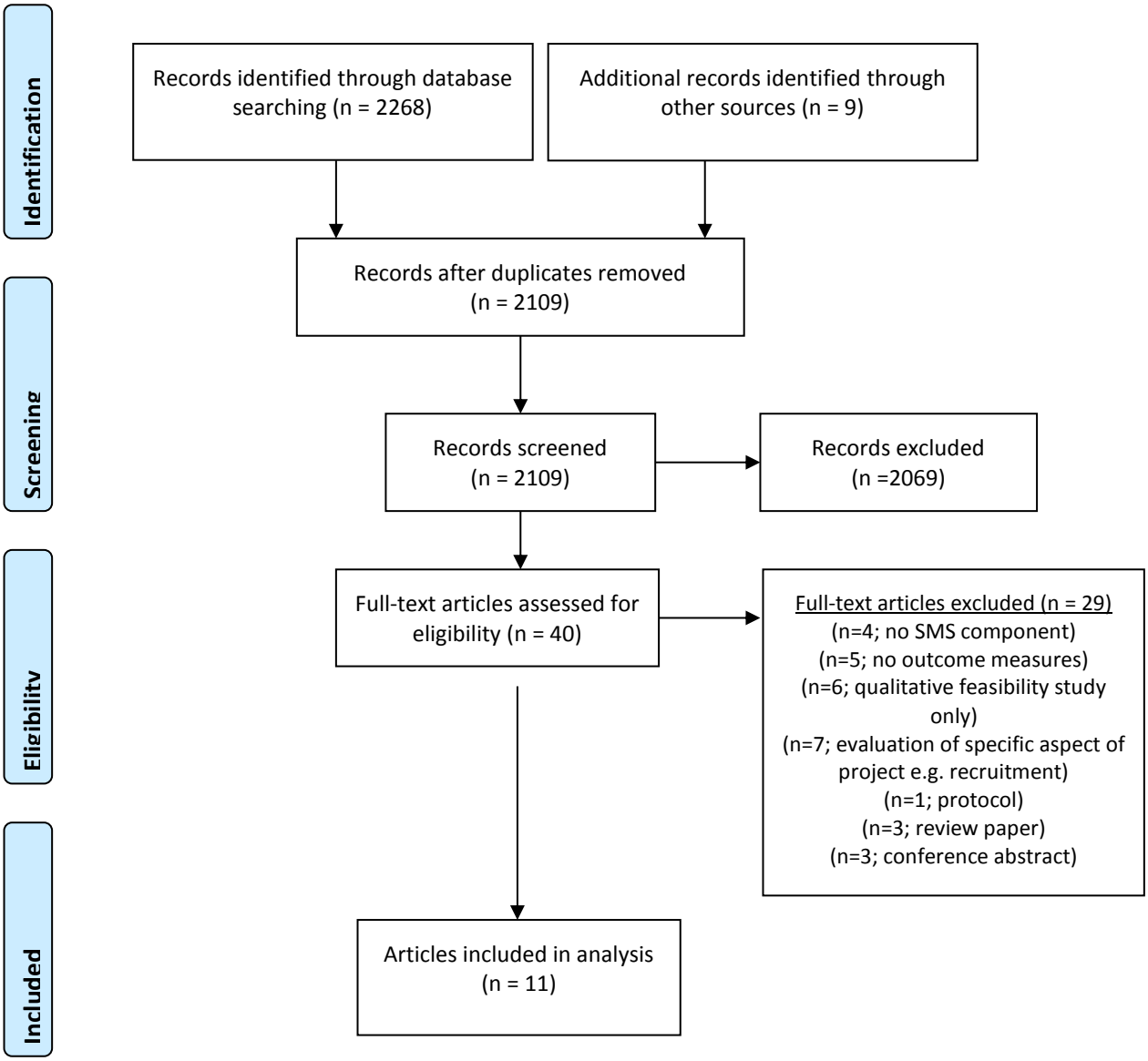


Figure 4.1: PRISMA flow chart (Moher et al., 2009) for articles included in the systematic review after search commenced September 2016.

Table 4.2: mERA Criteria (taken from Agarwal et al., 2016)

Item number	Name	Description
1	Infrastructure (population level)	a. Present availability of physical infrastructure e.g. electricity, access to power, connectivity b. Present network coverage for specific study area (not just country rates)
2	Technology/platform	a. Describe and provide justification for the technology architecture b. Description of the software and hardware c. Details of any modifications made to publicly available software
3	Interoperability / Health information systems context	a. Describe how mHealth can integrate into existing health information systems
4	Intervention Delivery	a. Frequency of mobile communication described b. Mode of delivery of intervention described c. Time and duration of intervention delivery described
5	Intervention Content	a. Content of the intervention described b. Source and any modifications of the intervention content described
6	Usability/content testing	a. Describe formative research/content or usability testing with target group
7	User feedback	a. User feedback or user satisfaction with the intervention described
8	Access of individual participants	a. Barriers and facilitators to the adoption of the intervention among study participants described b. Include individual-level, structural, economic and social barriers and facilitators
9	Cost Assessment	a. Present basic cost assessment of mHealth intervention from varying perspectives
10	Adoption inputs/programme entry	a. Describe how people were informed about the problem e.g. advertising b. Describe training, if relevant required to implement mHealth intervention
11	Limitations for delivery at scale	a. Presents limitations for delivery at scale
12	Context adaptability	a. Describe adaptation of the solution to different language, population or context b. Any relevant tailoring or modification of the intervention that resulted from pilot or usability assessment is described

Item number	Name	Description
13	Replicability	a. Present the source of code/screenshots/flowcharts of the algorithms or examples of messages to support replicability in another setting
14	Data security	a. Describes data security and confidentiality protocols
15	Compliance with national guidelines	a. Clearly show that intervention content is in alignment with existing national guidelines
16	Fidelity of the intervention	a. Describe the strategies employed to assess fidelity of the intervention e.g. assessment of participant engagement, use of backend data to track message delivery b. Describe technological challenges in the delivery of the intervention

4.3 Results of the systematic review

Each of the 11 articles included in the review described an intervention using SMS to deliver health education on sexual and reproductive health (see Table 4.3). Quantitative research methodology was used by all studies, with five also including qualitative evaluation (Gold et al., 2011a; Gold et al., 2011b; Lim et al., 2012; Jamieson et al., 2013; Vahdat et al., 2013).

Seven studies were from Sub-Saharan Africa, (Kenya (n=4), Tanzania (n=1) and Uganda (n=2)), with the remainder from Australia (n=3) and the United States (n=1). The three Australian studies (Gold et al., 2011a, Gold et al., 2011b; Lim et al., 2012) derived from the same research group, and a further two studies (L'Engle et al., 2013; Vahdat et al., 2013) implemented a replication of the same intervention in two cultural contexts, Kenya and Tanzania.

Participant age, gender and ethnicity differed across the studies. Five studies recruited a wide age range: targeting 16-29 year olds (Gold et al., 2011a, Gold et al., 2011b; Lim et al., 2012); 18-35 year olds (Jamieson et al., 2013); and 18 years and over (Kitagawa, 2015). Three studies were more specific in their inclusion criteria including African American 16-20 year olds (Juzang et al., 2011), female 18-35 year olds (Njuguna et al., 2016) and male participants aged 18 and over (Odney et al., 2014). The final three studies created open access campaigns with no age limit (Chib et al., 2012; L'Engle et al., 2013; Vahdat et al., 2013).

The studies varied considerably in terms of intervention delivery method and target behaviours. Three intervention delivery methods were executed; one-way intervention (n=6), two-way intervention (n=2) and question and answer interventions (n=3). One-way interventions involved sending pre-determined and fixed SMS messages to all participants at once and this was used to convey educational information specific to: sexually transmitted diseases (STIs) and the practice of safe sex (Lim et al., 2012); practice of safe sex (Gold et al., 2011a); STIs and condom use (Gold et al., 2011b); HIV prevention (Juzang et al., 2012); and circumcision aftercare advice (Odney et al., 2014). Lim et al. (2012) was the only study in this review to include supplementary health information, sending participants monthly e-mails in addition to monthly SMS.

Two-way interventions were interactive, where participants used SMS to choose which health information they wished to receive. Two way interventions were used to deliver information on contraceptive methods (L'Engle et al., 2013; Vahdat et al., 2013). Question and answer interventions involved either a quiz format or a general information service. In the quiz format, the participant received questions about sexual health via SMS and provided answers via SM and received feedback. In the general information service, the participants asked questions via SMS which were answered by SMS. Chib et al. (2012) used the quiz format to test and relay HIV knowledge. The question and answer format was used by two separate interventions to answer questions on any aspect of sexual and reproductive health (SRH), and was answered either by trained counsellors (Kitagawa, 2015) or automated algorithms triggered by key words in the question (Jamieson et al., 2013).

Table 4.3: Summary of 11 Studies included in analysis of the Systematic Review

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
Lim et al., 2012 Australia	Randomised Controlled Trial (RCT) Peer-reviewed journal article	16 - 29 years n=994	STIs and safe sex	One way SMS sent every 3-4 weeks for 12 months (14 SMS) and e-mails sent less than monthly (8 over 12 months). Participants invited to complete follow up questionnaire online 12 months post intervention.	• STI knowledge • STI test in past 6 months • talking to GP about sexual health • condom use with risky partners (new or causal partner or 2 or more partners within 12 months) • opinion of SMS/e-mail messages	• 40% completed follow up 12 months post intervention. • STI knowledge higher in the intervention group for both male (OR=3.19, 95% CI 1.52 to 6.69) and female (OR=2.36, 95% CI 1.27 to 4.37) compared to control group. • Female participants in intervention group more likely to have STI test 12 months post intervention (OR=2.51, 95% CI 1.11 to 5.69) compared to control group. • Female participants in intervention group more likely to discuss sexual health with GP at 12 months post intervention (OR=2.92, 95% CI 1.66 to	• 96% recalled receiving SMS at 12 months, 75% shown SMS to others, 24% found SMS annoying and 69% entertaining.

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
						5.15) • No significant impact on condom use.	
Gold et al., 2011a Australia	RCT Peer-reviewed journal article	16 - 29 years n=7606	Safe Sex	One way SMS sent through telecommunication advertising broadcasts fortnightly for 3 months. Control group received sun safety SMS and intervention group received safe sex SMS. Participants invited to complete follow up questionnaire online 5 months post intervention.	• Sexual health knowledge • Frequency of condom use • Proportion recently seeking STI test • Change in number of sexual partners • Participant experience of receiving SMS messages.	Follow up analysis only, 5 months post intervention • Group receiving safe sex SMS significantly higher knowledge compared to sun safe sex group (OR=1.9, 95% CI 1.1 to 3.4) • No significant differences between groups in frequency of condom use, proportion recently seeking STI test or change in numbers of sexual partners.	• 48% of intervention group found SMS entertaining and 22% annoying. 39% reported they learned something • Participants in the sexual health group less likely to report they learnt something (OR=0.6, 95% CI 0.4 to 1.0) and significantly more likely to report found the messages annoying (OR=1.9, 95% CI 1.1 to 3.2).

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
Gold et al., 2011b Australia	One group pre-test/post-test Peer-reviewed journal article	16 -29 years n=1771	STIs and condom use	One way SMS sent fortnightly for 6 months (12 SMS). Participants invited to complete follow up questionnaire online 2 weeks post intervention.	• Sexual health knowledge • STI test in past 6 months • 2 or more opposite sex partners in past 12 months • Regular sexual partner/s in past 12 months • Casual sexual partner/s in past 12 months • New sexual partner/s in past 3 months • Condom Use	• 33% completed follow up 2 weeks post intervention. • Significant sexual health knowledge increase at follow up in males (p<.001) and females (p<.001). • Significant increase in STI testing within the past 6 months in males (p=.002) and females (p<.001). • Significantly lower proportion of males reported multiple (p=.002), casual (p<.001) or new partners (p<.001) at follow up compared to baseline. • Significantly higher proportion of females reported multiple sexual partners at follow up (p<.001) but lower proportion of causal	• 80% found SMS entertaining, 68% learned something new and 23% found annoying

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
						(*p*<.001) or new partners (*p*<.001) at follow up. • In males, a higher proportion reported always using condoms with causal partners at follow up (*p*<.001) compared to baseline and a lower proportion reported using condoms with new partners (*p*<.001). • In females, a significant lower proportion reported using condoms with causal (*p*<.001) or new (*p*=.002) partners at follow up compared to baseline.	
Njuguna et al., 2016 Kenya	Quasi-experimental study Peer-reviewed journal	Women 18-24 years, uninfected or unaware of HIV status	HIV & reproductive health	One-way SMS sent weekly, participant had option to access up to 3 extra SMS per week. Total of 63 messages	• HIV testing • Number of new/recurrent partners • Condom use • Perceived risk of HIV past month	• 99% of sample completed follow up 5 months post intervention. • Significant increase in reported HIV testing in intervention group	

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
	article	n=600		sent over 6 months. Monthly follow up SMS surveys sent 5 months post intervention.		compared to control (p<.001) • Women in intervention group reporting current sex partners, 1.42 times as likely to test for HIV during previous month compared to control (p<.001) • No significant differences between groups in condom use (p=.11) or perceived risk of HIV in past month (p=.44).	
Juzang et al., 2011 USA	Quasi-experimental design Peer-reviewed journal article	16-20 years and identified as Black or African/American n=60	HIV Prevention	One way SMS sent three times per week for 12 weeks. One quiz sent by SMS each week for the participant to respond.	• Condom norms • Intention to use condoms • Sexual Health awareness • Experience with arrest or incarceration • Experience with being drunk or high during sex • Had male sexual	• 65% completed follow up 3 months post intervention • 3 months post intervention condom norms were higher in the control group compared to the intervention group (no p values provided in paper). • No differences in intervention to use	

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
					partner • Had a partner who tested positive for HIV • Proportion of protected sex acts in last 3 months • Practicing monogamy	condoms, experience with arrest or incarceration, experience with being drunk or high during sex, had a male sexual partner, had a partner who tested positive for HIV or proportion of protected sex acts in last 3 months. • Significant increase in sexual health awareness at follow up (7.8 units) over baseline (8.2 units) in intervention but not significantly different from control (no p values provided in paper). • Significant increase in monogamy at follow up (63%) in intervention compared to control (49%) (no p values provided in paper).	
Odney et al.,	RCT	Male patients 30	Male Circumcision	One-way SMS sent at set time	• Self-reported resumption of sex	• 82% of sample completed follow up 42	

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
2014 Kenya	Peer-reviewed journal article	minutes post-circumcision operation n=1200	(MC)	chosen by participant every day for first 7 days post-op and on days 8, 14, 21, 28, 35, 42. Participant received telephone call for follow up after 42 days.	• (if relevant, number partners, number of acts, number of acts with condom)	days post intervention. • No difference in resumption of sex before 42 days between the intervention and control group (RR= 1.13, 95% CI 0.91 to 1.38; *p*=0.3) • Participants more likely to have sex if married/live in partner (*p*<.01), had 1 sexual partner (*p*=.02) or >1 sexual partner in month prior to MC (*p*<.001), primary school or lower education (*p*<.001) or employed (*p*=.02).	
Vahdat et al., 2013 Kenya	Cross sectional Peer-reviewed journal article	Open access n=4817	Contraception methods	Participants used SMS to identify the method of contraception they required information on, and this was automatically sent to them.	• Self-reported behaviour change qualitative question	• 39% of sample (n=314) answered behaviour change question • 2.3 contraceptive methods requested on average for 19 years and younger and 2.8 for 20-29 year olds. • Natural family planning	• Participants liked the convenience of the platform, easy to use and confidential.

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
				Additional self-report questions were sent via SMS for follow up analysis an average of 9 months post intervention.		most requested method (34%) • 69% of sample reported changing their contraceptive method or beginning a new one. 22% reported a change to long acting methods, 23% to short acting methods, 18% to condoms, 6% to natural methods.	
L'Engle et al., 2013 Tanzania	Cross Sectional Peer-reviewed journal article	Open access n=2870	Contraception methods	Participants send SMS with designated code to indicate their choice of information to receive which automatically triggers the information to be sent. Additional self-report questions also sent through	• Self-reported behaviour change qualitative question	• 18% (n=509) answered behaviour change question • 2.9 contraceptive methods requested on average for 19 year olds and younger, 2.6 methods for 20-29 year olds. • Natural family planning methods most requested (26%) • 85% of sample reported changing their	

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
				SMS.		contraceptive method or beginning a new method. 32% reported behaviour change in long acting methods, 29% short acting, 16% changes in condoms and 8% changed in natural methods.	
Kitagawa, 2015 Kenya	RCT Extended Abstract for Conference	18 years and over n=884	HIV/AIDS, safer sex and SRH	Participants SMS questions and receive answer in one of three conditions; generic information from algorithm, personalised answer from counsellor or social cue answer which a personalised answer from counsellor plus social cue "Thank	• Knowledge of SRH • Contraception use at last sexual encounter • Number sexual partners in last month	• 93% of participants completed follow up • No improvement in SRH knowledge regardless of SMS type (no p values provided in paper). • Personalised SMS (OR=1.33, 95% CI 0.85 to 2.09) and social cue SMS (OR=1.60, 95% CI 0.98 to 2.66) more likely to 'always' use condoms compared to generic SMS. • Generic SMS less likely to be using protection than control group (p<.05)	

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
				you! You have joined hundreds of other people in the community you are using Nishauri to improve their health!" Follow up delivery method not disclosed.		• Generic SMS group had an significant increase in sexual partners compared to all other groups (p<.05)	
Jamieson et al., 2013 Uganda	Quasi-experimental National Bureau of Economic Research (NBER) Working Paper. NBER working papers are circulated for	18 - 35 years n=1791	SRH	Question and Answer format where computerised algorithm sent answer by SMS to participants' questions. Baseline and follow up questionnaire conducted face to face.	• HIV and contraception knowledge • Attitudes to condom use • Non risky behaviour index (includes including never been unfaithful in past 3 months and number of sexual partners in past 3 months, used any	• 1200 (67%) approached for follow up 12 months post intervention • No differences in HIV knowledge (*p*>.05), contraception knowledge (*p*>.05) or attitudes to condoms (*p*>.05) between the intervention and control group • Non-risky behaviour index (*p*<.05) and non-promiscuity index (*p*<.05) decreases in intervention	• Self- reported knowledge increase in qualitative interviews but this was not found in quantitative analysis • Participants reported receiving wrong answers to their SMS queries

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
	discussion purposes, they have not been peer-reviewed.				type of contraceptives during last sex and condom during last sex) • Non promiscuity index (including never been unfaithful in past 3 months and number of sexual partners in past 3 months) • Perceived relative own non-riskiness (includes perceived risk taking relative to other people and perceived own HIV risk).	compared to control (i.e. intervention group have increased risky behaviour and promiscuity). • Decrease in perception of one's own non-riskiness in intervention group compared to control (p<.05), equating to participants perceiving their behaviour as more risky.	• Participants reported being unable to change behaviour due to lack of resources and/or no co-operation from partner (particularly in young, unmarried women).
Chib et al., 2012 Uganda	Cross sectional Peer-reviewed	Open access n=10000	HIV/AIDS	13 quiz questions sent to participants. Correct responses	• Knowledge via correct/incorrect answers	• 1954 answered at least one quiz question (majority answered one question n=790 or two n=337)	

Study, Country	Design	Target Population and Sample Size	Sexual Health Topic	Intervention	Outcome Measures	Results	
						Outcome Measures	Participant Experience
	journal			received free HIV counselling and testing services and entered into prize draw, incorrect answers receive feedback of correct information.		• Average 2.8 questions answered per mobile number with 2.1 correct. • On average quiz respondents got 68% of the questions correct. 19% all responses incorrect and 44% only provided correct responses • 677 people used local HIV counselling and testing services, 33% increase in average monthly visitors, with 364 presenting the SMS they received.	

4.3.1 Quality Assessment

There was a mix of methodological designs. Four were RCT (Gold et al., 2011a; Lim et al., 2012; Kitagawa, 2015; Odney et al., 2014), however Gold et al. (2011a) had technical difficulties separating out the baseline data for each group and thus were only able to complete follow up analysis. Three studies employed quasi-experimental designs (Juzang et al., 2011; Jamieson et al., 2013; Njuguna et al., 2016). Three studies used active control groups, with the control group receiving SMS messages about nutrition (Juzang et al., 2011) or sun safety information (Gold et al., 2011a). The remaining four studies did not use any SMS component in the control group. In addition, Jamieson et al. (2013) had an open access intention whereby any individual could sign up, however only the intervention group received a marketing campaign to encourage users to use the intervention. A further three studies used cross-sectional designs (Chib et al., 2012; L'Engle et al., 2013; Vahdat et al., 2013) and one study used pre/post intervention design (Gold et al., 2011b).

All studies scored poorly on the mERA criteria (Figure 4.2), with the average score of 34% (range 19% - 56%). The scores were similar across all methodological designs, with RCT studies averaging a slightly higher score at 37% compared to 33% of quasi-experiment designs, 31% of cross-sectional designs and 31% of the one group pre/post-test.

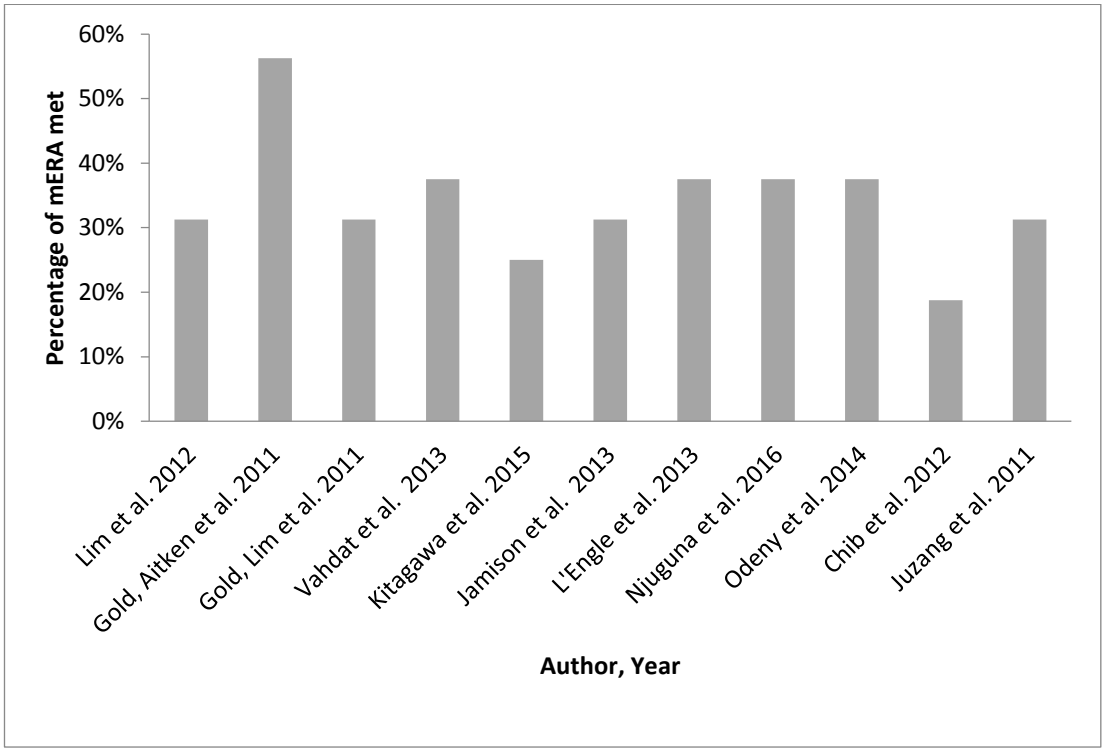


Figure 4.2: Percentage of mERA criteria for all 11 studies included in the systematic review.

Figure 4.3 depicts the number of studies which reported each item. It can be seen that intervention delivery and adoption inputs and program entry were the most frequently reported criteria being reported by ten and nine studies respectively. Contextual adaptability, user feedback, and usability and context testing were reported by six of the studies, whilst compliance with national guidelines, technology platform, data security and limitations to delivery at scale were fully reported by between one-three studies. Cost assessment and health information system context were not reported by any study.

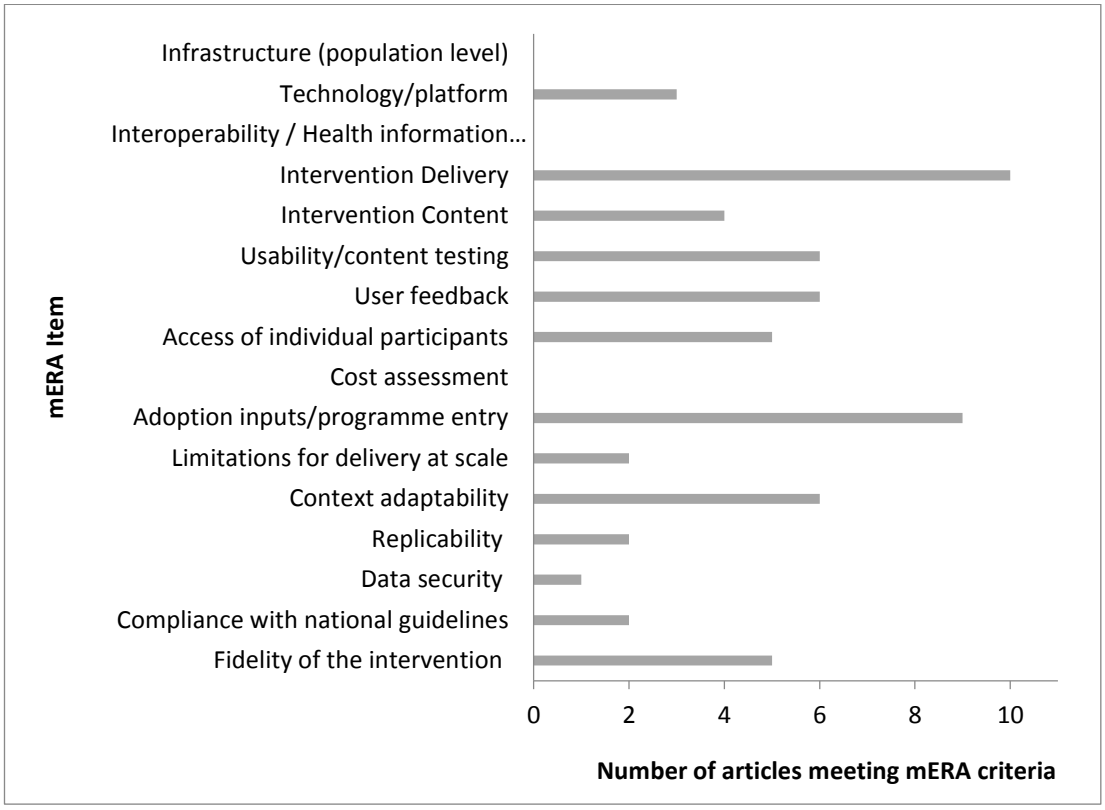


Figure 4.3: Number of articles from the systematic review meeting the mERA criteria

4.3.2 Theoretical underpinnings of intervention content

Seven articles (Lim et al., 2012; Chib et al., 2012; Jamieson et al., 2013; Vahdat et al., 2013; Odney et al., 2014; L'Engle et al., 2014; Njuguna et al., 2016) had no reference to theory in regards to the design of their intervention or SMS messages. Two articles (Gold et al., 2011a and Gold et al., 2011b), which derived from the same research group, outlined the Precaution Adoption Process model (Weinstein, 1988) as the basis for their intervention content with additional elements from the Theory of Planned Behaviour (Ajzen, 1985) and the inclusion of self-efficacy (Bandura, 1986). Juzang et al. (2011) tailored the intervention towards components of several health psychology theories including positive outcome expectancies, norms, behavioural intentions (Theory of Planned Behaviour; Ajzen, 1985) and self-efficacy (Social-Cognitive Theory, Bandura 1986). Finally Kitagawa (2015) did not outline a specific theory, however evidenced consultation of both behavioural economics and health psychology research to include three concepts to improve behaviour; information gap reduction, personalisation (message tailoring) and social comparison.

4.3.4 Intervention Effectiveness

There was considerable variety in quality and quantity of outcome measures in each study. Measures of knowledge and self-reported behaviour change in relation to the specific topics addressed were analysed by the majority of studies (64%) (Kitagawa 2015; Jamieson et al., 2013; Juzang et al., 2011; Lim et al., 2012; Gold et al., 2011a; Gold et al., 2011b; Chib et al., 2012). However four studies (Vahdat et al., 2013; L'Engle et al., 2013; Odney et al., 2014; Njuguna et al., 2016) only included self-reported behavioural measures. The majority of post intervention data collection was completed through SMS text and reply services (Juzang et al., 2011; Chib et al., 2012; L'Engle et al., 2013; Vahdat et al., 2013; Njuguna et al., 2016) and three studies provided a link for this to be completed online (Gold et al., 2011a; Gold et al., 2011b; Lim et al., 2012). Odney et al. (2014) conducted the post intervention survey on the telephone, while Jamieson et al. (2013) and Kitagawa (2015) conducted face-to-face surveys.

Six studies employed a one way SMS intervention (Table 4.4). Three of the six employed RCT designs, two quasi-experiment designs and one a one group pre-test/post-test. Four of the six studies measures STI/HIV testing behaviour, five measured condom use and one measured resumption of sex post circumcision. Four studies also measured SRH knowledge, three targeting STI knowledge and one targeting HIV knowledge. Of the four studies measuring STI/HIV testing behaviour three found significant increases in HIV or STI testing (Lim et al., 2012; Gold et al., 2011b; Njuguna et al., 2016). Of the five studies measuring condom use, one (Gold et al., 2011a) found a significant increase in use with new partners in the intervention group compared to control at follow up. Finally three of the four studies measuring knowledge found significant increases in the intervention compared to control (Lim et al., 2012; Gold et al., 2011a; Gold et al., 2011b).

Table 4.4: Summary of findings in one-way SMS interventions (n=6)

Author	Design	SRH Knowledge	STI/HIV Testing Behaviour	Sexual behaviour
Lim et al., (2012)	RCT	Significant increase in STI knowledge after 12 months in intervention group	Significant increase in STI testing in female participants in intervention group	No differences in condom use.
Gold et al., (2011a)	RCT (only able to compute follow up analysis)	Significant increases in STI knowledge in intervention group	No differences	Intervention group more likely to report always use a condom with new partners
Gold et al., (2011b)	One group pre-test/post-test	Significant increases in STI knowledge at 6 months post intervention	Significant increases in STI testing at 6 months post intervention	No differences in condom use.
Odney et al., (2014)	RCT	Not measured	Not measured	No significant differences in resumption of sex.
Njuguna et al., (2016)	Quasi-experiment	Not measured.	Significant increase in reported HIV testing in intervention group compared to control. Women in intervention group reporting current sex partners, 1.42 times as likely to test for HIV during previous month compared to control	No significant differences in condom use.
Juzang et al., (2011)	Quasi-experiment	No significant differences in knowledge of HIV prevention between intervention and control.	Not measured.	No significant differences in condom use.

Both interventions employing the two way delivery method found self-reported increases in contraceptive use post intervention, neither study measured knowledge or STI/HIV testing behaviour (Table 4.5)

Table 4.5: Summary of findings in two-way SMS interventions (n=2)

Author	Design	SRH Knowledge	STI/HIV Testing Behaviour	Sexual behaviour
L'Engle et al., (2013)	Cross-sectional	Not measured	Not measured	71% reported positive change in contraceptive behaviour
Vahdat et al., (2013)	Cross-sectional	Not measured	Not measured	85% reported positive change in contraceptive behaviour

Three studies employed a Question and Answer intervention delivery style (Table 4.6). Each study employed a different design, RCT (Kitagawa, 2015), quasi-experiment (Jamieson et al., 2013) and cross sectional (Chib et al., 2012). All three studies measured knowledge, two found no significant differences between intervention and control (Kitagawa 2015; Jamieson et al., 2013) and Chib et al., (2012) found 68% of respondents correctly answering the Question and Answer intervention content. However it was common for participants to only respond to the SMS if they knew the answer to the question which limits the impact on knowledge of this intervention. One study (Chib et al., 2012) measured STI/HIV testing behaviour and found an increase in HIV testing at the local HIV clinic post intervention compared to baseline. Two of the three studies measured condom use, one study (Kitagawa, 2015) showed an increase in condom use in those who received personalised or social cue SMS messages compared to generic SMS messages or the control, whereas in another study (Jamieson et al., 2013) the intervention group were less likely to use condoms compared to control group.

Table 4.6: Summary of the findings in Q&A interventions (n=3)

Author	Design	SRH Knowledge	STI/HIV Testing Behaviour	Sexual behaviour
Kitagawa (2015)	RCT	No significant differences	Not measured	Personalised and social cue messages significantly more likely to increase regularity of condom use and condom use at last sexual encounter
Jamieson et al., (2013)	Quasi-experiment	No significant differences	Not measured	Intervention group more likely to not use condom at last sexual encounter than control.
Chib et al., (2012)	Cross-sectional	On average quiz respondents got 68% of the questions correct. 19% all responses incorrect and 44% only provided correct responses	33% increase in HIV counselling and testing attendance during intervention period.	Not measured.

Five studies included a qualitative component. Two studies (Jamieson et al., 2013; Vahdat et al., 2013) assessed participant experience of the intervention. One found high acceptability of a two way intervention (Vahdat et al., 2013), whereas the other (Jamieson et al., 2013) found that participants had difficulties understanding the SMS information received as part of a Question and Answer intervention, as it was not always related to the question they had asked. Three one way studies (Gold et al., 2011a; Gold et al., 2011b; Lim et al., 2012) included qualitative evaluation of participant experience of the intervention content. One study (Lim et al., 2012) found that 69% of participants who received the intervention rated the messages as entertaining while 24% found them annoying. Similarly, Gold et al. (2011a) found that 48% of participants receiving the intervention rated their messages as entertaining, 33% as annoying and 22% felt they had learned something from the SMS messages. Finally Gold et al. (2011b) found that 80% of participants in the intervention group rated the messages as entertaining and 23% found them annoying.

4.4 Discussion of the included articles and implications for intervention development

Eleven studies employing SMS for sexual health education were reviewed from five countries, showing a higher representation (64%) of research implementation in low income countries. This is a positive advancement for research in low income countries, as previous reviews in mHealth have found extremely low representation from low income countries (Cole-Lewis & Kershaw, 2010; L'Engle et al., 2016). However the fact that the current review did not focus solely on peer-reviewed literature or RCTs designs may have resulted in a larger number of studies from low income countries meeting the inclusion criteria.

Most studies focused their intervention on individuals under 35 years; this is likely due to content being more relevant for those of childbearing age. This was echoed in the open access interventions (Chib et al., 2012; L'Engle et al., 2013; Vahdat et al., 2013), as each found their service was mostly used by participants under 30 years of age. The specific intervention content of each study varied but developed countries tended to focus on STIs (including HIV), whilst developing countries were focused on general SRH issues including HIV prevention and testing.

4.4.1 Quality of the Evidence

Study designs included RCT, quasi-experiment, one group pre/post-test and cross-sectional methods. The reporting of mHealth interventions as assessed against the mERA (Agarwal et al., 2016) was poor, with an average score of 34% across all study designs. The best example of reporting was from Gold et al., (2011a) with 56% of the criteria reported on, in contrast to Chib et al., (2012) which scored 19%. Reporting of all aspects of the mERA criteria is integral to further advance the field of mHealth, as it is currently inundated with small-scale pilot studies which are rarely up-scaled or replicated (Tomlinson et al., 2013). Accurate and detailed reporting of behaviour change interventions is required to enable to development of a cumulative evidence base (Shultz et al., 2010; Hoffman et al., 2014). A cumulative approach enables interventions to be improved and to understand how the flexibility required to meet the needs of local healthcare systems and populations might be achieved without affecting intervention effectiveness. Accurate reporting is also important

in interventions which produce negative intervention effects. This was found in one study (Jamieson et al., 2013), where the intervention groups were less likely to use condoms than the control, and accurate reporting of this intervention is required in order to identify how not to cause harm to participants.

Additionally, only three studies referenced theory in relation to the creation of the SMS message content and a further study reported consideration of health psychology literature, but did not describe a specific behaviour change theory or construct. Although the inclusion of theory is not specifically addressed in the mERA reporting criteria, it is an essential element of the TIDieR guidelines which is used for the reporting of all interventions (Hoffman et al., 2014) to improve replicability. Creating interventions grounded in theory and evidence base is necessary in order to design and implement interventions which will elicit behaviour change and is recommended in national guidelines for the development of complex interventions (Craig et al., 2008).

4.4.2 Intervention Effectiveness

Of the six one-way SMS interventions, three found significant increase in SRH knowledge and positive impact on behaviour (Gold et al., 2011a; Gold et al., 2011b; Lim et al., 2012), and one study, which only measured behavioural outcomes, found a significant increase in HIV testing in the intervention group (Njuguna et al., 2016). These are promising results for the utility of SMS for sexual health behaviour change; however, only two of these studies (Lim et al., 2012; Njuguna et al., 2016) included a control group, limiting the conclusions which can be drawn. In addition, Lim et al. (2012) included e-mail as a supplementary component of the intervention, and therefore the effects of the intervention cannot be attributed solely to SMS.

The two way interventions (L'Engle et al., 2013; Vahdat et al., 2013) found high self-reported contraceptive behaviour change in both countries in which the intervention was implemented. However, the design of both studies (cross-sectional with no control group) limits the conclusion that can be reliably drawn. It is unclear from either study whether individuals had begun a contraceptive method as a result of the intervention, or were simply citing current or past use. Vahdat et al. (2013) also conducted qualitative analysis of participant experience of the intervention and found high acceptability of the two way

intervention. This is important, particularly for low income countries, as preventative healthcare is undertaken by understaffed and over-burdened health centres (0.2 physicians per 1000 people in Kenya, World Bank (2013)). Therefore supplementary services to educate the community are needed and identifying services which are acceptable to the communities involved will increase the likelihood of their engagement in such services.

The only quiz intervention (Chib et al., 2012) had a high response rate from participants answering the questions, and 44% of individuals who answered a question got the answer correct. This may be because individuals are more inclined to reply to the question if they had prior SRH knowledge which inadvertently excluded individuals with no prior knowledge of HIV/AIDS. In addition, this is not an inclusive method to educate individuals. If participants do not attempt to answer the questions they will not receive feedback on the correct answer or details of HIV services. This was the only study to include an objective behavioural measure (HIV testing rates at the local clinic), and found a 33% increase in HIV testing post intervention. This suggests that increased awareness from this health education campaign encouraged users to attend HIV services, however attendance at the clinic was not limited to participants thus other factors may explain the increase.

The final two studies (Jamieson et al., 2013; Kitagawa, 2015) found no effect from their question and answer intervention on SRH knowledge and appeared to produce negative effects on increasing risky sexual behaviour. Kitagawa (2015) tested three different types of SMS messages; a generic response which was automated (based on an algorithm) and contained no personalised information, a personalised response in which a community health worker composed the answer, and a social cue response which echoed the personalised response and included a statement reinforcing the fact that others in the community were also using the SMS service. Kitagawa (2015) found that the social cue messages produced the greatest impact on likelihood of regularly using a condom or using a condom at last sexual encounter. In contrast those who received a generic response were more likely to have multiple partners, a risky sexual behaviour. This could have been down to the algorithm search used in this generic response, as qualitative feedback from Jamieson and colleagues (2013) found in their study that participants received irrelevant information in reply to their questions, presumably due to inefficient algorithms. These errors could be detrimental to participant engagement and consequently behavioural

effects, as if the participant or their peers received an incorrect or confusing message, there may be less inclination for continued use. In addition, this type of service required the participant to not only be engaged with the platform, but also have enough prior knowledge to form a question. This limits engagement to the intervention as individuals will not ask questions on SRH issues they are unaware of and may not ask questions on culturally sensitive topics or those which challenge cultural beliefs.

All outcome measures for the 11 studies included in this review were obtained through self-reporting, although this is the norm for sexual health research due to ethical and practical limitations of more direct assessment measures (Weinhardt, 1998). Self-report data is subject to bias in participant recall, social context, willingness to accurately provide the sensitive information and personal characteristics (Schroder, Carey, & Vanable, 2003). In sexual health research, this self-report bias is also heavily influenced by societal norms and cultural expectations within the specific study area (Langaug, Sherr, & Cowan, 2010), where participants may over-report societal acceptable behaviours and under-report behaviours which are not the norm. This is important to consider in the results of the studies identified, particularly the five studies in low income countries (Kenya, Tanzania and Uganda), where preventative sexual behaviours are not as commonly practiced as in high income countries (UNAIDS, 2016). Yet only one of these studies (Jamieson et al., 2013) referenced the impact of cultural specific beliefs on intervention effectiveness and uptake. Therefore future research must address cultural implications such as traditional practices and community perceptions within the study area, to gain a better understanding of the impact these beliefs and practices have on the design and implementation of interventions.

4.4.3 Limitations of this systematic review

The mERA checklist was used as a measure to assess quality of the studies included in this review. The scoring instructions for this checklist are not sufficient to detail how to score studies which report on some but not all sub-components of an item. For example, within this review, item 1; infrastructure, was partly reported by 81% of all studies and this was primarily due to studies stating mobile penetration rates at the country or population level (sub-component b) but not reporting on physical infrastructure such as electricity, power or connectivity required to conduct such an intervention (sub-component a). As this item was not fully reported in these cases, it was judged to be insufficient to fulfil the criteria to score

this item. However it could be argued that reporting both sub-components is not necessary when interventions are implemented in developed countries where such physical infrastructure is assumed to be adequate. Therefore it may be appropriate to review the scoring system for this checklist to acknowledge studies which have reported on sub-components of items to a high standard, yet not fulfilled the item completely.

4.5 Implications for a SMS intervention in Malawi

Of the 11 studies there were a number of different delivery methods, some of which were more labour intensive for the healthcare workforce than others. For example, Kitagwa (2015) recruited healthcare professionals to answer questions directly from participants. Due to such staff shortages in Malawi, it is important to design an intervention which can stand alone, educating and directing participants to the nearest healthcare facility without further adding to the health workers extensive workload. Two-way interaction in mHealth interventions is beneficial, as the participants are involved in their learning by asking questions relevant to their circumstances. However, without sufficient health staff this is difficult to achieve. The proposed SMS intervention will work closely with the local health centre, yet it does not have the resources or the capacity to tailor each message to each individual's needs and questions.

It is possible to deliver a two-way intervention without additional support from health workers, however Jamieson et al. (2013) found negative consequences of using algorithms to answer each individual's question. If the answer was incorrect or irrelevant, participants were put off using the intervention or confused by the answers they received. In addition, the ability to formulate a question on a specific health topic, requires a level of prior knowledge and understanding and does not provide the individual with the full picture in terms of preventative health education. It is crucial to provide correct, coherent and trusted education on such a sensitive health topic. Therefore this SMS behaviour change intervention will utilise a one-way messaging service, ensuring all participants receive correct information and receive information on every contraceptive method available, so they are able to make an informed decision regarding their current or future contraceptive use.

This review highlighted the need for adequate reporting of intervention context, content (including theoretical underpinnings) and delivery in order to allow for adequate comparison of similar studies, as some aspects could not be reviewed as no information was provided. The proposed SMS behaviour change intervention in the Chikwawa District will be one of the first to be implemented in a community setting in Malawi, and as such it is essential to detail each aspect of the mERA criteria to help the design and development of future interventions. In addition, due to the novelty of the SMS intervention in the area and self-report bias which is inherent with sexual health research, it is important that sufficient investigation is conducted on the cultural practices, traditions and community perceptions of sexual health practices in rural Malawi. This will allow the impact of such beliefs to be assessed and subsequently inform the design and implementation of the SMS intervention. It is this investigation of cultural practices and perceptions which will be addressed in the next two chapters of this thesis.

4.6 Summary of Chapter 4

This review included 11 studies focused on SMS sexual health education interventions and their effectiveness on increasing knowledge and changing behaviour. Four one-way interventions found positive effects on knowledge and behaviour change, however three of these derived from the same research group and all had methodological limitations which fail to isolate SMS intervention effects. No study employing two-way or question and answer interventions were able to demonstrate an increase in knowledge. The addition of social comparison to SMS messages was more likely to positively impact regularity of contraception use (Kitagwa, 2015) and a positive correlation of HIV clinic attendance was found from a health education quiz (Chib et al., 2012). However no behavioural outcomes were directly accountable to the SMS intervention, predominately due to weak study designs failing to include controlled comparisons or pre/post testing. Nevertheless, these small scale pilot interventions, particularly one-way interventions, show promising results regarding positive participant opinion of the confidentiality and ease of access for the intervention. mHealth research desperately needs interventions to comply to the mERA guidelines for clear reporting and to conduct adequately controlled pre/post designs with scientific rigour to review the true effectiveness of SMS interventions. This will be addressed in the proposed SMS behaviour change intervention, where a one-way

messaging service will provide information on contraceptive methods and each criterion of the mERA is detailed in Chapter 9. However before the intervention can be designed, it is necessary to identify cultural practices, traditions and community perceptions of sexual health, in order to assess the impact these beliefs may have on intervention effectiveness. The next two chapters aim to look at this in more detail, understanding cultural practices in the area (Chapter 5) and community perceptions of contraception (Chapter 6).

Chapter 5: Qualitative Study on Initiation Ceremony Practices in the Chikwawa District of Malawi.

Previous SMS behaviour change research in low income countries, as identified in the systematic review in Chapter 4, did not mention specific cultural implications which may influence sexual health interventions, nor is it included in the mERA guidelines for mHealth reporting. Culture impacts our decision making, even when we are not aware of it, as our beliefs and opinions are shaped by the world around us. This is particularly important in relation to contraceptive decision making within the Malawian culture, with the existence of adolescent initiation ceremonies, where adolescents are presented with information regarding the transition from adolescents to adulthood after puberty. The actual information provided in these ceremonies is not well documented in the literature due to the secrecy of these practices; however there is the potential for these ceremonies to include information related to sexual and reproductive health. It is therefore important to identify whether these cultural practices are still attended and what, if anything, is taught regarding sexual and reproductive health. This chapter presents a qualitative study which focuses on understanding the teachings of current day initiation ceremonies and examines the potential influence they may have on sexual behaviour and contraception decision-making in adolescents.

5.1 Introduction to initiation practices in Malawi

Culture is defined as the "ideas, customs and social behaviour of a particular people or society" (Oxford Dictionary, 2017). It takes into account specific societal norms which one is expected to adhere to in order to be accepted. These norms, or unwritten rules of how to behave, influence all aspects of an individual's life, from attitudes and beliefs to behaviours and practices (Sherif, 1936). Societal norms have great influence over an individual and will impact their decision-making and lifestyle choices in all aspects of their life, including the clothes they choose to wear to the car they drive or food they eat. These choices can be positive in their impact to the individual, but they can also be detrimental to health. For example, societal norms associated with Western culture such as poor diet and sedentary behaviour have led to an increased risk of chronic conditions like diabetes and cardiovascular disease (Thomas, 2004). Therefore culture can have substantial sway over an individual, due to their desire to conform to the ways of their society (Zou et al., 2009).

As well as influencing everyday behaviours and practices, culture also influences involvement in specific practices or rituals. Rituals feature in all human societies regardless of their size, and are important to the interdependence and social cohesion of any group of people (Bell, 2009). Involvement in these cultural rituals provides both psychological and social benefits. Presenting a normalised example of how to behave in certain situations such as funerals or birthday celebrations, can reduce anxiety at times of the unknown (Helman, 2007). Socially, rituals provide a platform where the values of the society are set out and to which behaviour can be modified to, as well as providing opportunity to strengthen old or create new relationships within members of the same society (Helman, 2007). Traditional ceremonies – or rites of passage – are an example of cultural practices which can exert this societal influence.

Rites of passage are extremely common in Malawi, and take different forms depending on which ethnic group or religion one belongs (Skinner, Underwood, Schwandt, & Magombo 2013). They are a celebration of each transitioning stage throughout the human life cycle, which in turn is a change in social position within society (Helman, 2007). Examples of life events include puberty, marriage, pregnancy and death. The point is therefore to acknowledge and prepare an individual for their next role, for example preparing adolescents for adulthood by instructing them on how to behave and what must change going forward. This particular rite of passage in Malawi is commonly referred to as an initiation ceremony, and is conducted by initiation counsellors in separate ceremonies for male and female adolescents (van Bruegel, 2001). They generally include instructions for adolescents about puberty, the changes in their body and how they are to behave now they are entering into adulthood; this is usually conducted through song and dancing by both initiation counsellors and initiates (Fiedler, 2005).

The most common adolescent initiation ceremonies in Southern Malawi according to the Malawian Human Rights Commission (2006) are Chinamwali, Jando and Kulowa Gule. Chinamwali is the rite of passage from puberty to adulthood and occurs after first menstruation. The main purpose is for instruction and counselling for girls after this event. It occurs all over Malawi but will vary slightly depending on ethnic groups and region. Girls are instructed on how to look after themselves hygienically, how to interact with adults and to avoid sexual relationships with men and boys before marriage to avoid pregnancy

(Malawi Human Rights Commission, 2006). Jando refers to circumcision for boys and involves going to a dedicated space away from the village for a period of two weeks to two months after the circumcision has taken place. They are advised on information such as female menstruation, respect for elders, to take care of the infirm and to abstain from sex with a women during menstruation or after childbirth (Malawi Human Rights Commission, 2006). Finally, Kulowa Gule is an initiation specifically for the Chewa ethnic group, whereby boys undergo the rite to be initiated into the Gule Wamkule cult. The initiates are taken to a secluded place and instructed on how to behave in society, they are blindfolded and sworn to secrecy as to all the information given (Malawi Human Rights Commission, 2006).

These ceremonies have been embedded into the cultural life of Malawians for centuries, yet have recently come under fire due to the nature of the content involved. Initiation counsellors believe that after puberty, particularly for girls after menstruation, adolescents are considered adults and are able to get married and have children and are instructed accordingly. However due to the potential onset of first menstruation being as young as 10, other stakeholders in Malawi believe this is too young to be learning about sexually explicit material (Malawi Human Rights Commission, 2006). They are concerned that these initiation ceremonies are encouraging adolescents to take part in risky sexual behaviours at a young age (Munthali & Zulu, 2007). Particularly with the use of cultural practices such as ‘kuchotsa mafuta’ which is when older men (afisi) have intercourse with young girls after their initiation to cleanse them upon entering adulthood, or ‘kuchotsa’ where male initiates after Jando are instructed to have sexual intercourse in order to prevent ill health or the inability to perform during intercourse (Malawi Human Rights Commission, 2006). Furthermore, there is research suggesting these ceremonies could be a contributing factor to early marriage (UNICEF, 2015), teenage pregnancy (Kaphagawani, 2006; Munthali et al., 2004) and the spread of HIV/AIDS (Moyo & Muller, 2011; Skinner et al., 2013; Sovran, 2013).

Not all adolescents attend initiation ceremonies. One recent study by United Nations Population Fund (UNFPA) (2015) which surveyed 613 individuals from seven Malawian ethnic groups, identified that 65% of girls and 44% male adolescents surveyed had taken part in an initiation ceremony. Of these, 89% who were initiated were pleased with their ceremony and only 8% were not pleased. This is interesting, in light of the popular opinion

of the negative impact of initiation ceremonies. However this study did find bullying/beating, obscene language and forced sex after initiation the primary reasons why adolescents were not happy with their ceremony. Therefore there is support for the negative impact of initiation ceremonies within this study, however it appears to be in the minority of cases. It is worth noting that all data collected in this study was based on self-report and could be influenced by social desirability bias of the interviewees, who may withhold information or their true opinion, in order to present their cultural practices and sexual behaviour in a positive light (Kelly et al., 2013). Adolescence is a sensitive life stage, whereby individuals are forming their own unique identity and trying to understand their sense of purpose and place within society (Kroger, 2007). The attitudes and beliefs of gender roles within specific cultures and how these are communicated will shape adolescents' own understanding of who they are (Wexler, 2009). Therefore, understanding cultural practices such as initiation ceremonies is imperative, when trying to elicit behaviour change in sexual and reproductive health, as is the aim of the proposed mHealth behaviour change intervention, as they will be significant in cementing societal beliefs and behaviour during this very influential phase of development.

Myths and misinformation regarding medical practices and advice is common in rural Malawi, particularly surrounding family planning and sexual health (Munthali et al., 2004; Bisika, 2008; Chipeta et al., 2010; Ntata, Mvula, & Muula., 2013). There is widespread belief, throughout sub Saharan Africa that contraception causes cancer (Miller & Murphy, 1998; Dusabe et al., 2015), leads to infertility (Kaler, 2009; Williamson, Parkes, Wright, Petticrew, & Hart, 2009), that the disruption of bleeding patterns is harmful to women's health (Geuye et al., 2015), and that contraception is not suitable for young people or adolescents (Wood & Jewkes, 2006; Path, 2015). In addition, men can be against the use of condoms as they believe it will lead to impotence (Fiaveh, 2012) and that some condoms are laced with HIV (Dusabe et al., 2015). These beliefs tend to come from a mix of personal experience and rumours which spread across communities (Diamond-Smith, Campbell, & Madan, 2012). They are spread through villages from word of mouth and cultural practices may contribute to the distribution of false education on these sensitive topics.

It is therefore extremely important to understand adolescent initiation ceremony practices, particularly what is taught, and to identify whether they are attended by current

adolescents. Gaining a better understanding of these secretive practices will help to identify whether the instructions given regarding puberty and sexual intercourse are in line with national guidelines of sexual and reproductive health (Government of Malawi, 2009). If the information is different, it will not only cause confusion for adolescent contraceptive decision making, but may lead to increased risk taking in sexual health behaviours. In addition it is important to identify whether initiation ceremony education contradicts the information delivered by public health programmes, including the planned SMS behaviour change intervention which will be implemented in the Chikwawa district of Malawi. This qualitative analysis aims to look into adolescent initiation ceremonies in detail to identify the potential influence cultural practices may have on the planned mHealth behaviour change intervention, a range of participants will be interviewed to account for adolescents themselves as well as parents and other family members.

5.2 Methods to understand initiation practices in Malawi

5.2.1 Study Design

This was a qualitative study, conducting individual in-depth interviews with residents of three villages (Chinkole, Mpokonyola and Thukutu) in Chikwawa District, Southern Malawi. The interviews were conducted in September 2015.

5.2.2 Study Sample

Thirty-two participants were recruited from Chinkole (n=13), Mpokonyola (n=11) and Thukuta (n=8) through convenience sampling. Eligibility criteria included being aged 15 and over, the ability to speak Chichewa and ability to consent to the study. If the participant was 15, additional consent was obtained from a guardian. Both genders were included in the study.

5.2.3 Chapter 5 Procedure

Participants were recruited through a village walkthrough (see Section 2.3.3 for complete description as the procedure was identical). The interviews followed a pre-determined semi-structured interview guide (Appendix 7) which asked questions to understand what happens at the initiation practices, what is taught, participation and opinions of such

practices. After being read the information sheet and having the opportunity to ask questions, participants were asked to give their consent for participation, this was recorded on a consent form (Appendix 8). Each interview, lasted between 20 and 60 minutes, was conducted by a trained facilitator and audio recorded.

5.2.4 Qualitative analysis

Audio recordings were transcribed verbatim and then translated into English for thematic analysis (see Chapter 2, Section 2.3.4 for description of this process).

5.2.5 Ethical considerations

Ethics were carried out as discussed in section 2.4.

5.3 Results of the qualitative study

Thirty-two interviews were analysed, both male (41%) and female (59%) participants were interviewed with ages ranging from 15-84; Table 5.1 presents the full demographic information.

Table 5.1: Demographic Information for interviewees in Chikwawa, Malawi (Sept 2015).* denotes where the participant was unable to disclose their age.

PP	Sex	Age	Village	Marital Status	No. of Children	Completed Years in Education	Ethnic Group	Attended Adolescent Initiation Ceremony	Mentioned another Initiation Ceremony
1	F	21	Thukuta	Single	1	10	Mang'anja	Chinamwali	No
2	F	*	Thukuta	Married	2	4	Mang'anja	Chinamwali	No
3	F	*	Thukuta	Widow	4	2	Mang'anja	Chinamwali	No
4	M	63	Thukuta	Married	2	6	Mang'anja	Undisclosed	No
5	F	*	Thukuta	Married	4	5	Sena	Chinamwali	Dzoma
6	F	49	Thukuta	Single	0	7	Mang'anja	Chinamwali	No
7	M	29	Thukuta	Married	2	8	Chikunda	No	Chinamwali
8	F	20	Thukuta	Single	0	12	Unknown	No	Jando
9	M	84	Mpokonyola	Widower	9 (3 alive)	2	Tonga	No	Dzoma
10	M	33	Mpokonyola	Married	8	1	Tonga	No	Dzoma
11	M	15	Mpokonyola	Single	0	8	Tonga	No	No
12	M	65	Mpokonyola	Married	7	0	Chikunda	No	Dzoma
13	M	32	Mpokonyola	Married	4	6	Lomwe	Jando	No
14	M	18	Mpokonyola	Single	0	7	Mang'anja	Jando	No
15	M	69	Mpokonyola	Married	6	0	Chikunda	No	Dzoma
16	M	16	Mpokonyola	Single	0	7	Mang'anja	No	No
17	M	75	Mpokonyola	Married	5	0	Chikunda	No	Dzoma
18	M	21	Mpokonyola	Married	1	2	Mang'anja	No	No
19	M	20	Mpokonyola	Single	0	10	Mang'anja	No	No
20	F	*	Chinkole	Widow	5 (1 alive)	2	Mang'anja	Chinamwali	No
21	F	57	Chinkole	Divorced	8 (7 alive)	1	Mang'anja	Chinamwali	No
22	F	16	Chinkole	Single	0	5	Mang'anja	No	No
23	F	54	Chinkole	Widow	2	5	Mang'anja	Chinamwali	No
24	F	16	Chinkole	Single	0	8	Mang'anja	Chinamwali	No
25	F	*	Chinkole	Widow	4	0	Sena	Chinamwali	No
26	F	30	Chinkole	Divorced	2	8	Sena	Chinamwali	No
27	F	*	Chinkole	Widow	3	4	Mang'anja	Chinamwali	No
28	F	*	Chinkole	Married	5 (3 alive)	0	Mang'anja	Chinamwali	No
29	F	20	Chinkole	Single	1	0	Mang'anja	No	No
30	F	50	Chinkole	Widow	5	2	Sena	Chinamwali	No
31	F	21	Chinkole	Single	3	0	Sena	Chinamwali	No
32	F	15	Chinkole	Single	0	4	Sena	Chinamwali	No

Fifty-six percent of participants (n=18) had attended an adolescent initiation ceremony, only two of which were male. Reasons for not attending the initiation ceremony are presented in Table 5.2. An additional 15% (n=5, all male) had attended a pregnancy initiation ceremony called Dzoma.

Table 5.2: Reasons for not attending an adolescent initiation ceremony given by participants interviewed in Chikwawa Malawi, in September 2015.

Participant	Gender	Age	Education	Ethnic Group	Reason for Not attending
7	M	29	8	Chikunda	Own choice not to attend
8	F	20	12	Unknown	Own choice not to attend
9	M	84	2	Tonga	Did not provide reason, discussed Dzoma.
10	M	33	1	Tonga	Did not provide reason, discussed Dzoma
11	M	15	8	Tonga	Did not provide a reason.
12	M	65	0	Chikunda	Did not provide reason, discussed Dzoma
15	M	69	0	Chikunda	Did not provide reason, discussed Dzoma
16	M	16	7	Mang'anja	Couldn’t afford to take part
17	M	75	0	Chikunda	Did not provide reason, discussed Dzoma
18	M	21	2	Mang'anja	Own choice not to attend
19	M	20	10	Mang'anja	Couldn’t afford to take part
22	F	16	5	Mang’anja	Not yet had first period
29	F	20	0	Mang’anja	Couldn’t afford to take part
32	F	15	4	Sena	Not yet had first period

Three themes arose from the data, adolescent initiation ceremony teachings, motivations for initiation ceremony attendance, and sensitivities of initiation ceremony practices.

5.3.1 Adolescent Initiation Ceremony Teachings

Participants were encouraged to provide detail about what occurred at the adolescent initiation ceremonies and what was taught during the ritual. This led to discussion about

male (Jando) and female (Chinamwali) adolescent initiation ceremonies, and also a pregnancy initiation (Dzoma) which had been attended by participants in this study. A summary of each ceremony is displayed in Table 5.3.

Table 5.3: Summary of each Initiation Ceremony and target group as provided by interviewees from Chikwawa, Malawi in September 2015

Type of Ceremony	Target Group	Description Summary
Chinamwali	Female Youth	Ceremony for those who have begun menstruation to be educated on how to look after themselves hygienically and how to be a wife as they are now regarded as adults who can marry.
Jando	Male Youth	Ceremony for those in puberty to be instructed on how to behave in the household and to respect their elders. Initiates are then circumcised and have to wait at the camp to heal.
Dzoma	Couple expecting a baby	Ceremony for pregnant woman and their husbands to be educated on how to look after the baby and how the husband should treat his wife and child.

5.3.1.1 Chinamwali Initiation

Sixteen female participants out of the 19 involved in the study had taken part in Chinamwali, and this encompassed participants with a range of education levels, ethnic groups and marital status. This initiation was discussed as a practice in 21 interviews (19 female representing youth, adults and elderly, one male elderly and one male youth); the ceremony is for adolescent females after their first menstruation;

> "The girl has reached puberty so they go and report at the chief's place and the chief looks for a counsellor then we take the girl and instruct her. We sing out songs advising her that this is how we live in marriage. When you are with a man, give him respect. If she is a good listener she will." *Participant 3, Female age unknown*

These group ceremonies contain specific instructions, taught through song and dance, on menstruation, primarily hygiene practices, and on other aspects such as marriage and how to be a wife. Specifically they convey a set of rules which women must follow during menstruation;

> "Maybe in your house you are menstruating and the man wants to have sex, you deny and tell him you are not alright. When you are fine, the man will know that my wife is fine. But not when you are menstruating, if you do it you will make him sick. You will give the man diseases, that's not allowed." *Participant 5, Female age unknown*

> "… they advise you that at your parents' home what is required is respect. You should respect your parents. ... you should stop entering into your parents' bedroom. If you used to enter into your parents' bedroom before you started menstruating you should stop because you are now menstruating." *Participant 21, Female aged 57*

> "…when a girl is having menstruation, she should not add salt to relish, [they] say that the parents will get sick and die earlier than required. … she should not sit on a chair which her father will be sitting as well, she can sit on a stone. Even the cleaning itself, it should not take place in the bathroom but in the rivers." *Participant 8, Female aged 20*

Initiation counsellors appear to provide instruction on practices which should not occur during menstruation. There is a belief that if these actions are carried out, it will spread disease to other family members, either directly through intercourse or via cooking and household chores.

Eight participants stated that after this ceremony the adolescents are considered adults and able to get married and have children. This was primarily stated by older female adults (n=6), with only two younger participants (male and female) stating this opinion;

> "…this initiation ceremony does not consider age, it happens when the parents feel ready for the celebration that their child has grown up … accepting she is free to get married. One can only get married after this initiation ceremony and cannot be charged at the Chiefs court since she has been initiated at this ceremony which is perceived as important." *Participant 1, Female aged 21*

> "Participant: In terms of this ceremony (Chinamwali), in our village, it involves telling the girl they are grown up, we tell them that they are now mature and they should not fear boys.
> Facilitator: You have said that she is told she should not fear boys, what does that mean?
> Participant: it means she can have intercourse." *Participant 7, Male aged 29.*

Participants provided specific information on instructions regarding menstruation. Even though eight participants stated that after this initiation ceremony female adolescents are generally accepted as being able to be married and in some instances are encouraged to have intercourse, there was no mention by any participant of instructions provided regarding family planning or safe sex practices.

5.3.1.2 Jando Initiation

Two male participants had taken part in the Jando initiation ceremony, both from the same family and both of whom stated this was a Muslim ceremony primarily regarding circumcision;

> "We take the children to a camp where they are circumcised. We also teach them other things about life but mostly the ceremony is about circumcision." *Participant 13, Male aged 32.*

A further two participants mentioned this ceremony by name and all four participants discussed how this ceremony is the traditional initiation ceremony for adolescent males whereby they are given instruction about how to behave in adulthood and are circumcised;

> "[Jando] happens every year, they also have a camp. … the difference [between girls] comes in length, the boys stay there 1 or 2 months in the camp but the girls stay there 2 days or 3 and they are out. When the boys go there they get circumcised [which] makes it longer because they wait for the wound to heal right there at the camp. They don't stay the whole time for counsel but for healing the wound." *Participant 7, Male aged 29*

From the current literature, Jando is primarily a Yao initiation ceremony. However the 4 participants who mentioned it in this study were from the Chikunda, Lomwe and Mang'anja ethnic groups, therefore it is possible that this particular male adolescent initiation ceremony has been adopted by other ethnic groups.

A further 11 interviews (4 male elderly, 1 male adult and 4 male youth and 2 female adults) discussed the traditional male adolescent ceremony, but did not disclose a name for the ceremony;

> "A celebration takes place, they dress in similar things, some hats and sticks and songs are sung, they have at least 1 person to accompany them who is already circumcised. Most of the time is takes place along river, like hidden places and a red flag is placed near the area that the circumcision is taking place, which means do not come here." *Participant 8, Female aged 20*

From the descriptions of the traditional male ceremony it appears that the focus is on circumcision of male adolescents. Teachings were also mentioned briefly on topics such as how to behave, respecting elders, menstruation in women and general discipline, however no specific instructions or detailed information was provided. In addition there was no evidence of information provision during this ceremony on sexual and reproductive health after circumcision.

5.3.1.3 Female Dzoma Initiation

Although not directly asked about, the final ceremony discussed was the Dzoma ceremony for women and it was mentioned by name in 6 interviews (2 male adults, 3 male elder and 1 female elder) and discussed in a further 2 (female adult and female elder). This represented multiple ethnic groups, education levels and varied marital status. It was explained as an initiation ceremony providing instruction on pregnancy and how to raise a child well;

> "…the first one [Chinamwali] helps that you should live well, behaviour and taking care of your home. The second one [Dzoma] is when she is pregnant, you instruct her that you are supposed to do this and that and especially rush to the hospital for the doctor to help you." *Participant 5, Female age unknown*

Interestingly this was mentioned primarily by male participants (n=5) who had not taken part in an adolescent initiation, but were involved in the Dzoma or household initiation ceremony. These males were all elderly (except one who was 33) and were of Chikunda and Tonga ethnic groups.

> "When I got married and impregnated my wife, the female elders came over to my house to advise me on how to take care of a pregnant wife and the expected child…they told me that I should not sleep around with other women when my wife is pregnant because that may cause miscarriage of the pregnancy or death of my wife during delivery." *Participant 10, Male aged 33*

> "Only women initiated us, with one man who accompanied me…after the initiation then we had a cerebration at home with my wife where people gave us some money … I learnt that I should not abuse my wife and her family but take good care of them." *Participant 17, Male aged 75*

This ceremony involved instruction on another phase of life, pregnancy, and participants discussed instructions they received regarding sexual practices with the wife/others and what not to do. Although it was reported that during this ceremony there is discussion of sexual practices, there was no mention of instruction or teaching surrounding any form of family planning or medical advice, nor advice to go to the hospital.

5.3.1.4 Differences in Initiation Ceremony Teaching

There appears to be a contrast between the two types of adolescent initiation ceremonies. During discussion of Chinamwali, 7 of the 20 female participants stated this initiation ceremony encouraged participants to abstain in order to not become pregnant at a young age;

> "They just give advice like the way a girl child should live with her parents, the way she can avoid boys and giving respect to the elders." *Participant 27, Female aged 30*

> "…they told us you shouldn't rush having a man, you are still young, you should be a nurse in future." *Participant 28, Female age unknown*

In these cases, it appears the ceremonies are trying to encourage abstinence, however it is not clear in how much detail this is discussed. In contrast, this was not mentioned in any discussion about the male initiation ceremony and one participant noted the opposite;

> "They [male adolescents] are told that when you go outside there you should have sex with a girl to clean yourself [after circumcision] as you are coming from there" *Participant 8, Female aged 20*

Therefore there may be discrepancies as to what advice is given regarding sexual intercourse after initiation in the two ceremonies. In addition, no evidence of information provision on family planning or safe sex practices have been disclosed within this study, apart from abstinence.

5.3.2 Motivation for Initiation Ceremony Attendance

Throughout the interviews there was reference to three motivators towards adolescent initiation ceremony attendance; desire to conform to the cultural practices, desire to learn and financial pressure.

5.3.2.1 Conformity to Cultural Practices

Twelve participants (1 female elder, 3 male elders, 2 female adults, 1 male adult, 3 female adolescents and 3 male adolescents), mentioned conforming to the cultural practices of their parents as a reason for initiation ceremony attendance. These participants represented a range of age, education levels, marital status and all ethnic groups. This was stated as a reason for personal attendance to adolescent initiation ceremonies (n=7);

> "They [adolescent initiation ceremonies] are important since we learn our parents' culture." *Participant 29, Female aged 20*

It was also stated by participants who were parents when discussing the importance of adolescent initiation ceremonies for their own children (n=5);

> "It is the customs of the parents, if their parents were initiated [their children] should also learn about it" *Participant 26, Female age unknown*

Therefore conforming to the cultural customs of their families appears to be an important motivator for both parents and adolescents.

5.3.2.2. Desire to learn

Twenty (15 females and 5 males, representing youth, adult and elderly) interviews emphasised their desire to learn of the teaching which is imparted through the adolescent initiation ceremony. This represented a range of education levels, marital status and ethnic groups. The desire to learn was referenced most often in regards to Chinamwali (n=14) and this information provision appears to be a motivating factor which drove them to attend;

> "It is very important that girls go through initiation because this is where you are told what exactly is happening to your body and how to deal with it." *Participant 32, Female aged 21*

> "It is important to be initiated because you learn new things and you are corrected on the things which you were doing wrongly…when our parents advise us on things we don't listen because we think they are lying but at initiation ceremonies they teach us everything….and we believe it." *Participant 14, Male aged 18*

This has been discussed as a reason why an individual would attend an initiation ceremony, but also why a parent would send their child to be initiated (n=4);

> "…when my son got initiated I was very happy because I knew he was taught everything about marriage which as a parent I could not manage to do. As parents we keep some things confidential, but at the initiation ceremonies they are taught everything." *Participant 10, Male aged 33.*

5.3.2.3 Financial Penalties

Financial penalties of getting pregnant without having taken part in the adolescent initiation ceremony was mentioned by 8 participants (2 female elderly, 2 female youth, 3 male youth and 1 male elderly) representing a range of education levels, marital status and

ethnic groups. The cost associated with the fine appears to be a motivator to attend the adolescent initiation ceremonies for adolescent girls and their families;

> "…if I get pregnant, my parents have to pay a fine to the chief, but when I have undergone all the initiation ceremony they cannot pay any fine to chief. … [attendance] is important, my parents are poor and the chief fine is huge." *Participant 33, Female aged 15*

> "…my little sister was about to be initiated so I was told to go together with her. But I had no much interest on it. With the way it was happening I didn't see any benefit. So here the belief is if you get impregnated without being initiated you are charged by the chief. So I entered the second initiation ceremony." *Participant 1, Female aged 21.*

This fee can take the form of set amounts of maize or poultry, and in most families it will be a struggle to pay for the extra food needed. Therefore initiation attendance may be motivated to prevent financial fines, rather than a desire to go based on the merits of the ritual, in those who can afford it.

5.3.3 Sensitivities of Initiation Practices

5.3.3.1 Information Restriction

Initiation ceremonies are widely believed to be private practices within Malawian culture and there is a level of secrecy surrounding the customs. There were 6 participants who refused to explain specific details of the adolescent initiation ceremony due to this secrecy and they were primarily older individuals (2 male elderly, 2 female elderly, 1 female adult and 1 male youth) but did represent multiple ethnic groups, marital status and education levels.

> "No I cannot explain [about initiation]…you are a girl, you will hear about it yourself then." *Participant 20, Female age unknown*

> "…you will make me sin, I am not supposed to openly say it [teachings in Chinamwali]." *Participant 26, Female age unknown*

These participants were unwilling to provide detail on the specifics of what was taught or instructed during the adolescent initiation ceremonies. Even though only 6 participants were unwilling to provide specific information on teachings of initiation ceremonies, amongst those who did provide information, the answers were very vague, particularly surrounding teaching of sexual practices, sexual health and relationships

One male participant commented further on the privacy of the rituals and how it has changed current initiation practices;

> "We have lost the way [in initiation ceremonies], that's why we have attracted disgust, people are just barking around, they are blabbing about our culture. But when we were in full control, it didn't happen." *Participant 4, Male aged 63*

This participant is referring to the negative publicity adolescent initiation ceremonies have had recently with regards to their teachings and practices, particularly surrounding 'Kuchotsa mafuta' (Gruenbaum, 2016) and he feels that these practices were better when individuals kept the information to themselves.

5.3.3.2 Negative Perceptions

Seven participants presented strong views against the practices of initiation ceremonies, this was due to the content not being age appropriate (n=2), teachings leading to immoral behaviour (n=2), and participants not seeing the benefit of the ceremony or its teachings (3). These participants were largely young people (2 male and 2 female), as well as 1 male elder, 1 female elder and 1 female adult, they all represented varied education levels, marital status and ethnic groups.

Participants who attend adolescent initiation ceremonies can be as young as 10, yet the content remains the same for every participant;

> "There is a certain traditional dance which is related to those things that happen during sexual intercourse, I think that is not good. They sing songs with bad messages, according to the culture they consider it to be good but I don't think it is good because they are young. If you are experiencing menstruation, it doesn't mean that you are ready to get married." *Participant 8, Female aged 20*

This participant believed strongly against initiation ceremonies, due to the content not being age appropriate.

The content has also led participants to believe that it directly causes bad behaviour;

> "I have never been initiated since I was born because most of the people who are initiated are the ones who have immoral behaviours…for example, these initiated people enter their parent's bedrooms to get things…they learn nothing from these initiation ceremonies…people who don't go to initiation ceremonies are the ones who are well behaved." *Participant 18, Male aged 21*

This participant believed teaching from the initiation ceremonies had a negative effect on behaviour and from what he had witnessed, those who did not attend were better behaved in the community that those who had attended. This was echoed by another participant who felt that initiation ceremonies did not alter the behaviour of the attendees;

> "…a rude person is a rude person. If someone is rude and went to an initiation ceremony no matter how they can instruct her, even if they take a sword and cut her or make her crawl on the dust, it's impossible to change." *Participant 2, Female age unknown.*

Interestingly, 3 of the 4 young people who noted their strong views against initiation ceremonies had actively chosen not to attend their ceremony, they represented multiple ethnic groups and education levels. It was only those in this age group who reported having chosen against attending due to negative perceptions of the practices.

5.4 Discussion of the imitation practices in Malawi

Understanding the practices, and more importantly the teaching, which occurs in adolescent initiation ceremonies in the Chikwawa District of Malawi, is important in order to identify the potential influence this information could have on health education interventions in the area.

Just over half of the sample (18 of the 32 participants) reported attending an adolescent initiation ceremony, and most of these were female, with only two male participants attending a ceremony as an adolescent. This is lower attendance rates than what was found in the national UNFPA (2015) study where 65% of female and 44% of male adolescents had taken part, and this may reflect the ethnic groups of participants included in this study. However both studies do indicate that males are less likely to attend initiation ceremonies.

The descriptions of Chinamwali and Jando support that of previous research in terms of their purpose and general instructions given (Malawi Human Rights Commission, 2006; UNFPA, 2015). There was no evidence from this study of any instructions regarding safe sex practices or sexual and reproductive health advice when participants were asked what they were taught in the ceremonies. This is in contrast to a recent national study of initiation in Malawi (UNFPA, 2015) which found that 15% of initiation ceremonies contained information on modern contraception, and 15% discussed unsafe sex. These are relatively small percentages, but do allude to the possibility of this content being included within these cultural practices. Although no evidence of family planning or safe sex practice was found, teaching on abstinence was mentioned by a fifth of participants (n=7). Abstinence only teaching to prevent pregnancy and the transmission of STI's has been repeatedly found to be ineffective (Underhill, Montgomery, & Operario, 2007; Stanger-Hall & Hall, 2011). Providing comprehensive and correct sexual and reproductive health education to adolescents is a basic human right (Advocates for Youth, 2007), and providing this complete education has not been found to increase risky sexual behaviour in teens (UNESCO, 2009). Therefore it is important to educate adolescents on all aspects of sexual and reproductive health, rather than providing abstinence only information.

The teaching of abstinence was only discussed in regards to Chinamwali, and no specific mention of this was found in the male ceremonies. Yet one participant affirmed the 'kuchotsa' practice where male initiates are instructed to have sex as soon as they finish with Jando. This is one cultural practice which experts believe are contributing to risky sexual behaviours in adolescents and the potential spread of sexually transmitted diseases such as HIV (Munthali & Zulu, 2007). Although there was no identification in this study of 'kuchotsa mafuta' the cultural practice for girls, and only 1 report of 'kuchotsa', it is still of concern that this practice is being actively encouraged, particularly so when there is no

evidence of any accompanying information regarding safe sex practices. This further cements the need for accurate and comprehensive sexual and reproductive health education to complement initiation ceremonies, particularly surrounding safe sex practices and the introduction of contraceptive education. This has previously been highlighted by prominent social scientists in Malawi (Munthali & Zulu, 2007), who emphasised the need for contraceptive health education to be included in both adolescent initiation ceremonies to ensure adolescents are prepared in advance for early or unexpected sexual intercourse.

An additional ceremony, Dzoma, was discussed by five participants. This literally translates as 'rite' and from the literature the description given in the current study correlates to 'Kumulangiza Wapakati', involving elderly women giving advice to both husband and wife during pregnancy on how to take care of mother and baby (Malawi Human Rights Commission, 2006). In this study, more men attended this rite of passage (n=5) than the male adolescent ceremony (n=2), therefore this is a rite of passage which may have more prominence in this area. There was no evidence found in the description in the current study of education on sexual and reproductive health. Although this ritual is for those already pregnant, it provides another rich opportunity for the inclusion of sexual and reproductive health teaching, and this could be a target for future research in this area.

The desire to learn from the initiation ceremonies and the need to be given instruction regarding puberty (Jando and Chinamwali) was cited as one of the main motivators for attendance. This was particularly true for Chinamwali (which accounted for 70% of these references) where instruction on menstruation and bodily changes was cited as a reason for attendance. Participants disclosed detailed instructions of what they were told not to do during menstruation including: not having sexual intercourse; not adding salt to food when cooking; not sitting on a seat which may be sat on by their father; not entering their parents' bedroom; and not cleaning cloths in the house but rather using the rivers. These instructions have been cited before (Munthali et al., 2004) and appear to be due to beliefs of disease transmission from menstrual blood (van Breugel, 2001). Van Breugel was immersed in Malawian culture and through ethnographical research unearthed the same menstruation specific instructions, which the author believed were conducted in order to prevent 'Mdulo'; Mdulo is a disease which is believed to be inflicted as punishment from ancestral spirits if certain restrictions are not adhered to. If these restrictions, including

those mentioned for menstruation, are not met then a member of the adolescent's family would be struck down with Mdulo. Symptoms are believed to include swelling of the cheeks and legs, swelling and hardening of the abdomen, chest pain and vomiting of blood. Fear of this disease leads to the continued instruction and adherence to these rules. Scientifically, there is no basis to these instructions and the symptoms of Mdulo have been attributed by medical personnel to anaemia caused by diseases such as malaria, bilharzia and chronic malnutrition (Pachai, 2000). Therefore myths regarding menstruation appear to be passed through the generations during the cultural practices of Chinamwali and Jando despite there being no scientific basis to the preventative measures instructed. The advice given is not in line with advice from health centres or national guidelines, and this provides further support for the need to provide health instructions which are accurate and medically affiliated.

The second motivator for initiation attendance was to take part in the customs of one's parents. This discussion was vague and not broken down further, although appears to relate to the fact that adolescents are encouraged to take part in the same practices their parents completed. Similar findings were revealed in the recent UNFPA (2015) study of initiation in Malawi, where adolescents stated they had no control over the practices or the ability to change them. This was because the ceremonies had been passed down over generations and parents wanted their children to continue the practices of their ancestors.

A third motivating factor was also tied into the customs of the culture, as girls and parents of girls, appeared to be motivated to attend Chinamwali for fears they could not afford to pay the fine for pregnancy. If the adolescent is initiated this acts as a preventative mechanism against the village headman's fine. This is significant, as in this incidence, individual's views and perceptions of initiation ceremonies and the influence on adolescent development are bypassed by fears for not being able to afford the fine. This is noteworthy, and suggests the lack of education surrounding contraception within these areas, as this preventative measure to attend may not need to occur if the parents and adolescents themselves were confident they would not get pregnant.

In the current study, adolescents were the only age group to actively choose not to take part in adolescent initiation ceremonies. This was primarily down to negative perceptions of the initiation ceremonies and was discussed in regards to the sexually explicit content

and initiation practices leading to immoral behaviour. These views are supported by other stakeholders in Malawi, who have argued that initiation ceremony attendance increases sexual risk taking behaviour (Munthali et al. 2004; 2007). This is reinforced by recent findings comparing initiated adolescents with those not initiated. Initiated adolescents were more likely to have had sexual intercourse and were twice as likely to cite a sexual partner in the last 12 months (UNFPA, 2015). This evidence is also troubling, as these practices may be increasing sexual risk taking when no evidence has been found in the current study for information provision on safe sex practices.

It is evident that cultural practices, particularly Chinamwali, are still being attended within the Mfera catchment of Chikwawa and although adolescents are perceived as adults after the completion of these ceremonies, there is no evidence of any education on safe sex practices or sexual and reproductive health within the rituals. This may increase incidences of teenage pregnancy and the negative consequences of this for the young girl, such as lower education attainment and the transmission of diseases such as STI's and HIV/AIDS. It is therefore essential to provide health education to adolescents of age to attend these practices, as is the aim for the proposed SMS intervention. Once this intervention is established, future research must engage with the initiation counsellors specifically, as they are providing instructions to adolescents. Upskilling them in health education techniques for medically correct sexual and reproductive health would complement the current cultural practices and ensure no unnecessary sexual risks occur. Counsellors are already encouraging adolescents to abstain until marriage, however they need the correct training to go further with this education and include the introduction of contraceptive methods to enhance learning during this significant life event within their culture.

5.4.1 Limitations of this qualitative study

The study area was restricted to three villages in the Chikwawa district of Malawi and therefore has limited generalisability. However this analysis has provided insight into the motivators and barriers in attending such cultural ceremonies which may be similar elsewhere.

This study regrettably did not obtain information on religion, which may be pertinent to fully understanding the initiation practices. UNFPA (2015) found that Muslim adolescents

were almost three times more likely to attend initiation ceremonies than Christians, and it would have been advantageous to provide similar data in this study, and tease out any variations in each ceremony accordingly. Chinamwali can be undertaken by both traditional initiation counsellors and church leaders (Munthali & Zulu, 2007), and the differences between each ceremony in this area could have been documented if religious beliefs were known.

Initiation ceremonies cover sensitive topics and the secrecy of these practices are embedded into the culture. Within this study, six participants refused to discuss specific details either due to the sensitive nature or because they felt they did not have permission to do so. Initiation ceremony practices are notoriously difficult to fully understand and lack complete detailed analysis in the wider literature due to the ingrained secrecy. Even though the interviews in this study were conducted by trained Malawian interviewers, some participants felt unable to disclose information and the information which was provided was at times vague and unclear. Therefore information which has been withheld could be vital to aid understanding or could be contradictory to the evidence presented. Additionally, only 4 out of the 16 women who had taken part in Chinamwali had done so in the past 5 years, therefore information identified on this practice may be biased towards practices prior to this.

5.5 Summary of Chapter 5

This study has described two adolescent initiation ceremonies which take place after puberty to instruct and advise initiates on how to look after themselves and behave in society. Yet there has been no evidence of any instruction on safe sex practices or sexual and reproductive health, indeed certain ceremonies actively advise initiates to take part in risky sexual behaviour. Furthermore, instruction within Chinamwali includes myths and misinformation of routine tasks which cannot be performed during menstruation, yet have no scientific basis. It is also possible, due to this limited sample size and the hesitancy of participants in discussing the topic freely, there could be more myths and misinformation spread in these practices that have not been uncovered in the current study. It is therefore evident that there is a clear need for education on safe sex practices with adolescents, and this need is not currently being met from the known instructions given within these traditional adolescent initiation ceremonies.

This chapter further emphasises the need for provision of accurate information on sexual and reproductive health in the area, which will be delivered via SMS messages in the proposed behaviour change intervention. It is clear however, that there is little information provision regarding sexual health within these practices, yet there are instructions which do not adhere to medical guidelines. It is therefore of interest to identify further myths and misinformation which may be being spread throughout communities, and in order to understand these beliefs the next chapter will conduct a multi-generational qualitative study to specifically identify contraceptive beliefs and opinions and any differences which may occur between the generations.

Chapter 6: Qualitative interviews to determine generational differences in knowledge and beliefs of modern contraceptive use in Chikwawa, Malawi.

Previous chapters have established the self-identified need for health education on sexual and reproductive health within the study area (Chapter 3 and 5), particularly surrounding contraceptive methods and decision making for adolescents. Chapter 5 outlined that this education is not routine practice within the adolescent initiation ceremonies; however the ceremonies do perpetuate myths and misinformation, e.g. information on menstruation and 'kuchotsa' which is not in line with national health guidelines. As such information has the potential to impact decision making with respect to contraception use and safe sex practices among adolescents, it was important to identify any other myths and misinformation which exist in the community, specifically regarding contraception which may influence the proposed SMS behaviour change intervention. Therefore this chapter outlines interviews with three generations of the same family (grandparent, parent and adolescent), in order to identify whether there are any discrepancies between each generations' beliefs of how and by whom modern contraception is perceived to be used. This is important, as strong negative views from older generations may have an impact on adolescent decision-making. Themes from the generational interviews are presented and discussed in relation to the proposed behaviour change intervention providing education on contraception.

6.1 Introduction to knowledge and beliefs of modern contraception in Malawi

In Malawi, there has been significant progress in contraceptive availability and use from 1% in 1984, to 44% in 2016 (NSO, 1987; 2017). Fertility rates have declined from 7.6 in 1984 to 4.4 in 2016, however there is a notable difference between urban and rural areas; rural women give birth on average to approximately two more children and the average lifetime births per woman is 6.1 in rural areas compared with four in urban areas (NSO, 2017). Increasingly contraception would be beneficial in reducing family sizes, reducing teenage pregnancy and reducing the burden of disease from STIs and HIV; however implementation of such programs in practice can be challenging.

Socio-cultural factors and beliefs play a role in encouraging or dissuading both the adoption of contraception and continued use. Examples include myths and misinformation of

modern methods (Bisika, 2008; Chipeta et al., 2010), use of traditional methods (Maliwichi-Nyirenda & Maliwichi, 2010) and religion (Yeatman & Trinitapoli, 2008). Relationships and the opinion of others can also influence contraceptive decision-making. Research exists into the influence of male partners on contraceptive choice (Chipeta et al., 2010; Population Reference Bureau, 2014), however there is limited research into the influence of other family members. The attitudes and beliefs of family members may impact the beliefs and attitudes of adolescents which will likely influence their decision-making. Commendador (2010) conducted a systematic review of parental influence on adolescents' contraceptive use and found that mother/adolescent communication delayed sexual intercourse and increased contraceptive use in high income countries. It was concluded that maternal communication could be a positive resource for increasing adolescent contraception use. However application of the findings of the study to sub-Saharan Africa may be limited and further research specific to sub-Saharan Africa is needed to draw a comparison in the relative cultural and socio-economic contexts.

Due to the potential influence of maternal and paternal advice, it is important to identify discrepancies of knowledge and beliefs between generations. Specifically to identify if families discuss this topic with one another, and if they do, whether views of family members contradict healthcare guidance and consequently lead to confusion among adolescents on their contraceptive decision-making. Therefore this study aimed to understand the knowledge, beliefs and practices of modern contraception among three generations of the same family (adolescent, parent and grandparent) for both male and female members.

6.2 Method to understand generational differences in knowledge and beliefs of modern contraception

6.2.1 Study Design

This was a qualitative study conducting individual in-depth interviews with three generations of the same family in the Chikwawa District of Malawi. Interviews were conducted in September 2015.

6.2.2 Study Sample

Twenty five participants from nine families were recruited from two villages (Chinkole and Mpokonyola) in the Mfera region of Chikwawa (see Figure 3.1). A grandparent, parent and adolescent (aged 15-25) from the same family were recruited through convenience sampling. Participants had to be able to speak Chichewa, be able to consent and live in the same village as their family in order to be included in the study; both male and female participants were included.

6.2.3 Chapter 6 Procedure

The researchers walked around the village with the village headman who pointed out eligible households. After reading the information sheet and having the opportunity to ask questions, participants were asked to give their consent for participation, which was recorded on a consent form (Appendix 7). One on one interviews were conducted in a nearby quiet area in Chichewa, where each member of the family was interviewed separately. Interviews were conducted by trained data collection assistants, lasted between 20 and 60 minutes and were audio recorded.

6.2.4 Data Collection Instrument

The study instrument was a semi-structured interview guide (Appendix 8) with a series of open-ended questions discussing contraception knowledge, sources of knowledge, access to contraception methods and whether contraception was discussed within families.

6.2.5 Qualitative Analysis

Interviews were transcribed verbatim and translated from Chichewa to English. Thematic analysis was used following the Braun and Clarke (2006) guide (see Chapter 2, Section 2.3.4 for a full description of this process).

6.2.6 Ethical considerations

Ethics were carried out as discussed in section 2.4.

6.3 Results of the three generation interviews

Data from 11 male and 14 female participants were obtained from the two villages; the sample was made up of 36% grandparents, 24% parents and 40% adolescents. It was not always possible to recruit all three generations, therefore four families contained three generations, and four families of two generations (2 of which included 2 adolescents and their grandparent). Demographics for each participant can be found in Table 6.1.

Table 6.1: Demographic information of participants who were interviewed in Chikwawa, Malawi in September 2015.

Family	Generation	Gender	Age	Marital Status	Number of Children	Completed Years in Education
1	Grandparent	Male	84	Widower	9 (3 alive)	2
1	Parent	Male	33	Married	8	1
1	Adolescent	Male	15	Single	0	8
2	Grandparent	Male	65	Married	7	0
2	Parent	Male	32	Married	4	6
2	Adolescent	Male	18	Single	0	7
3	Grandparent	Male	69	Married	6	0
3	Adolescent	Male	16	Single	0	7
4	Grandparent	Male	75	Married	5	0
4	Adolescent	Male	21	Married	1	2
4	Adolescent	Male	20	Single	0	10
5	Grandparent	Female	unknown*	Widow	5 (1 alive)	2
5	Parent	Female	57	Divorced	8 (7 alive)	1
5	Adolescent	Female	16	Single	0	5
6	Grandparent	Female	unknown*	Widow	8	0
6	Parent	Female	54	Widow	2	5
6	Adolescent	Female	16	Single	0	8
7	Grandparent	Female	unknown*	Widow	4	0
7	Parent	Female	30	Divorced	2	8
8	Grandparent	Female	unknown*	Widow	3	4
8	Parent	Female	unknown*	Married	5	0
8	Adolescent	Female	20	Single	1	0
9	Grandparent	Female	50	Widow	5 (3 alive)	2
9	Adolescent	Female	21	Single	3	0
9	Adolescent	Female	15	Single	0	4

*unknown represents participants who were unable to state how old they were or what year they were born.

Four themes emerged from the analysis: Reasons for Contraceptive Use, Perceptions of Contraceptive Use, Personal Use and Communication in Families. These four themes are presented in relation to the three generations interviewed.

6.3.1 Reasons for Contraceptive Use

All discussions centred on the use of contraception due to four main motivations; child spacing, limiting family size, pregnancy prevention and disease prevention. A breakdown for each generation can be found in Figure 6.2.

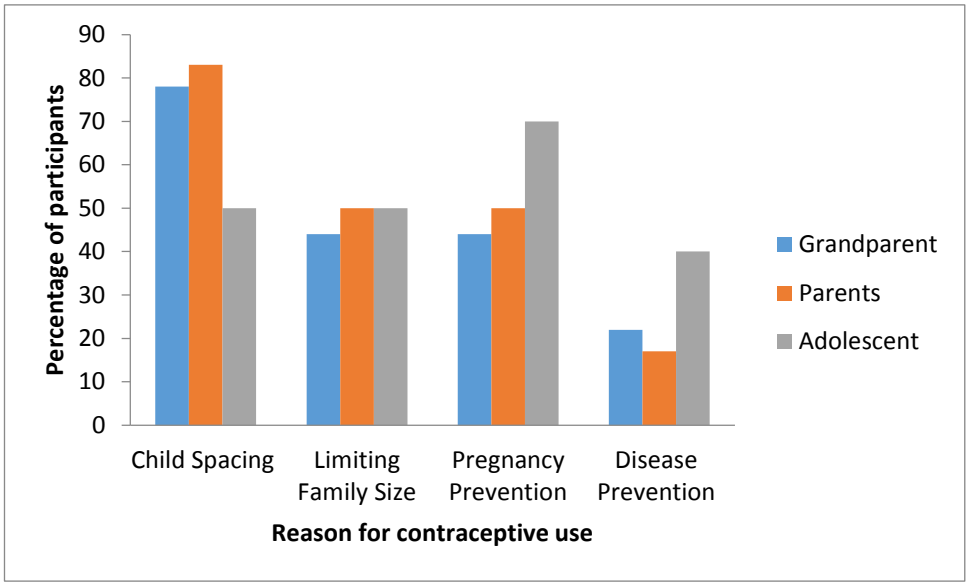


Figure 6.1: Reasons for contraceptive use by generation (n= 9 grandparents, 6 parents, 10 adolescents) from participants interviewed conducted in Chikwawa, Malawi in September 2015.

6.3.1.1 Child Spacing

Child spacing to improve the health of mother and child was the most common reason mentioned for contraception use, being quoted by 68% (n=17) of the sample;

> 'Some people use injection contraceptives when they have a baby…so that they should not have another child until that baby has grown up and they are ready to have another kid.' *Male parent, Family 1*

> 'It is necessary since they are trying to prevent your body from bearing so many children, you should wait for a child to reach a certain stage then bear the other children.' *Female adolescent, Family 8*

However it was more commonly mentioned by parents (83%) and grandparents (78%), than by adolescents (50%). Of the 17 participants who mentioned child spacing, 8 females, representing all three generations, stated it as their only reason for using contraception.

6.3.1.2 Limit Family Size

Of the 11 participants (44%) who stated contraception was used to limit family size, 9 were male, equally representing all three generations. Six of these male participants (from all generations) related this to government guidance on reducing population growth, as this was where they had first heard about contraception and the benefits of using it;

> 'I just know that women access contraceptives because the government is encouraging people to have small families to control the population growth.'
> *Male grandparent, Family 1*

> 'Because they [government] explained that that the population is increasing fast because we are having a lot of children.' *Male adolescent, Family 4*

In addition, financial reasons were also mentioned by these 11 participants;

> 'It's [contraception use] important because we prevent some problems in the family…for example, when you have a lot of children and you cannot manage to feed them well they suffer from malnutrition…even some of them may die because of that.' *Male parent, Family 1*

> '…you should bear children depending on the earnings you make knowing that you will be able to feed them, clothe them so contraceptive methods are good.'
> *Female parent, Family 7*

> 'I know that contraceptives are used as birth control….at first we used to have a lot of children. Now, we live healthy lives because we can afford to feed our families.' *Male grandparent, Family 2*

Due to rapid population increases and recent climate conditions food is harder to come by, and therefore perceptions of planning families in accordance with income have become more salient.

Two male families (Family 1 and 4) had consistent views regarding using contraception to limit population growth and due to financial pressures. In Family 1, the grandfather and father had 9 and 8 children respectively, which appears contradictory to their statements above. However, the grandfather had only 3 surviving children and the parent discussed his wife undergoing female sterilization at the hospital so it may be that these beliefs are from both personal experience and not only due to governmental guidance.

6.3.1.3. Pregnancy Prevention

Fifty-six percent of participants (n=14) mentioned the use of contraception to prevent or delay pregnancy. Pregnancy prevention was mentioned the most by adolescents and interestingly they were the only generation (with one exception) to discuss pregnancy prevention outside marriage (6 out of 7 participants);

> 'Contraception is important because you can continue with your studies in school…they can easily impregnate girls if they don't use contraceptives.' *Male adolescent, Family 3*

> 'The importance of using contraceptive methods is that you protect yourself from unexpected pregnancy whilst we are schooling.' *Female adolescent, Family 6*

Therefore although all generations mentioned the use of contraception to prevent pregnancy in regards to their understanding of why it is used, it was mainly the adolescent generation who discussed this as a method to practice safe sex outside marriage. It appears that these participants believe that contraception can be used whilst schooling to prevent unplanned pregnancy and to engage in safe sex practices during adolescence.

6.3.1.4 Disease Prevention

The least mentioned reason for contraceptive use, cited by 28% of participants (n=7), was to prevent diseases. As with pregnancy preventing, more adolescents (40%) mentioned this reason than parents (17%) and grandparents (22%).

> '…it is no longer safe to do unprotected sex, there are a lot of sexually transmitted diseases out there…HIV/AIDS and STDs like syphilis and herpes"
> *Male adolescent, Family 1*

> '…contraception provides women with protection, so to have a new life … preventing from different kinds of diseases.' Female parent, Family 6

These participants are aware of the benefits of contraception for disease prevention such as HIV and other STIs, however no specific type of contraception method was mentioned, so it is unknown whether these participants believe other forms of contraception apart from condoms will prevent STIs.

6.3.2 Perceptions of Contraceptive Use

Seventy-two percent of participants (n=18), representing all three generations, appear to hold the belief that contraception is not routinely practiced amongst young people. Five participants (20%) (2 grandparents, 2 parents and 1 adolescent) stated in their interview that it was not appropriate for young people to use contraception, and contraception not being routinely practiced in young people was also discussed in relation to marriage and those who have already had children.

6.3.2.1 Contraception to be used within Marriage

When discussing either personal use of contraception or the use of contraception among young people, 7 participants (representing all generations) stated that its use should be limited to those who are married;

> ‘All I know is that contraceptives are for those who are in marriage if those going to school are using it then it is behind parents’ backs.’ *Female grandparent, Family 8*

> ‘It is not proper for youth to be using contraceptives before they know anything about marriage.’ *Female parent, Family 6*

This belief was voiced equally by both genders and was mentioned by grandparents (n=3) and adolescents (n=3) more than parents (n=1). Grandparents were more likely to want to restrict contraceptive use to those in already in marriage, whilst adolescents used it as a reason for why they had not yet used contraception.

6.3.2.2. Contraception to be used for child bearing

In addition to marriage, 12 participants (48%) (5 grandparents, 2 parents and 5 adolescents) stated that contraception should only be used by those who have already given birth.

> ‘No it is not proper...why should they take contraceptive methods as if they have given birth to children?’ *Female grandparent, Family 5*

> ‘Adolescents need to have children first, may be 2 or 3 children before they start using contraceptives… it’s not right for adolescents to use contraceptives before they have children.’ *Male grandparent, Family 1*

This view was represented by all three generations, however it was stated by twice as many females (n=8) than males (n=4).

6.3.2.3 Contraceptive Myths

Within the sample, 32% of participants (n=8) expressed belief that the use of contraception leads to infertility in the user;

> ‘Yes destroying [their life], since at that time you will want to get married but you won’t be able to see it [infertility]... it is hard for you to get pregnant.’ *Female grandparent, Family 9*

> ‘For us to take contraception at our age is difficult, because maybe we can become infertile. In that way we are destroying our own future.’ *Female adolescent, Family 5*

> ‘The problem with contraceptives is that if you use them you lose the ability to have children…so there is need for partners agree on what to do in the family.’ *Male adolescent, Family 4*

This view was represented by each of the generations. In every case, each generation discussed infertility as a consequence of contraceptive use and as a strong reason against the use of contraception in youth or in their own life.

A further three participants reported that the use of contraception causes difficulties in childbirth delivery and can cause miscarriage. Two male parents reported their personal experience that when their wife used the injection it had direct negative effects on them;

> ‘…although when they [wives] use them it affects us men in that we lose energy and do not last in bed…I really don’t know what happens.’ *Male parent, Family 2.*

> ‘As men we use condoms because injections are not good for us. When women use contraceptives us men are affected, we are not strong in bed…we lose energy.’ *Male parent, Family 1.*

One parent felt so strongly that he was advising his son against their use because of his past experience;

> ‘I advise my children that he should use condoms and not injections. …he should use condoms and not the other contraceptive method because they have side effects.’ *Male parent, Family 1.*

6.3.3 Personal Experience

A third of participants (n=8) had experience of using modern contraception, five participants (two female, three male) who had personally used contraception and a further three male participants whose wife had used contraception (Table 6.2). A further eight grandparents (half female, half male) and three mothers noted that contraception was not available to them when they were of childbearing age, while two female adolescents had not started menstruation yet and had no reason to use contraception.

Table 6.2: Personal experience of contraceptive use in the sampled participants interviewed in Chikwawa, Malawi in September 2015

Participant	Age	Marital Status	Contraceptive Methods Used
Male Parent	33	Married	Implant and Female Sterilization
Male Parent	32	Married	Injection
Male Adolescent	21	Married	Contraceptive Pill and Injection
Male Adolescent	20	Single	Condoms
Male Adolescent	15	Single	Condoms
Male Adolescent	18	Single	Condoms
Female Parent	30	Divorced	Injection
Female Adolescent	21	Single	Injection

Interestingly, two of the three male adolescents using condoms did not view this as contraception;

> 'Facilitator: Have you ever used contraceptives before or do you currently use contraceptives?
> Participant: I have never used contraceptives.
> Facilitator: Really? Have you never used condoms?
> Participant: Yes I have used condoms before.'
> *Male Adolescent, Family 4*

Both adolescents discussed how they did not use contraception but when probed admitted to using condoms.

6.3.3.1 Contraception Access

Ninety-two percent of participants (n=23) were able to explain where contraception could be obtained, regardless of personal use, and all stated the local health centre or district hospital. Figure 6.3 depicts where participants first heard about contraception. Grandparents were more likely to have first heard from peers in the village (n=5), and adolescents were more likely to have first heard from the hospital (n=5). Parents reported a mixture of sources.

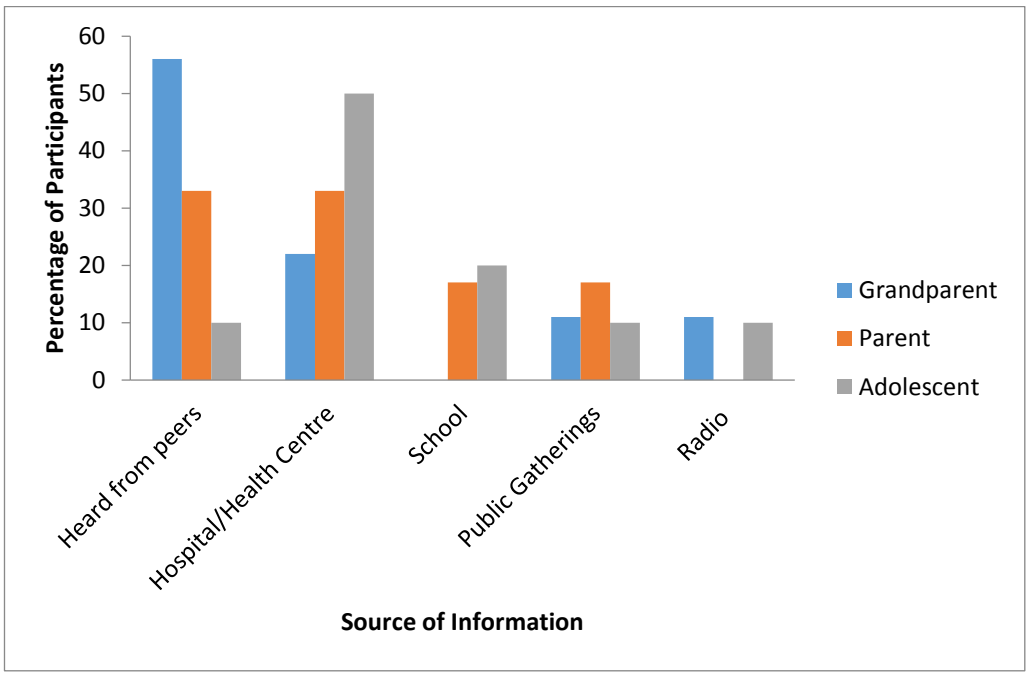


Figure 6.2: Sources of contraceptive information in the three generations (n=25) who were interviewed in Chikwawa, Malawi in September 2015.

Twenty participants reported believing the information they were given when first learning about contraception; 12 of these participants stated that they believed the information because of seeing the effects in action themselves;

> 'Yes I believed, since I see children growing well when people use contraception.' *Female adolescent, Family 8*

> 'Yes I believed as I saw the consequences of not using contraception through my friends.' *Male adolescent, Family 2*

The remaining 8 participants stated that they believed the information, but gave no reason as to why.

Four participants (all female participants who had never used contraception) felt that it was not their place to comment on what they believed;

> 'People who can believe are those who are the [contraception] users, because they see the benefits. I cannot believe because I stopped giving birth.' *Female parent, Family 5*

6.3.3.2 Traditional Methods

The use of traditional medicine to prevent pregnancy was mentioned by four grandparents and four parents during the discussions. Of these, three reported having used them before;

> 'I used the method where after we give birth our parents took roots of trees dug from the ground and gave us to drink [to prevent further pregnancy]…we were using so that my child grows.'
> *Female parent, Family 8*

> 'We go to the herbalist with the wife where you explain the problem you have…he then gives you a charm tied in a knot, this charm is placed in the woman's vagina during sex to prevent pregnancy. Unfortunately, after using the charm your wife becomes expectant again.' *Male parent, Family 2*

These methods were used to practice child spacing, using methods such as drinking herbs or using a thread to act as a contraceptive method to leave enough time between childbirth and promote the mother and child's health. This was referred to as practices of the past and no participant mentioned current use. Fifty-two percent of participants (n=13) stated that they believed modern contraception was more effective than traditional methods, while 24% (n=6) had no experience of contraception and therefore felt they could not decipher which was more effective, and 32% (n=6) did not provide an answer to which they felt was more effective.

6.3.3.3 Abstinence

In addition, although not a method provided by traditional healers, abstinence as a method to prevent pregnancy was mentioned by nine participants, this was predominately the elder two generations with one female adolescent mentioning it as an example method.

There was discordance between genders as to the use of abstinence. Female participants discussed abstinence as a method they had practiced during their childbearing years;

> 'For me I was just keeping my children, not having a man, during those months [practicing child spacing].' *Female grandparent, Family 9*

Whereas male participants mentioned the difficulties of abstinence and used this as a reason to use modern contraceptives;

> 'Most cannot manage to stay away from sex, so they even sleep with their wives when they have a baby…this leads to having a lot of kids if they do not use contraceptives.' *Male grandparent, Family 1*

6.3.4 Communication in Families

From the nine families interviewed, all members of five families stated that they do not discuss contraception within their families. In the other four families there was discussion between families, predominantly between parents and adolescents, and representing an array of education levels, marital status and number of children. The parent and adolescent in families 1 and 8 both independently stated that they are able to discuss issues around contraception together and be open with each other about contraception practices;

> 'Yes, we tell them that you need to do family planning; go to the hospital and if they say you should use it get the contraception method and use it.' *Female parent, Family 8*

> '…parents just tell us that we should be careful.' *Female adolescent, Family 8*

However this did not extend to the grandparent generation who both acknowledged not discussing this topic with relatives.

Two other families reported being able to discuss the topic; the adolescent from family three stated that he is able to discuss contraception issues with his father, however his father declined to participate in the study so we are unable to validate this. One of the adolescents from Family 4 stated that he was able to discuss these issues with extended relatives, but not his parents. All participants from the parent generation stated that they never discussed contraception with their own parents and this was echoed in the answers of the grandparent generation. Interestingly male participants frequently reported being able to discuss contraception use and feel free to ask questions (3 families) compared to female participants (1 family).

6.3.4.1 Importance of Communication

There appears to be discrepancy between belief and action in regards to communication of contraception in families. Forty-four percent of families reported having these discussions, yet 76% of participants (n=19) noted the importance of communicating within families;

> 'It is important to talk about it…it gives courage and knowledge…the same with raising a child you tell them of the goodness of contraception to give them knowledge and courage.' *Female grandparent, Family 8*

> 'Times have changed that's why we have to discuss about contraceptives…we have to use contraceptives so that [we] can manage to take care of our children.'
> *Male grandparent, Family 1*

Therefore participants are vocal about the need to discuss contraception to increase knowledge and confidence in contraception use and to limit family sizes to what parents can afford, however these beliefs have not been transferred into action amongst the majority of those interviewed.

6.3.4.2. Barriers to communication

Lack of experience with modern contraception methods appears to be a barrier to communication amongst grandparent generations who may be initiating the discussion, this was mentioned by a third of grandparents;

> 'I cannot tell my child to use contraceptives as if I have done that before. So why would I tell her as if I have ever used that? But if yourself, the parent has ever used it then you can tell your child to use it as well.' *Female grandparent, Family 5*

> 'I haven't used them in my life so I am not in the position where I can say the pros and cons.' *Female grandparent, Family 6*

The grandparents' lack of knowledge and experience, primarily due to contraceptives not being readily available when they were of childbearing age, means that they do not believe they are able to provide advice in regards to use.

In addition, two male participants (1 parent and 1 grandparent) reported that they do not discuss contraception with their children for fear of the perception of others;

> 'I don't discuss about contraceptives with my children because this area is not that developed…by that I mean that when you try to tell them such things they think that you are being indecent to them...even when the grandparents hear you telling the children such things they think that it is wrong and you are damaging the children.' *Male parent, Family 2*

It appears that there may be some stigma around the discussion of contraception with children and as such some parents avoid the topic.

6.4 Discussion of the inter-generational findings

Beliefs around contraception use and who should use contraception were generally unified across the generations. Contraception was primarily seen as a method of child spacing, in order to protect the health of mother and child by delaying further pregnancies until the

mother was ready. This is in line with Word Health Organisation guidelines stating that mothers should wait at least 2 years between pregnancies (WHO, 2011). This was further embedded by the general belief in the sample (72%) that contraception should only be used by those who are married or those who have already begun child bearing, which was represented across all generations. If the common practice in the area is for contraception to be used by married women and those who already have children only, the fact that the majority of participants stated child spacing as the primary benefit of contraception is not surprising, as this will no doubt be the reason many of these woman chose to begin using modern contraception.

Contraception use for pregnancy prevention was discussed by 14 participants (56%), however only seven participants (six of which were adolescents) mentioned contraceptive use in regards to preventing unplanned or unwanted pregnancy outside marriage. Therefore there are some differences between the generations as to how contraception is used, with grandparents and parents likely to limit use to marriage and those with children for child spacing means. Adolescents were more likely to mention contraceptive use as a safe sex practice whilst still at school and outside marriage, which is positive for the proposed intervention focusing on adolescents increasing contraceptive use. The fact that pregnancy prevention outside marriage was not widely discussed could be due to religious reasons as around 87% of men and women in Malawi (specific data for Chikwawa could not be located) are Christian (all denominations) (NSO, 2017), and it is common in rural Malawi to hold traditional Christian beliefs of no sex before marriage. This can be further supported from the evidence found in Chapter 4, where abstinence before marriage was actively discussed in adolescent initiation ceremonies. Therefore if cultural norms in the area dictate contraceptive use solely within marriage then participants may have felt unable to discuss this aspect. That being said, contraception is currently being used by 44% of unmarried women in rural Malawi (NSO, 2017), therefore this appears to not be a barrier for everyone.

Contraceptive use as a means to limit family size was reported by 44% of participants. This coincides with government efforts to curb population growth and also relates to financial pressures of having many children. This was mainly mentioned by male participants of all generations, as their focus tended to be more on their responsibility to provide for their

families and the financial difficulties which occurred as family sizes increase. Government guidance for contraceptive use to control population growth was solely mentioned by male participants and could be down to targeted efforts in their village. Furthermore, two male adolescents did not report condom use as a method of contraception. This could be due to the association of condoms with HIV prevention, or could be down to gender roles in contraceptive use, as male participants may see contraception as the woman's role in this village. A delineation of roles and beliefs demonstrates the need to include men in the contraception decision-making process to ensure they are both educated and involved in these decisions (Greene et al., 2006). The proposed SMS behaviour change intervention will focus on both genders, to increase knowledge of contraceptive methods to enable more informed contraceptive decision making.

Knowledge of contraception access was very good, with 92% of the sample able to identify where contraception can be obtained. In regards to sources of contraceptive information, 32% heard from peers in the village (which was the prominent source for grandparents), and 36% from the hospital or local health centre (which was the prominent source for adolescents). Other sources included school (12%), public gatherings (12%) and radio (8%). There was no mention of traditional practices, such as initiation ceremonies, as a source of information provision for contraceptive education within this study. This reinforces the findings from Chapter 4, where no evidence of contraceptive education was found within these practices, despite the influence these ceremonies have on sexual practices and consequently sexual health.

Traditionally Malawi is an oral culture, so evidence that information provision by peer-to-peer discussion is similar to that of the local health centre is not surprising, particularly from the elder generation who will rely on word of mouth as a source of information due to low literacy levels. However it is noteworthy that participants are willing to discuss this sensitive topic with peers and at community meetings, which could influence future health promotion programme impact. This oral culture could also be a prominent reason for the spread of myths and misinformation in addition to advice. Infertility as a consequence of contraception use was mentioned by 32% of the sample, representing all generations, education levels, marital status and number of children. This was particularly directed to adolescent use, as infertility in adolescents was discussed more than in adults, even though

adults appear to routinely use contraception for child spacing. Malawian culture places importance on those with many children, and as such fear of infertility will be a strong barrier against contraceptive use, as it would affect social status and value within the community (Levandowski et al., 2012).

Further contraceptive myths included causing difficulty in childbirth, causing miscarriage and negative effects on men during intercourse. These myths could have spread from misinformation, hearsay, confusion or personal negative experiences. It appears that individuals are willing to share advice and experiences of contraceptive use which is positive; however it may mean that one negative experience could develop into widespread belief of negative connotations of contraceptive use. Especially when the information provided does not adhere to national health guidelines, as was found in the cultural practices discussed in Chapter 4. Contraceptive myths are widespread in rural Malawi (Munthali et al., 2004; Chipeta et al., 2010; Kapito et al., 2012) and belief in this misinformation will heavily affect decision making processes. Health education is necessary in order to educate participants on the benefits and costs of contraceptive methods and try to eliminate fear of use because of misinformation about modern methods. Interestingly, despite more children equating to more power in Malawian society, child spacing is evident in the region, therefore education from health facilities have clearly impacted these cultural practices to ensure enough time is left between births, which is promising for contraception education dispelling myths and misinformation.

Traditional methods of contraception were practiced by three participants and mentioned by nine, however this was a reflection on past practices, mainly abstinence, and no-one stated current use of these methods. There was discord among genders as to the use of abstinence. Grandmothers and mothers mentioned past personal use; however grandfathers noted the need for modern contraception due to their inability to abstain. Only one adolescent mentioned abstinence as a potential method. It is interesting that participants chose to discuss abstinence, when the interview questions focused on modern contraception. This is likely due to only a third of participants having experience (direct or through their wives) of contraception and an equivalent third never having access to contraception in their childbearing years. It is also possible abstinence was discussed because of this teaching in some adolescent initiation ceremonies, as it was found in

Chapter 4 by seven participants that their initiation ceremony encouraged abstinence before marriage. Abstinence only teaching is not effective as the sole education for adolescents (Underhill et al., 2007; Stanger-Hall & Hall, 2011), as it does not highlight the dangers of STI transmission and the prevention of STIs including HIV. Therefore, this emphasises the need for accurate education on modern contraception in the area, as without education, individuals may not know methods exist or are available at their local health centre. It is also important that this education reaches the entire community, so that all have the same understanding and individuals cannot be influenced from false teaching.

Four families out of the nine reported family discussion of contraception, three were between parents and adolescents and one adolescent reported speaking to other family members. The grandparent generation reported never communicating on the topic with any relatives, and grandparent/parent generations had never had formal discussions regarding contraception practices. Interestingly, within this sample, male participants reported being open with their relatives about contraception (3 out of the 4 families were male), which is positive for the inclusion of men in contraceptive decision-making processes. As the reporting of within family communication within this study was low, there is not enough evidence to compare to Commendator's review (2010) that maternal communication can positively influence contraceptive use in adolescents. This is unlikely to be the case in the current setting, as parents and adolescents both reported similar fears for contraception use in regards to the myths of negative health consequences in adolescence. Research in Tanzania (Nundwe, 2012) has found that some communication between parent and child does takes place around reproductive health, however this tends to avoid sensitive topics such as the use of contraception. In addition, a review on the type of discussion conducted in sub-Saharan Africa has concluded that in discussion about HIV, parents tend to take a direct authoritarian approach, rather than encouraging open discussion and questions (Bastien, Kajula, & Wuhwezi, 2011), which is needed to encourage positive behaviour change.

In addition, research in high income countries suggests that barriers towards this type of parent/child communication include a lack of knowledge and understanding by the parent, in the issues being addressed (Turnbull, 2012). This was found in the current study; as grandparents and parents who had no previous experience of using contraception did not

feel able to discuss it will younger generations. Even though there is little evidence of discussion between families, beliefs surrounding contraception benefits, side effects and use have permeated through the three generations, despite participants not necessarily taking part in facilitated discussions with family members. Cultural norms and practices in these communities are evidently passed down the generations, perhaps through other relatives or community members. Furthermore, the importance of discussing contraception within families was mentioned by 76% of participants, yet only 28% of participants were actually communicating within their families. All this evidence affirms the need for contraception education in these villages, like that which will be provided in the proposed SMS behaviour change intervention. In order to expel the myths of infertility, increase confidence in contraceptive decision-making and in turn increase confidence in facilitating discussions with younger relatives on such topics.

6.4.1 Limitations of this qualitative study

Recruitment of families with three living generations was difficult and restricted the sample size. Furthermore, male participants work long hours farming and as such were often unavailable when interviews were due to take place; therefore fewer fathers were interviewed than originally anticipated.

6.5 Summary of Chapter 6

Within this sample contraception is primarily seen as a method to practice child spacing within marriage or for those who have already conceived. This is represented throughout all generations; therefore these cultural norms are permeating down through the generations, by peer discussion, cultural practices and public gatherings. Despite limited communication amongst families regarding contraceptive practices. Adolescents were the only generation (with one exception) to mention contraceptive use to prevent unexpected or unwanted pregnancy out with marriage, providing the only clear generational difference, and this is positive in regards to increasing contraceptive use and preventing pregnancy in this population. However these views contradicted the general negative consensus of contraceptive use in adolescents for fear of adverse medical consequences, particularly infertility.

These findings echo that of chapter 5, where both chapters have identified the clear need to educate individuals on contraceptive methods, particularly the benefits and costs of each. This is needed to provide accurate information to inform contraceptive decision making and eliminate fears of using contraception methods, which are based on myths and misinformation, spread through cultural practices or by word of mouth within communities. In order to dispel these myths and ensure the intervention content is believed, the education must come from a trusted source, and be in line with national medical guidelines. This will ensure participants understand and believe the health content, as they will receive the same advice from both the SMS intervention and their local health centre. This will allow decisions to be made based on individual's personal beliefs and knowledge of contraception methods, rather than be based on fear of ungrounded medical consequences and lack of information. In addition, it is important for the SMS behaviour change intervention to increase awareness of the intervention and content to adults as well as adolescents (of both genders) to increase their knowledge and confidence and to encourage discussion among families of the correct information and advice. This supportive discussion will not only open the communication channels between family members, but has the potential to positively influence adolescent decision-making regarding the use of modern contraception.

Chapter 7: Development of the SMS contraceptive Behaviour Change Intervention

This chapter describes the design process for the sexual health intervention which informed the feasibility study and main SMS intervention. The implementation of the feasibility and intervention studies are described in Chapter 8. The Behaviour Change Wheel (Michie et al., 2014) was used as a practical guide to design the intervention content, using evidence from Chapters 3, 5 and 6 to aid decision-making. The steps of the Behaviour Change Wheel are outlined and then the development of the intervention content and subsequent translation into Chichewa is explained in detail.

7.1 Introduction to Behaviour Change Theory

Successful behaviour change interventions draw on health psychology theory and evidence to understand both health behaviours and mechanisms for change. Many theories have been used in sexual health research for behaviour change, however no one theory has been wholly successful in accounting for all the influences on sexual health behaviour (Rosenstick, 1974; Azjen, 1985; Prochaska & Diclemente, 1982). These theories focus on the individual and only include external factors such as social, economic or environmental factors via one route, i.e. the influence they have on cognitions (Taylor et al., 2006). It has been argued that this is not enough to encapsulate the influence external factors have (Kippax & Crawford, 1993), particularly in regards to culture, gender or religion which can be extremely important in influencing behaviour. For example, the existence of adolescent initiation ceremonies and presence of contraceptive myths and beliefs which were identified in Chapters 4 and 5. The theories also fail to provide practical guidance on how to include theoretical constructs into intervention design and development. There is no current single psychological theory which offers a comprehensive guide to both the design and understanding of sexual health behaviour change (Marks et al., 2011). Further, there is little guidance available on how to choose a theory for any particular context or behaviour (Michie et al., 2011). Therefore there has been a call for the introduction of more comprehensive integrated theoretical frameworks (Francis, O'Connor & Curran, 2012; Barker, Aitkens, & de Lusignan, 2016) to aid the design of behaviour change interventions.

These frameworks encompass multiple theories and models and allow the researcher to draw on a wide range of constructs in order to address the mechanisms for change in real

world behaviours. The Behaviour Change Wheel (BCW) is an example of an integrated theoretical framework, which pulls together 19 existing frameworks (Michie et al., 2011a), to provide a detailed systematic approach for design and evaluation of theory based behaviour change interventions (Michie et al., 2014).

7.2 Behaviour Change Wheel

The BCW is made up of three levels which all address aspects of intervention design (Michie et al., 2014). The inner layer of the wheel details three conditions viewed as essential for behaviour change, the middle layer describes nine intervention functions which influence behaviour via their ability to impact upon the three conditions for behaviour change, and the outer layer describes wider policy categories which allow execution of the intervention at a higher level.

The inner circle of the wheel comprises of the COM-B model of behaviour. This model identifies that behaviour is influenced by the actor's capability, motivation and opportunity (Figure 7.1).

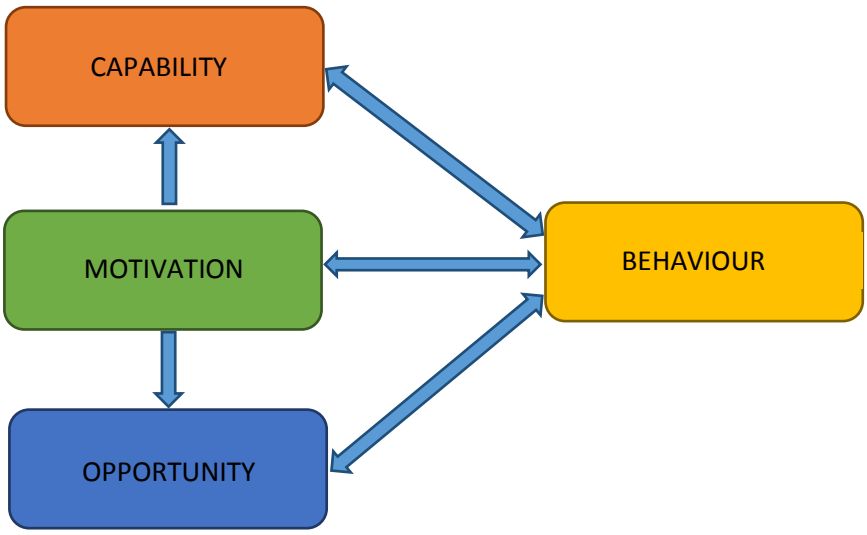


Figure 7.1: COM-B Model (adapted from Michie et al., 2011a)

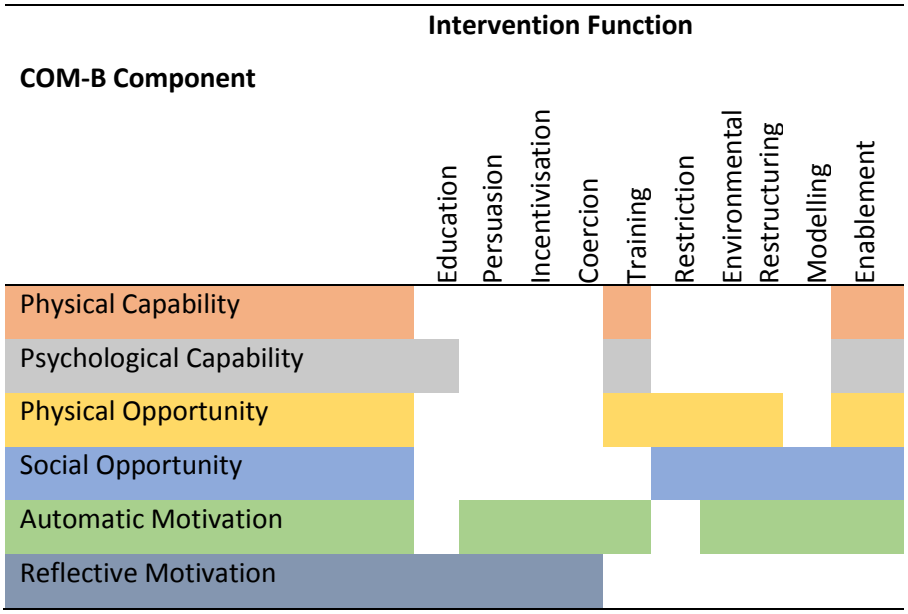
The COM-B model (Michie et al., 2011a) then states that each of the three components can be broken down into two types. Capability encompasses both the psychological capacity to

engage in thought process related to the behaviour and the physical capacity to enact the behaviour. Motivation represents both reflective and automatic mechanisms that can start or stop the target behaviour, such as reflective conscious intentions, decisions and plans and automatic emotional responses, impulses or habit formation from associative learning. Opportunity comprises factors external to the individual; these can be physical opportunities within the environment or social opportunities which shape thoughts and beliefs. The BCW uses this layer to identify which of these three components require adaptation to positively influence the target behaviour. It is possible that multiple components need to be altered before the target behaviour is initiated and then maintained. The components which are relevant to contraceptive behaviour in this intervention can be found in Section 6.5.1

The middle layer of the wheel describes nine intervention functions which can be used to act upon one or more of the components of the COM-B. They include functions such as: training, where the intervention can impart skills relevant to the behaviour; restrictions, such as government level legislation; and persuasion, by using positive or negative feelings and beliefs to stimulate behavioural action. Table 7.1 identifies each of the intervention functions and the COM-B components they target.

The outer layer of the BCW depicts the seven policy categories which can be used to implement an intervention. It includes service provision, legislation, communication or marketing, environmental or social planning, guidelines, fiscal measures and regulation. Some of the policy categories allow the intervention to be delivered widely, such as changes in legislation or fiscal measures, and some are on a more targeted scale such as service provision or communication and marketing. Not all the functions are equally available to researchers and practitioners, for example, those that require government authority are not readily available for use. Therefore this feature of the BCW can be bypassed if intervention designers are limited in the specific policies they can implement (Michie et al., 2014). This is the case in the current intervention, where the implementation of an SMS intervention is limited to two policy categories: communication and service provision, and both will be used in the design of this intervention.

Table 7.1: Intervention Functions and the COM-B component which they relate to are colour coded for each function (adapted from Michie et al. (2014).



There is emphasis in the BCW of the importance of the social context within which the intervention will be implemented. It is important to consider many factors within this context when making decisions regarding intervention design. Therefore the BCW outlines the APEASE criteria (Table 7.2) which describes six criteria for consideration when choosing intervention functions and subsequent behaviour change techniques. These criteria are important to consider as it may be that the best intervention function, as ascertained from the evidence base, cannot be used in a given social context.

Table 7.2: APEASE criteria (taken from Michie et al. 2014)

A	Affordability	An intervention is affordable if it can be delivered and accessed by all those it would be relevant or benefit, within an acceptable budget.
P	Practicability	An intervention is practicable if it can be delivered the way it was designed to the target population.
E	Effectiveness & cost-effectiveness	An intervention is deemed to be effective if the intended effect sizes are met on the objectives set. Cost-effectiveness examines the ratio of effect size to cost of implementing the intervention.
A	Acceptability	An intervention is acceptable if it is judged appropriate by relevant stakeholders – including members of the public, health professionals and members of government.
S	Side effects & safety	An intervention needs to take into consideration participant safety and any side effects or unintended consequences which may exist.
E	Equity	An intervention is equitable if it can be delivered fairly to all sectors of society.

The BCW has been used for the design and development of a number of behaviour change interventions, e.g. the development of a mobile application for smoking cessation (Fulton, Brown, Kwah, & Wild, 2016), digital interventions to increase condom use (Webster & Bailey, 2013), an intervention to improve long term hearing-aid use in adults (Barker, Atkins, & de Lusignan, 2016), improving medication management in patients with multiple chronic conditions (Sinnott et al., 2015), and improvement of district hospital children services in Kenya (English, 2013). Therefore the three stage intervention design process (Figure 7.2) outlined in the BCW guidelines (Michie et al., 2014) and shown in Figure 7.2 will be used in the design and development of the current SMS based behaviour change intervention.

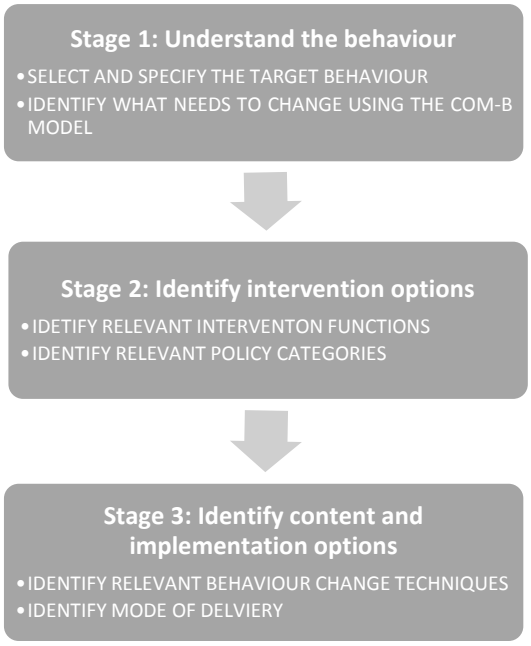


Figure 7.2: Intervention Design Process (taken from Michie et al., 2014)

The BCW outlines decisions regarding mode of delivery at the latter stages of the design process (Stage 3 in Figure 7.2). In this instance, mode of delivery was an integral part of the research, in order to understand if mHealth can be used as a solution to increase health care service provision in rural Chikwawa. Therefore mode of delivery was fixed as SMS texts after results from Chapter 3 identified this as the preferred mode of delivery, and this constrained decision making throughout the design of the intervention content. For example, it was not possible to employ some of the BCW intervention functions and techniques such as elements of training or enablement which are best administered in a face to face environment.

7.3 Aims of this chapter

The aim of this chapter was to describe the design process for the development of the SMS based behaviour change intervention using the Behaviour Change Wheel process, and to detail the intervention content and translation process.

7.4 Methods to design the SMS intervention

The design of the intervention was a five phase process:

- Phase 1: Behaviour Change Wheel Process
- Phase 2: Stakeholder Involvement
- Phase 3: Development of Intervention Content
- Phase 4: Discriminant Content Analysis
- Phase 5: Translation of Intervention Content.

The Behaviour Change Wheel informed Phase 1 of the intervention, using three qualitative studies (Chapters 2, 4 and 5) to aid decision making, all decisions were made by the author during this phase. Phase 2 is comprised of clinic observations and a focus group study to ascertain availability of contraception resources. Phase 3 describes the creation of the SMS messages by the author from the literature and Government of Malawi policy. Phase 4 assessed the fidelity of the delivery of BCTs in the SMS intervention content, and Phase 5 describes the translation process of the intervention content from English to Chichewa.

7.5. Phase 1: Behavioural Change Wheel Process

7.5.1. Stage 1: Understanding the behaviour

From qualitative research undertaken with residents of Chikwawa (described in Chapter 3) it was identified that the mHealth behaviour change intervention would focus on contraceptive behaviour. The COM-B model was utilised, coupled with evidence from Chapter 2 and cultural implications from Chapters 4 and 5, to identify which behaviours needed to be influenced to bring about a change in contraceptive practices – namely increased and regular use. Table 7.3 outlines the behavioural diagnosis as applied to contraceptive behaviour, judgements as to the behavioural diagnosis were made by the author and discussed with her supervision team.

Table 7.3: Behavioural diagnosis for contraceptive behaviour (concept taken from Michie et al., 2014).

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability	Have the physical capability to put on a condom	No – adolescents should have this physical ability
	Physical capability to walk to the Health Centre to begin contraceptive methods	No – adolescents should have this physical ability
Psychological capability	Knowledge of contraception methods, potential side effects, where to get access and how often to use each method.	Yes - adolescents in this area do not have this knowledge as evidenced in Chapter 2
	Decision making skills to know which method is best for them	Yes – adolescents require the information and understanding of contraceptive methods to base their decision making as evidenced in Chapter 2
	Skill in putting on a condom	Yes- not all adolescents in this area possess this skill as evidenced in Chapter 2
	Interpersonal skills in discussing contraception options with partners	Yes –guidance on how to discuss contraception use with partners is needed as evidenced in Chapter 2
Physical opportunity	Access to the contraceptive methods	No – access is available through the Health Centre (see Section 6.5.2)
Social opportunity	Inclusion of safe sex practice in cultural practices	Yes – as evidenced in Chapter 2 this is needed to ensure adolescents have accurate information and to decrease incidences of risky sexual behaviour; however this change will be extremely difficult to execute as it is not widespread practice.
	Social acceptance of contraception use out with marriage and in adolescents.	Yes – this is needed as evidenced in Chapters 4 and 5, however this change will be extremely difficult to execute as it not widely believed in this area.
Reflective motivation	Hold beliefs that contraception prevents pregnancy and condom use prevents STIs.	Yes – adolescents need knowledge of the consequences of not using contraception as evidenced in Chapter 2.
	Have self-belief in ability to use contraception and obtain from Health Centre	Yes – adolescents need to have self-belief in order to effectively use contraception, as evidenced in Chapter 2.
	Have self-belief in the ability to discuss contraception with partners	Yes – adolescents need to discuss contraception with partners as they may need to rely on partners for successful use, as evidenced in Chapter 2.
Automatic motivation	Have established routine for obtaining and using contraception	Yes – adolescents need to have routine in place to obtain contraception methods and use at the correct time.

As can be seen in **Error! Reference source not found.**, within the target population, it is sychological capability, social opportunity, reflective motivation and automatic motivation which need to be addressed to modify current contraceptive behaviours among adolescents in Chikwawa.

7.5.2 Stage 2: Identify intervention options

Stage 1 identified four COM-B components as relevant to the intervention: psychological capability; social opportunity; reflective motivation and automotive motivation. Table 7.1, which was taken from Michie et al. (2014), maps intervention functions to each COM-B component and examination of this table indicates that all nine intervention functions should be considered for inclusion in this intervention. Taking into consideration mode of delivery via SMS messages and the APEASE criteria, Table 7.4 lists the intervention functions and their appropriateness for the target population and study setting.

Table 7.4: Intervention functions vs. APEASE criteria (taken from Michie et al., 2014)

Intervention Function	APEASE (Affordability, Practicability, Effectiveness & Cost-Effectiveness, Acceptability, Side effects & Safety, and Equity) Criteria
Education	Yes
Persuasion	Yes
Incentivisation	Not practical, affordable, acceptable or equitable to implement for every adolescent or every time they use contraception.
Coercion	Not acceptable, this is not a behaviour which has to be reinforced.
Training	Not affordable, practical or equitable to deliver training to all adolescents in the area or practical in terms of the workload of the Health Centre staff - *however aspects could be incorporated into the SMS intervention.*
Restriction	Not possible within this context.
Environmental restructuring	Not practical to restructure the environment within this setting, resources are available from the Health Centre and it is not affordable, equitable or practical to make these available to all individuals in every village.
Modelling	Not possible within the strict 160 character limit of the SMS messages.
Enablement	Not practical, affordable or equitable to deliver this to

	all adolescents in the area - *however, aspects can be incorporated in to the mHealth intervention*.

Therefore the intervention functions; education and persuasion were considered to be feasible to include in the SMS intervention. There was also potential to include certain elements of training and enablement.

7.5.3 Stage 3: Identify content and implementation options

The BCW was then used to identify BCTs relevant to each of the four intervention functions identified in stage 2 (Michie et al., 2014). The APEASE criterion was then used to determine whether it was possible for the BCTs to be used within the specific behaviour, target population, context and study setting. Table 7.5 outlines the decisions from this process, which were made by the author.

Table 7.5: Frequently used Behaviour Change Techniques vs. APEASE (taken from Michie et al., 2014)

Intervention function	Most frequently used BCTs*	Does the BCT meet the APEASE criteria in the context of contraception use?
Education	Information about social and environmental consequences	Yes
	Information about health consequences	Yes
	Feedback on behaviour	Not possible, practical, affordable or equitable in SMS intervention
	Feedback on outcomes(s) of the behaviour	Not possible, practical, affordable or equitable in SMS intervention
	Prompts/cues	Yes – for contraceptive pill behaviours
	Self-monitoring of behaviour	Difficult to execute in SMS intervention
Persuasion	Credible source	Yes – SCHI is a trusted source as identified in Chapter 2
Training	Demonstration of the behaviour	Not possible in SMS intervention nor affordable, practical or equitable for every adolescent
	Instruction on how to perform a behaviour	Yes
	Behavioural practice/rehearsal	Not possible for every contraceptive method and difficult to execute in SMS intervention.
Enablement	Social support (unspecified)	Yes
	Social support (practical)	Yes
	Goal setting (behaviour)	Not possible in SMS intervention nor practical, affordable or equitable
	Goal setting (outcome)	Not possible in SMS intervention nor practical, affordable or equitable
	Adding objects to the environment	Not practical, affordable or equitable
	Problem solving	Not possible in SMS intervention nor practical, affordable or equitable
	Action planning	Yes for condom use behaviours
	Restructuring of the physical environment	Not practical, affordable or equitable
	Review behaviour goal(s)	Not possible in SMS intervention nor practical, affordable or equitable
	Review outcome goal(s)	Not possible in SMS intervention nor practical, affordable or equitable

*duplicates between intervention functions were only included once

Therefore it was possible to include eight frequently used BCTs;

- Information about social and environmental consequences,
- Information about health consequences,
- Prompt/cues,
- Credible source,
- Instruction on how to perform a behaviour,
- Social support (unspecified),
- Social support (practical)
- Action planning.

In addition, one less frequently used BCT was identified and judged to meet the APEASE criteria; information about others' approval. A total of nine BCTs were, therefore, identified as feasible to include in the SMS behaviour change intervention targeting contraceptive behaviour in adolescents.

7.6 Phase 2: Stakeholder Involvement

Intervention content was created in conjunction with the local health provider – Mfera Health Centre – to ensure that all contraceptive methods included in the SMS messages were relevant to the study setting. This included regular discussion with the local Health Surveillance Assistants (HSAs) to ensure all contraceptive methods could be easily accessed. As well as observation at weekly contraceptive clinics to ensure methods referred to in the intervention were regularly available at the health centre.

7.6.1. Contraception access focus groups

It was imperative that adolescents in particular could access the methods of contraception included in the intervention content. Therefore, two informal focus groups were conducted with male and female groups separately to discuss elements of contraception access within the Mfera catchment area of Chikwawa. Physical access to the resources and perceptions of

being able to access contraceptives from the clinic as an adolescent were topics for discussion during the focus groups.

7.6.1.1 Methods to understand access to contraception

Participants: Fourteen adolescents took part in the two focus groups, five female and nine male adolescents both groups were aged between 16-20 years. The focus groups were conducted in October 2016.

Procedure & Analysis: Participants were recruited following the same procedures described in Chapter 2 (Section 2.3.3). Participants were asked to give their consent prior to the start of the focus groups (Appendix 11) which were conducted in Chichewa following a pre-determined schedule (Appendix 12), audio recorded, transcribed verbatim and translated into English by a trained facilitator and experienced translator. Responses were then thematically analysed using the method described in Chapter 2 (Section 2.3.4).

Ethics: Ethical approval was obtained from both the University of Strathclyde and National Commission for Science and Technology in Malawi, see Chapter 2, Section 2.3.5 for more details.

7.6.1.2 Results of the focus group analysis

Two themes emerged from the focus groups, contraception access and contraception availability.

Contraception Access

Both groups reported that the Mfera Health Centre was their primary source for contraception, but they could also buy condoms from the local shops. The male group stated that where they go to buy condoms depends on their circumstances. Most male participants (n=7) stated they went to Mfera because of the regular availability compared to shops, however two participants felt Mfera was too far away to obtain condoms quickly;

> "Some people think that the hospital is very far based on the urgency of the condoms." *Male adolescent*

The female group mentioned an additional resource, and reported getting infrequent access to the contraceptive injection from HSAs who live in their village;

> "…we get them [contraceptive injection] from HSAs, they keep them sometimes." *Female adolescent*

This was favoured by one participant who felt she was too embarrassed to go to the health centre because of the other women present at the contraceptive clinic;

> "Participant:…we are afraid of the women who also go to the hospital to get contraceptives…you will hear them saying look at that kid she uses contraceptives.
> Facilitator: so is it shameful to use contraceptives?
> Participant: they start dissing you when you are back in the village"
> *Female adolescent*

Contraceptive Availability

Both groups stated that their preferred contraceptive method was always available at Mfera Health Centre. All the male participants stated their preferred method was condoms. Whereas three out of the five female participants preferred the injection, one female preferred condoms and one female preferred the implant.

The male group stated that Mfera was a more reliable source for condoms than the local shops;

> "Participant: Condoms are always available at Mfera.
> Facilitator: Are they always available at the shops as well?
> Participant: No, sometimes they run out." *Male adolescent*

In addition, one female participant had used the contraceptive injection for the past 5 years and never had any availability issues from Mfera;

> "Facilitator: So you know the dates when you have to get the injection?

Participant: Yes I know when to get the injection.

Facilitator: In those 9 years, were the contraceptives available every month?

Participant: Yes, they were always available" *Female adolescent*

7.6.1.3. Discussion of contraception access in Chikwawa, Malawi

Focus group participants believed there is adequate contraception availability at Mfera Health Centre, with additional availability of condoms from local shops. Although the sample was small and gender biased, due to difficulties recruiting female adolescents, it does provide some evidence that contraception is available in the local area. This information was important to obtain prior to intervention implementation, so that information provided in the intervention was consistent with contraception availability from local sources.

In addition to Mfera and local shops, female adolescents stated it was possible to receive the contraceptive injection within their village from HSAs and one participant preferred this method as it was more private than attending the contraceptive clinic. This adolescent felt that if older women saw her at the clinic they would speak unfavourably about her to others in the community. This echoes findings from Chapter 5, where the consensus was that contraception should be used by those who were married or already have children. This is an important point, as although there appears to be sufficient resources at the Mfera Health Centre and no complaint was made regarding the treatment of adolescents by staff, the fear of seeing someone from the adolescents' community may dissuade them from accessing their preferred contraception choice.

Although beyond the scope of the current study, it is, therefore, important to consider how to change local perceptions, so that unmarried individuals feel able to freely access their preferred method of contraception.

7.7 Phase 3: Intervention Content Development

Phase 2 raised no concerns regarding contraception access or availability at Mfera Health Centre. Therefore, SMS messages were tailored around 10 contraceptive methods available at the health centre. SMS messages on general contraceptive advice and specific

instructions of how to use them, including benefits and side effects of the 10 modern methods, were created using the World Health Organisation family planning global guidelines (WH0, 2011).

The messages directly incorporated six of the nine BCTs identified during Phase 1 (Section 6.5.1). The SMS format of the intervention meant that three of the originally identified BCTs could not be included: information on social and environmental consequences; social support (practical) and credible source. The six BCTs included were: information on health consequences; instruction on how to perform the behaviour; information on others' approval; action planning; prompt/cues and social support (unspecified).

Table 7.6 displays the full set of SMS messages created for the feasibility and main studies. SMS messages adhered to the 160 characters limit to allow them to be received on a basic mobile phone. The messages were in line with Malawi Health Policy (Government of Malawi, 2013) and approved by the Ministry of Health Reproductive Health Unit (see Section 6.5.5 for the full translation process).

Table 7.6: Content of 25 SMS Message sets used in the feasibility and/or main intervention study (created by the author October 2016)

Message Set	Content	Study	
		Pilot	Main
1: Welcome (2 SMS)	Welcome to SCHI Healthy Messages Service. All messages you receive will be free. You will receive messages about contraception methods every Monday, Wednesday and Friday at 4pm.	✓	✓
2:Planning for Families (2 SMS)	For couples, discussing the chance of pregnancy and seeking family planning advice as soon as possible will help prevent unintended pregnancy. Men as well as women need to know that contraceptive methods help prevent unintended pregnancies.		✓
3: Contraception Part 1 (2 SMS)	Contraception methods, other than sterilization, do not permanently affect the woman's ability to have children. These methods can be used to delay pregnancy.		✓
4: Contraception Part 2 (2 SMS)	When a woman is ready to have a child, she can simply stop using the method. Over the next few weeks you will receive information about methods of contraception. For more information or to start any method visit Mfera Health Centre.		✓
5: Condoms Part 1 (2 SMS)	Male and female condoms are the ONLY contraceptive that protects against both pregnancy and STIs, including HIV. Being able to use condoms means that you need to buy them, carry them and discuss them with your partner- so planning is important.		✓
6: Condoms Part 2 (2 SMS)	Sex can occur unexpectedly, so you need to be well prepared. Think about situations where you would want to use a condom and plan in advance.		✓
7: Male Condoms (3 SMS)	Male condom is a sheath that unrolls over an erect penis. No side effects, protects against pregnancy and STIs/HIV if used correctly for every sexual encounter. Always use a new condom every time. Condoms do not make men sterile, impotent or weak and can be used with married and non-married couples.	✓	✓

Message Set	Content	Study	
		Pilot	Main
8: Female Condoms Part 1 (2 SMS)	Female condom is a lubricated pouch made of thin, soft plastic that fits loosely inside the vagina. Inserting and removing from the vagina becomes easier with practice. To be continued…	✓	✓
9: Female Condoms Part 2 (2 SMS)	Women can initiate condom use but the method requires partner's cooperation. Talk to your partner about using this method. Can be used with married and non-married couples, has no side effects and cannot get lost inside a woman's body.	✓	✓
10: Pill Part 1 (2 SMS)	Oral contraceptive pill should be taken 1 pill at the same time every day, regardless of whether sex is practiced that day or not. It is the most effective if no pills are missed and new packs are started without delay. If you struggle to remember to take your pill, try linking it to a daily activity – for example take it as soon as you get up or with your evening meal.	✓	✓
11: Pill Part 2 (2 SMS)	Side effects such as irregular bleeding in the first few months or lighter bleeding are common but not harmful. Taking your pill at the same time every day may help reduce some side effects.	✓	✓
12: Contraceptive Injections (3 SMS)	Injectable contraceptives are injected into the woman's arm by a nurse every 4 weeks. It is most effective if the woman comes back on time for every injection. Common side effects are bleeding changes, such as irregular, heavy or prolonged bleeding. This is not harmful. Some women say they like injectables because they do not require daily action, do not interfere with sex and are private (no-one else can tell).	✓	✓
13: Implant Part 1 (2 SMS)	Implant is a small flexible rod placed under the skin of the arm by a nurse. It provides continuous pregnancy protection for 3-5 years. To be continued…	✓	✓
14: Implant Part 2 (2 SMS)	Some women say they like implants as after insertion there is no further action or cost until they are removed, do not interfere with sex and are long-lasting. Bleeding changes are common in the first year, including irregular or no bleeding but this is not harmful.	✓	✓

Message Set	Content	Study	
		Pilot	Main
15: IUD Part 1 (2 SMS)	IUD are small, flexible plastic devices inserted into the woman's uterus by a nurse. It provides up to 12 years pregnancy protection. To be continued…	✓	✓
16: IUD Part 2 (2 SMS)	Some women say they like the IUD as it's a long-lasting method and no further action or cost is required after the IUD is inserted. Side effects include heavier and longer bleeding, which may be accompanied by increased cramping. This is most likely in the first 3-6 months.	✓	✓
17: Standard Days Method Part 1 (2 SMS)	Standard Days Method (SDM) involves avoiding unprotected sex on fertile days, day 8-19 of every menstrual cycle. Day 1 is the first day of monthly bleeding. To be continued…	✓	✓
18: Standard Days Method Part 2 (2 SMS)	Successful use requires a joint decision to abstain or use a condom on fertile days of cycle, talk to your partner about using this method. This method works best for pregnancy protection if menstrual cycle is 26 to 32 days long.	✓	✓
19: Withdrawal (3 SMS)	The man withdraws his penis and ejaculates outside the vagina, keeping sperm out of the woman's body. This is the least effective method of pregnancy protection. Semen may be released into the vagina before full ejaculation, without knowing. This small amount can be enough to cause pregnancy and transmit STIs/HIV.	✓	✓
20: Emergency Contraceptive Pills Part 1 (2 SMS)	Emergency contraceptive pills can help prevent pregnancy if taken within 5 days after unprotected sex. The sooner they are taken, the more effective they are. They will not protect against pregnancy for acts of sex AFTER the pill is taken, even the next day. To be continued…		✓
21: Emergency Contraceptive Pills Part 2 (2 SMS)	To stay protected, begin another method at once. They are not meant to be used for on-going contraception or to replace a regular method. Talk to Mfera health centre for long-term methods.		✓
22: Female Sterilization Part 1 (2 SMS)	Female sterilization is a permanent, irreversible contraceptive method for women who do not want more children. Minor, safe surgery performed by a doctor. To be continued…		✓

Message Set	Content	Study	
		Pilot	Main
23: Female Sterilization Part 2 (2 SMS)	Talk to your partner and a health professional before making your decision, this is a permanent method and cannot be undone. No side effects and complications after surgery are uncommon. Does not cause lasting pain, or changes in bleeding, sex drive or appearance.		✓
24: Male Vasectomy Part 1 (3 SMS)	Male vasectomy is permanent, irreversible contraceptive method for men who do not want more children. Minor, safe surgery performed by a doctor. No side effects and will not affect male sexual performance or enjoyment. Procedure keeps sperm out of semen to prevent pregnancy, ejaculation will still occur. To be continued…		✓
25: Male Vasectomy Part 2 (2 SMS)	Pregnancy prevention effective 3 months AFTER surgical procedure, other methods such as condoms must be used to prevent pregnancy for first 3 months. Talk to your partner and a health professional before making your decision, this is a permanent method and cannot be undone.		✓

7.8 Phase 4: Discriminant Content Validity of SMS messages against BCT Taxonomy

A behaviour change technique (BCT) is the 'active ingredient' present in interventions aiming to change behaviour (Michie et al., 2011b). BCTs are techniques which can be observed, replicated and cannot be simplified any further i.e. the smallest component of behaviour change interventions (Michie & Johnston, 2013). An extensively reviewed taxonomy of 93 techniques (Michie et al., 2013) provides precise terms to both describe and compare the content of theory driven behaviour change interventions (Michie & Abraham, 2008). This taxonomy, BCTTv1, allows BCTs included in interventions to be identified reliably (Michie et al., 2013), and enables the development of a cumulative evidence base, as the BCTTv1 provides the basis to compare BCT content across studies. This common language enables researchers to identify BCTs which are effective, and investigate whether particular BCTs or combinations of BCTs are effective for particular behaviours, contexts or populations.

Although the BCTTv1 provides theory-linked definitions for each BCT and examples of BCT delivery, these definitions are not always fully adhered to when executed within interventions (Tate et al., 2016). Therefore, to assess the fidelity of the delivery of six BCTs (information on health consequences, instruction on how to perform the behaviour, information on others' approval, action planning, prompt/cues and social support (unspecified)) within this SMS based intervention, a discriminant content analysis (DCV) was conducted. A DCV study allows for quantitative evaluation of measures against their theoretical construct to ensure content validity (Johnston et al., 2014). This study used DCV to examine the relationship between the SMS message sets against the definitions of each BCT as defined in the BCTTv1. This will assess the fidelity of the BCTs as delivered in the SMS mode of delivery.

7.8.1 Method to determine content validity of SMS messages

7.8.1.1. Study Design

This was a cross sectional online questionnaire DCV study conducted in October 2015.

7.8.1.2. Study Sample

Six participants acted as judges to identify the presence of BCTs in the 25 sets of SMS messages. Previous research has suggested between 2 and 20 judges should be used in a judgement task (Lynn, 1986), with Haynes and colleagues (1995) stating that a minimum of 5 is necessary. Participants all had expertise in health behaviour theory and included two practicing health psychologists and 4 PhD students involved in behaviour change research. Participants were recruited online through health psychology social media pages. Eligibility criteria included familiarity with the Behaviour Change Taxonomy and an involvement in behaviour change research.

7.8.1.3. Materials used within the study

The labels and definitions of the 93 BCTS in the BCTTv1 (Michie et al., 2013) were provided as well as the 25 sets of SMS messages (**Error! Reference source not found.**).

7.8.1.4. DCV study procedure

Participants were provided with an online survey link where information about the study, a consent form, and the DCV questionnaire could be accessed. Participants were asked to consent (Appendix 13) before they could proceed to the DCV task. Participants were given as much time for the questionnaire as they required and could go back to it repeatedly for up to 1 week, but were asked to complete the task on their own without discussion. Participants were provided with a copy of the BCTTv1 (Michie et al., 2013), and asked to read each SMS message set (**Error! Reference source not found.**) and identify which, if any, CTs were present. They were then ask to identify up to 3 BCTs that they judged to be present (or state no BCTs were present) and to give a confidence rating for each judgement on a visual analogue scale anchored with 0% confident to 100% confident.

7.8.1.5 Statistical Analysis

Each SMS message was designed to contain one or more BCTs; judgements were assessed against this list of intended BCTs for each SMS message set. A judgement was coded 1 if it matched one of the BCTs intended for that message set. If two or more participants judged the same BCT to be present in the message and that BCT was not on the list of intended

BCTs for that message, this was also coded 1 and included in the analysis. If a BCT, not initially intended for the SMS message, was identified by one judge only this was not included in the analyses. Each judgement was multiplied by the corresponding confidence rating and expressed as a proportion, therefore, weighted judgements ranged from 0 to 1.

One-sampled t-tests were used to analyse for the presence of each BCT identified in the SMS message. A BCT was deemed to be present in the message set if the judgements were significantly greater than zero. Benjamini-Hochberg procedure was used to correct for multiple tests (Benjamini-Hochberg, 1995).

7.8.1.6. Ethical consideration

Ethical approval was received from the School of Psychological Sciences and Health Ethics Committee.

7.8.2. Results of the DCV analysis

Table 7.7 presents the DCV analysis for the six intended BCTs included in the 25 sets of SMS messages. Six intended BCTs were designed into the SMS messages and four of these were reliably identified by the judges: information about health consequences; action planning; instruction on how to perform a behaviour and information on others' approval. The other two BCTs: social support (unspecified) and prompt/cues, were found to be not significant after correction for multiple tests and therefore not reliably identified by the judges.

Table 7.7: DCV analysis for intended BCTs in 25 SMS message sets

Message Set	Intended BCT	BCT reliably identified as being present	*t*	*p*
1: Welcome	No BCT present	Yes	4.39	.007*
2: Planning for Families	Information about health consequences	No	3.15	.025[a]
	Social support (unspecified)	No	1.57	.117
3: Contraception 1	Information about health consequences	Yes	4.20	.008*
4: Contraception 2	Information about health consequences	Yes	4.49	.006*
5: Condoms 1	Information about health consequences	Yes	23.09	.000*
6. Condoms 2	Action planning	Yes	14.11	.000*
7:Male Condom	Information about health consequences	Yes	4.79	.005*
8: Female Condom 1	No BCT present	No	2.14	.085
9: Female Condom 2	Information about health consequences	No	2.19	.080
	Social support (unspecified)	No	1.55	.181
10: Pill 1	Instruction on how to perform a behaviour	No	1.58	.175
	Information about health consequences	No	2.21	0.78
	Prompts/cues	Yes	2.99	.030[a]
11: Pill 2	Information about health consequences	Yes	24.24	.000*
12: Injection	Information about health consequences	Yes	13.62	.000*
	Information about others' approval	No	3.08	.027[a]
13: Implant 1	No BCT present	No	2.22	.077
14: Implant 2	Information about others' approval	Yes	4.78	.005*
	Information about health consequences	No	2.18	.081
15: IUD 1	No BCT present	No	2.18	.081
16: IUD 2	Information about others' approval	Yes	4.64	.006*
	Information about health consequences	Yes	4.78	.006*
17: SDM 1	Instruction on how to perform a behaviour	Yes	4.29	.008*
18: SDM 2	Social support	No	1.58	.176

Message Set	Intended BCT	BCT reliably identified as being present	*t*	*p*
	(unspecified)			
19: Withdrawal	Information about health consequences	Yes	4.50	.006*
20: ECP 1	Information about health consequences	Yes	4.49	.006*
21: ECP 2	No BCT present	No	1.58	.175
22: Female Sterilization 1	Information about health consequences	Yes	4.75	.005*
23: Female Sterilization 2	Information about health consequences	Yes	4.65	.006*
	Social support (unspecified)	No	3.04	.029[a]
24: Male Vasectomy 1	Information about health consequences	Yes	10.62	.000*
25: Male Vasectomy 2	Information about health consequences	Yes	4.85	.005*
	Social support (unspecified)	No	3.13	.026[a]

*significant at 0.05 level

[a] not significant at 0.05 level, after Benjamini-Hochberg correction for multiple tests

Two or more judges identified two BCTs that had not been intentionally designed into the SMS messages, and a further nine incidences where the BCT was coded as present but this was not the intention in the design, however none of these BCTs reached significance for reliability (Table 7.8).

Table 7.8: Additional BCTs identified by judges as being present

Message Set	BCT	*t*	*p*
2. Planning for Families	Instruction on how to perform a behaviour	1.52	.189
	Information about Antecedents	1.57	.177
5: Condoms 1	Action planning	1.46	.203
7. Male Condoms	Instruction on how to perform a behaviour	1.57	.178
13: Implant 1	Information about health consequences	2.21	.079
15: IUD 1	Information about health consequences	2.17	.082
18: SDM 2	Instruction on how to perform a behaviour	2.00	.101
19: Withdrawal	Instruction on how to perform a behaviour	1.53	.187
	Salience of consequences	1.97	.106
20: ECP1	Instruction on how to perform a behaviour	1.57	.178
21: ECP 2	Information about health consequences	1.51	.191

7.8.3. Discussion of the DCV analysis

Four of the six intended BCTs were reliably identified by the judges. Two BCTs, social support (unspecified) and prompt/cues, were not identified by the judges as being present in the SMS messages. That two BCTs did not reach the criteria for reliability can be due to either uncertainty in judgements as to the presence or absence of the BCT, or disagreement among judges (Johnson et al. 2014).

The four BCTs identified by the judges as being present in the SMS messages were: information about health consequences; instruction on how to perform a behaviour; information about others' approval and action planning. This DCV study establishes the fidelity of the intervention design at this stage, i.e. that four BCTs can reliably be identified in the SMS messages.

7.9 Phase 5: Translation of Intervention Content

Once the content was created and the presence of the BCTs in the SMS messages confirmed, it was critical that the translation process into Chichewa was as accurate and thorough as possible to ensure the information and BCTs included in English were also present in the final message sets delivered to participants.
7.3 displays the 5 step translation process employed.

SMS messages were created in English adhering to the 160 character limit and then directly translated into Chichewa by a member of the SCHI team. Messages were reviewed to ensure they adhered to the 160 character limit and those which did not were altered or split into two SMS messages. The full set was then checked (in English and Chichewa) by two Environment Health Lecturers at the University of Malawi – The Polytechnic with considerable experience in reproductive health projects. Comments and corrections were then implemented to make a first draft message set. Messages were then piloted with 10 first year Environmental Health students at the University of Malawi – The Polytechnic, who commented on message structure, content and relevance to the topic area. Additionally, they discussed colloquialisms or slang terms which are frequently used in Chichewa for certain contraceptive methods. For example, the contraceptive injection is referred locally as Jackson in the villages of Chikwawa. Therefore after this stage, contraceptive method

names were reviewed to fit with local slang terms to ensure the content was as relevant and relatable to the adolescent participants as possible. This final set of messages was checked by two Health Surveillance Assistants at Mfera Health Centre, and by the Director of the Reproductive Health Unit at the Ministry of Health to ensure they were medically accurate and in line with government guidance and policies.

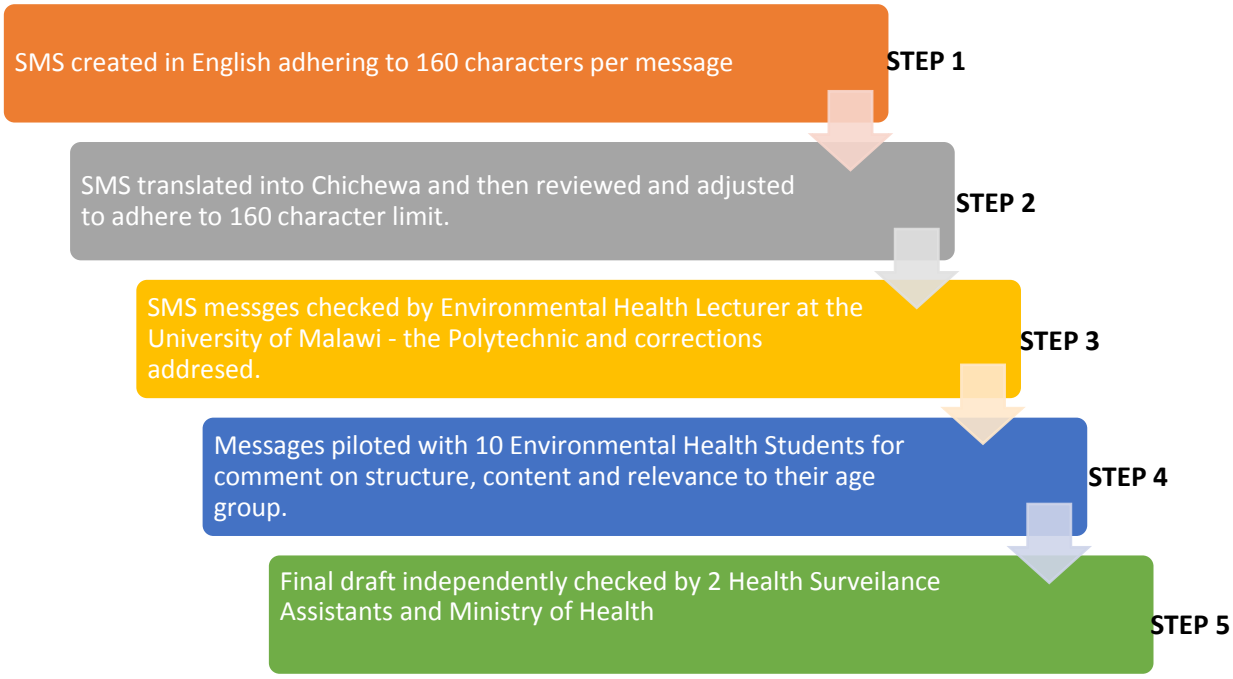


Figure 7.3 5 Step Translation Process for SMS content

7.10 Summary of Chapter 7

A five phase process was conducted to develop the SMS based contraceptive behaviour change intervention. The BCW was utilised as a theoretical framework to guide the design and development during Phase 1, and incorporated qualitative research from Chapters 3, 5 and 6 to inform decision making during this process. Phase 2 identified the accessibility of contraception in the Mfera catchment area of Chikwawa and Phase 3 built on this to create a set of SMS messages focusing on educating and persuading adolescents about the relevance of 10 modern contraceptive methods. SMS messages aimed to include six BCTs

which were identified in the BCW process (Phase 1) and Phase 4 identified that four of the six were identified to be reliably present by 6 independent judges. This corroboration allows the researchers a level of certainty that the theoretical components intended to be present in the intervention content are reliably included. Finally Phase 5 outlined the 5 step process to ensure accuracy within the translation of the SMS messages from English to Chichewa. After intervention development, the next step is intervention implementation to determine both the feasibility and acceptability of implementing this type of intervention in Chichewa, as well as to test the effectiveness of it on changing contraceptive knowledge, attitudes and behaviour change (Chapter 8).

Chapter 8: SMS Intervention: Feasibility Study and Intervention Evaluation

Chapter 7 provided a detailed explanation of how the SMS behaviour change intervention was designed using the Behaviour Change Wheel, as well as an outline of the intervention content and subsequent translation process. This chapter now details two studies implementing this SMS behaviour change intervention in Chikwawa, Malawi. Study 1 is an acceptability and feasibility study of the SMS behaviour change intervention delivering contraceptive education to adolescents in Chikwawa. The results of Study 1 were used to design Study 2. Study 2, the main study, evaluated the effectiveness of this SMS intervention in terms of its impact on contraception knowledge (recall and recognition), attitudes towards condom use and contraceptive behaviour. Both studies are then discussed in relation to intervention implementation, effectiveness and participant experience of the intervention.

8.1 Contextual background to the need for contraception in adolescents

Malawi has one of the world's highest adolescent birth rates with 143 births per 1000 women aged 15-19 (UNFPA, 2016); 35% of women aged 20-24 report giving birth before the age of 18 (UNFPA, 2013). Teenage pregnancy increases the risk of infant mortality by 50% (WHO, 2014) and significantly increases the likelihood of school drop-out due to greater responsibility and prejudice by teachers and peers (Munthali et al., 2004; Cassie, 2014). A recent national survey of Malawian Youth Friendly Health Services (YFHS) reported that 40% of female respondents aged 10-24 years who had given birth either did not want their last pregnancy or would rather have waited longer before becoming pregnant (E2A, 2014). Whilst specific reasons for the expressed desire for not wanting pregnancy at this age were not collected, these views suggest there is a need to make contraceptive information and advice widely accessible, particularly among adolescents.

Despite significant increases in contraceptive use in the last decade, about 40% of unmarried women in rural Malawi report an unmet need for contraception (Government of Malawi, 2016), defined by the WHO as those who wish to delay or stop childbearing but are currently not using any contraceptive method (United Nations, 2014). In 2007, the

Malawian Government set up a YFHS programme nationally, aiming to create adolescent specific services, including the provision of resources and advice on contraception (Health Policy Project, 2015). An evaluation of these services determined less than one third of those surveyed (n=2040) reported having heard about YFHS and only 13% had ever used the service (E2A, 2014). The inaccessibility of the YFHS services at community level was viewed as a barrier to their use, with little YFHS outreach, long distances to travel, and insufficient transport links being reported (E2A, 2014).

In addition, adolescents in the Chikwawa District voiced a need for education on sexual and reproductive health (SRH) particularly around contraception methods (see Chapter 2 or Laidlaw et al., 2017). This perceived need was irrespective of whether the YFHS was available at the nearest health centre. Therefore, there is a need to increase awareness of locally existing YFHS and to increase accessibility of such services, to encourage use and provide adolescents with the health education and contraception resources they require.

The introduction of mHealth services, particularly an SMS behaviour change intervention, could provide health education and direct adolescents towards the nearest YFHS via personal or shared mobile phones. SMS behaviour change interventions for SRH, piloted in Tanzania and Kenya (FHI 360, 2013; Vahdat et al., 2013), show positive opinion on the acceptability of such services. However their weak methodology limits the conclusions on intervention effectiveness for health education delivery in these settings, and to date no studies have been conducted in rural Malawi. Therefore this research seeks to understand whether an SMS intervention would be an appropriate method of health education delivery in the target area, using a robust and accepted research methodology, as well as determining effectiveness in changing contraceptive knowledge and behaviour in the Chikwawa District of Malawi.

8.2 Study 1: Feasibility and Acceptability Study

Interventions to change health behaviours are complex, thus the Medical Research Council (MRC) guidance on the development of complex interventions should be followed. The MRC guidance (Craig et al., 2008) details a four step cyclical process which guides design and development of evidence based interventions (Figure 8.1). Feasibility and pilot testing represent a core component of this process, and allows determination of whether the

intervention is practical to implement, acceptable to the target population and able to be replicated at scale. It can also identify issues which may impinge on recruitment and participant attrition rates.

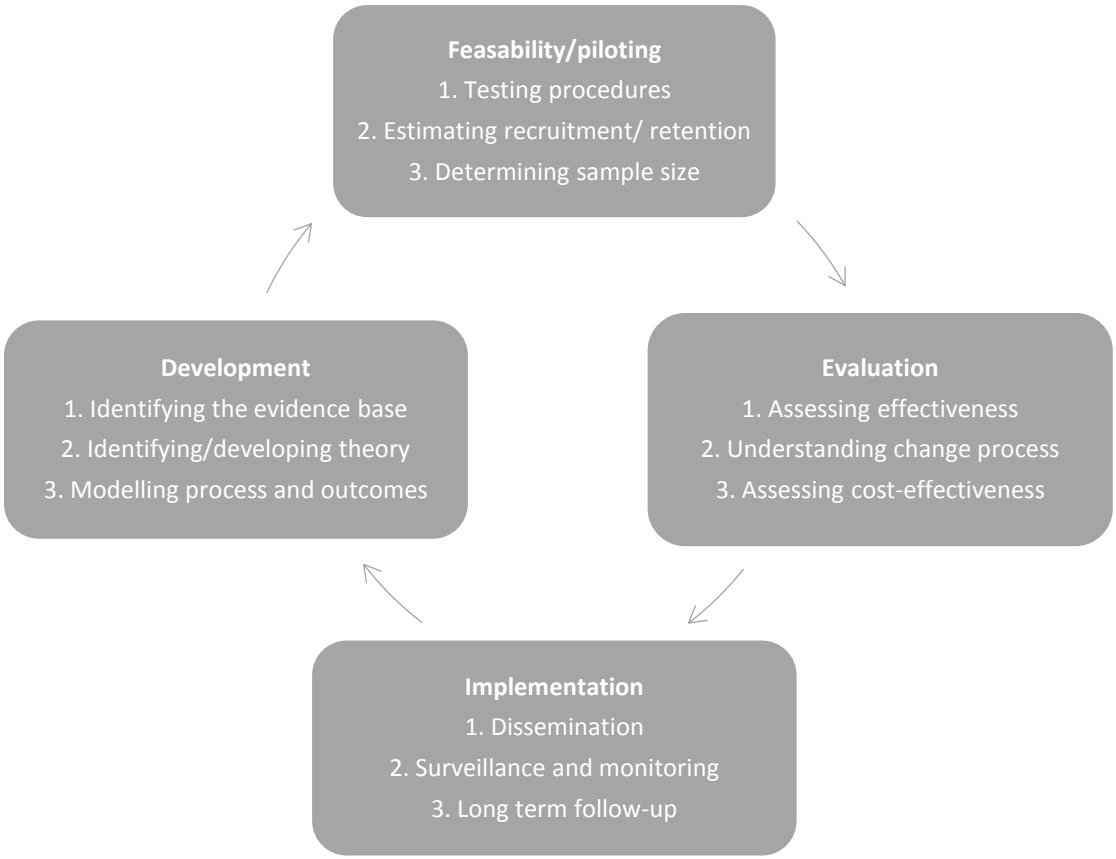


Figure 8.1: Main stages of intervention development as described by the MRC guidance on the development of complex interventions (Craig et al., 2008)

Feasibility studies are a necessary component in the design and development of evidence-based interventions and aid understanding in eight core areas: acceptability; demand; implementation; practicality; adaption; integration; expansion and limited efficacy testing (Bowen et al., 2009). This is particularly important in the current study when an SMS based intervention has never, to the author's knowledge, been implemented in the geographical area. Consequently, determining practicality of intervention delivery and acceptability from participants is especially significant before a larger study can be considered. Therefore, Study 1 presents the feasibility of an SMS intervention delivering contraceptive education to adolescents using a one way SMS messaging service. The focus was on feasibility

objectives and not significance testing, to generate an understanding of whether it is possible for the intervention to be implemented at scale (Thabane et al., 2010).

The objectives were to determine:

i) the feasibility of implementing an mHealth intervention in terms of attrition, mobile infrastructure and intervention accessibility;

ii) the acceptability of an SMS intervention for contraceptive health education targeting adolescents in Chikwawa District, Malawi.

8.3 Methods to determine feasibility of the SMS intervention

8.3.1 Participants and Setting

Thirty participants were recruited from Chimoto, a village in Chikwawa District, Southern Malawi in October 2015. Eligibility criteria included being a resident of Chimoto: aged between 15 and 25; owning or having access to a shared mobile phone; literate in Chichewa; and the able to consent to the study (through a signature).

8.3.2 Study 1 Procedure

Participants were recruited through convenience sampling. After obtaining permission from the village headman, the research team walked around the village with a member of the Village Action Group (community leadership group), and individuals who were eligible to take part were informed of the study and what would be expected of them. If they chose to take part and provided written consent (Appendix 14), one-on-one interviews were conducted by trained data collection assistants asking questions on demographic information and mobile phone access (Appendix 15). The answers to these questions were inputted into an electronic questionnaire by the data collection assistants using the Magpi mobile phone application (Magpi, n.d). This software allows the questionnaire to be uploaded to the mobile application, where it can be accessed on multiple phones simultaneously. Data is then entered for each individual and uploaded to a secure online database for analysis. If participants were aged 15, additional consent was obtained from a parent or guardian (Appendix 14). Participants were then registered for the intervention

and 4 weeks after the delivery of the final SMS participants took part in a second follow up one-on-one interview asking questions on mobile phone access and participant experience of the intervention (Appendix 15).

8.3.3 Intervention Content

The intervention content consisted of a subset of the SMS messages developed in Section 6.5.3, in order to determine the feasibility of intervention delivery and intervention acceptability in a short time scale. Thirty-three SMS messages (Table 7.6) providing information on 8 contraceptive methods (Table 8.1) were delivered.

Table 8.1: Timetable of SMS message delivery delivered in Study 1 in October 2015.

	Monday	**Wednesday**	**Friday**
Week 1	Condoms (4xSMS)	Male Condoms (3xSMS)	Female Condoms (4xSMS)
Week 2	Pill (4xSMS)	Injection (3xSMS)	Implant (4xSMS)
Week 3	IUD (4xSMS)	Withdrawal (3xSMS)	Standard Days Method (4xSMS)

SMS messages were based on the World Health Organisation Family Planning Guidelines (WHO, 2011) and incorporated behaviour change techniques from the Behaviour Change Taxonomy (Michie et al., 2013). The messages were consistent with Malawi Health Policies including the National Sexual and Reproductive Health and Rights Policy (Government of Malawi, 2015a), National HIV Prevention Strategy 2015-2020 (Government of Malawi, 2014), National Youth Friendly Health Services Strategy 2015-2020 (Government of Malawi, 2015b) Malawi Health Promotion Policy (Government of Malawi, 2013) and were in line with the priorities in the Malawi Health Sector Strategic Plan 2011 – 2016 (Government of Malawi, 2011). All messages were approved by the Ministry of Health Reproductive Health Unit. An example set of messages is displayed in Figure 8.2. Messages were created in English and adhered to the 160 character limit of basic mobile phones and were translated into Chichewa (see Section 6.5.5).

Once translated, messages were again reviewed to ensure they adhered to the character limit; some messages required to be split into two. Translations were independently

verified for accuracy by two Environmental Health Lecturers from the University of Malawi. The messages were then piloted with 10 undergraduate students from the University of Malawi. The students provided comments on message structure, content and relevance. Grammatical errors were then corrected to create a final set of messages (Figure 8.2).

Figure 8.2: Example set of messages for Injection contraception method (English and Chichewa) delivered to participants in Chikwawa, Malawi in October 2015.

8.3.4 Intervention delivery

TextIt (https://textit.in/), an online open sourced system capable of sending SMS messages at predetermined times, was used to deliver the intervention content. For successful message delivery, a smartphone installed with the TextIt application, sufficiently powered, connected to Wi-Fi and with adequate mobile credit was required. This allowed the SMS

messages to be sent via the TextIt application on the mobile handset and paid for using the mobile credit.

The one way messaging intervention required registration; this was achieved by the participant placing a missed call to the project number. TextIt automatically registered the caller and scheduled them to receive SMS messages in the order programmed. On registration the participant was immediately sent a welcome message; “Welcome to the SCHI Healthy Messages Service. All messages you receive will be free. You will receive messages about contraception methods every Monday, Wednesday and Friday at 4pm”. The participant was then sent a set of messages (between 3-5 SMS) focusing on a different contraception method every Monday, Wednesday and Friday at 4pm for three weeks. Registration and access to all messages was free for participants and messages could be received on any type of mobile phone.

8.3.5 Outcome measures

Two outcomes were measured: feasibility and acceptability.

8.3.5.1 Measuring Feasibility

Feasibility was assessed through three indicators: attrition rates measuring the number of participants lost at follow up; mobile infrastructure using the TextIt delivery reports as a proxy; and intervention accessibility which was assessed through participant self-reported mobile phone access at baseline and follow up.

8.3.5.2 Measuring Acceptability

Acceptability was assessed through individual follow up interviews with participants 4 weeks after the last SMS message was sent. These interviews followed the interview schedule presented in Appendix 15. This asked six multiple choice questions delivered verbally to participants and the data collection assistants recorded the answers into the electronic questionnaire via a mobile handset. These questions asked whether participants received access to the messages, what type of phone access they had, acceptability of the registration process was, acceptability of the amount of messages received, acceptability of when the messages were received and whether participants would use this type of service

in the future. Two additional open ended questions were included regarding positive and negative aspects of participant experience; the data collection assistants also inputted these answers into the electronic questionnaire via a mobile handset.

8.3.6 Study 1 Analysis

Feasibility was assessed through calculating the attrition rate, identifying how many SMS messages were sent and delivered using the TextIt delivery reports as a proxy, and comparing self-reported mobile phone access at baseline and follow up. Responses to the multiple choice questions in both interviews were used to assess acceptability. Open answer questions were analysed to identify positive and negative aspects of participant experience.

8.3.7 Ethical considerations

Ethics were carried out as discussed in section 2.4.

8.4 Results of the feasibility study

8.4.1 Participant Characteristics at baseline

Information on participant demographics at baseline is presented in Table 8.2. Mean age and completed school years were similar between the sexes, with females more likely to be married and have children than males.

Table 8.2: Participant demographics at baseline (n=30) from participants interviewed in Chikwawa, Malawi in October 2015.

	Female (n=12)	Male (n=18)
Mean age (SD)	17.6 (3.4)	17.8 (3.3)
Mean years of school completed (SD)	4.8 (2.7)	6.0 (3.0)
Married, n, (%)	7 (58.3)	3 (16.6)
With children, n, (%)	7 (58.3)	2 (11.1)

8.4.2 Feasibility

8.4.2.1 Attrition rates

The attrition rate was 27%. Of the 30 participants who were registered for the SMS intervention, one female participant voluntarily opted out as they no longer wanted to participate, and seven participants were lost to follow up as they could not be located after multiple communication attempts both in person and by phone. Figure 8.3 represents the participant flow in this study.

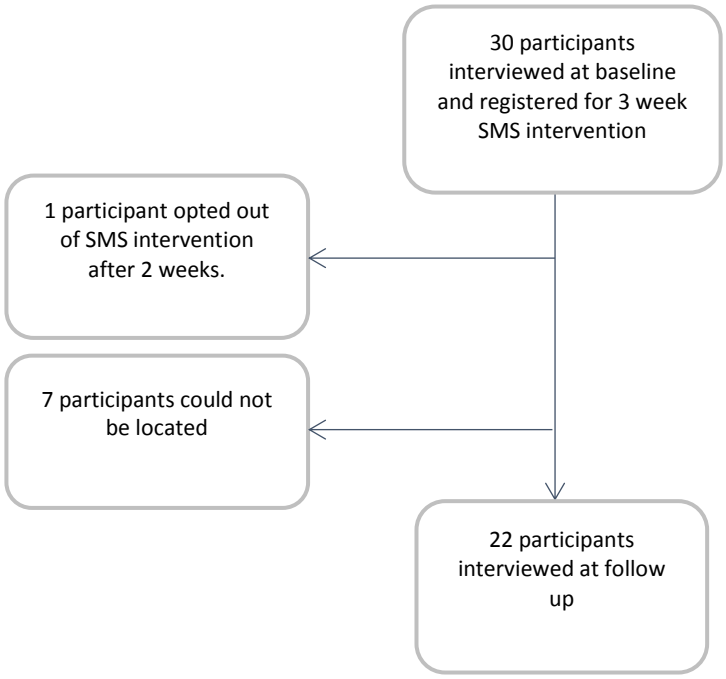


Figure 8.3: Flow chart of the participants' journey throughout the pilot study conducted in Chikwawa, Malawi in October 2015.

8.4.2.2 Mobile Infrastructure

The data collection and intervention implementation timeline is displayed in Figure 8.4**.** The intervention was scheduled as a three week programme, however due to power outages and Wi-Fi difficulties, the seventh set of messages (Withdrawal method) was not sent to participants. The technology to deliver the messages, TextIt, automatically attempted to re-send the seventh set, yet was ultimately unsuccessful. This attempt at re-sending the

seventh set prolonged the intervention and the final set of messages was delivered to participants two weeks later than intended. Therefore 7 of the 8 sets of messages were sent to participants, and using the TextIt delivery reports as a proxy, all sent messages were successfully delivered to the participants' mobile devices. Appendix 16 shows an example of the flow of messages sent to each participant.

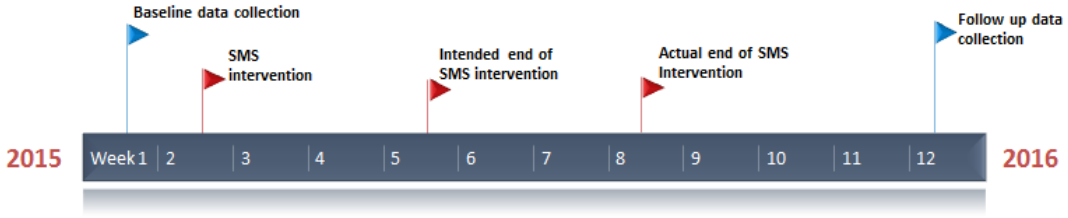


Figure 8.4: Timeline of data collection and intervention implementation during the pilot phase in Chikwawa, Malawi in October 2015.

8.4.2.3 Intervention Accessibility

Of the 30 participants interviewed at baseline, just under half (47%) indicated they had access to their own mobile phone, while just over half (53%) shared a device. Figure 8.5 shows the changes in mobile access over the course of the intervention; at follow up 7 participants, all male, reported owning a mobile phone, while 10, four of which were female, reported access to a shared phone. Figure 8.6 presents the type of mobile phone access in participants who received the SMS content. All seven participants who reported owning a mobile phone at follow up received the intervention and they were all male. Ten of the 22 participants interviewed at follow up reported shared access to a mobile phone and of these 6 self-reported having received the SMS messages. Only one female received the intervention content.

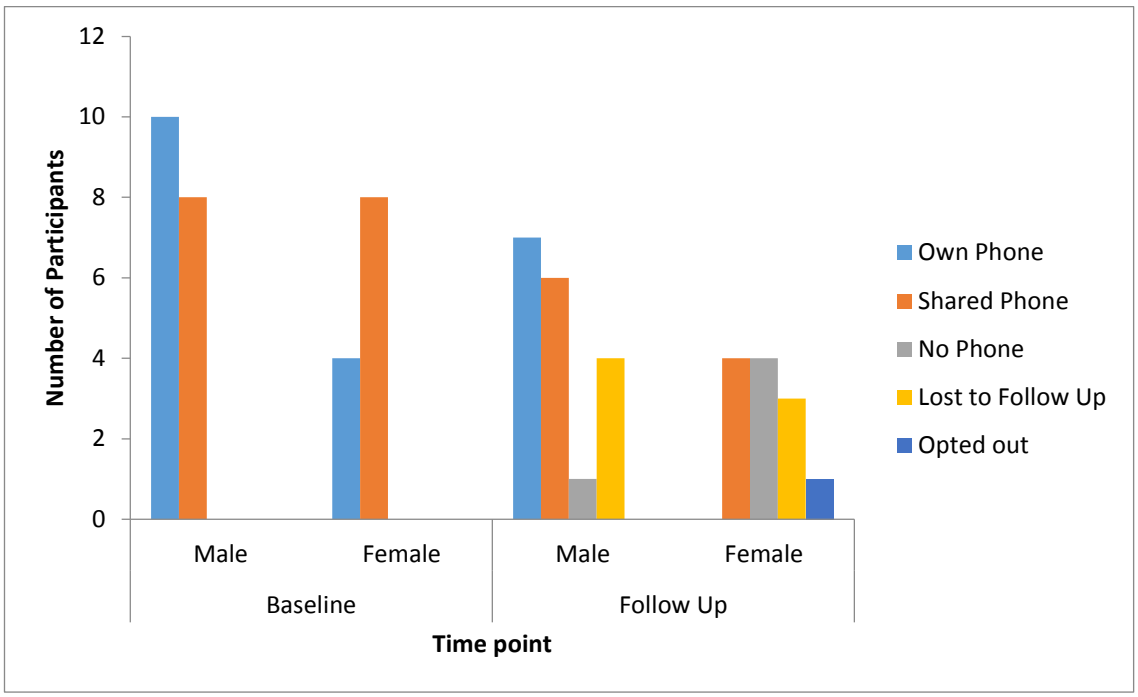


Figure 8.5: Phone access pre and post intervention by gender (n=30) in participants from Chikwawa, Malawi, interviewed in October 2015.

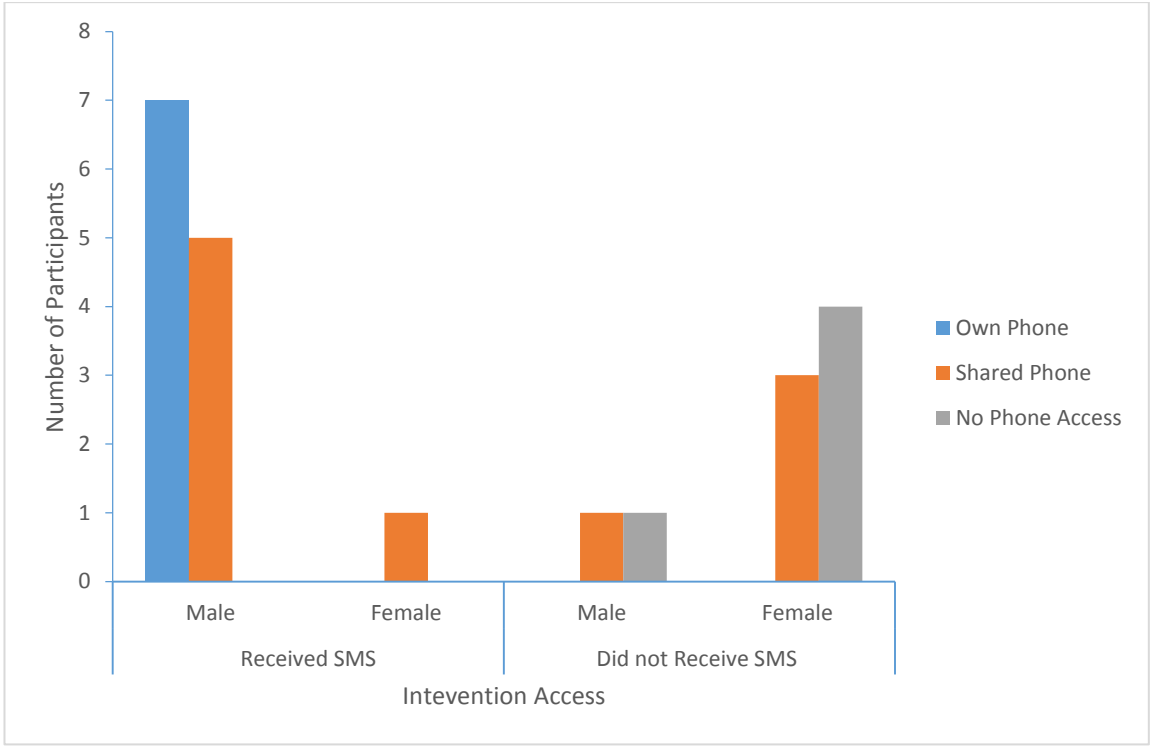


Figure 8.6: Phone access and Intervention access by gender (n=22) in participants from Chikwawa, Malawi, interviewed in October 2015.

8.4.3 Acceptability

Responses have been separated between those who received the SMS intervention and those who did not.

All thirteen participants (12 male, 1 female) who received the intervention provided feedback on what they liked about the intervention, the majority (n=10) of responses were one word adjectives which have been summarised into three categories in Figure 8.7.

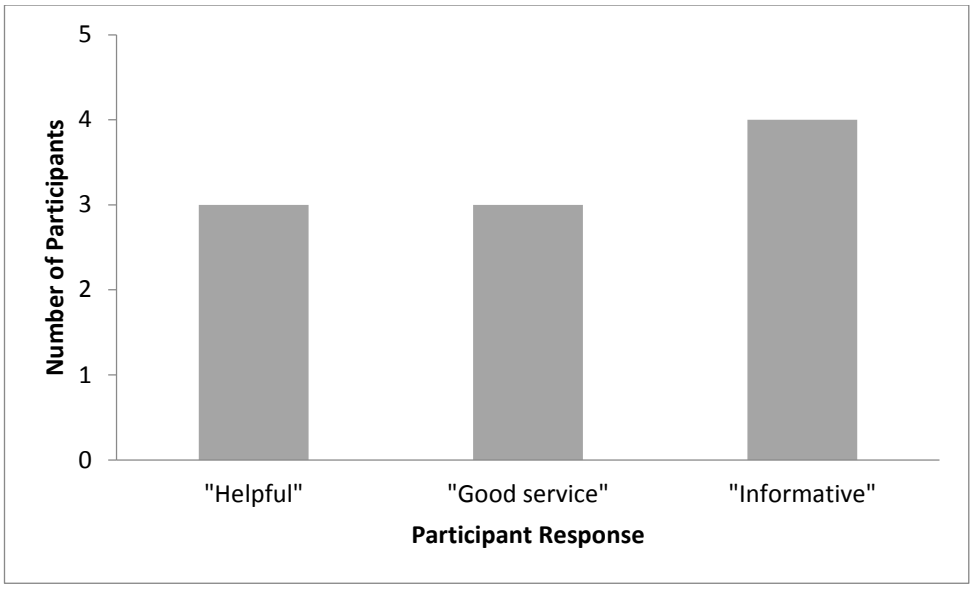


Figure 8.7: Positive feedback on SMS intervention (n=10) from participants interviewed in Chikwawa, Malawi in October 2015.

The remaining three participants provided more detailed positive feedback and all three were related to an increase of knowledge of contraceptive methods;

> "…it [SMS intervention] is good because it's educating us to prevent unwanted pregnancies." *Participant 4 Male aged 23*

> "…it [SMS intervention] was helpful especially to my life and how I can take care of myself." *Participant 11, Male aged 20*

> "It's [SMS intervention] good because we were being given knowledge of the contraceptive methods that we did not know." *Participant 17, Female aged 18*

Only two out of the thirteen participants provided an answer to the second open ended question as to what they did not like about the intervention. Both of these responses were around the difficulties of getting access to the shared phone;

> "Sometimes the person denied me access to his phone." *Participant 7, Male aged 15.*

> "I had to rely on using friend's phone." *Participant 27, Male aged 17.*

Participants were asked their views on the volume of messages and times at which they were sent. Seven of the thirteen participants (54%) who had access to the messages stated message volume was just right, with a further three participants believing they needed more messages and stating five or six messages per contraceptive method as the preferred number. In contrast, a further three participants believed there were too many messages and would prefer two or three for each contraceptive method. Six participants believed the time (4pm) the messages were sent should stay the same in future interventions and the remainder (n=7) stated it did not matter to them when the messages were sent. Twelve participants stated that the registration process was easy and one participant stated it was difficult. In regards to future use of this type of intervention, all 13 participants stated they would use the same type of health education service in the future if it was available.

Nine of the 22 participants interviewed at follow up did not receive access to the intervention. Of these participants, four provided comment as to what they liked about the intervention despite not gaining access;

> "It's [the SMS intervention] good because most of the people don't know the methods and are learning through this process." *Participant 3, Female aged 21.*

> "It [SMS intervention] is good to send messages personally." *Participant 16, Female aged 20.*

> "It [SMS intervention] is helpful, especially to us youth." P*articipant 20, Female aged 19.*

> "I thought it [SMS intervention] was a good idea." *Participant 29, Male aged 17.*

In regards to negative feedback, all nine participants provided comment. Four participants discussed the difficulties of accessing a shared phone;

> "The messages came but the owner of the phone, my relative did not give me access." *Participant 23, Female, aged 21.*

> "Relying on someone else's phone was not beneficial." *Participant 16, Female aged 20.*

A further two participants stated a change in circumstances to their mobile phone access both due to the mobile phone owner selling the device;

> "The person whose phone I was borrowing ended up selling his phone after some time, so I did not receive any messages." *Participant 29, Male aged 17.*

The final three participants commented on their lack of phone and therefore no intervention access;

> "I was not able to see the messages because I did not have access to a phone." *Participant 1, Female aged 22.*

Of the participants who provided feedback on the registration process for the SMS intervention, four stated it was easy, while five stated they did not know how the registration occurred. This may be due to reliance on a shared mobile phone or initial help with registration during the recruitment phase. Participants did not provide feedback on the volume of messages, but four stated that they would prefer messages to be sent in the afternoon. Of the 9 participants who did not receive the messages 6 stated they would be willing to use such a service in the future.

8.5 Discussion of the feasibility study

The objectives of study one were to determine i) the feasibility of implementing an mHealth intervention and ii) the acceptability of an SMS intervention for contraceptive health education for young people in Chikwawa, Malawi.

Feasibility was assessed in three domains; attrition rate, mobile coverage and mobile phone accessibility. Attrition rate (26.6%) was within the boundary to qualify for an effective intervention (Amico, 2009). Further although technical complications failed to deliver one set of messages (7 out of 8 were successfully sent), all messages which were sent were successfully delivered to participants' phones demonstrating adequate mobile coverage in the area. Thirteen of the twenty-two (59%) participants interviewed at follow-up received the intervention content, including all participants who owned a mobile phone, and 60% of those with access to a shared device. There was considerable variation in mobile accessibility between baseline and follow up. Malawi is one of the most expensive countries in the world for call, text and data charges on a mobile phone (ITU, 2014) and this has likely affected mobile phone ownership and use during the course of this study. Participants may not be able to afford access to phone charging services or may need to sell the device to fund other living expenses. Even though mobile ownership is increasing rapidly in the country (GSMA, 2016) high running costs remain a barrier to mHealth interventions.

There was inequality in access for females, as only one female participant received access to the intervention. It is likely this was due to dependency on shared mobiles phones and receiving infrequent access to the device, as difficulties in shared mobile phone access was a focus of negative feedback of the intervention. Consequently, even though 59% of the participants at follow up received access to the intervention content, there was a significant bias towards male participants. Even though more needs to be done to increase accessibility for females, it is positive that males were open to receiving contraceptive information. It is important to include men in the contraceptive decision-making process (Greene et al., 2006), and providing education is a step towards encouraging their involvement (Vouking et al, 2014).

The intervention was acceptable to adolescents in Chikwawa. All participants who received the intervention reported positive attitudes towards it, particularly in regards to increasing their knowledge of contraceptive methods. Negative feedback on the intervention format was only in relation to frustrations in shared mobile phone access, and this was expressed by those who did not receive access and those who did. Therefore mobile phone access, particularly in those who shared phones, was highlighted as a barrier to intervention accessibility in this study. The majority of participants who received the intervention

provided positive feedback on the intervention format including message volume, timings and the registration process. This is consistent with previous research which reported the acceptability of SMS based reproductive health education services (FHI 360, 2013; Vahdat et al., 2013). Twenty of the 22 participants (91%) interviewed at follow up stated they would use an SMS health education service in future, including all thirteen participants who received access. Although participants were vocal about accessibility issues, no negative feedback was provided on SMS content or sensitivity of receiving such information through mobile phones and shared devices.

8.5.1 Lessons learned from the feasibility study

Improvements to the design and implementation of the intervention were required to increase sustainability in a large scale assessment of intervention effectiveness. Firstly, the technology used to send the SMS messages was not sustainable. The requirement of TextIt to send SMS messages through a mobile handset is not practical for implementation at scale and electricity shortages in Malawi prevented the delivery of one set of messages via this means. A virtual delivery system is required, allowing external management of message delivery and avoiding reliance on a single handset. Secondly, high variation in mobile phone access throughout the duration of the intervention, i.e. differences in mobile phone access between baseline and follow up time points, provided evidence of the fluidity of mobile phone access in Malawi. This is likely due to the high costs associated with mobile phone usage. Therefore more rigorous recruitment methods are needed to ensure participants have access to a device before entering the study and to include the phone owner's permission for those with shared devices, encouraging access for the entirety of the intervention. Difficulties in mobile phone accessibility will impact intervention effectiveness and access, limiting use of the intervention to those who can afford to own a mobile phone or have access to a reliable shared device. More research is needed to understand mobile phone accessibility in this area. Study 2 will provide more data on ownership as well as determine the impact this intervention has on contraceptive knowledge, attitudes and behaviour change.

8.6 Study 2: Intervention Evaluation

Study 1 found that the SMS health education intervention was acceptable to participants in the Chikwawa District of Malawi. Mobile coverage was found to be adequate in the area, however issues with technology and intervention access needed to be re-evaluated. Small scale feasibility studies should be interpreted with caution and a larger scale evaluation was required to determine intervention effectiveness. This is in line with MRC guidance for complex behaviour change interventions (Craig et al., 2008), where a cyclical process of development, evaluation and implementation is recommended throughout the pilot and main implementation phases to evaluate effectiveness and ensure the intervention is evidence-based and up to standard. Therefore this study aimed to address limitations found in Study 1 by using an online technology system to eliminate technical disruptions and improve recruitment procedures to encourage mobile phone access in those who share devices.

This study also evaluated intervention effectiveness on key core variables: contraception knowledge (recall and recognition); attitudes to condom use; and self-reported contraceptive behaviour. Identifying intervention effectiveness in these areas is important in rural Malawi, as myths surrounding contraceptive use and consequences of use are common, as was discussed in Chapters 4 and 5. Myths and misinformation influence contraceptive decision-making (Kamara et al., 2015), so it is crucial to deliver health education which is in line with the Malawian Ministry of Health guidance and is government approved. Therefore measuring changes in knowledge, attitudes to condom use and self-reported behaviour can allow conclusions to be drawn about intervention effectiveness in these three areas.

The specific research questions addressed were:

1. Does the SMS intervention affect knowledge of contraceptive methods at follow up, 3 months and 6 months?
2. Does the SMS intervention affect attitudes to self-reported condom use at follow up, 3 months and 6 months?
3. Does the intervention affect self-reported contraceptive behaviour at follow up, 3 months and 6 months?

4. Does shared phone access affect whether or not the intervention content is received?
5. Is SMS an acceptable method of receiving information on contraceptive methods?

8.7 Methods to determine SMS intervention effectiveness

8.7.1 Participants and Setting

Two hundred and fifty six participants were recruited from five villages in the Mfera catchment area of Chikwawa. A quasi-experimental design was employed as random allocation of individual participants was not possible due to high dependence on shared mobile phone access. Therefore two clusters of villages, not involved in Study 1, and chosen to provide the greatest geographical distance between the two clusters to minimise cross over effects, were randomised to receive the intervention (three villages) or to receive usual care and act as a control group (two villages). The three villages (n=127) allocated access to the intervention were Kalonga, Matumula and Mpokonyola and the two villages (n=129) allocated usual care were Khumbulani and Chinkole. Eligibility criteria replicated Study 1 (see Section 1.2).

8.7.2 Study 2 procedure

Participants were recruited using a similar process to Study 1. Information sheets and consent forms are presented in Appendices 17 and 18. In addition, where possible, researchers sought verbal permission from mobile phone owners of shared devices to make them aware of the study and increase likelihood of participants being provided with regular access to the shared devices. Participants were interviewed at 4 time points by trained data collection assistants; at baseline (May 2016), within 14 days after the final SMS was sent (August 2016), 3 months post intervention (October 2016) and 6 months post intervention (January 2017). Interview schedules for all four time points are presented in Appendices 19-22. At each time point, questions were read aloud to participants and answers inputted into the electronic questionnaire (Magpi, n.d) as described in Section 7.4.5. In order to monitor shared mobile phone access, participants in the intervention group who reported sharing a phone were given a diary to complete on the days which they got access, diaries were returned during the follow-up interview.

8.7.3 Intervention Content

The intervention consisted of 52 SMS messages, of which 33 were the same as in Study 1 (Table 7.6). The additional 19 SMS messages concerned general information on planning for families, what contraception is and three additional contraception methods: Emergency Contraceptive Method; Female Sterilization and Male Vasectomy. After discussion with nurses at the contraceptive clinic, the additional messages were included to provide a complete overview of all modern contraceptive methods available at Mfera Health Centre (10 modern contraceptive methods), even permanent methods considered less relevant to adolescents. SMS messages encouraged participants to attend Mfera Health Centre for advice or further information on any of the included contraception methods.

The 52 SMS messages were sent over a period of 8 weeks; Table 8.3 shows the timetable of SMS message delivery. Messages were created and translated as described in Study 1 (see Section 7.4.3) and were approved by the Ministry of Health in Malawi, all contraceptive methods were available at the nearest health centre.

Table 8.3: Timetable of SMS message delivery in Study 2 which were delivered in Chikwawa, Malawi in May 2016.

	Monday	**Wednesday**	**Friday**
Week 1	Planning for families (2xSMS)	Contraception (2xSMS)	Contraception (2xSMS)
Week 2	Condoms (2xSMS)	Condoms (2xSMS)	Male Condoms (3xSMS)
Week 3	Female Condoms (2xSMS)	Female Condoms (2xSMS)	Pill (2xSMS)
Week 4	Pill (2xSMS)	Contraception Injection (3xSMS)	Implant (2xSMS)
Week 5	Implant (2xSMS)	IUD (2xSMS)	IUD (2xSMS)
Week 6	SDM (2xSMS)	SDM (2xSMS)	Withdrawal (3xSMS)
Week 7	ECP (2xSMS)	ECP (2xSMS)	Female Sterilization (2xSMS)
Week 8	Female Sterilization (2xSMS)	Male Vasectomy (3xSMS)	Male Vasectomy (2xSMS)

Participants in the control group received usual care for sexual health which consisted of the choice to attend weekly contraceptive clinics at Mfera Health Centre and Youth Friendly Health Services for advice or to begin a new contraceptive method. Information regarding youth club attendance was obtained for both groups to identify if this was a source of health education (Section 7.9.7). Upon completion of the project, i.e. after the final six month follow up, those in the control group were given access to the intervention content.

8.7.4 Intervention Delivery

Due to the reliability concerns pertaining to the single handset for the intervention delivery software in Study 1, an online open sourced system (Engagespark.com) was used to provide a more convenient and less disruptive service which did not rely on continuous power supply to successfully send the messages. Engagespark, specialising in SMS based projects in low income countries, was used to schedule and send the intervention content. This

allowed the messages to be pre-programmed and automatically sent in the predetermined order once a participant was registered. Participants provided their mobile number at baseline and were manually registered on the online system.

8.7.5 Outcome Measures

Participants were asked twelve questions regarding their personal characteristics such as age, gender, education level, marital status, and phone ownership. Participants who did not own a mobile phone were asked four further questions on mobile phone accessibility, primarily around phone ownership of the shared phone (Appendix 19).

The Illustrative Questionnaire for Interview-Surveys with Young People (Cleland, 2001) was adapted to be specific to Malawi in order to determine contraceptive knowledge (recall and recognition) and attitudes to condom use. The questionnaire was created for the World Health Organisation as a core instrument for data collection in sexual and reproductive health (Cleland, Ingham & Stone, 2001). It was designed to understand knowledge, beliefs, behaviours and outcomes of sexual and reproductive health and includes 238 items addressing 10 variables in sexual health: sources of information on sexual and reproductive health; sexual and reproductive health knowledge; sexual conduct; sexual ideology/gender; protective behaviour; attitudes to condom use; current (most recent) boy/girlfriend; sexual and reproductive health services; sexual and reproductive health outcomes and background characteristics. This questionnaire is commonly used for sexual health research in low income countries (Mohammadi et al., 2006; Labrague et al., 2013; Decat et al., 2015), as well as in middle and high income countries (He et al., 2012; Ministry for Health Malta, 2012; Carlos et al., 2016).

Two sections of the Illustrative Questionnaire for Interview-Surveys with Young People were used in this study as they were relevant to the research questions; contraceptive health knowledge and attitudes to condom use.

8.7.5.1 Contraceptive Health Knowledge

Knowledge was assessed using two indicators; Contraception Recall Score and Contraception Recognition Score (Appendix 19). The Contraception Recall Score was obtained through free recall of known contraceptive methods and correctly recalled

methods were tallied to create the score (maximum of 10, if all 10 contraception methods were correctly recalled, see Appendix 19 for all possible methods). The Contraception Recognition Score was obtained using the dedicated section of the questionnaire which prompted participants with a one sentence summary of each contraceptive method. Participants were asked if they recognised each of the methods and recognised methods were tallied to create the score (maximum of 10, if all 10 contraception methods are correctly recalled).

8.7.5.2 Attitudes to condoms

Eight items measured attitudes towards condom use (Appendix 19). Participant were verbally presented with eight statements and asked to respond as to whether they agreed, did not know or disagreed with each statement. This was scored 3, 2 or 1 respectively, producing a score from 8-24. Items were reverse scored where necessary such that a higher score indicated a more positive attitude. An example of a statement from the scale is as follows; “if a girl suggested using condoms to her partner, it would mean that she didn't trust him”.

8.7.5.3 Contraceptive Behaviour

A single item measured behaviour in those who self-reported being sexually active (Appendix 19). Participants reported the frequency with which they used contraception on a three point scale; always, sometimes, never, and this was scored 3, 2 or 1 respectively. A higher score indicated more frequent use of contraception.

8.7.5.4 Intervention Acceptability

Participants in the intervention group were given an additional 7 multiple choice questions and four open ended questions at the initial follow up interview (Appendix 20) which asked questions about participant experience of the intervention, acceptability of SMS as a method for health education delivery, and self-reported changes in knowledge and behaviour post intervention. At 3 months and 6 months participants in the intervention group were given seven multiple choice questions and four open ended questions regarding their participant experience of the intervention, self-reported changes in knowledge and behaviour and other sources of health education provision, specifically

youth club attendance (Appendix 21). Participants in the control group were asked four questions regarding any other sources of health education provision and if they came into contact with members of the intervention group (Appendix 22).

8.7.6 Study 2 Analysis

Intention-to-treat (ITT) analysis was performed, therefore every participant was included in the analysis regardless of whether or not they were lost to follow up (Fisher et al., 1990). This method also disregards aspects such as whether or not the participant complied with the intervention (i.e. whether they read the messages or had issues with phone access) (Gupta, 2011). In this study, clusters were randomised to receive the intervention or act as a control, ITT analysis allows an accurate and unbiased interpretation of intervention effects, as limiting analysis to only those who received the intervention would produce biased and overestimated intervention effects (Nich & Carroll, 2002). The use of ITT analysis minimises type 1 error (false positive) and allows for the greatest generalisability of intervention effects (Fergusson, Aaron, Guyatt, & Hébert et al., 2002). Due to issues of evidence quality in the mHealth literature, it was imperative to conduct robust analysis to truly measure intervention effectiveness.

T-tests and Chi-squared analysis was used to identify any differences between groups in demographic variables (age, gender, education in years, marriage, children and whether the participant had ever had sexual intercourse) and outcome variables at baseline.

A one way analysis of covariance (ANCOVA) was used to determine differences between the change scores of the two groups after adjustment for covariates in demographic data. Change scores were generated by subtracting the baseline score from the follow up score at each time point for all outcome measures. This was employed for group differences between baseline and initial post intervention follow up, baseline and 3 month follow up and baseline and 6 month follow up in the 4 variables measured; contraceptive knowledge (recall and recognition), attitudes to condom use and self-reported contraceptive behaviour. Chi-squared analysis was used to determine whether there were any differences in receiving the intervention content by phone access.

Intervention acceptability multiple choice questions were collated and presented in terms of percentage of participants selecting each response. Open answer questions were analysed to identify positive and negative aspects of participant experience.

Examination of the data revealed significant contamination of the control group (30% of the control group received the intervention), therefore, post-hoc analysis was applied. Participants were separated into two new groups; those who received the intervention and those who did not. Analysis was repeated on all primary outcome measures using non-parametric Mann-Whitney U tests.

8.8 Results of SMS intervention evaluation

8.8.1 Study 2 Sample

The baseline demographic information for both the control and intervention group is displayed in Table 8.4.

Table 8.4: Baseline Demographics for control and intervention groups interviewed in Chikwawa, Malawi in May 2016.

		Control (n=129)		Intervention (n=127)	
		Female (n=67)	Male (n=62)	Female (n=61)	Male (66)
Age (years)	Mean (SD)	18.81 (2.9)	18.45 (3.1)	18.19 (3.2)	18.57 (2.9)
Years in education	Mean (SD)	6.91 (2.2)	7.73 (2.7)	6.40 (1.9)	7.00 (1.9)
% Married		41	24	22	17
% with children		48	20	38	23
% had sex		77	83	61	69

At baseline, there were no statistical differences between control and intervention groups in age ($t(254) = 0.65$, $p=.514$); gender ($X^2(1, N=256), = 0.39$, $p=.532$); or whether participants had children (X^2 (1, $N=256) = 0.34$, $p=.561$). However, at baseline, participants in the control group had spent longer in education ($t(244.56) = 2.05$, $p=.042$), were more likely to be married ($X^2(1, N=256) = 6.11$, $p=.013$) and were more likely to have had sex ($X^2(1, N=256)$ =

6.76, *p*=.009) compared to those in the intervention group. Therefore education, marriage and ever had sex were controlled for in the analysis.

The participant flow for the study is displayed in Figure 8.8, this states the number of participants who were interviewed at each of the four time points.

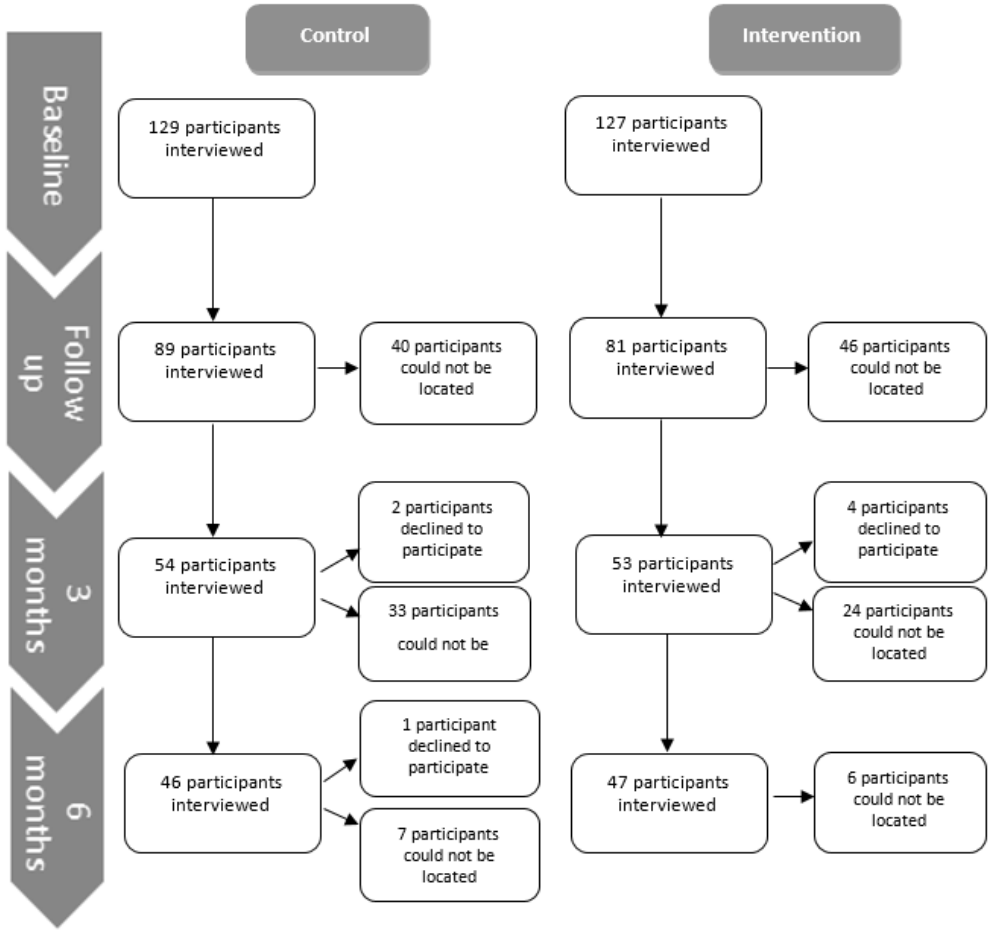


Figure 8.8: Participant flow throughout the four time points: baseline, follow up, three months and six months.

8.8.2 Attrition Rate

At initial follow up the attrition rate was 31% for the control group and 36% for the intervention group. This was primarily due to being unable to locate participants at follow

up either because they had relocated or were away from the area on the days of follow up interviews. At the three month intervention, 39% of those still involved at the initial follow-up were lost from the control, while 35% were lost from the intervention group: six participants declined to participate any further in the study and a further 57 could not be located. Finally at the six month time point 15% of those who were still involved at three month follow up were lost in the control and 11% from the intervention group. This is discussed in terms of feasibility in Section 8.10.

8.8.3 Intervention Access

In the intervention group, of the 127 participants interviewed at baseline, 45% (n=57) had access to their own device and 55% (n=70) had access to a shared device. However of those interviewed at follow up (n=81), those that owned their own phone dropped to 37% (n=30), while the number with shared access rose to 60% (n=49). Figure 8.9 compares mobile ownership by gender at baseline and follow up. Over both time points, males were more likely to own a mobile phone and females more likely to share a device.

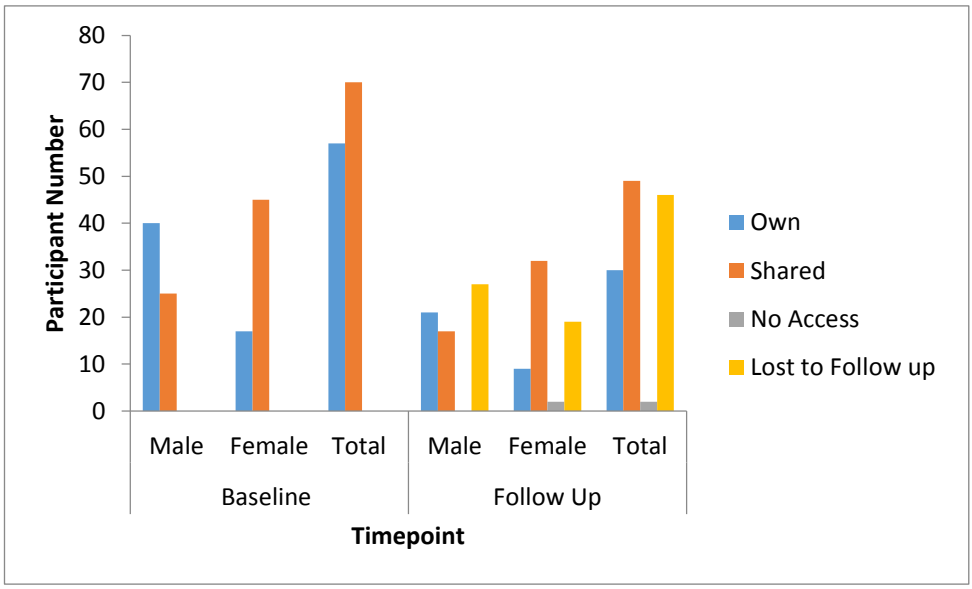


Figure 8.9*:* Phone access at baseline and follow in Intervention Group (n=127) in participants interviewed in Chikwawa, Malawi in 2016.

Figure 8.10 displays intervention access by gender, 59 participants, 46% of those recruited at baseline, received the intervention content, either through their own device (n=22) or a shared device (n=37).

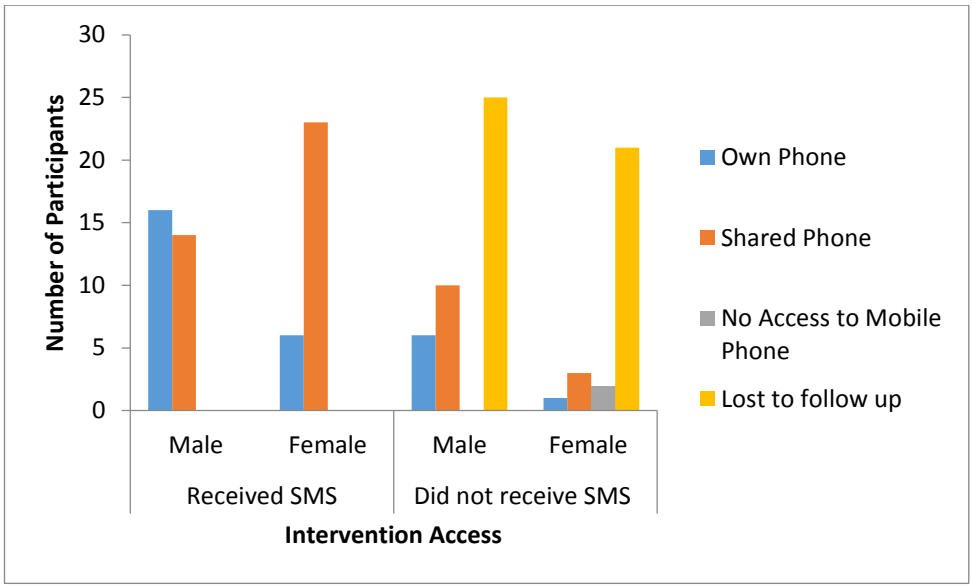


Figure 8.10: Intervention access by gender in intervention group (n=127) in participants interviewed in Chikwawa, Malawi in 2016.

Intervention access was equal for both male (n=30) and female participants (n=29). Of the 29 females who received the intervention, 21% received texts to their own phone and 79% to shared phone. In contrast, of the 30 males who received the intervention, 53% received texts to their own phone and 47% to a shared phone.

Sixty-eight participants (53%) did not have access to the intervention content and this was primarily due to a loss of participants to follow up (n=46). It is possible some participants who were lost to follow did receive the intervention, however for the purposes of the analysis it was assumed they did not as no further data was received. More males (n=41) did not receive the intervention compared to females (n=27). The expressed reasons for not receiving the intervention by participants included at follow up are displayed in Figure 8.11. There was no statistical difference between type of phone access and likelihood of receiving the intervention content, $X^2(1, N=127), 0.79, p=.375$.

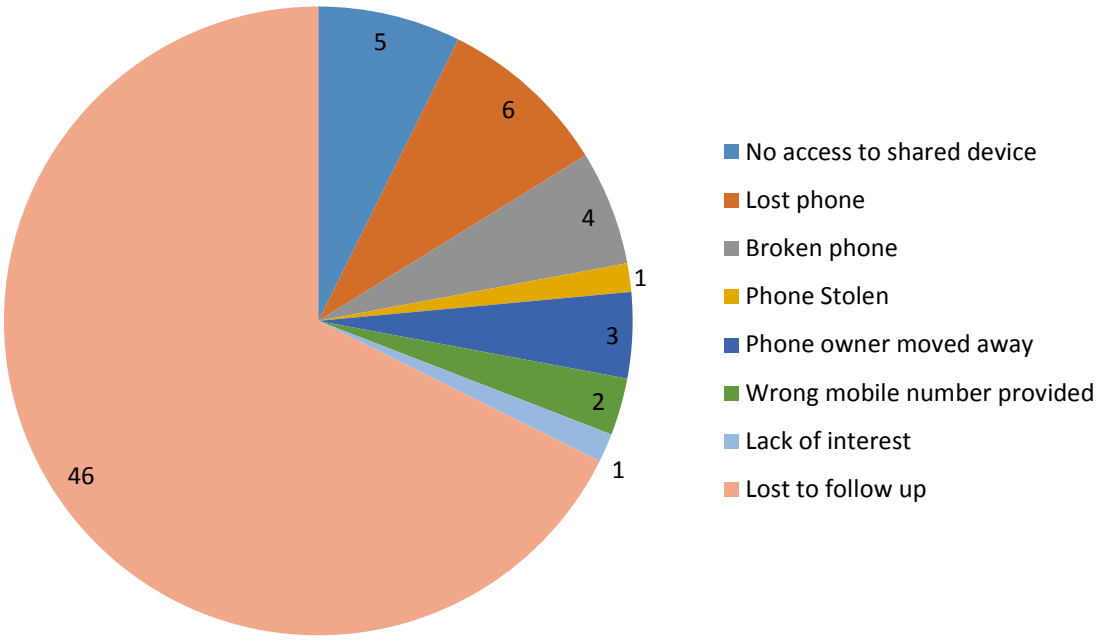


Figure 8.11*:* Reasons given for not receiving intervention access (n=68) in participants interviewed in Chikwawa, Malawi in 2016.

Participants with shared phone access at baseline (n=70) were given a paper diary to complete as they received the messages. Fifty-one percent (n=36) of the diaries were handed in at initial follow up and of these six were empty and 13 incomplete. Of the 17 which were completed; 41% had received all 25 message sets, 29% received 24 message sets, 12% received 22 message sets, 6% 20 message sets, 6% 18 message sets and 6% 16 message sets. Reasons provided for not accessing the messages on the date specified in the diary included mobile phone was not charged (on three occasions for one participant), phone owner on holiday (on three occasions for one participant), away from phone owner (on one occasion for two participants) and the remainder provided no comment as to why they did not receive the messages.

8.8.4. Cost Assessment

The SMS intervention sent 56 messages over a period of 8 weeks (see Section 7.9.3). The Engagespark system charged $0.06 per SMS message, therefore the cost to send the SMS intervention content was $3.36 per mobile phone.

8.8.5 Missing Data

There were no significant differences in gender, age, years in education, marriage, having children or ever had sex between those who were lost to initial follow up and those who stayed in the study. Nor were there any significant differences in any of the outcome variables between these two groups. There were also no significant differences in gender, age, years in education, marriage, having children, ever had sex or in any outcome variable between those lost to follow up at 3 months and 6 months and those who stayed in the study. Therefore it is appropriate to assume that participants were lost to follow up at random.

Last observation carried forward (LOCF) was implemented for participants who were lost to follow up so no missing values were in the dataset and intention to treat analysis could be performed. LOCF ensures each participant, regardless of length of time in the study, has a complete dataset for statistical analyses (European Medicines Agency, 2010). This method has been criticised for potentially introducing bias to the analysis due to two assumptions; assuming participant responses are stable across the time points and the assumption that participants have dropped out completely at random (Molnar, Hutton, & Fergusson, 2008). However this study has found no statistical differences in demographics among the missing data and as such proceeded with this technique.

8.8.6 Outcome Measures

8.8.6.1 Descriptive Statistics

The mean scores and standard deviations for the 4 outcome measures in the control and intervention group across the 4 time points are displayed in **Error! Reference source not ound.** 8.5. The two groups did not have equal scores at baseline on any of the four outcome measures: knowledge recall ($t(254) = 2.55$, $p=.011$); knowledge recognition ($t(254) = 2.25$,

p=.027); attitude to condom use (*t*(249.46) = 18.41, *p*<.001) and self-reported behaviour (*t*(249.92) = 2.18, *p*=.030). However the inferential statistics analysis used variable change scores instead of absolute values.

Table 8.5: Outcome measure Means and Standard Deviations, for control and intervention groups, at baseline, initiation follow up, three months and six months in Stage 2.

Variable	Group	N	Baseline M (SD)	Initial Follow-up M (SD)	Three months M (SD)	Six months M (SD)
Knowledge Recall	Control	129	2.64 (1.29)	3.13 (1.47)	3.04 (1.42)	3.17 (1.50)
	Intervention	127	2.21 (1.41)	2.94 (1.67)	2.91 (1.55)	3.02 (1.59)
Knowledge Recognition	Control	129	5.26 (1.68)	6.05 (1.62)	6.11 (1.67)	6.29 (1.66)
	Intervention	127	4.76 (1.89)	5.55 (1.91)	5.65 (1.86)	5.73 (1.86)
Attitudes to condom use	Control	129	20.23 (2.73)	19.54 (3.10)	19.87 (3.00)	19.96 (3.07)
	Intervention	127	14.37 (2.35)	17.80 (3.94)	18.05 (3.78)	18.20 (3.89)
Self-reported Behaviour*	Control	103	1.79 (1.07)	2.00 (1.00)	1.97 (1.03)	1.99 (1.02)
	Intervention	83	1.48 (1.20)	1.58 (1.22)	1.66 (1.22)	1.72 (1.23)

* only participants who self-reported being sexually active were asked this question

Inferential Statistics

The impact of the intervention on the four outcomes measures (contraceptive knowledge recall, contraceptive knowledge recognition, attitudes towards condom use and self-reported contraceptive use) was examined.

8.8.6.2 Contraceptive Knowledge (Recall)

A one way ANCOVA was conducted to determine the effect of the intervention (group) on the contraceptive knowledge recall change score; years in education, whether the participant was married and if they had ever had sex were controlled for as covariates. This procedure was repeated for each time point; initial follow up, 3 months and 6 months.

Assumptions were tested prior to analyses. Standardized residuals were normally distributed at each time point, and there were no outliers at any time point. There was a linear relationship between the covariates and contraceptive knowledge recall change score at each time point and homoscedasticity and homogeneity of variances was not violated at any time point. When testing for homogeneity of regression slopes an interaction was found between ever had sex and group at initial follow up $F(2, 249) = 7.08$, $p=.001$, 3 month follow up $F(2, 249) = 4.32$, $p=.014$ and 6 months follow up $F(2, 249) = 4.29$, $p=.015$. Entering whether the participants had ever had sex violated the homogeneity of regression slopes assumption, which would influence differences between groups and make it difficult to conclusively determine that any differences were intervention effects and not interaction effects (Field, 2009). Therefore ever had sex was removed as a covariate from analysis at each time point.

Initial follow up: The intervention group had a marginally higher contraception knowledge recall change score ($M=0.73$, $SD=1.30$) than the control group ($M=0.49$, $SD=1.43$), however after adjusting for covariates, this difference was not significant; $F(1, 252) = 1.31$, $p=.254$, partial eta squared =.01. A summary ANCOVA table is presented in Table 8.6.

Table 8.6: Analysis of Covariance Summary for contraceptive knowledge recall change score at initial follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	0.84	1	0.84	0.45	.002
Marriage	2.35	1	2.35	1.25	.005
Group	2.44	1	2.44	1.31	.005
Error	470.11	252	1.87		

Three month follow up: The intervention group had a marginally higher contraception knowledge recall change score ($M=0.70$, $SD=1.23$) than the control group ($M=0.40$, $SD=1.27$), however after adjusting for covariates, this difference was not significant; $F(1, 252) = 3.51$, $p=.062$, partial eta squared =.014. A summary ANCOVA table is presented in Table 8.7.

Table 8.7: Analysis of Covariance Summary for contraceptive knowledge recall change score at three month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	0.02	1	2.00	0.02	.000
Marriage	0.05	1	0.05	0.03	.000
Group	5.53	1	5.53	3.51	.014
Error	397.42	252	1.58		

Six month follow up: The intervention group had a marginally higher contraception knowledge recall change score (*M*=0.80, *SD*=1.29) than the control group (*M*=0.53, *SD*=1.38), however after adjusting for covariates, this difference was not significant; *F*(1, 252) = 1.97, *p*=.162, partial eta squared =.008. A summary ANCOVA table is presented in Table 8.8.

Table 8.8: Analysis of Covariance Summary contraceptive knowledge recall change score at six month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	1.73	1	1.73	0.96	.004
Marriage	0.57	1	0.57	0.32	.001
Group	3.54	1	3.54	1.97	.008
Error	452.04	252	1.79		

8.8.6.3 Contraceptive Knowledge (Recognition)

A one way ANCOVA was conducted to determine effects of group on the contraceptive knowledge recognition change score after controlling for years in education, whether the participant was married and if they had ever had sex. This procedure was repeated for each time point; initial follow up, three months and six months.

Assumptions were tested prior to analyses. Standardized residuals were normally distributed at each time point, and there were no outliers at any time point. There was a

linear relationship between the covariates and contraceptive knowledge recognition change score at each time point and homoscedasticity and homogeneity of variances was not violated at any time point. When testing for homogeneity of regression slopes an interaction was found between ever had sex and group at initial follow up $F(2, 249) = 4.37$, $p=.014$ and so was removed as a covariate from this analysis. There were no interaction between ever had sex at three and six months and therefore it was kept as a covariate in these analyses.

Initial follow up: The Intervention ($M=0.79$, $SD=1.55$) and control ($M=0.79$, $SD=1.56$) groups had similar contraception knowledge recognition change scores. After adjusting for covariates, no significant difference was found between the two groups; $F(1, 252) = 0.17$, $p=.681$, partial eta squared = .001. A summary ANCOVA table is presented in Table 8.9.

Table 8.9: Analysis of Covariance Summary for contraceptive knowledge recognition change score at initial follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	4.67	1	4.67	1.94	.008
Marriage	4.96	1	4.96	2.06	.008
Group	0.41	1	0.41	0.17	.001
Error	607.51	252	2.41		

Three month follow up*:* The intervention ($M=0.88$, $SD=1.40$) and control ($M=0.85$, $SD=1.48$) change scores were similar and no significant difference was found between the contraception recognition change score, $F(1, 251) = 0.04$, $p=.835$. A summary ANCOVA table is presented in Table 8.10.

Table 8.10: Analysis of Covariance Summary for contraceptive knowledge recognition change score at three month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	1.14	1	1.14	0.55	.007
Marriage	0.42	1	0.42	0.20	.001
Ever sex	5.63	1	5.63	2.73	.011
Group	0.09	1	0.09	0.04	.000
Error	518.05	251	2.06		

Six month follow up: The intervention (*M*=0.97, *SD*=1.58) and control (*M*=1.03, *SD*=1.57) change scores were similar and no significant difference was found between the contraception recognition change score, $F(1, 251) = 0.60$, $p=.438$. A summary ANCOVA table is presented in Table 8.11.

Table 8.11: Analysis of Covariance Summary for contraceptive knowledge recognition change score at six month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	1.16	1	1.16	0.47	.002
Marriage	0.00	1	0.00	0.00	.000
Ever sex	10.73	1	10.73	4.39	.017
Group	1.47	1	1.47	0.60	.002
Error	613.21	251	2.44		

8.8.6.4. Attitudes to Condom Use

A one way ANCOVA was conducted to determine effects of group on the attitudes to condom use change score after controlling for years in education, whether the participant was married and if they had ever had sex. This procedure was repeated for each time point; initial follow up, three months and six months.

Assumptions were tested prior to analyses. Standardized residuals were normally distributed at each time point, and there were no outliers at any time point. There was a linear relationship between the covariates and attitudes to condom use change score at each time point and homoscedasticity and homogeneity of variances was not violated at any time point. When testing for homogeneity of regression slopes an interaction was found between ever had sex and group at initial follow up $F(2, 248) = 3.34$, $p=.037$ and so this covariates was removed from this analysis. There were no interactions between ever had sex and group at 3 and 6 months and therefore it was kept as a covariate in these analyses.

Initial follow up: The intervention group had a larger attitudes to condom use change score (*M*=3.43, *SD*=2.75) than the control group (*M*= -0.69, *SD*=2.33), and after adjusting for covariates, this difference was found to be significant; $F(1, 252) = 108.34$, $p<.001$, partial eta squared =.301. This equates to a significantly more positive attitude towards condom use in the intervention group compared to the control, representing a small effect (Cohen (1988). A summary ANCOVA table is presented in Table 8.12.

Table 8.12: Analysis of Covariance Summary for attitude to condoms change score at initial follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	4.40	1	4.406	0.45	.002
Marriage	8.99	1	8.99	0.92	.004
Group	1055.29	1	1055.29	108.34*	.301
Error	2454.59	252	9.74		

*indicates p value of less than .05

Three month follow up*:* The intervention group had a larger attitudes to condom use change score (*M*=3.68, *SD*=3.59) than the control group (*M*= -0.36, *SD*=3.09), and after adjusting for covariates, this difference was found to be significant; $F(1, 251) = 85.43$, $p<.001$, partial eta squared =.254. This equates to a significantly more positive attitude

towards condom in the intervention group compared to the control at the three month follow up, representing a small effect. A summary ANCOVA table is presented in Table 8.13.

Table 8.13: Analysis of Covariance Summary in attitude to condoms change score at three month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	33.12	1	33.12	3.00	.012
Marriage	12.63	1	12.63	1.15	.005
Ever had sex	14.65	1	14.65	1.33	.005
Group	941.63	1	941.63	85.43*	.254
Error	2766.7	251	11.02		

*indicates p value of less than .05

Six month follow up*:* The intervention group had a larger change score (*M*=3.83, *SD*=3.68) than the control group (*M*= -0.27, *SD*=2.39) and after adjusting for covariates, this difference was significant *F*(1, 251) =106.93, *p*<.001, partial eta squared = .299. This equates to significantly more positive attitudes to condom use in the intervention group compared to the control group six months post intervention, representing a small effect. A summary ANCOVA table is presented in Table 8.14.

Table 8.14: Analysis of Covariance Summary for attitude to condoms change score at six month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	0.29	1	0.29	0.31	.000
Marriage	33.08	1	33.08	3.48	.014
Ever had sex	29.37	1	29.37	3.09	.012
Group	1016.79	1	1016.79	106.93*	.299
Error	2386.72	251	9.51		

*indicates p value of less than .05

8.8.6.5. Contraceptive Behaviour

The dataset was split to only include participants who had sexual intercourse at baseline in the intervention (n=83) or control group (n=103). A one way ANCOVA was conducted to determine effects of group on how often participants used contraception after controlling for years in education and whether the participant was married. This procedure was completed for each time point; initial follow up, three months and six months.

Assumptions were tested prior to analyses. Standardized residuals were normally distributed at each time point, and there were no outlines at any time point. There was a linear relationship between the covariates and attitudes to condom use change score at each time point and homoscedasticity and homogeneity of variances was not violated at any time point. When testing for homogeneity of regression slopes there were no interactions between group and covariates at initiation or three month follow up however an interaction between marriage and group was found at six month follow up $F(2, 180) = 4.58$, $p=.012$, and was therefore removed as a covariate from this analysis as it violated this assumption.

Initial follow up*:* The intervention group ($M=0.11$, $SD=0.44$) and control group ($M=0.09$, $SD=0.70$) had similar contraceptive behaviour change scores and after adjusting for covariates, there was no significant difference between the two; $F(1, 182) = 0.15$, $p=.700$, partial eta squared =.001. A summary ANCOVA table is presented in Table 8.15.

Table 8.15: Analysis of Covariance Summary for contraceptive behaviour change score at initial follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	0.23	1	0.23	0.64	.003
Marriage	0.25	1	0.25	0.69	.004
Group	0.05	1	0.05	0.15	.001
Error	65.83	182	0.36		

Three month follow up: The intervention group had a marginally higher contraception behaviour change score (*M*=0.14, *SD*=0.83) than the control group (*M*=0.05, *SD*=0.54), however after adjusting for covariates, this difference was not significant; *F*(1, 181) = 1.57, *p*=.212, partial eta squared =.009. A summary ANCOVA table is presented in Table 8.16**Error! Reference source not found.**.

Table 8.16: Analysis of Covariance Summary for contraceptive behaviour change score at three month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	1.40	1	1.40	2.82	.015
Marriage	2.26	1	2.26	4.54	.024
Group	0.78	1	0.78	1.57	.009
Error	89.92	181	0.49		

Six month follow up: The intervention group had a marginally higher contraception behaviour change score (*M*=0.16, *SD*=0.53) than the control group (*M*=0.03, *SD*=0.83), however after adjusting for covariates, this difference was not significant; *F*(1, 182) = 1.84, *p*=.176, partial eta squared =.010. A summary ANCOVA table is presented in Table 8.17.

Table 8.17: Analysis of Covariance Summary for contraceptive behaviour change score at six month follow up

Source	Sum of Squares	df	Mean Square	F	Partial Eta Squared
Education	1.44	1	1.44	2.89	.016
Group	0.92	1	0.92	1.84	.010
Error	90.44	182	0.49		

Summary of Inferential Statistics

The only significant effect of the intervention was on attitudes to condom use. There was no effect of the intervention on any of the other outcome variables; contraceptive knowledge recall, contraceptive knowledge recognition and contraceptive behaviour.

8.8.7 Secondary Outcomes

8.8.7.1. Intervention Acceptability

Initial follow up: Of the 59 participants who received the intervention, 54 (92%) reported understanding the message content. Participants were asked if they had questions about the intervention content and 42 (71%) stated they did not have any further questions on contraception methods. Of the 17 participants (29%) who did have questions regarding contraception, 15 stated they wanted to be able to receive answers to these questions by SMS, 1 participant (1%) wanted to do this at Mfera Health Centre and 1 (1%) participant from their local youth club. A summary of preferred mode of health education delivery for all time points is displayed in Table 8.18.

Table 8.18: Preferred mode of health education delivery in participants who requested further information at each time point in participants interviewed in Chikwawa, Malawi in 2016.

Time point	Mode of delivery				
	SMS	Mfera Health Centre	Youth Club	Radio	School
Initial follow up (n=17)	15 (88%)	1 (6%)	1 (6%)	0	0
3 month follow up (34)	29 (85%)	1 (3%)	2 (6%)	1 (3%)	1 (3%)
6 month follow up (25)	21 (84%)	0	0	2 (8%)	2 (8%)

All participants stated they would continue to use such a service if it was available in the future, and 49 participants (83%) stated they believed SMS was a good way to receive health information. Seventeen of these participants provided comment on why they thought the intervention was a good idea, these are presented in Figure 8.12. Nine participants (15%) declined to answer this question and 1 participant (2%) stated they felt it wasn't a good method for health education due to issues around mobile phone sharing;

> "… unless you have a personal phone it cannot work." *Female participant, aged 15.*

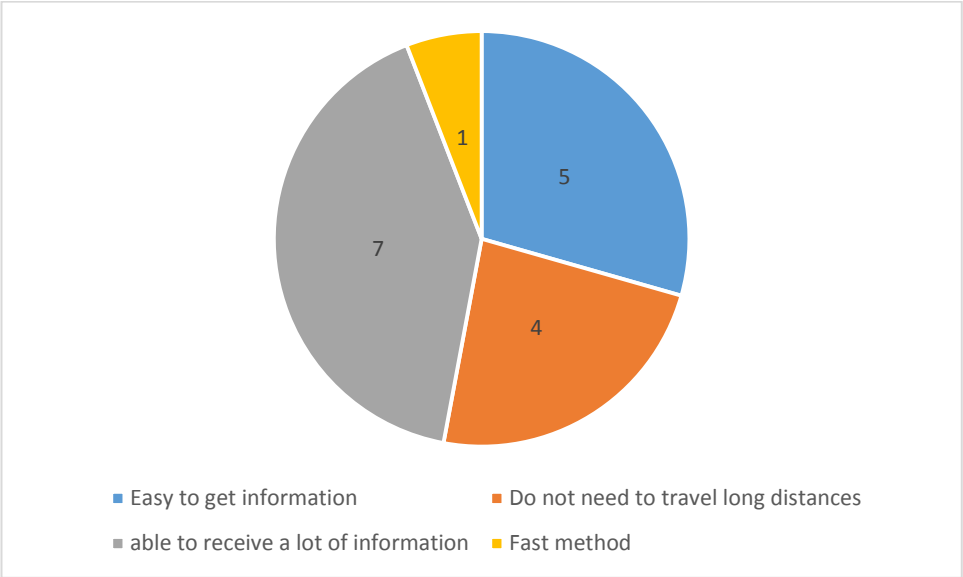


Figure 8.12: Participants' views about health education delivered using SMS (n=17) in participants interviewed in Chikwawa, Malawi in 2016.

Participants were asked if their personal opinion of contraception had changed post intervention; 40 participants (68%) stated they had changed their opinion and the reasons participants provided are presented in Table 8.19.

Table 8.19: Reasons for change in opinion of contraception (n=40) in participants interviewed in Chikwawa, Malawi in 2016.

Reason for change in opinion of contraception	N
Improved knowledge of contraception methods	9
Don't know	4
Now understands that contraception prevents unwanted pregnancy	4
Trust in the information	4
Will use contraception in the future	4
Undone contraceptive myths (e.g. injection causes cancer)	4
No comment	3
Now has confidence to use methods	2
Now knows how to use a condom properly (i.e. no repeat use)	2
Positive opinion of contraception post intervention	2
Changed contraceptive method	1
Started using contraception	1

Comments included;

> "Now know that injection doesn't bring cancer…as I previously thought" *Female participant, aged 21*
>
> "Now not afraid of the injection." *Female participant, aged 17*
>
> "Now know how to use condoms properly, won't use them twice." *Male participant, aged 15*
>
> "I know more types of contraceptives so I have a wider choice of what to use." *Male participant, aged 24*

Three month follow up*:* Of the 41 participants who had access to the intervention, 39 (95%) stated that they trusted the SMS messages they received (two participants did not respond to this question). Participants were asked if they wanted further information on contraception and if so, how they would prefer to receive the information. Thirty-four

participants (83%) wanted to receive further health education and of these the majority requested this education via SMS (**Error! Reference source not found.**).

At the three month follow up interview, participants who received access to the intervention (41 participants out of the 53 interviewed in the intervention group) were asked to comment on positive and negative aspects of the intervention (Table 8.20). The majority of participants (n=37) responded positively to the intervention, while four participants commented on negative aspects of the intervention;

> "We learned about other contraceptive methods we did not know." *Male participant, aged 15*
>
> "We could know the contraceptive methods easily rather than going to the hospital." *Male participant, aged 21*
>
> "I did not have anything to learn. I was an experienced person on family planning." *Female participant, aged 21*

Table 8.20: Positive and Negative comments on the Intervention (n=41) in participants interviewed in Chikwawa, Malawi in 2016.

	Number of Participants (%)
Positive Comments	
Increased knowledge of contraceptive methods	31 (76)
Easier access to contraceptive education	3 (7)
Able to receive information faster	1 (2)
Easier to remember information as stored on phone	2 (5)
Negative Comments	
Already knew the information	1 (2)
Did not understand the messages	1 (2)
Difficulty accessing shared device	2 (5)

Six month follow up: Thirty-six participants out of the 47 interviewed at follow up received the intervention. These participants were asked whether they felt they required further information on contraceptive methods and 25 participants (60%) agreed. Of these, 21 participants wanted to receive this information via SMS (**Error! Reference source not ound.**). Comments from those stating a preference for SMS included the ease of receiving information on mobile phones (n=10), the speed of getting the information (n=4), the confidentiality of information provision (n=3), the ability to store the information on the device (n=2) and there was no need for transport costs (n=2);

> "It's easy to access the messages on the phone." *Female participant, aged 21*
>
> "The messages are confidential and they come direct to me, so there is no worry that kids might get access to them." *Male participant, aged 21*
>
> "Cannot afford transport costs and I am a very busy person." *Female participant, aged 21*
>
> "…it does not need effort to go somewhere, it reaches the person instantly." *Female participant, aged 17*

Two participants stated they would prefer the information on the radio;

> "The information reaches everyone." *Male participant, aged 23*
>
> "…it is fast and reliable." *Male participant, aged 19*

The final two participants opted for information provision at their local youth club;

> "We can help each other and teach one another." *Male participant, aged 15*
>
> "Because access to phone was difficult." *Female participant, aged 17*

8.8.7.2. Self-reported knowledge and behaviour changes in those who received the intervention

Initial follow up: In terms of self-reported knowledge; 55 participants (93%) believed the intervention had improved their knowledge, one (2%) reported it had not changed their

knowledge and three (5%) declined to answer this question. A summary of the self-reported knowledge change at all time points is displayed in Table 8.21.

Table 8.21: Self-reported changes in contraceptive knowledge in the intervention group at all time points in participants interviewed in Chikwawa, Malawi in 2016/2017.

Contraceptive knowledge change	Initial follow up (n=59)	3 months (n=41)	6 months (n=36)
Self-reported improved knowledge	55 (93%)	38 (93%)	35 (97%)
Self-reported no change	1 (2%)	1 (2%)	1 (3%)
No answer to the question	3 (5%)	2 (5%)	0 (0%)

Participants were asked if their behaviour (contraceptive use) had changed post intervention; six participants (10%) stated no change, two participants (3%) didn't know and three (5%) declined to answer. Fifteen participants (26%) felt their contraceptive behaviour would change in the future (when they became sexually active); either due to increased knowledge (n=3) or intention to use contraceptives (n=9), and three participants provided no further comment.

"I now know a lot more about contraceptives." *Female participant, aged 24*

"I will now use contraceptive methods in the future." *Female participant, aged 15*

Thirty-three participants (56%) self-reported that they had already made a change in contraceptive behaviour post intervention; a summary of the self-reported behaviour change at all time points is displayed in Table 8.22.

Table 8.22: Self-reported contraceptive behaviour change in the intervention group at all time points in participants interviewed in Chikwawa, Malawi in 2016/2017.

Contraceptive behaviour change		Initial follow up (n=59)	3 months (n=41)	6 months (n=36)
Self-reported change in behaviour in those sexually active		**33 (56%)**	**28 (68%)**	**20 (56%)**
	New method	*8*	*3*	*5*
	Changed method (specific)	*0*	*3*	*7*
	Changed method (unspecified)	*0*	*0*	*4*
	Now use contraception properly	*3*	*2*	*0*
	Avoid unprotected sex	*3*	*3*	*2*
	Increased knowledge and perceptions	*19*	*16*	*2*
	Increased access to health education	*0*	*1*	*0*
Self-reported intention to change when become sexually active		**15 (26%)**	**9 (22%)**	**8 (22%)**
	Increased knowledge	*3*	*5*	*2*
	Intention to use contraception	*9*	*4*	*6*
	No comment	*3*	*0*	*0*
Self-reported no change		**6 (10%)**	**2 (5%)**	**4 (11%)**
Don't know		**2 (3%)**	**0**	**0**
No answer to the question		**3 (5%)**	**2 (5%)**	**4 (11%)**

Eight participants self-reported using a new contraceptive method including condoms (n=3), implant (n=1), IUD (n=1) and female condom (n=1) and two participants didn't state the specific method. Three participants stated avoiding unprotected sex and three participants stated they felt they had improved their contraception use;

> "I now use the condom more." *Male participant, aged 15.*
>
> "My use of family planning has improved." *Male participant, aged 23*

The remaining 19 participants (of the 33 who stated they had made a contraceptive behaviour change) provided information on increased knowledge and awareness of contraceptive methods and did not provide any information on the specific behaviour change they were referring to;

> "I have changed...it improves planning for future... you can even plan on how many kids you need using this." *Male participant, aged 15*
>
> "I am free and flexible to decide to use methods." *Female participant, aged 19*
>
> "Knowledge of contraception has been greatly improved." *Male participant, aged 19*

Three month follow up*:* When asked at the three month follow up (n=41), 38 participants (93%) stated they believed the intervention had changed their knowledge of contraception, one participant (2%) believed it hadn't impacted their knowledge and 2 participants (5%) did not respond (**Error! Reference source not found.**). In regards to self-reported behaviour hange, 9 participants self-reported an intention to change their behaviour when they became sexually active either through increased knowledge (n=5) or intention to use contraception (n=4) and 28 participants (68%) stated that they had changed their behaviour post intervention (Table 41).

Three participants self-reported changing contraceptive method, from condoms to the injection (n=2) and from condoms to the implant (n=1). An additional three participants reported they now used contraception but gave no specific method, three participants reported avoiding unprotected sex and two participants stated now using contraception properly;

> "I now know about the implant and started using it. I was using condoms before." *Female participant, aged 18*

> "At first we used to do unprotected sex but now we use conceptive methods." *Male participant, aged 16*

> "I use protection and don't do unprotected sex." *Female participant, aged 21.*

> "In the past I used a condom several times but now I use it once." *Male participant, aged 26*

The remaining 17 participants (of the 28 who reported a contraceptive behaviour change) commented on changes in knowledge of contraceptive methods (n=16), and increased access to education (n=1) rather than behaviour change.

> "I have learnt to use a condom during sex to prevent contracting sexually transmitted diseases." *Male participant, aged 23*.

> "Back then we used to get contraceptive information at the hospital only but now we can get it from our phones." *Male participant, aged 15*

Two participants (5%) believed it hadn't impacted their behaviour, both of these participants knew the contraceptive methods prior to receiving the messages and one was already using contraceptive methods prior to the intervention so at initial follow up and 3 months stated the intervention had not changed her behaviour. The final two participants (5%) did not respond to this question.

> "…because the contraceptive methods are the same as before." *Female participant aged 20*

> "It's the same, I was using contraceptive methods before and I am still, even now." *Female participant, aged 21.*

When asked if participants felt the behaviour change they made immediately post intervention was still the case 3 months post intervention, only 5 of the 28 believed this to be the case. Thirteen stated they did not believe this was the case and ten participants did not respond to the question. No comment was provided by participants as to how their behaviour had changed, only that it was not the same as immediately post intervention.

Six month follow up: Ninety-seven percent of participants (n=35) included at the six month follow up, self-reported their contraceptive knowledge had changed post intervention and 3% (n=1) believed it had not changed their knowledge (**Error! Reference source not ound.**). In regards to self-reported behaviour change, 8 participants self-reported an intention to change their behaviour when they became sexually active and 20 participants (56%) stated that they had changed their behaviour post intervention (Table 41).

Five participants stated starting a new contraceptive method including condoms (n=3), contraceptive pill (n=1) and injection (n=1). Seven participants stated they had changed their contraceptive method, including; pill to injection (n=1), condom to implant (n=1), injection to implant (n=1), injection to IUD (n=2) and condoms to SDM (n=2).

"I wasn't using any contraceptives back then but now I'm using condoms." *Male participant, aged 20*

> "I was using condoms back then because I didn't have knowledge of the other methods but now I am using implant." *Female participant, aged 19*

Six participants stated they now use an unspecified contraceptive method (n=4) or avoid unprotected sex (n=2).

> "In the past I never used contraceptive methods but now I use them." *Male participant, aged 23*

> "Now I refuse to sleep with men without protection." *Female participant, aged 20*

Two participants did not provide details of their behaviour change, but rather discussed their increased knowledge of contraceptive methods.

> "I now know I have various choices on contraceptive methods. *Female participant, aged 19*

When asked if this behaviour change was still adopted 6 months on only one participant (5%) stated yes, 11 (55%) said no and 8 (40%) did not respond to this question.

8.8.7.3 Youth Club Attendance

At three month follow up, participants in the control (n=54) were asked if they attended a local youth club, 23 participants (43%) stated they regularly attended and of those 21 participants had received health education. When asked again at 6 months (n=46), 24 participants (52%) regularly attended and of these, 19 participants reported received health education. In comparison, those in the intervention group at three months (n=53) were asked if they regularly attended youth club and 21 participants (40%) attended and of these 17 participants reported receiving health education. When asked again at 6 months (n=47), 22 participants (47%) reported attending and of these, 20 participants received health education. Self-reported topics for all participants are presented in Table 8.23, participants could state as many topics as they wished, however all participants only provided one general topic, so only topic headings could be collated.

Table 8.23: Self-reported health education topics received at youth club in Control Group and Intervention Group in participants interviewed in Chikwawa, Malawi in 2016/2017.

Health Education Topic Received	**Control Participants**		**Intervention Participants**	
	3 month follow up (n=21)	6 month follow up (n=19)	3 month follow up (n=17)	6 month follow up (n=20)
HIV/AIDS	7 (33%)	3 (16%)	2 (12%)	4 (20%)
Contraception	4 (19%)	5 (26%)	2 (12%)	7 (35%)
Hygiene	9 (43%)	10 (53%)	8 (47%)	8 (40%)
Nutrition	1 (5%)	1 (5%)	2 (12%)	0
Life choices	0	0	3 (17%)	0
Rights of children	0	0	0	1 (5%)

When comparing health education topics taught at youth club in both groups, there was more variation in the self-reported topics in the intervention group, however core health topics such as hygiene, HIV/AIDS and contraception were the most reported topics for both groups.

8.8.8 Post-Hoc Analysis

8.8.8.1. Study Sample

At 3 month follow up it was ascertained that 21 out of 54 participants in the control group had met someone with access to the intervention content and 16 of these participants had read at least one set of messages (average 3.44 sets read per person). Therefore due to this known cross-offer effect, the sample was split into two new groups; all participants who self-reported having access to the intervention (n=75) and all participants who did not have access to the intervention, either through mobile phone accessibility or loss to follow up (n=181). The analysis was re-run for differences in primary outcomes between the two groups. This was analysed using intention to treat analysis and LOCF was used to substitute missing data for each outcome. Mann Whitney U tests were performed for the change scores between baseline and initial post intervention follow up, baseline and 3 month follow up and baseline and 6 month follow up in the 4 variables. Table 8.24 displays baseline characteristics for the two groups.

Table 8.24: Baseline characteristics of those who had access to the SMS messages and those who did not have access when it was delivered in Chikwawa, Malawi in 2016/2017.

		Access to SMS (n=75)		No access to SMS (n=181)	
		Female (n=39)	Male (n=36)	Female (n=89)	Male (n=92)
Age, years	Mean (SD)	18.84 (2.9)	17.87 (2.8)	18.12 (3.0)	18.66 (2.8)
Years in education	Mean (SD)	6.77 (2.2)	7.24 (2.7)	6.82 (2.3)	7.32 (2.5)
% Married		41	16	30	23
% with children		30	28	34	30
% had sex		71	65	71	77

At baseline, there were no statistical differences between those who had access to the SMS messages and those who had no access in age; $t(254) = -0.57$, $p.571$; gender $X^2(1, N=256) = 0.17$, $p=.680$; years in education $t(158.16) = 0.89$, $p=.376$; marriage $X^2(1, N=256) = 0.11$, $p=.737$; having children $X^2(1, N=256) = 0.46$, $p=.497$ and ever had sex $X^2(1, N=256) = 1.92$, $p=.166$. In regards to outcome variables; at baseline there were no statistical difference

between those who had access to the SMS messages and those who had no access in knowledge recall $t(254) = -1.18$, $p=.238$; knowledge recognition $t(254) = -0.09$, $p=.931$ and self-reported behaviour $t(254) = 1.29$, $p=.198$. There was a significant difference in attitudes to condom use $t(254) = 4.01$, $p<.001$, with those who had no access to the intervention having a significantly more positive attitude score (M=17.93, SD=3.85) than those who had access (M=15.85, SD=3.59) at baseline. However post-hoc analysis compared change scores for each variable and not absolute values, therefore the potential bias is removed through this method (Bertrand et al., 2004).

8.25 displays mean scores and standard deviations for each of the 4 outcome variables across the four time points.

Table 8.25: Variable Means and Standard Deviations, for those who had access to the SMS messages and those who had no access, at each time point when it was delivered in Chikwawa, Malawi in 2016/2017.

Variable	Group	N	Baseline M (SD)	Initial Follow-up M (SD)	Three months M (SD)	Six months M (SD)
Knowledge Recall	Received SMS	75	2.59 (1.37)	3.99 (1.55)	3.72 (1.26)	3.85 (1.36)
	Did not receive SMS	181	2.36 (1.67)	2.65 (1.41)	2.67 (1.47)	2.78 (1.52)
Knowledge Recognition	Received SMS	75	5.03 (1.85)	6.32 (1.55)	6.44 (1.48)	6.61 (1.44)
	Did not receive SMS	181	5.01 (1.76)	5.59 (1.84)	5.65 (1.84)	5.76 (1.85)
Attitudes to condom use	Received SMS	75	15.85 (3.59)	19.96 (2.92)	20.25 (2.69)	20.59 (2.79)
	Did not receive SMS	181	17.93 (3.85)	18.15 (3.78)	18.43 (3.69)	18.46 (3.73)
Self-reported Behaviour	Received SMS	50	1.49 (1.17)	1.67 (1.21)	1.83 (1.20)	1.93 (1.21)
	Did not receive SMS	106	1.70 (1.34)	1.85 (1.10)	1.81 (1.11)	1.82 (1.11)

Mann-Whitney U tests were used to test for any differences between those who received (n=75) and those who did not receive the SMS messages (n=181) at all three time points for

knowledge recall, knowledge recognition and attitudes to condoms. Mann-Whitney U tests were also used to test for any differences between those who reported having sexual intercourse at baseline in those who received (n=50) and those who did not receive the SMS messages (n=106) at all three time points for contraceptive behaviour. Central tendency is reported as both the median and mean rank (from the Mann-Whiney U test) as the median is not always meaningful when a short response scale is used.

8.8.8.2 Contraceptive Knowledge (Recall)

Median and rank scores are shown in Table 8.26. Contraceptive recall change scores were greater in those who had received the SMS messages compared to those who had not received them, and this was the case at each time point (U= 9980.0, *z*= 6.31, *p*<.001, r= .39; U= 9525.5, *z*=5.41, *p*<.001, r=.34; U= 9397.0, *z*=5.17, *p*<.001, r=.32 at initial, 3 and 6 month follow-up respectively). The effect size was small throughout.

Table 8.26: Mean and rank scores for all measures: Contraceptive Knowledge (Recall), Contraceptive Knowledge (Recognition), Attitudes to Condoms and Contraceptive Behaviour

Variable	Group	N	Initial Follow-up		Three months		Six months	
			Median	Mean Rank	Median	Mean Rank	Median	Mean Rank
Knowledge Recall	Received SMS	75	1	171.07	1	165.01	1	163.29
	Did not receive SMS	181	0	110.86	0	113.37	0	114.08
Knowledge Recognition	Received SMS	75	1	156.67	1	161.15	1	158.61
	Did not receive SMS	181	0	116.87	0	114.97	0	116.02
Attitudes to condom use	Received SMS	75	4	182.21	5	180.22	6	185.44
	Did not receive SMS	181	0	106.25	0	107.07	0	104.91
Self-reported Contraceptive behaviour	Received SMS	50	0	102.12	0	105.26	0	180.01
	Did not receive SMS	106	0	90.70	0	88.46	0	87.44

8.8.8.3 Contraceptive Knowledge (Recognition)

Median and rank scores are displayed in Table 8.26. Contraceptive recognition change scores were greater in those who had received the SMS messages compared to those who had not received them, and this was the case at each time point (U=8893.0, z=4.12, p<.001, r.25; U=9236.5, *z*=4.78, *p*<.001, r=.29; U= 9045.5, *z*=4.39, *p*<.001, r=.27 at initial, three and six month follow up respectively). The effect size was small throughout.

8.8.8.4 Attitudes to condoms

Median and rank scores are displayed in Table 8.26. Attitudes to condom use change scores were greater in those who had received the SMS messages compared to those who had not received them, and this was the case at each time point (U=10815.5, *z*=7.91, *p*<.001 r=.49; U=10666.5, *z*=7.47, *p*<.001, r=.47; U=11058.0, *z*=8.34, *p*<.001, r=.52 at initial, three and six month follow up respectively). The effect size was moderate throughout.

8.8.8.5 Contraceptive Behaviour

Median and rank scores are displayed in Table 8.26. There was no difference in contraceptive behaviour change scores at initial follow up. Contraceptive behaviour change scores were greater in those who had received the SMs messages compared to those who had not received them at 3 and 6 months follow up post intervention (U=3781.0, *z*=1.45, *p*=.147, r=.12; U=3988.0, *z*=2.23, *p*=.026, r=.18; U=4125.5, *z*=2.78, *p*=.005, r=.22 at initial, three and six month follow up respectively). The effect size was small throughout.

8.8.8.6 Summary of post-hoc analysis

Those receiving the intervention had significantly higher knowledge in both recall and recognition at initial follow up, three months and six months post intervention; expressed more positive attitudes to condom use at initial follow up, three months and six months post intervention and were significantly more likely to regularly use contraception at three months and 6 months post intervention.

8.9 Discussion of the SMS intervention evaluation

8.9.1 Primary Outcomes

No significant differences were found in the mean change scores in contraception knowledge recall, contraception knowledge recognition or contraceptive behaviour between the control and intervention groups at any time point. This is in contrast to previous one way messaging interventions providing information on sexual health which found significant increases in knowledge post intervention (Lim et al., 2012; Gold et al., 2011a; Gold et al., 2011b), yet comparable to similar interventions which found no

significant change in contraceptive behaviour change post-intervention (Juzang et al., 2011; Lim et al., 2012; Gold et al., 2011; Odney et al., 2014; Njuguna et al., 2016).

However this study did find that, post-intervention, attitudes to condom use were more positive in the intervention compared to the control group and that this difference was sustained at 3 and 6 months post-intervention. These results are similar to those found in a study in Mozambique, which found an SMS based intervention reduced beliefs in contraceptive myths such as infertility and increased the proportion of participants who believed contraceptive can be used by young people (Feyisetan, Benevides, Jacinto & Mutumbo, 2015). However, the Feyisetan et al study used a pre vs post design and did not include a control, therefore the current study evidences increased attitudes to condom use using more rigorous methodology.

The measure of attitudes to condom use encapsulates attitudes and other beliefs surrounding the use of condoms, including whether the participant believes condoms should be used with casual partners, for those in relationships and for those who are married. Condoms are the only contraceptive method which protects against pregnancy and STIs including HIV (WHO, 2011), therefore fostering more positive attitudes to condom use is significant in regards to changing perceptions in rural Malawi. Contraception decision making is a complex process (French, Welling, & Cowan, 2009). It not only requires obtaining correct information and access to services (Institute of Medicine, 1995), but is also influenced by the perceptions of partners and family members (Hodgson, Collier, Hayes, Curry, & Fraenkel, 2013; Daley, 2014). Therefore changing attitudes to condom use is an important step towards an increase in condom use, as positive perceptions are a prerequisite to decision making about their use. Thus the observation that the SMS intervention in the current study increased positive attitudes to condom use is an important outcome. This is particularly true for adolescents, as condoms are the predominant contraceptive choice for first sexual intercourse in adolescents (Martinez, Copem, & Abma, 2011), so positive attitude change for this particular contraceptive method is an especially positive finding in this population.

8.9.2 Access to the intervention

In regards to intervention reach, 46% of participants in the intervention group received access to the intervention, and gender access was equal. Although equal gender access is positive, there were gender based differences in phone access, with male participants more likely to receive the intervention to their own device and female participants more likely to receive the intervention through a shared device. Message diaries showed that 41% of those with shared access self-reported they received all the SMS messages. Previous research in Nigeria, has shown that access to medical advice on a shared mobile phone is acceptable (Flax et al., 2017), however how much access participants actually have has been queried (Lau et al., 2014). The diary data in the current study, although limited, provides a starting point regarding shared phone access. Further work is needed to examine the impact of shared ownership on equality of health education reach, especially in relation to gender based inequality of access.

8.9.3 Intervention Acceptability

The current study found that provision of sexual health information via SMS messages was highly acceptable. The majority of those who received the intervention reported they understood the messages, trusted the message content and all participants stated they would use an SMS intervention in the future. This is consistent with previous findings in sub-Saharan African countries; SMS interventions have repeatedly been found to be acceptable in Kenya (Vahdat et al., 2013), Tanzania (FHI 360, 2013), Uganda (Chang et al., 2012) and South Africa (Nachega et al., 2016). The current study adds to this evidence base by providing support for the acceptability of an SMS behaviour change tool within this sample in rural Malawi.

Participants who received the intervention were asked if they required further education on contraception post intervention and what method of delivery they preferred to receive this on. The predominant modality requested to receive additional information at each time point was SMS, with an additional small proportion requesting education through Mfera Health Centre, youth club, radio and school. The preference for SMS is interesting, considering 40% and 47% of the intervention group attended a local youth club 3 months and 6 months post intervention respectively, and participants noted that they frequently

received health education during the youth club meetings. Information regarding the specific education received at youth club meetings was too general to analyse the extent to which this information may have influenced knowledge and behaviour change during the intervention. The fact that the majority of participants requested receiving further health education through SMS, even though so many attended youth club, could be due to a recency effect from this study, as previous research in rural settings has found that participants state a preference for face to face delivery methods (Kozica et al., 2015; Calderon et al., 2017). However participants provided valid reasons for their choice such as the ability to store educational messages for reference, the ease and speed of delivery, and the fact that this method prevented traveling long distances to receive information at the health centre. Due to participants requesting further education via SMS, future research could focus on the implementation of two way messaging systems in the area, enabling direct health professional to patient communication without the barriers identified above such as travel, cost and long waiting times. This method has been identified in reviews as more beneficial (Gurnman et al., 2012; Tomlinson et al., 2013; Wald, Butt, & Bestwick, 2015), and stated as a preference by two groups in initial qualitative analysis (Chapter 2), however implementation has more resource restraints than one way messaging systems.

In addition to the single item on the questionnaire asking about self-reported contraceptive use, additional qualitative questions were asked about the specific behaviour change which occurred. Qualitative data found that 27%, 65% and 14%, at initial follow up, 3 month and 6 months respectively, discussed an increase in contraceptive knowledge as opposed to demonstrable changes in contraceptive use. Therefore self-reported behaviour change might not be an accurate reflection of actual behaviour change. This has been found in similar SMS based studies in sexual and reproductive health (L'Engle et al., 2013; Vadhat et al., 2013), where SMS based questions of whether an SMS intervention changed the way participants' used family planning was poorly answered and answers included general discussion of changes in knowledge or perceptions of contraceptive use. These studies were cross-sectional and self-reported post intervention changes could not be compared to baseline data. Weak methodology is a frequent criticism of the field, particularly due to the reliance of small scale pilot studies with poor study designs (Gurman et al., 2012; Aranda-Jan et al., 2014; Hall et al., 2014). Therefore this study adds to this literature using quasi-

experimental methods, appropriate measures and robust statistical analysis to determine intervention effectiveness in addition to self-reported measures.

High contamination of the control group resulted in post-hoc analysis to compare those who reported receiving the intervention against those who reported not receiving the intervention. These analyses indicated those receiving the intervention had higher contraceptive knowledge (recall and recognition) at all three time points, more positive attitudes to condom use at all three time points and more likely to use contraception at 3 and 6 months post intervention. These results are in line with previous SMS interventions on sexual health in low income countries which have been evaluated and shown positive intervention effects on knowledge (Johnson et al., 2017), and attitudes and behaviour (Feyisetan, et al., 2015). However, the global evidence base of one way SMS interventions for sexual health, indicates a stronger evidence for positive intervention effects on knowledge (Lim et al., 2012; Gold et al., 2011a; Gold et al., 2011b) than on behaviour (de Tolly et al., 2012). It has been suggested that intervention content which is individually tailored (Cole-Lewis & Kershaw, 2010; Tomlinson et al., 2013) or includes additional face to face intervention components (Lau et al., 2011) are needed to support behaviour change.

Study 2 provides further evidence for the acceptability of an SMS behaviour change intervention for contraception, among adolescents in rural Malawi and has demonstrated significantly more positive attitudes to condom use in the intervention group which was sustained 6 months post intervention. Cost assessment of the intervention revealed that this 8 week intervention can be delivered at $3.36 (£2.52) per mobile phone. Cost-effectiveness evaluations of mHealth interventions are not routinely reported in the literature but are needed to secure investment (Schweitzer & Synowiec, 2012) and cost assessment has been identified as one of four barriers to mHealth implementation at scale (WHO, 2011). Two cost assessments of similar mHealth interventions implemented in low income countries are available (Chang et al., 2012; Larsen-Cooper et al., 2016). Chang and colleagues (2012) delivered a health intervention aiming to improve AIDS care outcomes via the use of peer health workers at a cost of $2.35 per patient, however the cost of the mHealth component could not be isolated. Larsen-Cooper et al. (2016) costed a telephone hotline for maternal and new-born health at $29.33 per user and $4.33 per successful contact with an estimated 48% reduction in costs if the service was used at full capacity.

The relatively low cost per mobile phone found in the current study is an advantage for this type of preventative healthcare provision, particularly as the percentage of the Malawian national budget attributed to healthcare has declined from 12% in 2013/2014 to 9% in 2016/2017 even though the total budget had been increasing (UNICEF, 2017). Due to budget cuts and overstretched national healthcare costs, the Government of Malawi will be looking for low cost options to deliver services to reach their national health priorities, such as contraceptive provision to reduce population growth.

8.10 General Discussion

Both Study 1 and Study 2 demonstrated that the mobile signal and infrastructure are adequate to implement such an intervention in the area. Limitations of the TextIt software used in Study 1 lead to a change in system to use Engagespark where messages were delivered online. Although registration using Engagespark required manual administration of mobile phone numbers, it had a 100% success rate in delivering the 25 sets of SMS messages throughout the 8 week intervention in Study 2. Limitations of the software in Study 1 were specific to Malawi, as the ability to send messages through online means was not yet available on TextIt, however both systems were open source and could be used in future research pending this function was available in the research country.

Mobile phone accessibility was highlighted as a potential barrier to intervention effectiveness in Study 1, particularly among female participants who were more likely to have shared phone access. This was not as prominent in Study 2, but females were still more likely to share a mobile phone, however more male participants struggled to get access to the intervention (n=41) compared to females (n=27). From both studies, access to shared mobile devices remains a barrier to this type of behaviour change intervention, although it may not be as specific to female participants as originally anticipated after Study 1. Changes to recruitment in Study 2 may have influenced better access to shared devices, by including shared phone owners in the recruitment process and obtaining their permission. In addition, greater awareness of the research in this geographical area at the time of Study 2, may have positively influenced shared phone owners to participate. This was found in earlier stages, where participants believed peers would be more likely to trust the intervention if they aware of the research beforehand (Laidlaw et al., 2017; Chapter 2). Nevertheless, gender differences in mobile phone access in the area needs to be

considered (Waldman, Morgan, & George, 2015), particularly in terms of shared access reach. A review by Jennings and Gagliardi (2013) found that mHealth can positively influence gender relations yet can also negatively influence power imbalances and inequality in access. Therefore, further research is needed to identify gender differences in mobile phone access in order to understand how this could impact the reach of large scale SMS interventions across Malawi.

Both studies highlighted intervention acceptability with 100% of participants who received the intervention willing to use a similar service in the future in both Study 1 and Study 2. Participants in both studies cited the advantages of this type of intervention in their area such as ease and speed of access, confidentiality, message storage and no requirement to travel to the nearest health centre. This echoes previous literature within sexual and reproductive health (Chang et al., 2012; FHI 360, 2013; Vahdat et al., 2013; Nachega et al., 2016). The current study adds to this evidence base by providing support for the acceptability of an SMS behaviour change tool within this sample in rural Malawi.

Attrition was high across all time points of Study 2 and moderately high in Study 1. This was primarily due to being unable to locate participants on the days of data collection. Residents of rural Malawi rely heavily on money from farming to provide for their families, and this is predominantly completed during core working hours. Therefore as the data collection schedule was limited to core working hours, due to safety issues in the area after dark, this coincided with both working participants and those who were attending school. Even with mobile phone numbers to contact participants, these commitments prevented participants from being interviewed on the specific days for data collection. A review of maternal health intervention studies in Sub-Saharan Africa found attrition to be a major challenge, with rates ranging from 19% to 89.4% within the 44 studies (Kalembo & Zgambo, 2012). Other similar SMS based interventions have found much lower attrition rates than the current study, 18% (Odney et al., 2014) and 10% (Njuguna et al., 2016) however both recruited in closed settings such as schools and hospital clinics and not out in the community. Eysenbach (2005) has previously noted that high drop-out rates in eHealth studies are a common feature, but do not always mean the intervention was unsuccessful. High loss to follow up due to not locating individuals does not necessarily mean that participants have lost interest or stopped using the intervention (Pine & Fletcher, 2015).

Therefore it is important to make every attempt to locate participants to identify whether this is the case, future studies may wish to discuss with participants the acceptability of long term follow up interviews over the phone and to arrange this method upon recruitment.

Participant location also contributed to contamination of the control group in Study 2, where participants in the control group received access to the intervention from peers in the intervention group. It was predicted that some cross-over would occur due to the geographical location of the control and intervention groups, however 30% reported reading intervention content. Even after taking measures to recruit from the two furthest possible areas in the Mfera catchment area, due to frequent travel between communities and access to local facilities and the only secondary school, more participants than anticipated received access to the intervention by peers. This is extremely positive in terms of participants' willingness to share health information and discuss such important health topics, however from the experience of this research, it makes the implementation of robust methodological designs extremely challenging. A randomised controlled trial (RCT) was not feasible in this instance, and cluster randomisation was the next best method, however this method still had difficulties in practice. Although RCTs are seen as the 'gold standard' design (Bothwell et al., 2016), it may be that in this type of research setting, unless a matched village can be located in a neighbouring district (requiring more substantial resources for data collection and the potential for incompatible belief systems and perceptions), pre/post intervention designs can provide an alternative to obtain conclusions about intervention effectiveness. This is in line with research in both health education (Sullivan, 2011) and public health (Victora, Habicht, & Bryce, 2004; Stewart-Brown et al., 2011) which has highlithed the need for multiple methodologies and not just RCTs.

8.10.1 Limitations of this chapter

Both Study 1 and Study 2 are limited in that self-reported measures can be influenced by social desirability bias, where participants' tailor responses to portray themselves in a positive light (van de Mortel, 2008); this is often more pronounced in socially sensitive subjects such as sexual health (Catania et al., 1990). There is also added complication cross culturally with participants responding in culturally specific ways to obtain peer approval

(Johnson, & van de Vijver, 2002). A clear example of this would be when participants in Study 1, who were not able to receive access to the intervention due to mobile phone accessibility issues, provided positive feedback on the intervention content and delivery methods. Bulmer (1993) reflected on survey research in low income countries and stated that having an opinion on a subject requires a degree of consciousness and awareness of the self to differentiate one's own beliefs and ideas from that of the tradition or customs of the culture. Therefore dependence on societal beliefs and attitudes may prevent individuals from forming or feeling confident expressing their own opinions of the SMS intervention.

The way in which questions were asked may have also biased results as participants found them difficult to answer. For example, participants were asked whether changes in contraceptive behaviour post intervention were still relevant 3 and 6 months later, 35% and 46% respectively, failed to answer. This has been found in similar studies in Sub-Saharan Africa where only 11% of the sample (L'Engle et al., 2013) and 16% of the sample (Vahdat et al., 2013) responded to open ended behaviour change questions post SMS intervention. It may be that this style of question, relating to time and comparisons to the past, is difficult for participants to understand or accurately answer. Although no research to date has examined differences in time related questions, some evidence exists to suggest cultural differences in the use of Likert scales in research (Hui & Triandis, 1989; Lee et al., 2002; Dolnicar & Grun, 2007), which may be down to differences in the use of language between rural and urban settings (Bachman & O'Malley, 1984), or that the format with the graded responses may be not well understood by some cultural groups (Flaskerud, 1988; Flaskerud, 2012). Future studies should take this into consideration when making decisions on outcome measures and look into alternative ways to ask these questions. Furthermore, the objective measure to determine participants' contraceptive knowledge was obtained through two indicators which were both based on the amount of contraceptive methods the participants was aware of. Repetition of this question throughout the time points may have influenced these scores, as participants' could remember the methods from the prompt within the recognition scale. This could be improved by using a measure which focuses on items which assess knowledge and understanding of how to use contraceptive methods, such as a specific measures assessing knowledge of short acting contraception methods and long acting contraception methods (e.g. where they can be obtained, regularity of use, benefits and side effects).

Finally there is no objective measure to determine if participants actually read the intervention content. The software system from both studies provided a 'send' report that messages had been successfully delivered to the correct phone, however whether this message was opened and read could not be ascertained. This has been reported in similar SMS intervention studies executed in low income countries (Deglise et al., 2012; Lau et al., 2014). Software exists to include read receipts on SMS messages (Schilling et al., 2013), however this is not always viable in low income countries, as was the case in this study. If possible, adoption of this type of technology in the future, would improve this aspect of the intervention. In addition, participants were asked if they received messages with a closed question in Study 1, therefore individuals who were categorised as receiving the intervention content may have in reality only received one or two. In Study 2, a message diary was given to participants with shared access to provide a more accurate analysis of shared device accessibility. This proved useful to an extent, however incomplete and non-returned diaries makes this difficult to generalise to a wider scale. Further research is needed to determine if differences exist in outcome measures between those who own or share a mobile phone. No differences were found in the current study, however small sample sizes limited the generalisability.

8.11 Summary of Chapter 8

This chapter has presented two studies which have examined the potential for mHealth to be used as a behaviour change communication tool for adolescents in rural Malawi. Study 1 provided evidence of the feasibility of implementing such an intervention both practically and in regards to participant acceptability and experience. Study 2 found evidence of significantly more positive attitudes to condom use post intervention in the intervention group which was sustained 6 months post intervention, however no evidence was found of differences between the intervention and control group in contraceptive knowledge (recall and recognition) or behaviour change. Known cross-over effects between groups may have affected this analysis and as such, post hoc analyses were carried out between those who self-reported receiving the intervention and those who did not receive access. This analysis identified higher contraceptive knowledge (recall and recognition) and attitude to condom use at all three time points in those with self-reported access to the intervention. Furthermore, those with self-reported access to the intervention were significantly more

likely to regularly use contraceptive three and six months post intervention compared to those who did not receive it. These post-hoc results shed light on the potential this modality has for behaviour change communication in sexual health, however further research is necessary to validate these conclusions.

Chapter 9: Conclusions and Recommendations

This final chapter aims to summarise the findings of the studies described in this thesis, considering the implications of using SMS as a mode of delivery for behaviour change interventions in Malawi. It then provides recommendations for both future research and future practice both in regards to mHealth research and cultural influences on sexual health.

9.1 Summary of Key Findings

This thesis was the first to implement a reproductive health intervention via SMS in a community health setting in Malawi. The theoretically informed SMS intervention, designed using evidence based guidelines (Chapter 7), previous evidence specific to sexual and reproductive health (Chapter 4), and qualitative evidence specific to Chikwawa (Chapters 3, 5, and 6) was repeatedly found to be acceptable to the target population (Chapter 8). This echoed similar research in neighbouring countries which has found SMS messages to be an acceptable method to deliver health education (Mitchell et al., 2011; Nachega et al., 2016) and specifically acceptable for sexual and reproductive health education (FHI 230, 2013; Vahdat et al., 2013). However these studies only implemented cross-sectional methodology and a controlled comparison is needed, along with statistical analysis, in order to additionally examine intervention effectiveness. Rigorous methodology, appropriate for the study setting, and robust statistical analysis was included in the current study in order to examine intervention effectiveness. Significantly greater positive attitude to condom use was identified in the intervention group compared to control group, and this was sustained 6 months post intervention (Chapter 7). This is extremely positive to combat prominent myths and misinformation of contraception in the area, and although this evidence is specific to condoms, this is arguably one of the most important contraceptive methods for this age range, due it being the only method to perform duel protection for pregnancy and STIs (Kirby, 2002). They also tend to be the most accepted method for first sexual debut (Martinez, Copen, & Abma, 2011). However it is important not to assume that a positive attitude equates to use in practice, and further work is needed to continuously promote regularity in contraceptive use within this population.

It was revealed from the three month follow-up interviews that 39% of the control group received access to the intervention. These known cross over effects may have influenced intervention effects across the two groups, as initial randomisation was not held true throughout the study. Therefore additional post-hoc analysis between those who self-reported access to the intervention and those who did not receive access, identified significantly higher knowledge (recall and recognition) and attitudes to condom use scores in those who self-reported receiving the intervention. These differences were sustained 6 months post intervention. Regularity of contraception use was also significantly higher in this group 3 and 6 months post intervention. These results are positive and provide evidence for the potential this 8 week intervention has on measures of contraception knowledge, attitudes and behaviour change. However these findings need to be replicated with consideration to appropriate methodology, to provide stronger evidence as to the effectiveness this type of behaviour change intervention has, within Malawi and within the wider sub-Saharan African setting.

This thesis identified that there was evidence of the provision of sexual and reproductive health advice with no scientific basis, such as instruction on how to take care of oneself during menstruation and incidences of instruction to have sexual intercourse as a cleansing ritual after circumcision (Chapter 5). This has previously been documented in Malawian initiation ceremonies (Munthali & Zulu, 2007), as well as incidence of the presence of myths and misinformation surrounding the use of contraceptive methods such as a perceived correlation between adolescent contraceptive use and infertility (Kapito et al., 2010; Chipeta et al., 2010; Ntata et al., 2013) and contraception leads to cancer (Munthali et al., 2004). This was echoed in this research, where three generations of residents in Chikwawa reported similar beliefs regarding infertility and also beliefs that contraception should be limited to those who are married or who have already had children (Chapter 5). Kapito et al. (2010) noted this same perception in Malawian adolescents, with participants in the sample reporting that contraception should not be used by adolescents, this is thought to be related to fears of infertility and negative side effects of contraceptive use (Chipeta et al., 2010).

Contradictory to the perceptions stated above, adolescents were more likely, than parents or grandparents, to discuss contraception use out with marriage to prevent unwanted

pregnancy (Chapter 6). Although no study known to the author has documented a shift in adolescents' perceptions of acceptable contraceptive use in Malawi, there is evidence of increased incidence of premarital sex by the age of 18 in Malawi (32% of 20-24 year old women compared to 25% of 40-44 year old women) (Mensch, Grant, & Blanc, 2005). Furthermore, the latest demographic and health survey in Malawi reported an increase in sexually active unmarried individuals using modern contraception, with 32% of 15-19 year olds using modern contraception and 44% of 20-24 year olds (NSO, 2017). Therefore results found in this study may represent a generational shift toward more positive perceptions of modern contraceptive use in adolescents, which is also reflected within the demographic survey data. However perceptions of adolescent contraceptive use needs further exploration both to understand beliefs of modern contraception and to inform future sexual health interventions. Additionally it may be necessary to further investigate adolescent opinions of condoms specifically, as there were two incidences where male adolescents reported not using contraception, however when probed admitted to using condoms. It is unclear why condoms were not seen as a method of contraception in these incidences, it may that they are seen as a more socially acceptable method for adolescents or may be due to them being the only male led modern contraceptive method. It is important to further explore this issue, to make sense of it and the implications this may have for research in adolescent sexual health in Malawi and in the wider sub-Saharan Africa context.

This thesis demonstrated the willingness of participants to share the message content with their peers, and this in itself is extremely important finding in regards to the openness of individuals to discuss sensitive health topic. Mobile accessibility was identified as a barrier to this type of intervention (Chapter 8), primarily around shared mobile phone access. However this thesis did not find any differences in likelihood of receiving the intervention or in outcome measures between mobile phone accessibility (shared or own phone). However it did find gender differences in mobile accessibility, specifically that female adolescents are more likely to rely on shared mobile phones for access. Inequality in mobile phone access has been found in other countries, with men having dominant access and women relying more on shared access in Ghana and India (Al Dahdah, 2017) and Kenya (van der Kop et al., 2016). Therefore gender equality in mHealth research requires further attention, to fully understand the impact it may have on intervention reach in Malawi and

also in other low income countries as this will be a common issue globally. That being said, mobile phone access should become less of a problem in future research as global mobile ownership is increasing dramatically (GSMA, 2016b), and the difficulties in accessing a shared device will reduce with increased mobile ownership

This thesis has demonstrated the acceptability and feasibility of an SMS behaviour change intervention, implemented within a rural low income community. It provides evidence of the positive impact this behaviour change intervention modality had on improving attitudes towards condom use in the intervention group. It also provides promising results of the potential impact this type of intervention could have on contraceptive knowledge, attitudes to condom use, and regularity of contraceptive use in those who self-reported receiving the intervention. However study replication is needed to support these results and identify whether this type of modality is suitable to both urban and rural settings in Malawi and other sub-Saharan countries. Reducing population growth is in line with government priorities and this thesis provides an up to date, quick and simple to implement intervention which does not add pressure to the workload of overburdened health workers or take away resources from local health centres. Implementation of this type of intervention nationally would be of great benefit, and pivotal to the health system as once it is set up it requires little extra assistance. However prior to this, further investment into mHealth research for sexual health is needed in order to conduct a large scale evaluation of intervention effectiveness, cost-effectiveness and gender equality in mobile access to ensure it can be delivered across the country to those who need it most.

9.1.1 Reporting of behaviour change interventions

Inadequate reporting on behaviour change interventions has been cited as a criticism of the field (Hoffman, Erueti & Glasziou, 2013; McCleary et al., 2013) and omission of detail can lead to studies being wrongly categorised, or misinterpreted (Johnson, 2014). It is therefore important for complete and transparent reporting of the entire intervention process to allow for replication and the accurate synthesis of evidence (Johnson, 2014). In mHealth, poor reporting is common, particularly due to widespread implementation of pilot studies and dissemination in multiple ways out with peer reviewed journals such as white papers, reports, presentations and blogs (Agarwal et al., 2016). This was evidenced in Chapter 4, where included studies scored poorly on the mERA in regards to the quality of reporting of

SMS interventions, yet this is fundamental to allow for accurate comparison between interventions and to further enhance the field (Agarwal et al., 2016). Clear reporting is vital to provide scientifically robust evidence and to evaluate intervention effectiveness, and accurate reporting is beneficial to policy makers in mHealth implementation and for improvements in intervention development. This thesis aimed to adhere to the mERA guidelines to provide a detailed account of each step of the intervention design, implementation and evaluation process, and is one of the first to do so in an SMS based intervention. Table 9.1 signposts to where each item in the mERA is reported within this thesis.

Table 9.1: mERA guidelines (Agarwal et al., 2016) and where each criterion is presented within this thesis

Item	Criteria	Description	Related section of this thesis	Key Findings
1	Infrastructure (population level)	Clearly presents the availability of infrastructure to support technology operations in the study location. This refers to physical infrastructure such as electricity, access to power, connectivity etc. in the local context.	Chapter 2, Section 1.3.1 outlines the current infrastructure of Malawi in terms of mobile phone usage and access. Chapter 8 outlines mobile accessibility issues in intervention implementation.	Chikwawa has sufficient infrastructure to support the delivery of SMS interventions however mobile phone accessibility is a barrier to intervention access, particularly for female adolescents as they are more likely to share a mobile phone.
2	Technology/platform	Describes and provides justification for the technology architecture. This includes a description of software and hardware and details of any modifications made to publicly available software.	Chapter 8, Section 8.3.4 outlines the software in Study 1 and Section 8.7.4 outlines the software in used to deliver the intervention in Study 2. Section 8.5.1 details why two different types of technology were used.	Relying on a single handset to deliver SMS messages (Study 1) was not effective or sustainable and moving to an online based system (Study 2) was a much more reliable method in terms of successful delivery of SMS messages.
3	Interoperability/ Health information systems (HIS) context	Describes how mHealth intervention can integrate into existing health information systems.	Chapter 1 identified the benefits mHealth can have amidst the current difficulties in health service provision in Malawi. Chapter 8 detailed how this intervention complements current services at Mfera Health Centre, and that the content is in line with National health policies.	This intervention was designed with input from health staff at the Mfera health centre and with guidance from the Ministry of Health. This study has shown that this delivery method is feasible on a small scale, and with further

Item	Criteria	Description	Related section of this thesis	Key Findings
				investment, has the potential to complement current preventative health services provided in rural Malawi.
4	Intervention delivery	The delivery of the mHealth intervention is clearly described. This should include frequency of mobile communication, mode of delivery of intervention (that is, SMS, face to face, interactive voice response), timing and duration over which delivery occurred	Chapter 8, Section 8.3.4 details intervention delivery and Chapter 3 describes the involvement of participants in how these decisions were made.	Participants opted for the delivery of a SMS intervention and had no strong preferences as to the time or duration of the intervention (Chapter 3). They initially requested an additional face to face component of the intervention (Chapter 3), however this was not as prevalent from the qualitative evaluation post intervention delivery (Chapter 8). Future research needs to look at how an additional face to face component could complement this intervention delivery method.
5	Intervention content	Details of the content of the intervention are described. Source and any modifications of the intervention content is described.	Chapter 7, Section 7.7 outlines the process for creating the intervention content and Table 7.6 presents the detailed content.	The intervention was found to be acceptable to the target population and stakeholders (Chapter 3 &

Item	Criteria	Description	Related section of this thesis	Key Findings
			Chapter 8 also presents information on the specific content for Study 1 and Study 2.	8).
6	Usability/content testing	Describe formative research and/or content and/or usability testing with target group(s) clearly identified, as appropriate.	Chapter 3 details the formative research which aided intervention design. Chapter 8, Study 1 details the feasibility study.	The intervention was found to be an acceptable and feasible delivery method for rural Malawi (Chapter 8). However mobile phone accessibility is a barrier to access, particularly in shared phones.
7	User feedback	Describes user feedback about the intervention or user satisfaction with the intervention.	Study 1 and Study 2 in Chapter 8, describe intervention acceptability by participants who accessed the intervention.	This intervention was found to be acceptable to participants throughout this research, however it is possible that qualitative data is biased by the social desirability effect and the desire of participants to receive this type of research within their communities.
8	Access of individual participants	Mentions barriers or facilitators to the adoption of the intervention among study participants.	Chapters 3 and 8 discuss implications of mobile accessibility on intervention access, particularly around shared mobile phones.	Female participants were less likely to receive the intervention content in Study 1, and more likely to rely on shared devices in both Study 1 and 2. This study found no differences between phone access on the outcome measures,

Item	Criteria	Description	Related section of this thesis	Key Findings
				however future research needs to understand the impact of gender imbalances on mobile access.
9	Cost Assessment	Presents basic costs assessment of the mHealth intervention from varying perspectives.	Chapter 8, Section 8.8.4 outlines the cost of delivering the intervention per mobile phone.	This intervention can be delivered for $3.36 (£2.52) per mobile phone, which was mid-range compared to other mHealth interventions. However cost assessment is rarely provided to allow for a complete comparison. Further research is needed on a larger scale to conduct a full cost effectiveness evaluation.
10	Adoption inputs/ programme entry	Describes how people are informed about the programme including training, if relevant. Includes description of promotional activities and/or training required to implement the mHealth solution among the user population of interest.	Chapter 8, Section 8.3.2 outlines the recruitment procedure for participants taking part in the study.	Participants were recruited through village walks to identify if individuals wanted to take part in the study. This was adapted in Study 2, to ensure that participants who shared a mobile phone had permission from the mobile phone owner in an attempt to increase shared mobile access.

Item	Criteria	Description	Related section of this thesis	Key Findings
11	Limitations for delivery at scale	Clearly presents mHealth solution limitations for delivery at scale	Chapter 8, Section 8.5.1 outlines the issues of delivery limitations in Study 1 and how this was adapted for Study 2.	High attrition rates and high cross over effects between groups limited the measurement of intervention effectiveness. Study replication with groups further away geographically or the utilisation of different methodology (e.g. pre/post-test) is required to fully understand intervention effectiveness.
12	Contextual adaptability	Describes the adaptation, or not, of the solution to a different language, different population or context. Any tailoring or modification of the intervention that resulted from pilot testing/usability assessment is described.	Chapters 5 and 6 outline cultural considerations for the development of the intervention. Chapter 7, Section 7.9 describes the translation process for the intervention into Chichewa, and Chapter 8, Section 8.5.1 describes the software modifications which occurred before the implementation of Study 2.	Qualitative studies confirmed the need for health education in the area and informed intervention development. Intervention content was translated into Chichewa for intervention delivery and independently checked before implementation (Chapter 7). Software modifications were required after Study 1 due to difficulties with the technology method.
13	Replicability	Detailed intervention to support replicability.	Chapter 7 describes in detail how the intervention was developed and Chapter 8 outlines how the	This thesis aimed to be transparent and adequately reports on each item of the

Item	Criteria	Description	Related section of this thesis	Key Findings
			intervention was delivered and changes which were made to Study 2 after feasibility testing in Study 1	mERA criteria.
14	Data security	Describes the data security procedures/ confidentiality protocols.	Chapter 2, Section 2.4 details data security and storage.	Data security protocols were followed at all times throughout the research process.
15	Compliance with national guidelines	Mechanism used to assure that content or other guidance/information provided by the intervention is in alignment with existing national/regulatory guidelines and is described.	Chapter 7, Section 7.7 outlines that the intervention content which was used in Study 1 and Study 2, was in line with the Ministry of Health guidelines in Malawi.	Intervention content was created in line with Malawian health policy and was reviewed by lecturers, health workers at Mfera Health Centre and the Ministry of Health (Chapter 7).
16	Fidelity of the intervention	Was the intervention delivered as planned? Describe the strategies employed to assess the fidelity of the intervention.	Chapter 8, Section 8.3.4 details technology issues in Study 1 which was adapted before implementation of Study 2. Chapter 8 details mobile phone accessibility, attrition and barriers and facilitators to accessing the intervention and limitations with the methodology employed. Participant experience is outlined in Chapter 8, Section 8.4.3.	Software delivery reports and participant self-report allowed for assessment of fidelity. However difficulties with the methodology employed meant that intervention effectiveness evaluation was limited.

9.2 Recommendations for Future Research

The geographical location of this study was the Mfera catchment area in the Chikwawa district, and therefore may not be generalizable to the whole of Malawi. Particularly as this is a rural part of the country, and mobile ownership, and mobile signal and infrastructure will be vastly different in the main urban cities of Malawi. Similar formative research is required in an urban area of Malawi to identify if this modality is acceptable and feasible in a different setting. Traditional cultural practices are less common in urban compared to rural areas of Malawi (NSO, 2017), however there may be different influences to consider such as peer to peer or more readily accessible media influences. It is imperative that more research into SMS behaviour change interventions are carried out both within other areas of Malawi and also in other low income countries, both to replicate the current study findings and also to identify the effectiveness of this modality on other populations and health topics. This study only included literate individuals aged 15-25 and therefore future research is needed to target this intervention towards adults to ensure all members of the community are actively aware of the benefits and side effects of each modern contraceptive method. Furthermore, as technology availability and mobile signal continues to improve in Malawi and generally across all of sub-Saharan Africa, it may be possible to create a two way messaging service or tailored mobile application. This would allow for the incorporation of additional health education, interactive components and more complex behaviour change techniques, which would in turn increase the likelihood of the intervention achieving sustainable health behaviour change.

Additional components could be incorporated into an SMS intervention to encourage maintenance of health behaviour change. Health education is not enough to elicit behaviour change (Kelly & Barker, 2016), and although the majority of participants in Study 2 who required further information on contraception requested it through SMS, additional elements such as peer groups or facilitated discussions at the health centre would complement this research and include social support to aid behavioural maintenance. Future research could include these components and identify whether this additional component is more effective than SMS messages alone. It would also be beneficial to focus future behaviour change interventions on specific contraceptive behaviours such as using a condom or taking the contraceptive pill. Targeting these specific behaviours will allow for

more tailored intervention content to the method of contraception in question rather than focusing on generic contraceptive behaviour for multiple methods. This would be specific to contraceptive behaviour change interventions delivered globally, regardless of the country of origin.

The intervention delivery method in this thesis was SMS messages due to the practical preferences identified in Chapter 3. These preferences may be specific to the study area and it would be beneficial to identify if alternative mHealth methods, for example Interactive Voice Response (IVR) based interventions, are acceptable in the context of Malawi and other countries in sub-Saharan Africa. Additionally, a comparison of an SMS based intervention compared to an IVR based intervention would provide evidence for both the effectiveness in changing behaviour and cost-benefit analysis. This would allow a comparison for both and aid future decision making around the use of mHealth methodologies in low income countries. The identification of preferred modes of mHealth delivery in middle and high income countries is also required prior to intervention development. It may be that specific populations, for example low income families, prefer SMS or IVR interventions over internet or mobile application based interventions.

Initiation ceremonies cover sensitive topics and the secrecy of these practices are embedded into the culture. Within Chapter 5, six participants refused to discuss specific details of initiation practices either due to the sensitive nature or because they felt they did not have permission to do so. Even though the interviews in this thesis were conducted by trained Malawian interviewers, some participants felt unable to disclose information and the information which was provided was at times vague and unclear. Therefore information which has been withheld could be vital to aid understanding or could be contradictory to the evidence presented. Therefore future research is required to fully comprehend the importance of these cultural practices within the community and determine their influence on health education on topics like sexual health. Additionally, Chapter 5 regrettably did not obtain information on religion, which may be pertinent to fully understand the initiation practices involved. UNFPA (2015) found that Muslin adolescents were almost three times as likely to attend initiation ceremonies as Christian adolescents, and it would have been advantageous to provide similar data in this study, and tease out any variations in each ceremony accordingly. Qualitative research which addresses the specific practices of each

religious cultural practice in Malawi and wider sub-Saharan Africa is required to fully understand the practices and the influences they may have on attitudes and behaviour.

9.3 Recommendations for future practice

This thesis identified a prime opportunity for the inclusion of health education on modern contraceptives within cultural practices, particularly initiation ceremonies which do not currently include this information. Adolescents are choosing, or being encouraged by relatives, to attend these practices and Chapter 5 identified this is because of a desire to learn about the transition into adulthood, particularly puberty. Therefore, there is scope to work with initiation counsellors to ensure that the teaching included is accurate and safe. There is evidence that some teachings focus on abstinence, yet this is not sufficient to reduce pregnancy or protect against STI's. Up-skilling initiation counsellors on medically accurate contraceptive methods could positively impact contraceptive use within these communities. This may come across as controversial in certain communities, nevertheless evidence of positive societal change exists, including reduced incidence of child marriage in rural Malawi through targeted interventions with village headmen (Girls Empowerment Network, 2013) and improvements to maternal and new-born health through community mobilisation (The Health Network, 2013). Focused efforts with rural communities is needed to educate and empower them to advance societal change; efforts to do this with initiation counsellors and community elders could be the next positive step for sexual health research in Malawi.

This thesis provided evidence for the acceptability and feasibility of delivering health education via SMS means in a community setting in Malawi. Qualitative data of participants' evaluation of the intervention showed a desire to continue to receive health education through mHealth means. This evidence must be drawn upon in public health service delivery to increase the reach of preventative health access not only in Malawi but in other low income countries, where this low cost and easy to use method could be effective in communicating important health education. In Malawi, SMS interventions could be incorporated into the Youth Friendly Health Services which are available at local health centres yet appear to not be readily utilised by the adolescent population (E2A, 2014). The inclusion of mHealth within these services would allow for a tailored, adolescent friendly education and could increase both the impact and reach of these government led services.

9.4 Thesis Conclusion

This thesis aimed to identify whether SMS is a feasible and acceptable solution to improve the delivery of preventative health services, which overburdened and under resourced heath centres in Malawi are struggling to do. This is due to an increasing population, increasing life expectancy and medical staff shortages. This thesis provides a foundation for the potential for this type of behaviour change intervention in rural Malawi, and included participants in the design of the intervention, rigorous methodology and robust statistical analysis in response to repeated criticisms for poor methodology in mHealth research, cited by multiple authors (Cole-Lewis & Kershaw, 2010; Free et al., 2013; Tomlinson et al., 2013; Gurman et al., 2012; Aranda-Jan et al., 2014; Hall et al., 2014). It is also one of the first pieces of research to adhere to the mERA guidelines to ensure adequate reporting of 14 key areas in mHealth research, which will allow for study replication and comparisons across the field (Agarwal et al., 2016). However limitations in mobile access, social desirability bias, and difficulties in measuring effectiveness due to high crossover between groups means that this piece of research must be built upon, before it is possible to identify whether it has full potential to be rolled out nationally to effectively increase the use of contraceptives in adolescents.

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Appendix 1: NCST Ethics Application Approval

NATIONAL COMMISSION FOR SCIENCE & TECHNOLOGY
Lingadzi House
Robert Mugabe Crescent
P/Bag B303
City Centre
Lilongwe
Tel: +265 1 771 550
+265 1 774 189
+265 1 774 869
Fax: +265 1772 431
Email:directorgeneral@ncst.mw
Website:http://www.ncst.mw

Ref No: NCST/RTT/2/6 **01 June 2016**

Rebecca Laidlaw
C/O University of Malawi
rebecca.laidlaw@strath.ac.uk

Dear Rebecca Laidlaw,

RESEARCH ETHICS APP ROVAL OF PROTOCOL P.03/16/90: CAN MOBILE COMMUNICATION BE USED TO INCREASE HEALTH PROMOTION IMPACT IN RURAL MALAWI

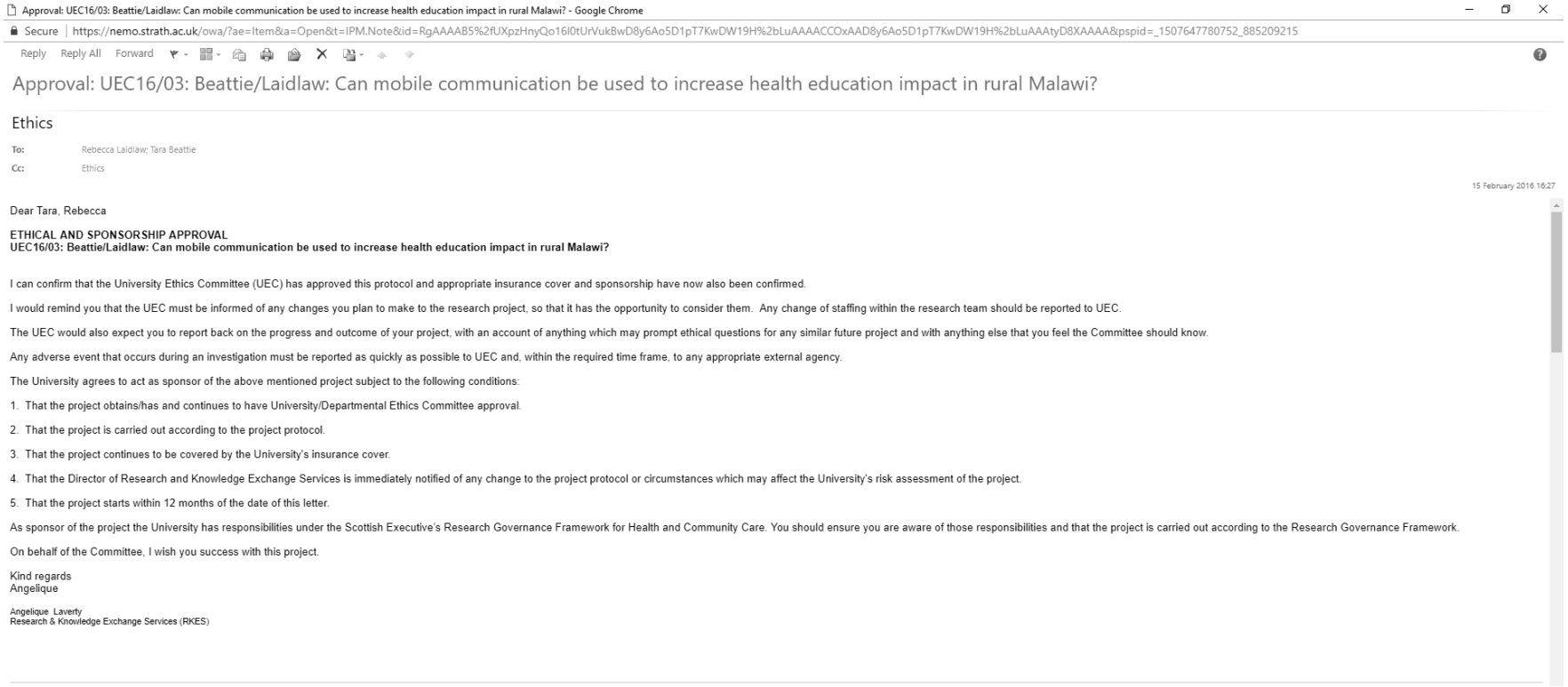
Having satisfied all the ethical, scientific and regulatory requirements, procedures and guidelines for the conduct of research in the social sciences sector in Malawi, I am pleased to inform you that the above referred research study has officially been approved. You may now proceed with its implementation. Should there be any amendments to the approved protocol in the course of implementing it, you shall be required to seek approval of such amendments before implementation of the same.

This approval is valid for one year from the date of issuance of this letter. If the study goes beyond one year, an annual approval for continuation shall be required to be sought from the National Committee on Research in the Social Sciences and Humanities in a format that is available at the secretariat. Once the study is finished, you are required to fur nish the Committee and the Commission with a final report of the study.
Wishing you a successful implementation of your study.

Yours Sincerely

Martina Chimzimu
NCRSH ADMINISTRATOR AND RESEARCH OFFICER
HEALTH, SOCIAL SCIENCES AND HUMANITIES
For: CHAIRMAN OF NCRSH

Appendix 2: University of Strathclyde Ethics Application Approval



Approval: UEC16/03: Beattie/Laidlaw: Can mobile communication be used to increase health education impact in rural Malawi? - Google Chrome

Secure | https://nemo.strath.ac.uk/owa/?ae=Item&a=Open&t=IPM.Note&id=RgAAAAB5%2fUXpzHnyQo16l0tUrVukBwD8y6Ao5D1pT7KwDW19H%2bLuAAAACCOxAAD8y6Ao5D1pT7KwDW19H%2bLuAAAtyD8XAAAA&pspid=_1507647780752_885209215

Reply Reply All Forward

Approval: UEC16/03: Beattie/Laidlaw: Can mobile communication be used to increase health education impact in rural Malawi?

Ethics

To: Rebecca Laidlaw; Tara Beattie
Cc: Ethics

15 February 2016 16:27

Dear Tara, Rebecca

ETHICAL AND SPONSORSHIP APPROVAL
UEC16/03: Beattie/Laidlaw: Can mobile communication be used to increase health education impact in rural Malawi?

I can confirm that the University Ethics Committee (UEC) has approved this protocol and appropriate insurance cover and sponsorship have now also been confirmed.

I would remind you that the UEC must be informed of any changes you plan to make to the research project, so that it has the opportunity to consider them. Any change of staffing within the research team should be reported to UEC.

The UEC would also expect you to report back on the progress and outcome of your project, with an account of anything which may prompt ethical questions for any similar future project and with anything else that you feel the Committee should know.

Any adverse event that occurs during an investigation must be reported as quickly as possible to UEC and, within the required time frame, to any appropriate external agency.

The University agrees to act as sponsor of the above mentioned project subject to the following conditions:

1. That the project obtains/has and continues to have University/Departmental Ethics Committee approval.
2. That the project is carried out according to the project protocol.
3. That the project continues to be covered by the University's insurance cover.
4. That the Director of Research and Knowledge Exchange Services is immediately notified of any change to the project protocol or circumstances which may affect the University's risk assessment of the project.
5. That the project starts within 12 months of the date of this letter.

As sponsor of the project the University has responsibilities under the Scottish Executive's Research Governance Framework for Health and Community Care. You should ensure you are aware of those responsibilities and that the project is carried out according to the Research Governance Framework.

On behalf of the Committee, I wish you success with this project.

Kind regards
Angelique

Angelique Laverty
Research & Knowledge Exchange Services (RKES)

Appendix 3: Information Sheet and Consent form (Chapter 3)

Scotland Chikhwawa Health Initiative (SCHI)
Healthy Settings Approach to Community Health
MFERA HEALTH CENTRE CATCHMENT AREAS, CHIKHWAWA

Certificate of Consent

The Scotland Chikhwawa Health Initiative, with funding from the Scottish Government are implementing a Healthy Settings Approach to Community Health in Mfera Health Centre Catchment Area. This is a collaborative programme between the **University of Strathclyde** (Glasgow), **Chikhwawa District Hospital** (Ministry of Health) and the University of Malawi – **Polytechnic**.
As part of this project we are looking into different ways to deliver Healthy Messages to the youth in your area. One of the ways we are looking at is an interactive SMS messaging service, which will be a free service enabling you to get access to health education information which is sent to your personal or shared phone.

We are here on behalf of the SCHI project to ask you to be involved in a focus group discussion so that we can understand what the health education needs are for you and your community. We will discuss a number of health topics including Nutrition, Hygiene, Malaria, Family Planning and HIV. We will then invite you to discuss what specific health education you require in these areas or in any other areas you want to discuss. We will then talk about mobile phone access in your community and what your thoughts and opinions are of a SMS health education messaging service being introduced in your area.

I would like to assure you that your responses will be kept confidential. I have a questionnaire to guide our discussion.
I have read/witnessed the foregoing information, or it has been read to me/the participant. I/the participant have/has had the opportunity to ask questions about it and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Print Name of Participant: _____
Signature of Participant): _____
Date: _____

Statement by the Research Assistant

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the aims of the focus group discussion.
I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily. A copy of this Information and Consent Form has been provided to the participant.

Print Name of Research Assistant_____

Signature of the Research Assistant _____
Date _____

Appendix 4: Interview Schedule (Chapter 3)

Focus Group Questions: Adults

Demographics

Find out participants; age, education level (literate/illiterate), marital status, number and ages of children.

Nutrition

It has been found in previous focus groups that there is a need for health education in Chikwawa on nutrition. What are your thoughts on this?

What kind of information do you want to know about food and nutrition?

Do you know of anywhere currently where you can go to access this information?

If so, do you use these services?

Hygiene

It has been found in previous focus groups that there is a need for health education in Chikwawa on hygiene. What are your thoughts on this?

Thinking specifically of your own needs, what kind of information do you want to know about hygiene practices?

Do you know of anywhere currently where you can go to access this information?

If so, do you use these services?

Family Planning and HIV

It has been found in previous focus groups that there is a need for health education in Chikwawa on family planning and HIV. What are your thoughts on this?

Thinking specifically of your own needs, what kind of information do you want to know about family planning/contraception?

Thinking specifically of your own needs, what kind of information do you want to know about HIV

Are there any other aspects of reproductive health you would like access to more information on?

Do you know of anywhere currently where you can go to access this information?

If so, do you use these services?

Health Education Needs

Thinking specifically about your own personal needs, are there any other health topics you would like information on?

What type of information do you require?

Mobile Phones

Do you own a mobile phone? / Do you have access to a mobile phone?

How many people in your family own a mobile phone?

Do you feel confident in your ability to use a mobile phone?

[Use this opportunity to explain my project; Scotland Chikwawa Health Initiative are looking to implement a health messaging service which will provide information about the health topics we have mentioned today, such as nutrition and hygiene. This service will primarily be providing information using mobile phones.]

Would you like to receive health information on your phone?

Would you feel comfortable with this? / What are your thoughts?

If you chose to be involved in the service, would you prefer to receive this information via text message on your mobile phone or listen to the message on your mobile phone?

Project Implementation

Do you think you would use this service if it became available?

Would you trust information sent from SCHI to your mobile phone?

Would you be happy with your family members using this service?

It has been highlighted in other previous focus group discussions than adolescents in Chikwawa would like access to reproductive health information. What do you think of adolescents receiving this information on their mobile phone?

When would you like to receive these messages?

How many messages would you like to receive per week?

Would you rather access the messages at your own leisure, or be sent messages at set times throughout the week?

Barriers to Implementation

Can you think of any problems with this type of information service?

How do you think this form of information giving will perceived across the villages of Chikwawa? Do you think your friends and relatives would use the service?

Focus Group Questions: Adolescents

Demographics

Find out each participants'; age, education level (literate/illiterate), marital status (how many children).

Family Planning / Reproductive Health / HIV

It has been found in previous focus groups that there is a need for health education in Chikwawa on family planning and HIV. What are your thoughts on this?

Thinking specifically of your own needs, what kind of information do you want to know about family planning/contraception?

Thinking specifically of your own needs, what kind of information do you want to know about HIV?

Are there any other aspects of reproductive health you would like access to more information on?

Do you know of anywhere currently where you can go to access this information?

If so, do you use these services?

Youth Friendly Services

It has been mentioned in previous focus group discussions the need for youth friendly services… What are your thoughts on this?

What do you think it means when asking for youth friendly services?

Why do you want youth friendly services?

Do you feel like you can go to the clinic and get health information?

Health Education Needs

Thinking specifically about your own personal needs, are there any other health topics you would like information on?

What type of information do you require?

Mobile Phones

Do you own a mobile phone? / Do you have access to a mobile phone?

How many people in your family own a mobile phone?

Do you feel confident in your ability to use a mobile phone?

[Use this opportunity to explain my project; Scotland Chikwawa Health Initiative are looking to implement a health messaging service which will provide information about the health topics we have mentioned today, such as reproductive health. This service will primarily be providing information using mobile phones.]

Would you like to receive health information on your phone?

Would you feel comfortable with this? / What are your thoughts?

If you chose to be involved in the service, would you prefer to receive this information via text message on your mobile phone or listen to the message on your mobile phone?

Project Implementation

Do you think you would use this service if it became available?

Would you trust information sent from SCHI to your mobile phone?

When would you like to receive these messages?

How many messages would you like to receive per week?

Would you rather access the messages at your own leisure, or be sent messages at set times throughout the week?

Barriers to Implementation

Can you think of any problems with this type of information service?

How do you think this form of information giving will be perceived across the villages of Chikwawa?

Do you think your friends and relatives would use the service?

Appendix 6: Focus Group Interview Schedule Adolescents (Chichewa)

Appendix 5: Example of screening tool for systematic review (Chapter 4)

Paper number	First Author	Year of publication between 2006 and 2016?	Is the language in English?	Are the participants human?	Does the source of the article meet the inclusion criteria?	Does the study include a quantitative component?	Is the intervention delivered via SMS?	Is the intervention content sexual health?	Does the study include at least one outcome measure?	Proceed to full text screening? (if no state reason)

Appendix 6: Data Extraction Tool from Systematic Review (Chapter 4)

Author	Country of Research Origin	Study Design	Target Population	Sample Size	Sexual Health Topic	Theory of Intervention content	Intervention Delivery Method	Outcome Measures

Appendix 7: Interview schedule (Chapter 5)

Interview Schedule for Initiation Interviews

How old are you?

Where are you from?

Are you married?

How many children do you have?

How many school years did you complete?

What ethnic group are you part of?

Have you taken part in an adolescent initiation ceremony?

If yes, please explain what happened before, during and after this ceremony?

If no, why?

Can you please explain what is taught during these adolescent initiation ceremonies?

[If appropriate] Have your children attended an adolescent initiation ceremony?

How important do you think initiation ceremonies are for adolescents?

*additional probing questions were used as appropriate to encourage participants to expand on relevant information, beliefs and opinions.

Appendix 8: Information sheet and consent form (Chapter 5)

Scotland Chikhwawa Health Initiative (SCHI)

The Scotland Chikhwawa Health Initiative, with funding from the Scottish Government are implementing a Healthy Settings Approach to Community Health in Mfera Health Centre Catchment Area. This is a collaborative programme between the University of Strathclyde (Glasgow), Chikhwawa District Hospital (Ministry of Health) and the University of Malawi – Polytechnic.

A researcher at the University of Strathclyde, Rebecca Laidlaw, is carrying out research looking into cultural practices in the area, particularly adolescent initiation ceremonies. The aim is to understand what is taught during the initiation ceremonies. We are here to invite you to take part in a one on one interview to discuss your own experience of adolescent initiation ceremonies. This will include questions on whether you have attended a ceremony in the past, what happened before, during and after this ceremony, what is taught in this ceremony and your opinion on adolescents attending these ceremonies today.

Interviews will be audio recorded and then transcribed by the researchers. Your responses will be kept completely confidential and only the researchers at the project will have access the recordings. This research will be written up for publication and any responses included will be kept anonymous and any identifyable information removed.

Participation in this study is voluntary and you have the right to stop taking part in the study at any point. If you have any questions, please ask any of the researcher.

I have read/witnessed the foregoing information, or it has been read to me/the participant. I/the participant have/has had the opportunity to ask questions about it and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Print Name of Participant: _____

Signature of Participant: _____ Date: _____

Signature of Parent/Guardian (if aged 15): _____

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the aims of the questionnaire we are about to complete. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the

participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____

Date _____

Appendix 9: Information sheet and consent form (Chapter 6)

Scotland Chikhwawa Health Initiative (SCHI)

The Scotland Chikhwawa Health Initiative, with funding from the Scottish Government are implementing a Healthy Settings Approach to Community Health in Mfera Health Centre Catchment Area. This is a collaborative programme between the University of Strathclyde (Glasgow), Chikhwawa District Hospital (Ministry of Health) and the University of Malawi – Polytechnic.

A researcher at the University of Strathclyde, Rebecca Laidlaw, is carrying out research looking into the use of mobile phones to deliver health education messages in your community. The aim is to create a health messaging service providing health edication about contraception which can be assessed through SMS messages to your mobile phone. To further understand the use of contraception in Mfera, we are here to invite you to participate in a one on one interview to discuss your expience of using contraception and your opinion of current family planning resources in the area. This will include questions on what you know about contraception, where you received this information, your opinion on the use of contraceptives in adolescents, access to contraception and whether or not you discuss contraception with your relatives.

Interviews will be audio recorded and then transcribed by the researchers. Your responses will be kept completely confidential and only the researchers at the project will have access the recordings. This research will be written up for publication and any responses included will be kept anonymous and any identifyable information removed.

Participation in this study is voluntary and you have the right to stop taking part in the study at any point. If you have any questions, please ask any of the researcher.

I have read/witnessed the foregoing information, or it has been read to me/the participant. I/the participant have/has had the opportunity to ask questions about it and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Print Name of Participant: _____

Signature of Participant: _____ Date: _____

Signature of Parent/Guardian (if aged 15): _____

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the aims of the questionnaire we are about to complete. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the

participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____

Date _____

Appendix 10: Interview schedule (Chapter 6)

Interview Schedule 3 Generational Interviews

Adolescent (15 to 25 years) Interview

How old are you?

What village are you from?

Are you married?

Do you have children? If so, how many?

How many school years did you complete?

***

Tell me what you know about family planning?

What do you believe are the benefits of using contraception methods?

What do you believe are the problems to using contraception methods?

Do you think modern contraception should be used by people your age? Why?

Do you currently or have you ever used contraception?

What were your reasons?

What methods do you use?

Have you ever used any traditional or herbal contraception methods, if so please describe them.

What methods do you believe are the most effective?

Where can you get access to contraception?

Do you feel able to go there and receive contraceptive methods?

Where did you first learn about contraception?

Did you believe what you were told? Why?

Do you discuss contraception with your family? If yes, who do you discuss it with? If no, why not?

How important do you think it is to discuss this with family?

Would you like to be able to talk to your family more about this subject?

Do you think it is important to use contraception? Why?

Parent Interview

How old are you?

What village are you from?

Are you married?

How many children do you have?

How many school years did you complete?

***

Tell me what you know about family planning?

What do you believe are the benefits of using contraception methods?

What do you believe are the problems of using contraception methods?

Do you currently or have you ever used contraception?

What were your reasons?

What methods did you use?

Have you ever used any traditional or herbal contraception methods, if so please describe them.

What methods do you believe are the most effective?

Where can you get access to contraception?

Do you feel able to go there and receive contraceptive methods?

Where did you first learn about contraception?

Did you believe what you were told? Why?

Where do you think your son gets information about contraception?

Are you happy about your son receiving contraception there?

Do you think contraception should be used by adolescents?

Do you discuss contraception with your family?

Did your family talk about contraception with you?

How important do you think it is to discuss this with family?

Do you think it is important to use contraception? Why?

Grandparent Interview

How old are you?

What village are you from?

Are you married?

How many children do you have?

How many school years did you complete?

***

Tell me what you know about family planning?

What do you believe are the benefits of using contraception?

What do you believe are the problems of using contraception?

Do you currently or have you ever used contraception?

What were your reasons?

What methods did you use?

Have you ever used any traditional or herbal contraception methods, if so please describe them.

What methods do you believe are the most effective?

Where can you get access to contraception?

Where did you first learn about contraception?

Did you believe what you were told? Why?

Where do you think your grandson gets information about contraception?

Are you happy about your grandson receiving contraception there?

Do you think modern contraception should be used by adolescents?

Do you discuss contraception with your family?

Did your family talk about contraception with you?

How important do you think it is to discuss this with family?

Would you like to be able to talk to your family more about this subject?

Do you think it is important to use contraception? Why?

Appendix 11: Information sheet and consent form for Contraception Access Study (Chapter 7)

Scotland Chikhwawa Health Initiative (SCHI)

Certificate of Consent for FGD

The Scotland Chikhwawa Health Initiative, with funding from the Scottish Government are implementing a Healthy Settings Approach to Community Health in Mfera Health Centre Catchment Area. This is a collaborative programme between the University of Strathclyde (Glasgow), Chikhwawa District Hospital (Ministry of Health) and the University of Malawi – Polytechnic.

A researcher at the University of Strathclyde, Rebecca Laidlaw, is carrying out research into the use of mobile phones to deliver family planning information and as part of this we want to understand how easy it is for you to get access to different contraception methods in the Mfera area of Chikwawa. We are here to invite you to take part in a focus group to discuss with your peers where contraception can be obtained in your area. This will include questions on what contraception methods you use, where you can get access to these methods, how reliable these sources are and what you do if you cannot get access to contraception.

Focus groups will be audio recorded and then transcribed by the researchers. Your responses will be kept completely confidential and only the researchers at the project will have access the recordings. This research will be written up for publication and any responses included will be kept anonymous and any identifiable information removed.

Participation in this study is voluntary and you have the right to stop taking part in the study at any point. If you have any questions, please ask any of the researchers.

I have read/witnessed the foregoing information, or it has been read to me/the participant. I/the participant have/has had the opportunity to ask questions about it and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Print Name of Participant: _____

Signature of Participant: _____ Date: _____

Signature of Parent/Guardian (if aged 15): _____

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the aims of the questionnaire we are about to complete. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher_____

Signature of Researcher _____ Date _____

Appendix 12: Interview Schedule for Contraception Access Study (Chapter 7)

Please write down each participant's name, age, school status, marriage status and number of children on the table attached.

1. **What contraception methods do you use?**

2. **Where do you get access to your chosen contraceptive method?**

3. **Why do you go there for contraception?**

4. **How reliable is this source? Are you always able to get access to your contraception choice?**

5. **What do you do if you cannot get access to your contraception choice?**

Appendix 13: Information sheet and consent form for DCV study (Chapter 7)

Participant Information Sheet

Title of the study: Behaviour Change Technique (BCT) coding of an SMS contraceptive behaviour change intervention

Introduction

My name is Rebecca Laidlaw and I am a 3nd year PhD student at the University of Strathclyde. I am inviting you to take part in this research study which will contribute towards my PhD thesis. Before you decide whether to take part, it is important for you to understand why the research is being carried out and what it will involve. Please take time to read this information sheet carefully. If, after reading, you have any questions about the study please do not hesitate to contact me on the e-mail provided below.

Thank you for taking the time to consider participating in this study.

What is the purpose of this investigation?

The aim of this study is to examine the content validity of 25 sets of SMS text messages. This will be achieved by analysing the presence of behaviour change techniques (BCTs) from the 93 taxonomy against each set of SMS messages. The SMS messages make up an mHealth behaviour change intervention targeting adolescents in rural Malawi. The messages are informing adolescents about the contraception methods available to them.

Do you have to take part?
No, you do not have to take part. Participation in this study is voluntary and you may withdraw from this study at any time without giving a reason. However, your data will be stored anonymously; therefore, you will not be able to withdraw your data after you have submitted it.

What will you do in the project?
If you decide to take part, you will be provided with a pack which will contain the 93 BCT taxonomy and 25 sets of SMS messages. You will be asked to familiarise yourself with the 93 BCTs and each definition. You will then be asked to code each set of SMS messages for BCTs from the taxonomy and rate how confident you are in each of your judgements. The task will take approximately 1 hour to complete. You will receive no payment or reimbursement for your participation in this study.

Why have you been invited to take part?
We are looking for individuals who have an understanding of psychological theory in general. You do not have to be familiar with the Behaviour Change Technique Taxonomy to take part in this study.

What happens to the information in the project?
The information you provide in this study will remain confidential, and will be securely stored on a password protected computer. All data will be stored anonymously.

The University of Strathclyde is registered with the Information Commissioner's Office who implements the Data Protection Act 1998. All personal data on participants will be processed in accordance with the provisions of the Data Protection Act 1998.

What happens next?
If you wish to take part, please complete the task in the pack provided. Please put completed packs in the pigeon hole of Dr Diane Dixon in the School of Psychological Sciences and Health or e-mail rebecca.laidlaw@strath.ac.uk for it to be collected. If you do not wish to take part, thank you for your time.

This investigation was granted ethical approval by the School of Psychological Sciences and Health Ethics Committee.

Researcher Contact Details:

Rebecca Laidlaw
University of Strathclyde
Room 5.05, James Weir Building
75 Montrose Street
G1 1XJ Email: rebecca.laidlaw@strath.ac.uk

Chief Investigator Details:
Dr Diane Dixon
School of Psychological Sciences and Health
University of Strathclyde
Graham Hills Building
40 George Street, Glasgow, G1 1QE
Telephone: 0141 548 2571, Email: diane.dixon@strath.ac.uk

If you have any questions/concerns, during or after the investigation, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:

Dr James Baxter
School of Psychological Sciences and Health
University of Strathclyde
Graham Hills Building
40 George Street, Glasgow, G1 1QE
Telephone: 0141 548 2242, Email: j.baxter@strath.ac.uk

Consent form

Title of the study: **Behaviour Change Technique (BCT) coding of an SMS contraceptive behaviour change intervention**

Name of Researcher: Rebecca Laidlaw

- I confirm that I have read and understood the information sheet for the above project and the researcher has answered any queries to my satisfaction.
- I understand that my participation is voluntary and that I am free to withdraw from the project at any time, without having to give a reason and without any consequences.
- I understand that I cannot withdraw my data from the study after I have submitted it.
- I understand that any information recorded in the investigation will remain confidential and no information that identifies me will be made publicly available.
- I consent to being a participant in the project

Participant Name:	
Signature:	
Date:	

Appendix 14: Baseline and Follow up Questionnaire for Study 1 (Chapter 8)

Screening question

Do you own a mobile phone?

Do you have access to a shared phone or can borrow one for your own use?

What is the mobile number?

Today we are going to talk about contraception methods and your own personal use of them. I will ask you the question then I will input the answer into the app on this phone which sends the information straight to the researcher, Rebecca Laidlaw, Scotland Chikwawa Health Initiative. Please tell the truth for each answer based on your own personal experience.

Demographic questions

[input participant's gender]

1. What is your name?

2. How old are you?

3. Do you attend school?

4. What year are you currently in? / What year of school did you complete?

5. Are you married?

6. Do you have children?

7. Where do you live?

Follow up Questions

Intervention Accessibility

1. Do you own or a mobile phone? /Do you have access to a shared phone or can borrow one for your own use?

2. Did you receive access to the messages? Yes—which ones? / No—why not?

3. What did you think about the registration process? [Easy / difficult]

4. What did you think of the amount of messages? [Too many, too little, just right]

5. What did you think of the time we sent the messages? [Keep at 4pm, change the time, doesn't matter]

6. Would you continue to use this service if it was available?

***

1. What did you like about the messaging service?

2. What did you not like about the messaging service?

Appendix 15: Information sheet and consent form Study 1 (Chapter 8)

Scotland Chikwawa Health Initiative (SCHI)
Healthy Settings Approach to Community Health
MFERA HEALTH CENTRE CATCHMENT AREAS, CHIKWAWA
Certificate of Consent for 1 Way Messaging Service

The Scotland Chikhwawa Health Initiative, with funding from the Scottish Government are implementing a Healthy Settings Approach to Community Health in Mfera Health Centre Catchment Area. This is a collaborative programme between the **University of Strathclyde** (Glasgow), **Chikhwawa District Hospital** (Ministry of Health) and the University of Malawi – **Polytechnic**.

As part of this project we are looking into different ways to deliver Healthy Messages to the youth in your area. One of the ways we are looking at is a SMS messaging service, which will be a free service sending SMS messages to your personal or shared phone. The content of the messages will be reproductive health, specifically contraceptive methods.

We are here on behalf of the SCHI project to ask you to be involved in this SMS messaging service. This will involve being asked questions about your knowledge of contraceptive methods and your current sexual health behaviours. You will then get access to the SMS service which will send you messages on contraceptive methods every Monday, Wednesday and Friday at around 4pm. To subscribe you need to text SCHI to 0888117086. Subscription to this service will not cost you any airtime, all messages you receive will be free. The service will last approximately 3 weeks, as we are testing different services to see what the best way to deliver Healthy Messages to the youth in your village is. You can decide to stop the messages at any time by texting STOP to 0888117086. After the service has ended we will come back and ask you some more questions on your knowledge of contraceptive methods, your sexual health behaviours and your thoughts and opinions of our healthy messages.

I would like to assure you that your responses will be kept completely confidential, only the researchers at the project will have access to the infomation.

I have read/witnessed the foregoing information, or it has been read to me/the participant. I/the participant have/has had the opportunity to ask questions about it and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Print Name of Participant: _____

Signature of Participant: _____ Date: _____

Signature of Parent/Guardian (if aged 15): _____

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the aims of the questionnaire we are about to complete.

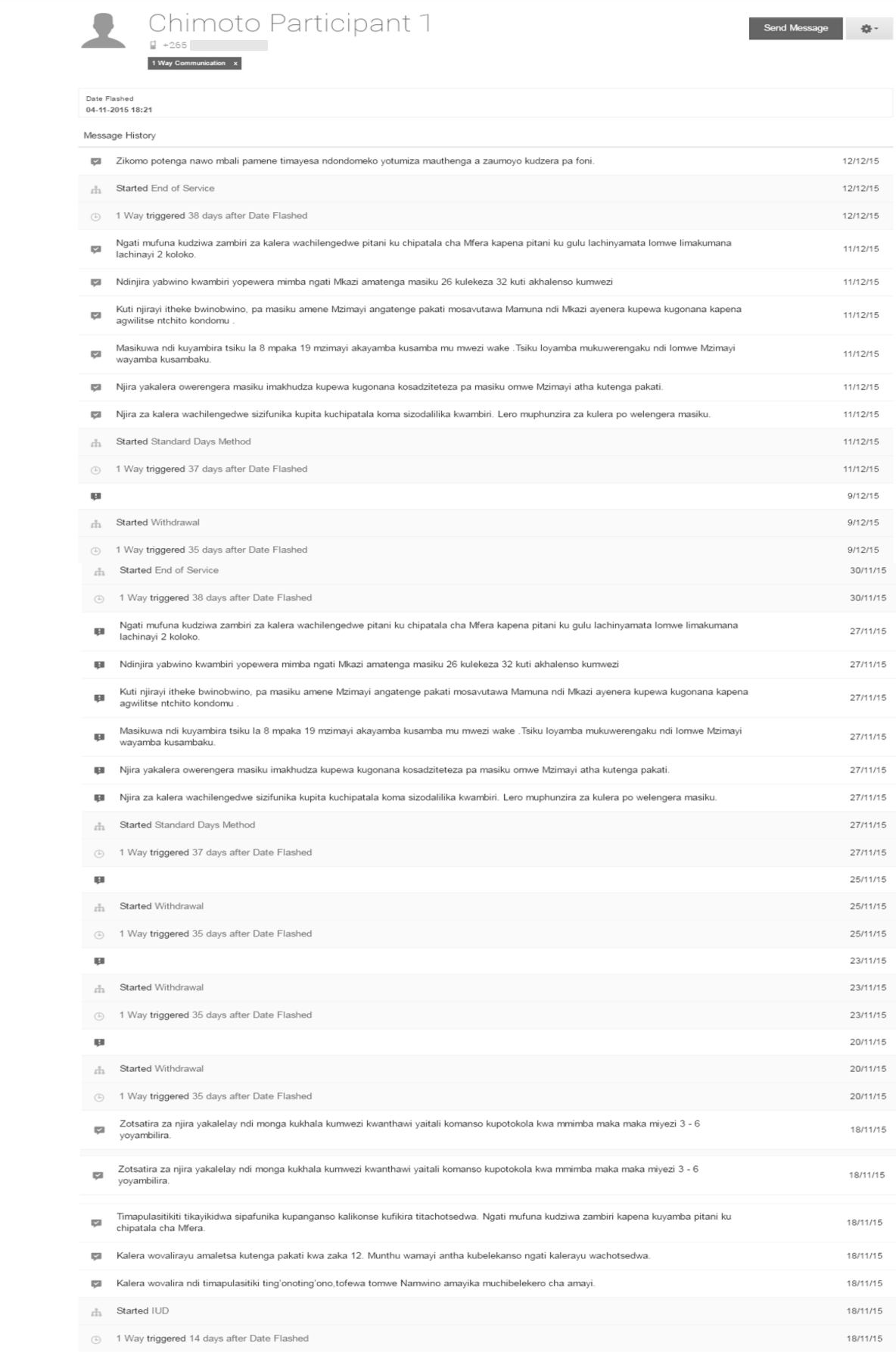
I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.
A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____

Date _____

Appendix 16: Example message flow from TextIt software in Study 1 (Chapter 8)



Chimoto Participant 1

+265

1 Way Communication x

Send Message

Date Flashed
04-11-2015 18:21

Message History

Zikomo potenga nawo mbali pamene timayesa ndondomeko yotumiza mauthenga a zaumoyo kudzera pa foni.	12/12/15
Started End of Service	12/12/15
1 Way triggered 38 days after Date Flashed	12/12/15
Ngati mufuna kudziwa zambiri za kalera wachilengedwe pitani ku chipatala cha Mfera kapena pitani ku gulu lachinyamata lomwe limakumana lachinayi 2 koloko.	11/12/15
Ndinjira yabwino kwambiri yopewera mimba ngati Mkazi amatenga masiku 26 kulekeza 32 kuti akhalenso kumwezi	11/12/15
Kuti njirayi itheke bwinobwino, pa masiku amene Mzimayi angatenge pakati mosavutawa Mamuna ndi Mkazi ayenera kupewa kugonana kapena agwilitse ntchito kondomu .	11/12/15
Masikuwa ndi kuyambira tsiku la 8 mpaka 19 mzimayi akayamba kusamba mu mwezi wake .Tsiku loyamba mukuwerengaku ndi lomwe Mzimayi wayamba kusambaku.	11/12/15
Njira yakalera owerengera masiku imakhudza kupewa kugonana kosadziteteza pa masiku omwe Mzimayi atha kutenga pakati.	11/12/15
Njira za kalera wachilengedwe sizifunika kupita kuchipatala koma sizodalilika kwambiri. Lero muphunzira za kulera po welengera masiku.	11/12/15
Started Standard Days Method	11/12/15
1 Way triggered 37 days after Date Flashed	11/12/15
	9/12/15
Started Withdrawal	9/12/15
1 Way triggered 35 days after Date Flashed	9/12/15
Started End of Service	30/11/15
1 Way triggered 38 days after Date Flashed	30/11/15
Ngati mufuna kudziwa zambiri za kalera wachilengedwe pitani ku chipatala cha Mfera kapena pitani ku gulu lachinyamata lomwe limakumana lachinayi 2 koloko.	27/11/15
Ndinjira yabwino kwambiri yopewera mimba ngati Mkazi amatenga masiku 26 kulekeza 32 kuti akhalenso kumwezi	27/11/15
Kuti njirayi itheke bwinobwino, pa masiku amene Mzimayi angatenge pakati mosavutawa Mamuna ndi Mkazi ayenera kupewa kugonana kapena agwilitse ntchito kondomu .	27/11/15
Masikuwa ndi kuyambira tsiku la 8 mpaka 19 mzimayi akayamba kusamba mu mwezi wake .Tsiku loyamba mukuwerengaku ndi lomwe Mzimayi wayamba kusambaku.	27/11/15
Njira yakalera owerengera masiku imakhudza kupewa kugonana kosadziteteza pa masiku omwe Mzimayi atha kutenga pakati.	27/11/15
Njira za kalera wachilengedwe sizifunika kupita kuchipatala koma sizodalilika kwambiri. Lero muphunzira za kulera po welengera masiku.	27/11/15
Started Standard Days Method	27/11/15
1 Way triggered 37 days after Date Flashed	27/11/15
	25/11/15
Started Withdrawal	25/11/15
1 Way triggered 35 days after Date Flashed	25/11/15
	23/11/15
Started Withdrawal	23/11/15
1 Way triggered 35 days after Date Flashed	23/11/15
	20/11/15
Started Withdrawal	20/11/15
1 Way triggered 35 days after Date Flashed	20/11/15
Zotsatira za njira yakalelay ndi monga kukhala kumwezi kwanthawi yaitali komanso kupotokola kwa mmimba maka maka miyezi 3 - 6 yoyambilira.	18/11/15
Zotsatira za njira yakalelay ndi monga kukhala kumwezi kwanthawi yaitali komanso kupotokola kwa mmimba maka maka miyezi 3 - 6 yoyambilira.	18/11/15
Timapulasitikiti tikayikidwa sipafunika kupanganso kalikonse kufikira titachotsedwa. Ngati mufuna kudziwa zambiri kapena kuyamba pitani ku chipatala cha Mfera.	18/11/15
Kalera wovalirayu amaletsa kutenga pakati kwa zaka 12. Munthu wamayi antha kubelekanso ngati kalerayu wachotsedwa.	18/11/15
Kalera wovalira ndi timapulasitiki ting'onoting'ono,tofewa tomwe Namwino amayika muchibelekero cha amayi.	18/11/15
Started IUD	18/11/15
1 Way triggered 14 days after Date Flashed	18/11/15

	Zina zodza kamba kotsata njirayi nazi: kutulutsa magazi ambiri kapena ochepa ngakhale kusatulutsa magazi nzimayi akakhala kumwezi, muchaka choyamba.	16/11/15
	Timapulasitikiti tikayikidwa sipafunika kupanganso kalikonse kufikira titachotsedwa. Ngati mufuna kudziwa zambiri kapena kuyamba pitani ku chipatala cha Mfera.	16/11/15
	Njirayi imapangitsa kusatenga pakati kwa zaka zitatu mpaka zisanu. Nzimayi atha kubelekanso ngati kalera wapathupiyu wachotsedwa.	16/11/15
	Mukalera oyikidwa pathupi; namwino amayika mankhwala onga kantengo kakang'ono kofewa nkati mwankono wa munthu wamayi.	16/11/15
	Started Implant	16/11/15
	1 Way triggered 12 days after Date Flashed	16/11/15
	Pakatha miyezi itatu, kutulutsa magazi koteleku kumasiya komanso sikowopsa. Ngati mufuna kudziwa zambiri kapena kuyamba njirayi pitani ku chipatala cha Mfera.	13/11/15
	Zina zodza kamba ka njirayi nazi: kutulutsa magazi ambiri kapena ochepa komanso kutulutsa magazi kwanthawi yotalikilapo nzimayi akakhala kumwezi.	13/11/15
	Kalera obaya amabayidwa ndi namwino pa nkono wamayi pa masabata 4 aliwonse. Njirayi imakhala yothandiza ngati mzimayi akumapita kukabayitsa panthawi yake.	13/11/15
	Started Injection	13/11/15
	1 Way triggered 10 days after Date Flashed	13/11/15
	Nzimayi atha kubelekanso ngati wasiya kumwa mapilisiwa. Ngati mufuna kudziwa zambiri kapena kuyamba njirayi, pitani ku chipatala cha Mfera.	11/11/15
	Zina zodza kamba ka njirayi nazi: kutulutsa magazi ambiri kapena ochepa pa nthawi yomwe nzimayi ali ku mwezi, makamaka miyezi yoyambilira, izi sizowopsa.	11/11/15
	Njirayi imakhala yothandiza ngati mapilisi akumwedwa mosadumphitsa komanso poonetsetsa kuti mapilisi atsopano akuyambidwa panthawi yake ngati akale atha.	11/11/15
	Mapilisi akalera amayenera kumwedwa pilisi limodzi pa tsiku pa nthawi yokhazikika kusatengera kuti patsikulo mkazi wagonana ndi mwamuna kapena ayi.	11/11/15
	Njira za kalera okhalitsa nazi: mapilisi akalera okumwa, kalera obaya, kalera oyikidwa pathupi, komanso kalera wovalira. Lero muphunzira za mapilisi.	11/11/15
	Started Pill	11/11/15
	1 Way triggered 8 days after Date Flashed	11/11/15
	Kuti muyambe kugwilitsa ntchito njirayi, kudziwa kagwilitsidwe ntchito kake kapena ngati pali mafunso pitani ku chipatala cha Mfera.	9/11/15
	Palibe zina zodza kamba ka njilayi ngati igwilitsidwa ntchito moyenera nthawi zonse pogonana. Itha kugwilistidwa ntchito ndi anthu omwe ali pabanja kapena ayi.	9/11/15
	Azimayi atha kuyambitsa nkhani yogwilitsa ntchito kondomuyi koma njirayi imafunika mgwilizano ndi abambo.	9/11/15
	Kulowetsa komanso kutulutsa kondomuyi kukhomo lachibelekero sikuvuta ngati mayiyo akumayeselasayesela	9/11/15
	Kondomu yachizimayi ndi kathumba kokhala ndi mafuta, kopangidwa ndi kapulasitiki kakang'ono kofewa, komwe kamaikidwa kukhomo lachibelekero.	9/11/15
	Started Female Condoms	9/11/15
	1 Way triggered 5 days after Date Flashed	9/11/15
	Kuti muyambe kugwilitsa ntchito njirayi, kudziwa kagwilitsidwe ntchito kake kapena ngati pali mafunso pitani ku chipatala cha Mfera.	6/11/15
	Palibe zina zodza kamba ndi njilayi ikagwilitsidwa ntchito moyenera nthawi zonse pogonana. Siyovuta kupeza ndipo imapewetsa pakati matenda odza pogonana ndi HIV	6/11/15
	Lero muphunzira za makondomu a abambo . Makondomu a a bambo ndi labala yemwe amavalidwa pachida chabambo chomwe chili chodzuka.	6/11/15
	Makondomu a abambo kapena a amayi ndi njira YOKHAYO ya kalera yomwe imateteza kutenga pakati komanso kumatenda odza pogonana kuphatikizilapo HIV.	6/11/15
	Started Male Condoms	6/11/15
	1 Way triggered 1 day after Date Flashed	6/11/15
	Ngati mufuna kusiya kulandila mauthengawa tumizani mawu oti LEKA ku 0888117086.	4/11/15
	Mudzilandila mauthenga akalera lolemba, lachitatu ndi lachisanu lililonse nthawi ya 4 koloko madzulo.	4/11/15
	Takulandilani kundondomeko yoyeselera yolandila mauthenga azaumoyo kuchokela ku SCHI.	4/11/15
	Started 1 Way Communication Pilot	4/11/15
	Started Join 1 Way Communication 2	4/11/15
	Started TEST	4/11/15
	Phone call (None)	4/11/15

Appendix 17: Information sheet and consent form control group of Study 1 (Chapter 8)

Scotland Chikwawa Health Initiative (SCHI)

The Schotland Chikwawa Health Initiative, with funding from the Scottish Government are implementing a Healthy Settings Approach to Community Health in Mfera Health Centre Catchment Centre. Thisis a collaborative programme between University of Strathclyde (Glasgow), Chikwawa District Hospital (Ministry of Health and the University of Malawi – Polytechnic.

A researcher at the University of Strathlyde, Rebecca Laidlaw, is carrying out research looking into the use of mobile phones to deliver health education messages in your area. The aim is to create a healthy messaging service providing health education about contraception which can be accessed through SMS messages to your mobile phone. In order to evaluate this research you are being invited to take part in a questionnaire about your current knowledge, attitudes on contraception and your current contraceptive behaviours. Questions will ask what you currently know about contraceptive methods and if you know where you can access them. You will then be asked if you have ever had sexual intercourse and whether or not you use or intend to use contraception. We will then come back in 8 weeks and repeat the same questionnaire.

The research will affect you, as when we determine effectiveness of this method of delivery, you will be able to access the messages in the future. You are eligible to take part if you can read Chichewa and either own or have access to a shared mobile phone.

Your responses will be kept completely confidential and only the researchers at the project will have access to your information. This research will be written up for publication and any responses included will be kept anonymous and any identifyable information removed.

Participation in this study is voluntary and you have the right to stop taking part in the study at any point. If you have any questions, please ask any of the researcher.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Print Name of Participant:_____

Signature of Participant:_____ Date**:** _____

Signature of Parent/Guardian (if aged 15))_____

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the aims of the questionnaire we are about to complete.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____
Date _____

Appendix 18: Information sheet and consent form intervention group of Study 2 (Chapter 8)

Scotland Chikwawa Health Initiative (SCHI)

The Schotland Chikwawa Health Initiative, with funding from the Scottish Government are implementing a Healthy Settings Approach to Community Health in Mfera Health Centre Catchment Centre. Thisis a collaborative programme between University of Strathclyde (Glasgow), Chikwawa District Hospital (Ministry of Health and the University of Malawi – Polytechnic.

A researcher at the University of Strathlyde, Rebecca Laidlaw, is carrying out research looking into the use of mobile phones to deliver health education messages in your area. The aim is to create a healthy messaging service providing health education about contraception which can be accessed through SMS messages to your mobile phone. We are here to invite you to be involved in this SMS messaging service. This will involve taking part in a questionnaire about your current knowledge and attitudes on contraception and your current contraceptive behaviours. Questions will ask what you currently know about contraceptive methods and if you know where to get them. You will then be asked if you have ever had sexual intercourse and whether or not you use or intend to use contraception. After the discussion you will be given access to the SMS messaging service which will send you messages on contraceptive methods every Monday, Wednesday and Friday at 4pm. **Subscription to this service will not cost you any airtime, all messages you receive will be free.**

The service will last 8 week and **you can decide to stop receiving the messages at any time by texting STOP to 0888117086**. After the service has finished we will come back and ask you some more questions on your knowledge of contraceptive methods and your current behaviour, as well as your thoughts and opinions on the messages you received.

You are eligible to take part if you can read Chichewa and either own or have access to a shared mobile phone. Participation in this study is voluntary and you have the right to stop taking part in the study at any point. If you have any questions, please ask any of the researcher. Your responses will be kept completely confidential and only the researchers at the project will have access to your information. We will record your name and mobile number in order to contact you in 8 weeks, however this information will be deleted after follow up and will only be available to the researcher. This research will be written up for publication and any responses included will be kept anonymous and any identifyable information removed.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Print Name of Participant:_____

Signature of Participant:_____ Date**:** _____

Signature of Parent/Guardian (if aged 15))_____

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the aims of the questionnaire we are about to complete.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____

Date _____

Appendix 19: Baseline Questionnaire for Intervention and Control group, Study 2 (Chapter 8)

SMS Intervention Baseline Questionnaire

****Magpi system will automatically skip some questions depending on answer****

Demographic Questions

[input participant's gender]

1. How old are you?

2. Do you attend school?

3. What year are you currently in? / What year of school did you complete?

4. Are you married?

5. Do you have children?

6. Where do you live?

7. Do you own a mobile phone?

8. What is the mobile number?

Shared Phone Accessibility

1. Do you have access to a shared phone or can borrow one for your own use?

2. Who owns the shared phone?

3. How often do you get access to the share phone?

4. Where does the phone owner live?

Knowledge

Contraceptive Knowledge Recall

1. Can you please tell me the names of the methods you have heard of? [give the participant enough time, do not rush and if they cannot think of any more then move on]

Contraceptive Knowledge Recognition

Okay, now we will go through some method definitions and see if you have heard of them.

1. Pill: Women can take a pill every day. Have you heard of this method?

2. Injection: Women can have an injection every 2 or every 3 months. Have you heard of this method?

3. Condom: a man can put a rubber device on his penis before intercourse. Have you heard of this method?

4. Emergency Contraceptive Pill: A woman can take pills soon after intercourse. Have you heard of this method?

5. IUD: Device inserted into woman's uterus by a nurse. Have you heard of this method?

6. Implant: small rod placed under the skin of a woman's arm by a nurse. Have you heard of this method?

7. Withdrawal: A man can pull out of a woman before climax. Have you heard of this method?

8. Standard Days Method: A couple can avoid sex on days when pregnancy is most likely to occur. Have you heard of this method?

9. Male Vasectomy: Men can undergo surgery for permanent sterilization. Have you heard of this method?

10. Female Sterilization: Women can undergo surgery for permanent sterilization. Have you heard of this method?

Attitudes

1. A girl can suggest to her boyfriend that he use a condom [agree/disagree/don't know]

2. A boy can suggest to her girlfriend that he use a condom [agree/disagree/don't know]

3. Condoms are suitable for causal relationships

4. Condoms are suitable for steady, loving relationships

5. It would be too embarrassing for someone like me to buy or obtain condoms [agree/disagree/don't know]

6. If a girl suggested using condoms to her partner, it would mean that she didn't trust him. [agree/disagree/don't know]

7. Condoms reduce sexual pleasure

8. If unmarried couples want to have sexual intercourse before marriage, they should use condoms

Behaviour

1. Have you ever had sexual intercourse?

2. Do you or your sexual partner use contraception to avoid pregnancy? [Always/Sometimes/Never]

That is the end of the questionnaire. Thank you for your time. We will be in touch soon to speak to you again about our research.

Appendix 20: Follow up Questionnaire for Intervention and Control group, Study 2 (Chapter 8)

SMS Intervention Follow Up Questionnaire

****Magpi system will automatically skip some questions depending on answer****

Phone Accessibility

1. Do you own a mobile phone?

2. Do you have access to a shared phone or can borrow one for your own use?

3. Who owns the phone you share?

4. How often do you get access to the share phone?

5. Where does the phone owner live?

Participant's Name

Participant's Gender

Knowledge

Contraceptive Knowledge Recall

1. Can you please tell me the names of the methods you have heard of? [give the participant enough time, do not rush and if they cannot think of any more then move on]

Contraceptive Knowledge Recognition

Okay, now we will go through some method definitions and see if you have heard of them.

1. Pill: Women can take a pill every day. Have you heard of this method?

2. Injection: Women can have an injection every 2 or every 3 months. Have you heard of this method?

3. Condom: a man can put a rubber device on his penis before intercourse. Have you heard of this method?

4. Emergency Contraceptive Pill: A woman can take pills soon after intercourse. Have you heard of this method?

5. IUD: Device inserted into woman's uterus by a nurse. Have you heard of this method?

6. Implant: small rod placed under the skin of a woman's arm by a nurse. Have you heard of this method?

7. Withdrawal: A man can pull out of a woman before climax. Have you heard of this method?

8. Standard Days Method: A couple can avoid sex on days when pregnancy is most likely to occur. Have you heard of this method?

9. Male Vasectomy: Men can undergo surgery for permanent sterilization. Have you heard of this method?

10. Female Sterilization: Women can undergo surgery for permanent sterilization. Have you heard of this method?

Attitudes

1. A girl can suggest to her boyfriend that he use a condom [agree/disagree/don't know]

2. A boy can suggest to her girlfriend that he use a condom [agree/disagree/don't know]

3. Condoms are suitable for causal relationships

4. Condoms are suitable for steady, loving relationships

5. It would be too embarrassing for someone like me to buy or obtain condoms [agree/disagree/don't know]

6. If a girl suggested using condoms to her partner, it would mean that she didn't trust him. [agree/disagree/don't know]

7. Condoms reduce sexual pleasure

8. If unmarried couples want to have sexual intercourse before marriage, they should use condoms

Behaviour

1. Have you ever had sexual intercourse?

2. Do you or your sexual partner use contraception to avoid pregnancy? [Always/Sometimes/Never]

That is the end of the questionnaire. Thank you for your time. We will be in touch soon to speak to you again about our research.

INTERVENTION GROUP ONLY

Intervention Acceptability

1. Did you receive messages about contraception?

Check box for: male condom, female condom, pill, injection, implant, IUD, withdrawal, SDM

2. Did you receive a diary when we last met? Have you completed it? No, why not?

3. Did you understand the messages and what they were telling you?

4. Did you have any questions on the information you received?

5. How would you like to receive the answers? In person /youth club/ on phone?

6. Would you continue to use this service if it was available?

7. Do you think this is a good way to receive information about your health?

***

1. Do you think the messages changed your contraceptive knowledge? If yes, in what way?

2. Do you think the messages changed your contraceptive behaviour / will change it in the future?

If yes, in what way?

3. Do you think the messages have changed your opinion of contraception? If yes, in what way?

Appendix 21: Three and six month follow up Questionnaire for Intervention Group, Study 2 (Chapter 8)

SMS Intervention Follow Up Questionnaire

****Magpi system will automatically skip some questions depending on answer****

Phone Access

1. Do you own a mobile phone?

2. Do you have access to a shared phone or can borrow one for your own use?

4. Who owns the phone you share?

4. How often do you get access to the share phone?

5. Where does the phone owner live?

Intervention Accessibility

1. Did you trust the content of the messages?

2. Did you have any questions on the information you received?

3. How would you like to receive the answers? In person /youth club/ on phone?

4. Would you continue to use this service if it was available?

5. What did you think of the messaging service?

6. What would you change about the messaging service?

7. Do you think the messages changed your contraceptive knowledge? If yes, in what way?

8. Do you think the messages changed your contraceptive behaviour? If yes, in what way?

9. Is this still the case now?

Other Influences

1. Have you attended any youth clubs over the past 3 months?

2. Did you receive any information about your health? If yes, what kind of information?

Knowledge

Contraceptive Knowledge Recall

1. Can you please tell me the names of the methods you have heard of? [give the participant enough time, do not rush and if they cannot think of any more then move on]

Contraceptive Knowledge Recognition

Okay, now we will go through some method definitions and see if you have heard of them.

1. Pill: Women can take a pill every day. Have you heard of this method?

2. Injection: Women can have an injection every 2 or every 3 months. Have you heard of this method?

3. Condom: a man can put a rubber device on his penis before intercourse. Have you heard of this method?

4. Emergency Contraceptive Pill: A woman can take pills soon after intercourse. Have you heard of this method?

5. IUD: Device inserted into woman's uterus by a nurse. Have you heard of this method?

6. Implant: small rod placed under the skin of a woman's arm by a nurse. Have you heard of this method?

7. Withdrawal: A man can pull out of a woman before climax. Have you heard of this method?

8. Standard Days Method: A couple can avoid sex on days when pregnancy is most likely to occur. Have you heard of this method?

9. Male Vasectomy: Men can undergo surgery for permanent sterilization. Have you heard of this method?

10. Female Sterilization: Women can undergo surgery for permanent sterilization. Have you heard of this method?

Attitudes

1. A girl can suggest to her boyfriend that he use a condom [agree/disagree/don't know]

2. A boy can suggest to her girlfriend that he use a condom [agree/disagree/don't know]

3. Condoms are suitable for causal relationships

4. Condoms are suitable for steady, loving relationships

5. It would be too embarrassing for someone like me to buy or obtain condoms [agree/disagree/don't know]

6. If a girl suggested using condoms to her partner, it would mean that she didn't trust him. [agree/disagree/don't know]

7. Condoms reduce sexual pleasure

8. If unmarried couples want to have sexual intercourse before marriage, they should use condoms

Behaviour

1. Have you ever had sexual intercourse?

2. Do you or your sexual partner use contraception to avoid pregnancy? [Always/Sometimes/Never]

That is the end of the questionnaire. Thank you for your time. We will be in touch soon to speak to you again about our research.

Appendix 22: Three and six month follow up Questionnaire for Control Group, Study 2 (Chapter 8)

SMS Intervention Follow Up Questionnaire

****Magpi system will automatically skip some questions depending on answer****

Other Influences

1. Have you attended any youth clubs over the past 3 months?

2. Did you receive any information about your health? If yes, what kind of information?

3. Have you met anyone who has been receiving SMS messages providing information on contraceptive methods? [Yes/No]

4. Did you read any of the SMS messages? If yes – what messages did you read? [tick box for each contraceptive method]

Knowledge

Contraceptive Knowledge Recall

1. Can you please tell me the names of the methods you have heard of? [give the participant enough time, do not rush and if they cannot think of any more then move on]

Contraceptive Knowledge Recognition

Okay, now we will go through some method definitions and see if you have heard of them.

1. Pill: Women can take a pill every day. Have you heard of this method?

2. Injection: Women can have an injection every 2 or every 3 months. Have you heard of this method?

3. Condom: a man can put a rubber device on his penis before intercourse. Have you heard of this method?

4. Emergency Contraceptive Pill: A woman can take pills soon after intercourse. Have you heard of this method?

5. IUD: Device inserted into woman's uterus by a nurse. Have you heard of this method?

6. Implant: small rod placed under the skin of a woman's arm by a nurse. Have you heard of this method?

7. Withdrawal: A man can pull out of a woman before climax. Have you heard of this method?

8. Standard Days Method: A couple can avoid sex on days when pregnancy is most likely to occur. Have you heard of this method?

9. Male Vasectomy: Men can undergo surgery for permanent sterilization. Have you heard of this method?

10. Female Sterilization: Women can undergo surgery for permanent sterilization. Have you heard of this method?

Attitudes

1. A girl can suggest to her boyfriend that he use a condom [agree/disagree/don't know]

2. A boy can suggest to her girlfriend that he use a condom [agree/disagree/don't know]

3. Condoms are suitable for causal relationships

4. Condoms are suitable for steady, loving relationships

5. It would be too embarrassing for someone like me to buy or obtain condoms [agree/disagree/don't know]

6. If a girl suggested using condoms to her partner, it would mean that she didn't trust him. [agree/disagree/don't know]

7. Condoms reduce sexual pleasure

8. If unmarried couples want to have sexual intercourse before marriage, they should use condoms

Behaviour

1. Have you ever had sexual intercourse?

2. Do you or your sexual partner use contraception to avoid pregnancy? [Always/Sometimes/Never]

That is the end of the questionnaire. Thank you for your time. We will be in touch soon to speak to you again about our research.