Title

EFFECT OF MOBILE-PHONE REMINDER TEXT MESSAGES ON MOTHERS' KNOWLEDGE AND COMPLETION OF ROUTINE IMMUNISATION IN RURAL AREAS OF OYO STATE, NIGERIA

BY

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**A THESIS IN THE DEPARTMENT OF HEALTH PROMOTION AND EDUCATION,
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To all the victims of vaccine-preventable diseases and their caregivers

ABSTRACT

Interventions aimed at promoting completion of Routine Immunisation (RI) in Nigeria have not yielded satisfactory results. Text Message Reminders (TMRs) through mobile phones have been used to promote adoption of innovations; however, its effectiveness in enhancing the completion of RI in rural areas has not been adequately investigated. This study was designed to evaluate the effects of TMRs on knowledge and completion of RI by Mothers of Infants (MI) in rural Local Government Areas (LGAs) in Oyo State, Nigeria.

The adopted quasi-experimental design involved random selection of Ibarapa North (IN) and Kajola from the list of 12 rural LGAs with highest immunisation dropout rates. Ibarapa North and Kajola were randomly allocated to Intervention Group (IG) and Control Group (CG), respectively by balloting. Five Primary Health Care facilities in each LGA with RI services were randomly selected out of 10 facilities in each LGA. All consenting 179 MI in IG and 187 MI in CG who registered their children at the health facilities for RI in June 2014 were enrolled. Data were collected through Focus Group Discussion (FGD) among MI, Key Informant Interview (KII) among Health Workers (HWs), and an interviewer-administered questionnaire, which included a 25-point knowledge scale, questions on receipt of TMRs and RI appointment keeping. Knowledge Scores (KS) <13 and ≥ 13 were categorised as poor and good, respectively. Baseline results were used to design an intervention that involved disseminating TMRs to MI in IG thrice weekly for 10 months on the importance of RI and RI appointment keeping. A thematic approach was used to analyse qualitative data. Quantitative data were analysed using descriptive statistics, t-test and Chi-square test. Level of significance was at $p=0.05$.

Respondents' ages in IG and CG were 26.4 ± 5.6 and 28.3 ± 5.5 years, respectively. The highest level of education was high school among IG (65.2%) and CG (57.0%). The FGD participants had little knowledge of RI. Many participants in both groups supported the use of TMRs for promoting RI appointments among MI. The KII revealed that few HWs counselled RI defaulting mothers on adherence to complete RI. Majority of the IG (79.1%) received TMRs and among this sub-group, 75.5% reportedly received TMRs often. Immunisation barriers listed by respondents in IG for not completing RI included busy schedules (24.4%), children's ill health (16.7 %) and apathy (16.7%). Baseline KS among IG and CG were 10.3±3.5 and 9.3±2.5, respectively, which increased significantly to 12.9±2.8 and 13.1±4.0 among IG and CG at Post-Intervention (PI). However, at PI, KS among IG was 12.9±2.8 and this was not significantly different from 13.1±4.0 among CG**.** Significantly, more MI in IG (77.4%) compared with those in CG (64.5%) completed RI. Percentage of completion of immunisation among IG was 87.1%, and this was significantly higher than the 56.7% among CG.

Text message reminders were effective in improving knowledge and completion of routine immunisation among mothers of infants in Ibarapa North Local Government Area. Therefore, its use among frontline health workers is recommended.

Keywords: Text message reminders, Immunisation-related knowledge, Immunisation barriers

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Oluwafemi Dipeolu
February 2017

CERTIFICATION

I certify that this work was carried out by Isaac Oluwafemi DIPEOLU in the Department of Health Promotion and Education, University of Ibadan.

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ABBREVIATION/GLOSSARY

CDC:	Centers for Disease Control and Prevention
HBV	Hepatitis B virus
HCV	Hepatitis C virus
Hib	Haemophilus influenzae type b
IPV	Inactivated poliovirus vaccine
MMR	Measles-mumps-rubella vaccine
MMWR	Morbidity and Mortality Weekly Report
MR	Measles-rubella vaccine
OPV	Oral poliovirus vaccine
SMS	Short Message Service
RTMs	Reminder Text Messages
TT	Tetanus toxoid
VAE	Vaccine adverse event
VPD	Vaccine-preventable disease
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Attenuated virus: A strain of virus whose virulence has been lowered by physical or chemical processes or by repeated passage through the cells of another species.

Cell phone: A GSM terminal connected through a GSM radio link to telecommunication network. They are also commonly referred to as mobile phone

Confirmed case: A case that is classified as confirmed for reporting purposes.

eHealth: Use of information and communication technologies (ICT) in healthcare, which can improve prevention, diagnosis, treatment, monitoring and management of diseases.

Functional mobile phone: A functional mobile phone is a phone that can make and receive telephone calls, and send and receive text messages commonly called SMS (Short Message Service).

GSM: Global System for Mobile communications (GSM) is major radio systems used in cell phones. GSM is an open, digital cellular technology used for transmitting mobile voice and data services.

Immunisation: A process by which a person becomes protected against a disease through vaccination. This term is often used interchangeably with vaccination or inoculation.

Immunity: Protection from an infectious disease. If you are immune to a disease, you can be exposed to it without becoming infected.

Immuno-compromised: A state in which an individual either has a decreased or absent ability to mount an antibody and/or cell-mediated immune response to infectious agents.

Incubation period: The period from exposure to an infecting agent to the onset of symptoms of the disease.

Laboratory confirmed case: A case that is confirmed by one or more of the laboratory methods listed in the case definition under “Laboratory criteria.”

Although other laboratory methods may be used in clinical diagnosis, only those listed are accepted for laboratory confirmation for reporting purposes.

mHealth: A general term for the use of mobile phones and other wireless technology in medical care. The most common application of mHealth is the use of mobile phones and communication devices to educate consumers about preventive health care services.

Mobile phone: Portable telephone device that does not require the use of landlines, often referred to as a cellular phone or cell phone. Mobile phones connect to a wireless communications network through radio wave or satellite transmissions. Most mobile phones provide voice communications, Short Message Service (SMS), Multimedia Message Service (MMS), and newer phones may provide Internet services such as Web browsing and e-mails.

Sentinel surveillance: Activities focused on monitoring key health indicators in the general population or in special populations. The primary intent is to obtain timely information needed for public health or medical action in a relatively inexpensive manner rather than to derive precise estimates of prevalence or incidence in the general population.

Short Message Service: A service for sending short messages or of up to 160 characters (224 characters if using a 5-bit mode) to mobile devices, including mobile phones, cellular phones, smartphones and Personal Digital Assistants (PDAs). Short Message Service (SMS) is also referred to as "text messaging". Personal digital assistant is a term for a small, mobile, handheld device that provides computing and information storage and retrieval capabilities for personal or business use, often for keeping schedules, calendars and address book information handy.

Susceptible: Being sensitive to the effects of infectious disease, allergen, or other pathogenic agents, lacking immunity or resistance.

Text Message: Used interchangeably with Short Message Service

Vaccination: The act of introducing a vaccine into the body to produce immunity to a specific disease.

Vaccine coverage: The proportion or percentage of persons that have received a vaccine among all individuals in a group who are eligible to receive the vaccine.

Vaccine effectiveness: The ability of a vaccine to provide protection against disease when used under field conditions (e.g., use of the vaccine in routine practice).

Vaccine efficacy: The ability of a vaccine to provide protection against disease under ideal circumstances (e.g., during a clinical trial)

Vaccine: A substance that stimulates a person's immune system to produce immunity to a specific disease, protecting the person from that disease. Vaccines are usually administered through needle injections, but can also be administered by mouth or sprayed into the nose.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Immunisation is the process by which an individual gains immunity or resistance to disease through the administration of a vaccine (Chachou, Mukinda, Motaze and Wiysonge, 2015; World Health Organisation [WHO], 2015a). In Nigeria, a fully vaccinated infant is one that has received one dose of Bacillus Calmette-Guérin (BCG) vaccine against tuberculosis, three doses of Pentavalent vaccine to prevent diphtheria, tetanus, whooping cough, hepatitis B and Haemophilus influenza type B, three doses of polio vaccine, one dose of measles vaccine and one dose of yellow fever vaccine (National Population Commission [NPC] and ORC Macro, 2009). For Diphtheria, Pertussis, Tetanus (DPT), the Global Alliance for Vaccines and Immunisation (GAVI) proposed a minimal coverage goal of 80 per cent (three doses) by 2005 and is to be achieved in all districts in all countries (Ophori, Tula, Azih, Okojie and Ikpo, 2014).

Immunisation against childhood diseases such as Diphtheria, Pertussis, Tetanus, Polio and Measles is one of the most important means of preventing childhood morbidity and mortality (Ophori et al., 2014). It is critical to child survival by lowering opportunity for vaccine-preventable infections, the associated sequelae, disability and death. In Ophori et al., (2014), benefits include good health and survival of children. Another is the cost-saving benefit of immunisation resulting from a lower incidence of disease and less frequent visits to the hospital. In 2004, parents in both Lagos and Enugu conclude that immunisation reduced mortality and morbidity, helped to minimise the anxiety associated with rearing children, and facilitated maximal use of time and money (Ophori et al., 2014).

Despite these advantages, studies have shown that over one million children die annually in Nigeria from vaccine-preventable diseases, making the country one of the least successful African countries in achieving improvements in child survival during the past four decades (Antai, 2010; Ngowu, Larson and Kim, 2008). Achieving and maintaining high levels of immunisation coverage must, therefore, be a priority for all health systems. However, lack of progress in moving towards high levels of coverage is usually a strong indication of failure to provide essential services to protect the health of children who are the most vulnerable segment of a population (Ophori et al, 2014).

Immunisation coverage in Nigeria has been unsatisfactory. As of 2013, Nigeria Fully Immunised Child (FIC) rate stands at 23% (National Population Commission (NPC) [Nigeria] and ICF International, 2014). This is hardly surprising, as the country's Routine Immunisation (RI) coverage has remained consistently low since the early 1990s (Ophori et al, 2014; World Health Organisation [WHO], 2011). Adebayo, Oladokun and Akinbami (2012) reported that drop-out rate on routine immunisation of children <23 months by vaccine types in Nigeria showed that Diphtheria Pertussis Tetanus (DPT)3/yellow fever had the highest dropout rate of 39.0%, followed by Bacillus Calmette–Guérin (BCG)/Yellow fever, 25.3% while the least was BCG/Measles (11.7%).

Low immunisation coverage in Nigeria has been linked to many factors. These include factors related to the health system, healthcare workers and caregivers (i.e. parents or other persons assuming the parental role) (Chachou et al., 2015; Wiysonge, Ngcobo, Jeena, Madhi, Schoub, Hawkridge, Shey and Hussey, 2012; Wiysonge, Uthman, Ndumbe and Hussey, 2012; Falagas and Zarkadoulia, 2008). Caregivers-related factors that influence childhood immunisation coverage include (but are not limited to) low socioeconomic status, low parental education, younger maternal age, lack of knowledge about the importance of immunisation, negative attitude towards immunisation, fear of claimed associated side effects with immunisation and forgetting vaccination schedules and appointments (Wiysonge et al., 2012; Falagas and Zarkadoulia, 2008).

The Nigerian government attempted to improve vaccination uptake through various effort and strategies. These efforts include an adaption of WHO/Reaching Every District (RED) approach in response to the decline or stagnation in routine immunisation coverage. The Reaching Every District approach was domesticated in Nigeria as the "Reaching Every Ward" approach (REW), as a political ward represents the lowest administrative level in the country. Nigeria defined its REW approach as "a strategy aimed at the provision of regular, effective, quality and sustainable routine immunisation activities in every ward, to improve immunisation coverage" (IMMUNIZATIONbasics, 2009). National Immunisation Days (NIDS), Immunisation Plus Days (IPDs) (days set aside to strengthen the fight against polio in Nigeria) and capacity building for health workers etc. Despite these efforts, immunisation coverage remains substantially low and misconceptions exist among caregivers relating to immunisation initiatives (WHO, UNICEF and USAID, 2006).

In addition to the vaccination-improvement interventions by the Federal Government of Nigeria, Oyo State government has made other efforts geared towards reducing cases of vaccine-preventable diseases. These include increased observance of the Immunisation Plus Days (IPDs) in all health facilities rendering routine immunisation services, Biannual Maternal New Born and Child Health (MNCH) week (formerly conducted once a year) and training of healthcare workers in all the 33 Local Government Areas on the administration of pentavalent vaccine and data management. The other immunisation-related initiatives include advocacy, stakeholders' meetings and community engagement; and monitoring and use of data for action through coverage/dropout reviews, dose charting, mapping of the population in each facility and categorising health facility based on access and utilisation of routine immunisation services. The indicator used as a standard measure of any immunisation programme's ability to reach target population is the proportion of children who receive the full series of three doses of diphtheria-tetanus-pertussis containing vaccines (DTP3) by 12 months of age (Okwo-Bele, 2011, WHO and UNICEF, 2009). Despite these huge potentials, the vaccination achievements so far have been described as 'fragile', given the occasional outbreaks of some of these vaccine-preventable diseases in some low and middle income countries (LMICs) (Oyo-Ita, Wiysonge, Oringanje, Nwachukwu, Oduwole and Meremikwu. 2016; SAGE, 2015; Duclos, Okwo-Bele, Gacic-Dobo and Cherian, 2009 and Siegfried, Wiysonge and Pienaar, 2010). Oyo-Ita et al. (2016), Strategic Advisory Group of Experts on Immunisation [SAGE] (2015) and Dubé, Laberge, Guay, Bramadat, Roy and Bettinger (2013) pointed out that these outbreaks are reflection on the existence of communities with partially vaccinated or unvaccinated children, which are communities whose herd immunity is not high enough to stall the transmission of these diseases.

In order to overcome these challenges therefore, it is imperative to identify and test innovative approaches that could address poor routine immunisation uptake and timely completion by mothers of infants. One approach of interest is the use of mobile telephone messaging. Results from systematic reviews of studies have established the feasibility of using Short Message Service (SMS) or text messaging to improve health outcomes. For example, the approach has been successfully used in projects focussing on adherence to medication regimen, appointment keeping, and managing chronic conditions such as asthma and diabetes (Deglise, Suggs and Odematt, 2012; Cole-Lewis and Kehsahw, 2010; Fjeldsoe, Marshall and Miller, 2009; Krishna, Boren and Balas, 2009; Lim, Hocking, Hellard and Aitken, 2008). However, its practicability on enhancing routine immunisation uptake and timely completion among mothers of infants in rural areas in Nigeria have not been adequately investigated.

The enthusiasm for using mobile phone messaging revolves around the current enthusiasm in using information communication technology for development (ICT4D) (Vallières, McAuliffe, Palmer, Magbity and Bangura, 2013). Mobile telephone text messaging or Short Message Service is a common mode of communication that is widely used in Nigeria due to its cheap and user-friendly nature. It has the potential of being used as public enlightenment strategy-mobilise people for action. This fits within the innovative use of Mobile health, or mHealth (a sub-segment of the broader field of electronic health (eHealth) that uses mobile phones to enhance the efficiency of service delivery and to improve quality of health care). While the use of mHealth tools has shown prospects in providing better access to healthcare and specific health interventions however, it is unclear whether it would have positive outcomes when applied to childhood immunisation.

1.2 Statement of the Problem

Although full childhood vaccination is one of the most important goals of the Nigerian immunisation programme, trends in immunisation coverage reveal consistent low immunisation coverage. Data on the percentage of children 0-12 months by type of immunisation received in 2010 in Oyo State released by the National Bureau of Statistics (2012) show that coverage for measles and BCG was 0%. Diphtheria Pertussis Tetanus (DPT) 1 was (2.6%), DPT2 (0%), DPT3 (0%), OPV0 (2.6%), OPV1 (2.6%), OPV2 (5.3), OPV3 (7.9%), Yellow Fever (0%), MMR (0%), Vitamin A (78.9%). The data presented for that year show abysmally low coverage for all routine immunisation antigens. This trend reflected in the Nigerian national immunisation coverage in terms of fully immunised children. Data from the Nigerian National Demographic Health Surveys (NDHS) show that children with no immunisation in 2003, 2008 and 2013 were 27%, 29% and 21%, respectively (National Population Commission (NPC) [Nigeria] and ICF International, 2014) (Appendix I). No doubt, incomplete vaccination among infants has been blamed for recurring occasional outbreak of vaccine-preventable diseases in Nigeria. Low level of knowledge, attitude and other factors contribute to this problem.

The question is what are the factors responsible for this low uptake and incomplete immunisation? Could the poor trend in immunisation coverage be because of mothers' inadequate knowledge and perception of the far-reaching consequences of not completing immunisation schedules and proven benefits of immunisation against childhood diseases? Full and timely completion of routine immunisation for children less than one-year-old have been a challenge in Nigeria and several strategies implemented to promote immunisation coverage yielded limited success. Most of the strategies adopted were public health enlightenment related. However, few studies have examined the potential of using a mobile telephone in mobilising mothers of infants to complete all routine immunisation schedules for their children and upgrading their knowledge as well as modifying their attitude toward immunisation. Use of mobile telephone reminder text messages or reminder SMS applications in health care service delivery has been tested. Its use in increasing mothers' knowledge, attitude, uptake and timely completion of routine immunisation has not been adequately investigated in Nigeria. Use of mobile telephone has great potential in helping to mobilise mothers of infants for immunisation coverage because ownership of mobile telephone is wide in both urban and rural areas and language is not a major barrier. Rural areas are medically underserved and this innovation could be used if tried out, to compliments the use of other strategies.

1.3 Justification

High dropout rates for almost all routine immunisation antigens especially measles and yellow fever whose antigens are given when a child is 9 months old have been reported (Adebayo, Oladokun and Akinbami, 2012). After delivery, mothers of infants visit routine immunisation clinics between 0 and 14 weeks to vaccinate their children for immunisation scheduled within these weeks. They only return to the clinic at the 9th month to vaccinate their children against measles and yellow fever. There is the possibility for mothers of infants to forget about their children's immunisation appointments or even travel out of the area where they registered among other reasons. If mothers were reminded about their children's routine immunisation appointments through reminder text messages, is it likely that this would promote full and timely completion of all routine immunisation schedules?

Mobile telephone reminder text messaging applications are increasingly being used in interventions to deliver health care services. Review of literature showed that several interventions have used reminder text messages to 1. Enhance the efficiency of health service delivery, 2. Improve diagnoses, treatment and rehabilitation of illnesses and 3. In public health programmes. However, evidence demonstrating the impact of mobile telephones as a tool for enhancing the uptake and timely completion of routine immunisation in Nigeria remains scarce. To date, the growing availability of mobile phones in Nigeria suggests that using text messages to remind mothers of infants in Oyo State about scheduled basic immunisations may be a feasible approach to improving immunisation coverage (Bangure, Chirundu, Gombe, Marufu, Mandozana, Tshimanga and Takundwa, 2015; Kannisto, Koivunen and Välimäki, 2014). Thus, this study provides evidence to the potential benefits of using SMS to enhance uptake of routine immunisation in Oyo State. By gaining a greater understanding of the mechanisms through which mobile phone technology supports community-based health care delivery, existing challenges facing current immunisation efforts can be overcome and effective scale-up of the programme enhanced.

Findings from this study can be used to design projects or intervention for scaling-up use of reminder SMS to promote adoption of health innovations with special reference to immunisation. Findings from this research have important implications for child health outcomes and services as well as contribute to the body of literature, which is currently scarce and could be used to influence m-Health policy dialogue and policy review.

1.4 Research Questions

The research questions framed to guide this study were as follows:

1. What do mothers of infants know about basic childhood immunisations for children?
2. What are the attitudes of mothers of infants towards childhood immunisation?
3. What is the pattern of mobile telephones use by mothers of infants?
4. What are the factors influencing the use of mobile telephone text messages by mothers of infants as an appointment reminder for routine immunisation clinics?
5. What is the effect of reminder text messages on appointment keeping and timely completion of immunisation for infants in selected rural areas of Oyo State, Nigeria?

1.5 Broad Objective

The broad objective of this study was to investigate the efficacy of reminder text messages sent to mothers of infants on their knowledge, attitude and uptake, full and timely completion of routine immunisation.

1.6 Specific Objectives

The specific objectives were to:

1. Conduct a needs assessment on the gap in knowledge of mothers of an infant in relation to routine immunisation and appointment keeping and identify factors influencing incomplete vaccination
2. Assess childhood immunisation-related knowledge among mothers of infants
3. Determine the attitude of nursing mothers to childhood immunisation.
4. Determine mothers of infants' ownership and pattern of use of mobile phones which can be used as a medium for reaching them with immunisation-related messages

5. Identify factors which influence the use of mobile telephone Short Messaging Service to mothers of infants regarding routine immunisation appointment keeping
6. Assess the effect of SMS appointment reminders on appointment keeping and timely completion of immunization for infants in the selected rural areas of Oyo State, Nigeria.

CHAPTER TWO

LITERATURE REVIEW

Conceptual clarifications

Many theories and models have been developed to help explain individual health behaviours. However, one of the key problems facing those promoting public health is the failure of many individuals to follow healthy lifestyle advice. Cole, Holtgrave and Ríos (1998) noted, "There are a number of factors that determine the likelihood of engaging in a particular behaviour". According to them, "These factors are categorised into 1. Internal factors, e.g. knowledge and 2. External factors, e.g. social support, which is instrumental in understanding behaviour (Cole et al., 1998). According to Cole and colleagues, internal factors are influenced by other important factors in advocating health-relevant behaviours and these include i. Knowledge about risk factors and risk reduction, ii. Attitudes, beliefs and core values (ABCs), iii. Social and life adaptation skills, iv. Psychological disposition, e.g. Self-efficacy, and v. physiology. Some external factors are i. social support, ii. Media, e.g. public service announcements (PSAs), iii. Socio-cultural, economic and political factors, iv. Biologic, v. Health care system, vi. Environmental stressors and vii. Societal laws and regulations (Cole et al., 1992). The presence or absence of these factors functions to either initiate or restrain healthy behaviours. For example, perceived personal susceptibility to a particular disease within the internal factor of attitudes, beliefs and core values (ABCs) augments the probability that the individual will engage in a health-relevant behaviour. On the other hand, lack of perceived seriousness of the threat, also related to ABCs, would not serve as a motivation to change risky behaviours (Cole et al. (1998).

2.1 Knowledge

Knowledge is defined as "the facts, feelings or experiences known by a person or group of people; awareness, consciousness, or familiarity gained by experience or learning; specific information about a subject or the body of facts, principles, etc. acquired through human experience and thought" (Collins English Dictionary, 2017). Knowledge is gained from peers, institutions of socialisation such as the school, family and church, the media such as newspapers, magazines, radio, films, television and the Internet (Murima, 2013). Knowledge is very important as it is the basis upon which decisions are made (Omotayo, 2015; Forbes Media, 2012). Knowledge is an essential attribute as it helps shape an individual's reality. There are different types of knowledge: conceptual, procedural, declarative, strategic and descriptive. These types of knowledge are dependent on whether the knowledge is factual or mythical (Byners, 2001). The following quotes from contemporary behavioural science literature mention some of the most important factors in explaining behaviour. Certainly, other factors are instrumental in understanding health-relevant behaviours.

> "*Heightened awareness and knowledge of health risks are important preconditions for self-directed change. Unfortunately, information alone does not necessarily exert much influence on refractory health-impairing habits*" (Bandura, 1990).
>
> "*The preconditions for change are created by increasing people's awareness and knowledge of the profound threat of (illness)*" (Bandura, 1990).

Apart from systemic factors such as policies, vaccine availability, healthcare workers-related factors and ethnoreligious factors in some parts of Nigeria, some authors have identified awareness and knowledge of mothers/caregivers as major obstacles to full immunisation coverage. Parents' knowledge about immunisation and their attitudes towards them are likely influence uptake (Yousif, Albarraq, Abdallah, and Elbur, 2013; Jheeta and Newell, 2008). Yousif et al. (2013) pointed out that, "previous studies revealed misconceptions on parents' knowledge and negative attitudes towards childhood immunization". Mothers' knowledge about vaccination was found to be quite low and their educational status was significantly associated with child's coverage (Siddiqi, Siddiqi, Nisar and Khan, 2010). In a study on the assessment of parents' knowledge on immunisation by Zagminas and colleagues, findings revealed that most respondents can be characterised as having a positive opinion about vaccination, although 20-40% of respondents indicated insufficient knowledge on this issue (Zagminas, Surkiene, Urbanovic and Stukas, 2007). In a related study, older parents, residents of towns and educated individuals expressed much concern about the safety of vaccines (Rogalska, Augustynowicz, Gzyl and Stefanoff, 2010).

According to Al-lela, Al-lela, Bahari, Al-Qazaz, Salih, Jamshed and Elkalmi (2014), deficiencies in parents' knowledge about the adverse effects and contraindications of vaccines often lead to many immunization errors. They stressed further that, to improve parents' awareness, good knowledge regarding vaccination is required. For instance, many parents believe that mild illness is associated with vaccine contraindication, therefore mild illness is considered as a reason for not giving their children up-to-date vaccinations (Al-lela et al., 2014; Richards and Sheridan, 1999; Salsberry, Nickel and Mitch, 1993; Schmalz and Larwa, 1997). Good parental practice regarding immunization will be able to reduce the incidence of infectious diseases (Al-lela et al., 2014).

Although knowledge on its own is not enough to influence behaviour change, attitudes and perceptions, play a role in supporting knowledge in realising behaviour change. According to Becker (1990), "Behaviour change can be attributed to a change in knowledge levels, attitudes and perceptions. A combination of all three results in behaviour change".

2.2 Attitudes

An attitude is "a feeling or opinion about something or someone, or a way of behaving that is caused by this" (Cambridge Dictionary, 2017). Attitude is a settled way of thinking or feeling about something or someone. Attitude influences an individual's choice of action. An attitude can also be defined as "an organised predisposition to respond in a favourable or unfavourable manner toward a specified class of objects" (Shaver, 1977). Attitude is a significant determinant of behaviour and it is the 'biases' for acting and behaving in a certain way.

As outlined by Pride and Ferrell (2017), an attitude consists of three major components: cognitive, affective, and behavioural. The cognitive components are the person's knowledge and information about the object or idea. The affective component comprises the individual's feelings and emotions toward the object or idea. Emotions involve both psychological and biological elements. They relate to feelings and can create visceral responses that result in behaviours. Love, hate, anger, and fear are emotions that can influence behaviour. The behavioural components manifest itself in the person's actions regarding the object or idea. Changes in cognitive, affective, or behavioural components may possibly affect other components. Efforts to understand attitudes has resulted in two major academic models: the attitude towards the object model (the Fishbein model) and the behavioural intentions model (also known as the Theory of Reasoned Action). These models provide an understanding of the role of attitudes in decision-making (Pride and Ferrell, 2017).

For the purposes of this study, attitudes are important as they enable the researcher to explore mothers' disposition to routine immunisation and its effect on routine immunisation uptake and completion. Review of literature shows that some researchers in the developed world found parents' attitudes and beliefs had little effect on their children's immunization levels (Strobino, Keane, Holt, Hughart and Guyer, 1996). However, Kimmel, Burns, Wolfe and Zimmerman (2007) in their study found that negative attitude such as mothers' fear from vaccination significantly affected the immunisation status of their children.

2.3.1 Vaccines and Immunisation

Vaccines are products made either from the entire disease-causing microorganism or some of its components. Vaccines are preparations that contain one of the following:

i. Non-infectious fragments of bacteria or viruses

ii. A usually harmful substance (toxin) that is produced by a bacterium but has been modified to produce a harmless substance called toxoid

iii. Weakened (attenuated), live whole organisms that do not cause illness

According to Pharmaceutical Research and Manufacturers of America (2013), vaccine may be constructed in several ways: (1) From living microorganisms that have been weakened, usually from cultivation under sub-optimal conditions (also called attenuation), or from genetic modification, which has the effect of reducing their ability to cause disease; (2) From whole micro-organisms that have been inactivated by chemical, thermal, or other means; (3) From components of the disease-causing micro-organism, such as specific proteins and polysaccharides, or nucleic acids; (4) From inactivated toxins of toxin-producing bacteria; (5) From the linkage (conjugation) of polysaccharides to proteins (this increases the effectiveness of polysaccharide vaccines in young children). Depending on their purpose and specific composition, vaccines can contain a very small dose of life, but weakened virus killed viruses, killed bacteria or small parts of bacteria, or a small dose of a modified toxin produced by bacteria.

Vaccines may also contain either a small amount of preservative or a small amount of antibiotic to preserve the vaccine. Some vaccines may also contain a small amount of aluminium salt, which helps produce a better immune response. Some other vaccines, such as influenza, may contain traces of egg protein and should be given with caution to people with a known egg allergy (Commonwealth of Australia, 2013).

The most common and serious vaccine-preventable diseases tracked by the World Health Organisation (WHO) are diphtheria, *Haemophilus influenzae* serotype b infection, hepatitis B, measles, meningitis, mumps, pertussis, poliomyelitis, rubella, tetanus, tuberculosis, and yellow fever (World Health Organization [WHO], 2015). The WHO reports the availability of licensed vaccines for preventing, or for contributing to the prevention and control of 25 vaccine-preventable infections (WHO, 2013a). Vaccines are administered in liquid form, by injection, either by oral or by intranasal routes.

In all, vaccines that are available today are highly reliable. Although adverse events do occasionally occur following vaccination, most people tolerate them well and rarely have side effects (Surkis and Santoro, 2015; Ada, 2005). Specifically, the vaccines used in the National Immunisation Programmes (NIPs) are considered safe and effective when used correctly. Besides, routine vaccination programmes have prevented the deaths of hundreds of millions of people and have saved billions of dollars in public health expenditures (PATH, 2015)

Immunisation protects people against harmful infections before they are exposed to them in the community. Immunisation uses the body's natural defence mechanism — the immune response — to build resistance to specific infections and helps children (and adults) to stay healthy by preventing serious infections. It copies the body's protective response to diseases by helping the immune system to detect and destroy the infection when it is encountered in the future — before significant symptoms or complications can occur (Commonwealth of Australia, 2013). According to a report, immunisation works by tricking the body into believing it is experiencing a full-scale invasion by an infectious agent so that the immune system can fortify its defences. During vaccination, a harmless version of a germ is introduced to the body and the immune system responds by producing antibodies to attack the intruder. Thereafter, a memory of this "invasion" remains so that the immune system can quickly recognize and neutralize disease-causing agents when they appear.

Technically, vaccination is the term used for giving a vaccine — that is, actually getting an injection or oral dose. However, immunisation is the term used for the process of being vaccinated and as a result becoming immune to a disease. Most people use the terms 'vaccination' and 'immunisation' interchangeably, but their meanings are not exactly the same. Immunity follows vaccination in most, but not all, cases. For the purposes of this study, the investigator used the term 'immunisation' because it is the most commonly used term in the community where the services are offered (Lymphoma Association, 2011; Commonwealth of Australia, 2013).

There are two types of immunisation: active immunisation and passive immunisation. In active immunisation, vaccines are used to stimulate the body's natural defence mechanisms. Such vaccines that contain live but weakened organisms include Bacille Calmette-Guérin (BCG—for tuberculosis), Chickenpox (varicella), Cholera (certain vaccines given by mouth), Influenza nasal vaccine, Measles-mumps-rubella, Polio (only the oral vaccine), Rotavirus, Typhoid (only the oral vaccine), Shingles (zoster) and Yellow fever (Surkis and Santoro, 2015; National Institutes of Health National Institute of Allergy and Infectious Diseases [NIAID], 2008; Ada, 2005). The body's immune system responds to a vaccine by producing substances (such as antibodies and white blood cells) that recognise and attack the specific bacteria or virus contained in the vaccine. Then whenever the person is exposed to the specific bacteria or virus, the body automatically produces these antibodies and other substances to prevent or lessen illness.

However, in passive immunisation, antibodies against a specific infectious organism are given directly to a person. These antibodies are obtained from several sources:

a. The blood (serum) of animals (usually horses) that have been exposed to a particular organism or toxin and have developed immunity

b. Blood collected from a large group of people—called pooled human immune globulin

c. People known to have antibodies to a particular disease (that is, people who have been immunised or who are recovering from the disease)—called hyperimmune globulin—because they people have higher levels of antibodies in their blood

d. Antibody-producing cells (usually taken from mice) grown in a laboratory

Passive immunisation is used for people whose immune system does not respond adequately to an infection or for people who acquire an infection before they can be vaccinated (for example, after being bitten by an animal with rabies). Passive immunisation can also be used to prevent disease when people are likely to be exposed but do not have time to get or complete a vaccination series. Passive immunisation lasts for only a few days or weeks until the body eliminates the injected antibodies (Surkis and Santoro, 2015; National Institutes of Health National Institute of Allergy and Infectious Diseases [NIAID], 2008; Baxter, 2007; Ada, 2005).

In summary, routine vaccination programmes have prevented the deaths of hundreds of millions of people and saved billions of dollars in public health expenditures.

2.3.2 Childhood Immunisation

Many reasons have been identified for immunising children. However, the three key reasons highlighted by Health Talk of the University of Oxford, United Kingdom, represent a summary of the entire reasons (Health Talk, 2015). Firstly, children are immunised in order to prevent them from becoming ill because of contracting serious infectious diseases, which have a risk of complications and long-term side effects. This implies that except these diseases are eradicated, any child that is not immunised against them is at risk of complications if such a child contracts the diseases. Complications such as ear infections, pneumonia and in rare cases measles encephalitis (a rare brain disease that happens in one in 1,000 cases of infected children) can occur (Health Talk, 2015; Commonwealth of Australia, 2016).

Secondly, children are immunised in order to protect all children in the population. According to the Health Talk (2015), the more the people that are immunised, the less the infectious diseases that are found around them. As a result, the risk of contracting diseases is low. This follows the concept of 'herd immunity', which suggests that when the level of immunisation against infectious disease is high, the risk of contracting the disease is low, even among those who cannot be immunised against it. In other words, the risk of infection among susceptible individuals in a population is reduced by the presence and proximity of immunised individuals. This is sometimes referred to as "indirect protection" or a "herd effect" (Health Talk, 2015; Fine, Eames and Heymann, 2011). When this happens, it means even children who have leukaemia or other forms of lowered resistance to infections who cannot be given live vaccines such as measles, mumps and rubella and polio - and also babies under the age of one who are too young to have the measles, mumps and rubella vaccine will also not be exposed to the disease. This is important, as measles can be fatal for these children. The proportion of immunised children (vaccine coverage) required to produce herd immunity varies from disease to disease but is estimated to be about 95% for measles (Health Talk, 2015).

Lastly, immunisation is implemented in order to eradicate as many infectious diseases as possible everywhere in the world. While improvements in living standards and access to clean water are the key factors that have contributed to the decline of infectious diseases across the world, it is quite clear that immunisation programmes have also made a significant impact in getting rid of infectious diseases (Health Talk, 2015; Commonwealth of Australia, 2016).

Evidence has shown that preventive care is the cornerstone of paediatrics, and that vaccination represents one of the most important strategies in the prevention of disease in children (Leib, Liberatos, and Edwards, 2011; Bronfin, 2008; Ada, 2001). The reduction in morbidity and mortality over the past century because of routine childhood immunizations is quite dramatic (Herzog, Álvarez-Pasquin, Díaz, Del Barrio, Estrada and Gil, 2013). Smallpox has been globally eradicated while diseases such as diphtheria, polio, and congenital rubella have become virtually non-existent in North America. Other life-threatening conditions such as measles, Haemophilus influenza type b disease, and pertussis have also been dramatically curtailed to the extent that families no longer fear their devastating effects (Bronfin, 2008).

Side effects of immunisation

Common side effects of immunisation are redness and soreness where the child has been injected and mild fever. While these symptoms may concern mothers, and upset their children at the time, they cannot undermine the benefit of immunisation, which is protection against disease. More serious reactions to immunisation are very rare. Mothers may consider using pain relief to help ease the fever and soreness. Other side effects are very rare but if they do occur, a doctor should be consulted immediately (Centers for Disease Control and Prevention, 2015).

In general, the normal immune response takes approximately two weeks. This means protection from an infection will not occur immediately after the vaccine is received. Most immunisations need to be taken more than once to build long-lasting protection. For example, a child who has been given only one or two doses of diphtheria-tetanus-acellular pertussis vaccine (DTPa) is only partially protected against diphtheria, tetanus and pertussis (whooping cough), and may still become sick if exposed to these diseases. However, some vaccines provide long-lasting immunity after only one dose (Commonwealth of Australia, 2013).

2.4 Vaccine-preventable Diseases

A vaccine-preventable disease is an infectious disease for which an effective preventive vaccine exists. If a person contracts a vaccine-preventable disease and dies of it, such a the death is considered a vaccine-preventable death. In 2012, the World Health Organisation estimated that vaccination prevents 2.5 million deaths each year (World Health Organisation, 2013b). With 100% immunisation, and 100% efficacy of the vaccines, one out of seven deaths among young children could be prevented, mostly in developing countries, making this an important global health issue (WHO, 2015).

Vaccine-preventable deaths are usually caused by a failure to obtain the vaccine in a timely manner. This may be due to financial constraints or to lack of access to the vaccine. The vaccine that is generally recommended may be medically inappropriate for a small number of people due to severe allergies or a damaged immune system. In addition, a vaccine against a given disease may not be recommended for general use in a given country or may be recommended only to certain populations, such as young children or older adults. Every country makes its own immunisation recommendations based on the diseases that are common in its area and its healthcare priorities. If a vaccine-preventable disease is uncommon in a country, then residents of that country are unlikely to receive a vaccine against it. For example, residents of Canada and the United States do not routinely receive vaccines against yellow fever, and this leaves them vulnerable to infection if travelling to areas where the risk of yellow fever is high (endemic or transitional regions) (Public Health Agency of Canada, 2015; Immunization Action Coalition, 2015).

Miller and Sentz (2006) reported that vaccines have been frequently cited as one of the most equitable low-cost, high-impact public health measures, saving millions of lives annually when immunisation programmes are implemented on the national level. In the last five decades, the use of smallpox, measles, diphtheria, tetanus, pertussis, and poliomyelitis vaccines have eradicated smallpox and eliminated these diseases in those populations affected. Although there are numerous licensed vaccines that could potentially benefit the African population, only those routinely used and potential vaccines with a broad application on the horizon are the focus of this study.

2.5 Burden of Vaccine-preventable Childhood Diseases in Nigeria

The epidemiology and burden of vaccine-preventable diseases vary by country and region partly because of differences in vaccine uptake. Other factors that contribute to the disease burden include geography, seasonal patterns, crowding, nutritional status, travel to and from other countries, and possibly genetic differences in populations (that affect disease severity). A number of vaccine-preventable diseases are not reportable events in many countries. The estimates of the burden of these diseases by the World Health Organization (WHO) are based on a combination of often incomplete vital registration data, mortality survey data, and mathematical models using numerous assumptions. Most models of vaccine-preventable diseases are derived from the susceptible fraction of the population (calculated from natural immunity from presumed historical infections in regions without previous vaccination and historical immunisation coverage rates), infectivity rates of disease, sequelae of diseases, and estimates of local Case Fatality Rates (CFRs).

Poliomyelitis

In 1988, polio was endemic in 125 countries, paralyzing an estimated 350 000 children every year (close to 1000 cases a day) (Jamison et al., 2006). In that year, the World Health Assembly (WHA) passed a resolution calling for the global eradication of the disease by 2000. An international partnership, the Global Polio Eradication Initiative (GPEI), came into existence to achieve that goal. By the end of 2007, the disease had been eradicated in three of WHO's six regions – the Americas, Europe, and the Western Pacific – but not worldwide. At the end of June 2009, indigenous poliovirus remained endemic in only four countries, where 440 new cases were reported– Afghanistan (10 cases), Pakistan (20 cases), India (89 cases), and Nigeria (321 cases) (WHO, UNICEF and World Bank, 2009).

Those countries missed the deadline for several reasons. For instance, the mass vaccination campaigns necessary to stop polio transmission did not kick off in Asia and Africa until the mid-1990s. Driving the infection from densely populated urban areas in Egypt and India proved more difficult than had been anticipated. In addition, vaccination was not reaching enough children among population groups on the move between the

Afghanistan and Pakistan borders. More recently, in 2003, unfounded rumours that the oral polio vaccine (OPV) was being used to sterilize young girls brought polio immunisation to a halt for 12 months in at least one northern Nigerian state, unleashing a nationwide polio epidemic and the transcontinental reinfection of 20 previously polio-free countries in Africa, Asia and the Middle East (WHO, 2008c). According to Dr Irene Isibor, the National Surveillance Officer, World Health Organisation, Nigeria, "most children in Nigeria were still dying from vaccine-preventable diseases due to people's wrong attitude. Every day in 2015, 16,000 children under five years continued to die, mostly of preventable causes (The Eagle Online, 2015). She stressed further that child survival must remain the focus of the post-2015 development agenda.

Despite this progress, as of early 2009, efforts to interrupt wild poliovirus transmission globally faced considerable challenges. In Africa, a large outbreak of type 1 polio in northern Nigeria, where about 20% of children were still not reached by vaccination, had spread to surrounding countries and threatened the entire region (WHO, UNICEF and World Bank, 2009). In 2012, Nigeria accounted for more than half of all polio cases worldwide, but the country has made significant strides recently, having marked on 24 July 2016 two years without a case. However, after more than two years without wild poliovirus in Nigeria, the Government reported two fresh cases of children paralyzed by the disease in the northern Borno State. Genetic sequencing of the viruses suggests that the new cases are most closely linked to a wild poliovirus strain last detected in Borno in 2011. The two cases in Nigeria particularly highlight the need to prioritize immunisation of children in hard-to-reach areas such as the Lake Chad region, which spans several countries and is often affected by conflict and large population movements (World Health Organization, 2016).

Tuberculosis

According to WHO, UNICEF and World Bank (2009), the first and only vaccine ever used to protect against tuberculosis is the Bacille Calmette-Guérin (BCG) vaccine, developed at the Pasteur Institute in Paris and first used in 1921. Since the 1950s, when routine BCG immunization against tuberculosis began in many countries, more than four billion people are believed to have received the vaccine worldwide. By 1990, 81% of the world's newborn infants were receiving the vaccine (Plotkin, Orenstein and Offit, 2012; WHO, UNICEF and World Bank, 2009).

WHO, UNICEF and World Bank (2009) reported that by the end of 2007, BCG coverage had climbed to 89%. In Europe and North America, several countries where the incidence of reported tuberculosis had dropped to below 25 cases per 100 000 have ceased routine BCG immunisation. However, over the past two decades, the burden of tuberculosis has followed an upward curve that peaked in 2004 with 8.9 million new cases (up from 8 million in 1997) and approximately 1.46 million deaths (WHO, 2008). The advent of HIV/AIDS in the 1980s, with its ability to lower natural protection against latent infections, including tuberculosis, has contributed to the escalation of tuberculosis cases. Globally, about 15% of tuberculosis cases occur in people with HIV/AIDS, but in some countries with high HIV incidence rates such as Mozambique, South Africa, and Zimbabwe, the proportion can be as high as 50–60%, (WHO, 2006; WHO, UNICEF and World Bank, 2009).

By contrast, estimates of both incidence and mortality rates in 2007 (WHO, 2006) suggest that the disease may be on the verge of a downswing. But despite worldwide use of BCG over the past three or four decades, and despite the availability since the early 1990s of an inexpensive highly effective treatment strategy (“DOTS”), tuberculosis is still a leading disease and cause of death. The inability to control this disease has been called “a colossal failure of public health” (Plotkin et al, 2008). Evidence from several trials has consistently shown that BCG gives strong protection against tuberculosis in infants and young children. Tuberculosis meningitis and disseminated (miliary) tuberculosis – the two most common and most severe forms of extrapulmonary tuberculosis – occur in about 25% of children with tuberculosis and are rapidly fatal without treatment. BCG is protective against these forms of tuberculosis in 64–78% of recipients (Plotkin et al, 2008; WHO, UNICEF and World Bank, 2009).

According to Nelson and Wells (2004) and Brent (2012), Tuberculosis in children is increasingly becoming an important cause of global child morbidity and mortality. The burden of childhood TB infection and TB disease is an important indicator of the overall trend of disease and ongoing transmission within a community. The national TB programme defined childhood or paediatric TB as TB occurring in children less than 15 years old.

Nigeria, which is one of the most populous countries in Africa, is currently ranked third among the 22 high TB burden countries responsible for about 80% of the global TB burden (World Health Organization, 2014). In 2013, the WHO estimated a TB prevalence rate of 338/100,000 population with 564,460 new cases annually (World Health Organization, 2014). A review of the annual TB case notification in the country from 2008 to 2010 shows that about 2% of the total smear-positive TB cases notified were children below 15 years of age (Daniel, Adejumo, Abdur-Razzaq and Ebunoluwa, 2015). The low childhood TB notification was largely because of the data capturing tools, which were not designed to disaggregate childhood TB for all forms of TB notified in the country. In order to address this challenge, the Nigerian National TB and Leprosy Control Programme (NTBLCP) revised the national recording and reporting tools in 2010 and disaggregated the total TB cases notified by age and sex in children aged 0–14 years (Federal Ministry of Health, 2013; Daniel, Adejumo, Abdur-Razzaq and Ebunoluwa, 2015). For instance, in their study on the trend of childhood TB case notification in Lagos State, Nigeria, Daniel, Adejumo, Abdur-Razzaq and Ebunoluwa (2015) found that between 2011 and 2014, the total number of children treated for all forms of TB was 2396, which represented 6.8% of the total 35,305 TB cases notified during the study period (Table 2.1).

Table 2.1: Childhood TB cases notified in Lagos State, 2011-2014

Year / Age group	2011 (n=495)		2012 (n=539)		2013 (n=682)		2014 (n=680)		Total (n=2396)	
	№	%	№	%	№	%	№	%	№	%
0-4	157	31.7	203	37.7	334	49.0	267	39.3	961	39.7
5-14	338	68.3	336	62.3	358	51.0	413	60.7	1445	60.3
% of Paediatric TB notified out of the Total TB cases notified	495/8424 = 5.9%		539/8455 = 6.4%		682/9444 = 7.2%		680/8982 = 7.6%		2396/35,305 = 6.8%	

(*Source: Daniel, Adejumo, Abdur-Razzaq and Ebunoluwa, 2015*)

Diphtheria

Diphtheria, a disease caused by *Corynebacterium diphtheria* and its exotoxin is characterised by high case fatality (Sadoh and Oladokun, 2012; Sadoh and Sadoh, 2011; WHO, UNICEF and World Bank, 2009). Diphtheria commonly affects the tonsils, pharynx and larynx. The *C. diphtheria* remains in the superficial mucosa or skin and elaborates its exotoxin. The diphtheria exotoxin, a potent 62 kd polypeptide is absorbed into the mucous membranes and causes the destruction of epithelium, inhibits protein synthesis leading to local tissue necrosis and superficial inflammatory response. The necrotic epithelium becomes embedded in exuding fibrin and red and white cells, resulting in a dense necrotic coagulum of organisms, epithelial cells, fibrin, leukocytes, and erythrocytes. This advances – commonly over the tonsils, pharynx, or larynx, and becomes a grey-brown, leather-like adherent pseudomembrane (*Diphtheria* is Greek for leather). With an increase in the concentration of toxin, it is spread to other tissues through haematogenous dissemination. Laryngeal involvement, which may occur on its own or because of membrane extension from the nasopharynx, presents as hoarseness, stridor, croupy cough and dyspnea. These patients are at significant risk for suffocation because of local soft tissue oedema and airway obstruction by the diphtheritic membrane (Sadoh and Sadoh, 2011).

There may be toxin-mediated paralysis of the soft palate, posterior oropharynx and hypopharynx (WHO, 2008). Although the toxin has no target organs, the myocardium and peripheral nerves are most affected. The mainstay of management of diphtheria is the antitoxin. The World Health Organisations recommends immediate administration of diphtheria antitoxin and antibiotics following clinical diagnosis. The diphtheria vaccine is one of the major approaches for the control and prevention of diphtheria (World Health Organization, 2013; Ophori, Tula, Azih, Okojie and Ikpo, 2014). Other toxin-mediated complications of diphtheria are toxic cardiomyopathy, which occurs in 10–25% of patients with respiratory diphtheria and is responsible for 50–60% of deaths (UNICEF, 2009). Neurotoxicity and renal damage can also occur. Some of these features may present up to six weeks after the onset of the illness suggesting an immunological basis for the pathophysiologic mechanism for these delayed features of diphtheria.

In Nigeria, the number of reported cases of diphtheria is decreasing. For instance, reported cases from Nigeria were 5,039 in 1989; 3,995 in 2000; 2,468 in 2001; 790 in 2002; and 312 in 2006 (World Health Organization, 2009). According to Sadoh and Sadoh (2011) and World Health Organization (2005), immunisation coverage with three doses of DPT in Nigeria has been inconsistent, reaching an all-time low in 2003 (World Health Organization, 2009).

Sadoh and Oladokun (2012) reported that, according to the WHO reporting system, there has been a steady decline of reported diphtheria cases in Nigeria from 5039 in 1989 to 2468 in 2001 and 312 in 2006. However, they pointed out that the reports of probable diphtheria from three centres in three different geographic areas in Nigeria may suggest that perhaps there is a resurgence of the disease. Four cases were reported in Lagos

(2007–2008), five in Benin (2008–2009) and 10 cases in three contiguous local governments of Katsina State (2009–2010) (Fajolu, Temiye and Egri-Okwaji, 2009; Sadoh, Okhakhu, Omuemu, Lofor and Oviawe, 2010; Oyeyemi, Suleiman, Ajetomobi and Ibrahim, 2011). This is against the backdrop of inconsistent immunisation coverage, which has ranged from low to moderate for DPT 3 (Sadoh and Oladokun, 2012). In all, three studies report the cases of affected children who were below 15 years (Fajolu, Temiye and Egri-Okwaji, 2009; Sadoh, Okhakhu, Omuemu, Lofor and Oviawe, 2010; Oyeyemi, Suleiman, Ajetomobi and Ibrahim, 2011). Majority of the children (63.2%) did not receive any dose of DPT. A common feature of all the three reports is the high case fatality rate (50% in Lagos, 40% in Benin and 80% in Katsina) and also the absence of definitive management (diphtheria antitoxin) (Sadoh and Oladokun, 2012). In 2011, an epidemic of diphtheria occurred in the Borno state in northern Nigeria and 107 probable diphtheria cases were identified with 24 deaths, giving a case fatality ratio of 22.4%. Majority of the cases (62.4%) were aged below 10 years and 38.5% of cases aged below 5 years died (Epicentre, 2012).

Pertussis

Pertussis, or whooping cough, is a disease of the respiratory system caused by infection with the bacterium *Bordetella pertussis*. The most characteristic symptom is a cough that occurs typically in spasms ending in a classic inspiratory whoop. In young infants, the only signs or symptoms may be a cessation of breathing (apnoea) and blue colouring of the skin (cyanosis) (WHO, UNICEF and World Bank, 2009).

Literature indicated that complications arise in 5–6% of cases – the most serious and often fatal of them being bronchopneumonia and encephalopathy. Death from pertussis still occurs in industrialised countries (less than 1 per 1000 cases), but more rarely than in developing countries (40 per 1000 infants, and 10 per 1000 in older children) (WHO, 2005). The global burden of the disease is difficult to estimate, given the paucity of surveillance data available. WHO's latest estimates put the annual number of cases worldwide as of 2004 at nearly 18 million, with about 254, 000 deaths, of which 90% are in developing countries (WHO, 2005; 2008a). The first pertussis vaccine used killed the whole bacterium (whole cell) as the immune-stimulating antigen. It appeared in 1914 and became available in combination with diphtheria and tetanus antigens (DTP) in 1948 (WHO, 2008a). Today, there are many whole-cell pertussis vaccines, some more effective and safer than others, and the variability depending mainly on the method of production. WHO have prequalified fifteen safe and effective pertussis vaccines, usually in combination with tetanus and diphtheria vaccines, for international distribution through the United Nations procurement systems (WHO, UNICEF and World Bank, 2009).

The World Health Organisation reports that in most countries, pertussis vaccination consists of three initial doses of pertussis containing DTP (the primary series) given at least one month apart to infants between six weeks and six months of age. In 1980, routine vaccination with three DTP doses was reaching about 20% of the world's infants (WHO, 2008b). By the end of 2007, the figure had risen to 81%. Determining the impact vaccination is making on the global burden of pertussis is difficult. Certainly, following widespread vaccination during the 1950s and 1960s, the industrialized world saw a more than 90% drop in pertussis cases and deaths. Moreover, numbers of cases reported annually to WHO dropped by 92% from about two million in 1980 to 162, 000 by the end of 2007 – a drop consistent with the upward trend of vaccination coverage. Nevertheless, due to lack of adequate surveillance, reported cases of pertussis are believed to reflect less than 1% of the true incidence (WHO, 2008; WHO, UNICEF and World Bank, 2009).

Pertussis is being increasingly found in previously immunised subjects. Nigeria's immunisation coverage rates are relatively low and ranked sixth among countries with high cases of pertussis accounting for 4.5% of global cases. In 2009 and 2012, there were 11, 281 and 11, 628 reported cases, respectively (Table 2.2). In a five-year review of the pattern of childhood pertussis in a tertiary hospital in Nigeria, Oloyede, Ekanem and Udoh (2015) found that 53 patients were diagnosed with pertussis during the five-year period, with the majority (54.7%) of cases in the year 2011. Routine immunisation should be strengthened and booster doses of vaccines should be considered for older children whose immunity may begin to wane. The table below shows 10 years' data on reported cases of Pertussis extracted from the WHO database.

Table 2.2: Reported Cases of Pertussis in Nigeria over a period of 10 years

Year	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
№ of cases	6592	9559	8530	11628	0	0	11281	13240	12573	10997

(*Source: Data extracted from the WHO database. Data for 2000-2015. Available online at http://www.who.int/immunization/monitoring_surveillance/routine/reporting/en/*)

Tetanus

Tetanus is characterised by muscle rigidity and painful muscle contractions caused by a toxin – one of the most potent ever identified – released by the bacterium *Clostridium tetani*. The spores of this bacterium are present throughout the world in the soil. A person is infected when the spores enter the body via dirt or soil through a scratch or open wound. Neonatal tetanus, which is the most common form of the disease in developing countries, is primarily caused by infection of the umbilical cord stump in babies delivered in unhygienic conditions. It is most prevalent among the poorest, most neglected population groups that have little or no access to medical care. In the late 1980s, tetanus was estimated to be causing more than a million deaths a year, of which about 790 000 were newborn infants (CDC, 2015; WHO, UNICEF and World Bank, 2009).

It is a common knowledge that prevention of tetanus is possible and inexpensive. The tetanus toxoid vaccine is one of the most effective, safest, and least costly vaccines on the market. Its discovery, subsequent development and initial use, at least in industrialized countries, date from the first half of the 20th century. In 1989, the public health community officially declared neonatal tetanus a target for elimination, defined as an incidence of less than one case per 1000 live births in all districts. At that time, 90 countries had not yet reached the elimination target. By 1995, 27 of the 90 countries had eliminated neonatal tetanus. In the 63 remaining countries, most cases were occurring in poor, hard-to-reach communities. To accelerate elimination efforts, a "high-risk approach" which aimed to reach out to these "high-risk communities" was adopted. This new approach called for mass immunisation campaigns, delivering three sequential doses of vaccine to all women of childbearing age in the high-risk communities (Saleh, Nemecek, Jones and Etsano, 2015; WHO, UNICEF and World Bank, 2009). Education about providing hygienic conditions for births was also part of the strategy.

The new approach paid off. Five years after, 135 countries had eliminated neonatal tetanus and annual deaths from the disease had fallen to an estimated 200, 000 – a 75% drop from the 790, 000 deaths in 1988 (Roper, Vandelaer and Gasse, 2007). Ninety per cent of these 200, 000 deaths were occurring in just 27 countries, mostly in South Asia and sub-Saharan Africa. The WHO, UNICEF, and the United Nations Population Fund (UNFPA) decided to launch a more vigorous attack on tetanus, both neonatal and, in a new development, maternal tetanus.

In a report from Nigeria, Isibor noted the following diseases and death statistics: Neonatal tetanus–59,000; tetanus (non-neonatal)–2,000; pneumococcal disease–476,000; rotavirus–453,000; pertussis–195,000 and Hib–199,000. The report also pointed out that, the number of children under five years dying every year reduced to 6.3 million from 12.7 million in 1990 due to the administration of vaccines (The Eagle Online, 2015). In a ten-year study on the incidence and outcome of neonatal tetanus in Enugu, Emodi, Ikefuna and Obichukwu (2011) found that of the total admission tetanus cases during the study period, 65% were neonates presenting at a mean age of 8.77 days. The data also showed that there were more rural (68.3%) than urban (31.7%) patients. During the study period, 31.7% of neonate patients with tetanus died.

In a related study on neonatal tetanus at the Niger Delta University Teaching Hospital, Peterside, Duru and George (2012) found that of all admissions during the study period, neonatal tetanus accounted for 0.84% of these admissions. The data also showed that neonatal tetanus accounted for 3.5% of all paediatric deaths and 9.0% of neonatal deaths.

Measles

Measles is an extremely contagious viral disease, which is transmitted from one person to another through aerosolized droplets or by direct contact with the nasal and throat secretions of infected persons (World Health Organization, 2004; Umeh and Ahaneku, 2013). This can lead to ear infection, pneumonia, seizures, brain damage and death (WHO, 2005). Children under five years are most at risk. Measles transmission is prevented by vaccination and in sub-Saharan Africa, it is recommended that the vaccine is given at 9 months of age, by which time the child would have lost passive immunity conferred by maternal antibodies. One dose of measles vaccine confers life-long immunity to approximately 85% of those vaccinated (World Health Organization, 2004). Childhood immunization programs targeted at children less than 59 months have led to a marked decrease in measles infections and outbreaks. However, in order to interrupt the endemic transmission of measles virus, a population immunity of ≥95% has to be achieved (Weldegebriel, Gasasira, Harvey, Masresha, Goodson, Pate, Abanida and Chevez, 2011; Umeh and Ahaneku, 2013).

Measles case fatality is estimated to be between 3 and 5% in developing countries and may be as high as 10% during epidemics (World Health Organization, 2004). Despite the efforts made at increasing immunization, measles remains a leading cause of under-five mortality in Africa (Odega, Fatiregun and Osagbemi, 2010). There were 139, 300 measles deaths globally in 2010 which represents nearly 380 deaths every day or 15 deaths every hour (WHO 2012). It has been reported in the literature that Nigeria is one of the 45 countries that together account for 94 per cent of the global deaths caused by measles (WHO/UNICEF, 2004). In 2005, measles killed more than 500 children in Nigeria. Of the 23,575 cases recorded in 2005, more than 90% were in Northern Nigeria, where people are wary of vaccinations largely for religious reasons (WHO, 2005). Measles-case based surveillance is a system put in place to detect cases and outbreaks of measles. It involves reporting and investigating any suspected case of measles and to use the data to evaluate immunisation efforts and predict outbreaks through the identification of geographical areas and age groups at risk (World Health Organization, 2004). In 2006, measles case-based surveillance was established in Nigeria using the resources and infrastructure of the already established surveillance for Acute Flaccid Paralysis (AFP). It involves both passive and active surveillance (Weldegebriel, Gasasira, Harvey, Masresha, Goodson, Pate, Abanida and Chevez, 2011; Odega, Fatiregun and Osagbemi, 2010; Umeh and Ahaneku, 2013).

In 2008, the WHO African regional office set a regional pre-elimination goal to be achieved by the end of 2012. The goals include (1) reducing the incidence of measles to < 5 cases/ 10 population per year in all countries, (2) increasing the first dose of measles-containing vaccine (MCV1) to greater than 90% at the national level and greater than 80% in all districts and (3) measles surveillance system performance that reports non-measles febrile rash illness rate of ≥2 cases per 100,000 population per year (WHO, 2008).

It is disheartening to note that Nigeria is among the 45 countries that account for 94% of the global deaths due to measles (Saleh, 2016). While there is a paucity of literature on the population-based prevalence of measles in Nigeria, several studies from tertiary hospitals show that prevalence of measles from paediatric admissions stands at around 1.3–5.1% (WHO, 2012; Odega, Fatiregun and Osagbemi, 2010; Saleh, 2016). Furthermore, the reported Case Fatality Ratios (CFRs) for this disease in Nigeria showed some variations ranging from 1.9% to 12.4% (Saleh, 2016). In Nigeria, data from previous studies on the trend of measles showed that most measles cases reported were children who were either not immunised with the measles vaccine or had an incomplete course of the routine vaccination. In a study conducted by Onyiriuka, cases of measles accounted for 3.1% of all admissions in the Paediatric Department with the age distribution of between 13 and 24 months of age (47.8%) and under 9 months old (18.1%). Although 22.1% had a vaccination against measles, 77.9% were not vaccinated against the disease. A significant number of these cases occurred in the dry season (80.5%) as compared to the wet season (19.5%). Two main reasons given by the mothers for not immunising their children against the disease were child's ill health (35.0%) and child less than 9 months old (23.3%) (Onyiriuka, 2011)

According to Fatiregun, Adebowale and Fagbamigbe (2014), of the 10,187 suspected measles cases investigated in Southwest Nigeria, 1,631 (16.0%) cases were confirmed. This indicates a rise in annual incidence from <1 case per million in 2007 to 23 cases per million in 2011. Furthermore, of the cases confirmed from six states in the zone, 97.4% were under the age of 20 years. They also noted that the peak of infection was in the first two quarters of the year. The result shows an increasing trend in the expected number of cases based on the projection (Fatiregun et al., 2014). In a related study in Southwest Nigeria, Fatiregun and Odega (2013), records from the local government areas (LGAs) showed that 10% of the cases were older than 14 years as against the 20% in the same age group found in the health facility records.

Table 2.3: Reported Cases of Measles in Nigeria over a period of 10 years

Year	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
№ of cases	12423	6855	52852	6447	18843	8491	1272	9960	2613	704

(*Source: Data extracted from the WHO database. Data for 2000-2015. Available online at http://www.who.int/immunization/monitoring_surveillance/routine/reporting/en/*)

Haemophilus influenzae type b (Hib)

It has been reported that since the mid-20th century, *Haemophilus influenzae* type b, or Hib, has been known by epidemiologists to cause meningitis, pneumonia, and other serious infections in infants and young children. WHO estimates of the year 2000 attribute to this bacterium an annual toll among the under-fives of nearly 8.1 million cases of invasive disease and pneumonia of which 363 000 are fatal (WHO, UNICEF and World Bank, 2009; Watt, Wolfson, O'Brien, Henkle, Knoll, McCall, Lee, Levine, Hajjeh, Mulholland and Cherian, 2009). Hib also causes potentially severe inflammatory infections of the face, mouth, blood, epiglottis, joints, heart, bones, peritoneum, and trachea. Yet, beyond the epidemiologists and public health analysts of the vaccine community, the burden of Hib disease is still not widely appreciated. One reason is the difficulty in detecting this bacterium as a common cause of pneumonia and meningitis cases, especially in developing countries. The problem is complicated by the fact that in many parts of the world, clinicians have treated these diseases with antibiotics, thereby masking the role of Hib (WHO, UNICEF and World Bank, 2009).

Since the early 1980s, researchers used conjugation technology to develop several vaccine products that were highly immunogenic and conferred protection on all age groups. The wide use of this Hib "conjugate" vaccine enabled several countries – both industrialized and developing – to virtually wipe out Hib disease. Moreover, large-scale studies in Africa and Latin America, and more recently also in Asia, found a substantial reduction in the burden of pneumonia and meningitis in countries that had used the vaccine widely. Particularly, one African trial showed a drop in pneumonia incidence of just over 20% in Gambian children (WHO, UNICEF and World Bank, 2009). Notwithstanding clear evidence of the vaccine's efficacy, by 1997 only 29 countries were using it routinely, prompting WHO to recommend its inclusion in the routine immunisation programmes of *all* countries where Hib was recognized as a public health burden and where the cost of the vaccine was not prohibitive (Centers for Disease Control and Prevention, 2008). Over the next few years, however, both conditions have constituted deterrents to Hib introduction by many countries.

Following the WHO global recommendation, and with the growing demand for the vaccine together with increasing supply, the cost of the three doses of the single-antigen Hib vaccine had fallen to approximately US$ 10 and is now beginning to see even more significant declines. In 2000, the GAVI Alliance began offering financial support for procurement of the vaccine to its then-75 eligible countries (i.e. those with a per capita gross national income of less than US$ 1000). The year 2005 also saw the birth of the Hib Initiative, a consortium of four public health entities (WHO, Johns Hopkins Bloomberg School of Public Health, the London School of Hygiene and Tropical Medicine, and the CDC), that was set up, with GAVI Alliance support, to speed up the adoption of Hib vaccine (Centers for Disease Control and Prevention, 2008).

Hib vaccines are administered at the same time as DTP, often in combination vaccines that also include the DTP and hepatitis B antigens. In industrialized countries, the infant vaccination schedule with Hib conjugate vaccines is usually followed by one further dose during the second year of life. In most other countries, the Hib vaccine is only used for younger infants. Recent data from Latin America and Africa suggest that Hib disease can be eliminated with a three-dose regimen. At the present time, therefore, there are no compelling reasons for recommending the fourth dose of vaccine outside of the routine immunization programme. However, it is not yet known whether the protection conferred by the primary three doses will last a lifetime or if susceptibility to Hib infection could appear later in life. To help dispel such doubts, countries using Hib vaccines need to sustain surveillance for bacterial meningitis. Prompt detection of a resurgence of Hib disease could enable an appropriate vaccination response to be made (WHO, UNICEF and World Bank, 2009).

There are variations in the prevalence of *H. influezae* in Nigeria. Results from a study in Enugu State, Nigeria, by Atiku, Ogbonnaya, Bozieghen and Umueze (2016) showed that of the 158 samples collected, 50 throat/swab specimens tested positive for *H. influezae*, giving a carriage rate of 31.7%. Cumulatively, the highest carriage rate of 61.1% was in children aged one year. The least carriage rate of 14.8% was obtained in those aged 3 years. In another study involving two teaching hospitals in Jos, Nigeria, of the 160 children, *H. influenzae* was isolated from 10 children representing 6.3% of the study population (Yunusa, Egah, Banwat, Shwe and Kolade-Yunusa, 2014).

Rotavirus

Rotaviruses, discovered in 1973, are the most common cause of severe diarrhoeal disease in young children throughout the world (Iyoha and Abiodun, 2015; Parashar, Gibson, Bresee and Glass, 2006; Parashar, Hummelman, Bresee, Miller and Glass, 2003; Parashar, Burton, Lanata, Boschi-Pinto, Shibuya, Steele, et al. 2009). Virtually all children under three years of age are infected in both industrialized and developing countries; and has been reported to be responsible for endemic viral diarrhoea in children in Nigeria (Parashar, Hummelman, Bresee, Miller and Glass, 2003; Iyoha and Abiodun, 2015). Most disease episodes consist of a mild attack of watery diarrhoea, accompanied by fever and vomiting. In about 1 in every 75 cases, however, the infection produces severe, potentially fatal dehydration and continues to have a great impact on childhood morbidity and mortality (Dennehy, 2008; Revelas, 2012; Cooke, 2010; World Health Organization, 2014; WHO, UNICEF and World Bank, 2009).

Rotaviruses are classified into serogroups A through G, but only groups A-C have been shown to infect humans with the severe disease mainly caused by members of group A

(Nguyen, Le Van, Le Huy and Weintraub, 2004). Rotavirus is highly transmissible and virtually all children will have experienced at least one rotavirus infection by the age of 5 years (White, Buttery, Cooper, Nokes and Medley, 2008). Reinfection is also common, although previous infections reduce the risk of severe disease (Pennap and Umoh, 2010; White et al., 2008). Adults are also known to experience rotavirus diarrhoea (Paul, Kobayashi, Nagashima, Ishino, Watanabe, Alam, Ahmed, Hossain and Naik, 2008). Each year rotavirus infection leads to about 600,000 deaths globally (Parashar et al., 2006; Mast, DeMuro-Mercon, Kelly, Floyd and Water, 2009) with more than 85% of these deaths occurring in Africa and Asia (CDC, 2008).

In 2004, six countries, including Nigeria, accounted for more than half of all rotavirus diarrhoea deaths in children under 5 years of age (Ahmed, Kabir, Rahaman, Hussain and Khatoon, 2009). Rotavirus disease is more severe than diarrhoea caused by other enteric pathogens (Albano, Bruzzese, Bella, Cascio, Titone, Arista, Izzi, Virdis, Pecco, Principi, Fontana and Guarino, 2007), with symptoms including an average of six stools per day (Castello, Arguelles, Rota, Olthoff, Jiang, Genstch and Gilman, 2006), severe dehydration which is 14 times more frequent in children with rotavirus diarrhoea than among those with the disease from other causes (Pennap and Umoh, 2010) and vomiting and fever (Nguyen et al., 2004; Aminu, Ahmed, Umoh, Dewar, Eson and Steele, 2008; Ahmed et al., 2009).

The administration of oral rehydration is also hampered by the accompanying vomiting (Parashar et al., 2006). The reported prevalence of rotavirus infection in children requiring hospitalization ranges from 17.7-69% in different countries and in different settings (Kazemi, Tabatabase, Agha-Ghazvini and Kelishadi, 2006). Parashar et al. (2003, 2006) noted that while diarrheal disease incidence has reduced in recent years, due in part to improved hygiene practices and sanitation, the incidence of rotavirus infection continues to increase. They further opined that hygiene and water interventions are likely to be effective only on diarrhoea caused by bacteria and parasitic agents. Conversely, Sergio and Ponce de Leon note that improvements in hygiene practices and access to clean water will reduce the incidence of rotavirus diarrhoea (Sergio and Ponce de Leon, 2009). In view of the seriousness of this disease burden worldwide, WHO has recommended the use of rotavirus vaccines in countries with an under-five mortality rate of more than 10.0% (WHO, 2010). Rotavirus vaccines do not protect against infection, but do protect against severe disease requiring hospitalization; a probable outcome for most children in African settings (White et al., 2008). In fact, in the United States, rotavirus vaccine is now included as part of the routine vaccine schedule for all infants (Bernstein, 2009).

Rotavirus infection is endemic in Nigeria and most studies conducted are hospital based. Tagbo, Mwenda, Armah, Obidike et al. (2014) in their study reported that, of the 615 diarrhoea stool samples collected, 344 (56%) were positive for human rotavirus of which 77% were children <1 year of age. In a related study by Aminu, Esona, Geyer and Steele (2008) in Zaria, Kaduna State, Nigeria, 154 stool samples from young infants and children with diarrhoea, were screened for rotaviruses and astroviruses. Rotavirus and astrovirus antigens were respectively detected with a prevalence of 8.0% and 5.0% in the total stool samples analysed and with a prevalence of 9.0% and 5.0% in the diarrheic stools. In another study involving 470 patients with diarrhoea recruited from the tertiary, secondary, primary health care centres, and twelve randomly selected private hospitals in Benin City, Edo State, Southern Nigeria. Results showed that out of the 470 children with diarrhoea recruited for the study, 13.8% stool samples tested positive for rotavirus antigen using ELISA while 19.2% tested positive with RT-PCR (Iyoha and Abiodun, 2015).

Pneumococcal Infection

Recent literature shows that *Streptococcus pneumoniae* (the Pneumococcus) has continued to remain an important human pathogen since its initial recognition in the late 1800s. As the leading cause of lower respiratory tract infection, its global burden in causing disease and deaths is comparable to that of Human Immunodeficiency Virus (HIV), malaria, and tuberculosis combined (Iliyasu, Habib, Borodo, Babashani and Ahmed, 2014; WHO, 2013). The 10 countries with the highest burden of Pneumococcal Infection (PI) are in Africa and Asia and combined together they account for 66% of reported cases worldwide (O'Brien, Wolfson, Watt, Henkle, Deloria-Knoll and McCall, 2009). Nigeria accounts for 5% of the total burden at the third place after India and China (Iliyasu, Habib, Borodo, Babashani and Ahmed, 2014; WHO, 2013). The Pneumococcus is the commonest cause of Community-Acquired Pneumonia (CAP), sporadic meningitis, and bacteraemia in children and adults. Worldwide it accounts for 30-70% of CAP cases requiring hospitalization (Iliyasu et al., 2014). Studies in Nigeria have shown that PI accounts for 50, 54.5, and 60% of CAP cases in Zaria, Enugu, and Kano, respectively (Musa, Tijjani, Okpapi, Borodo, Babashani, Shehu, et al., 2008).

Iliyasu et al. (2014) quoted a similar report by Ozumba in Enugu that Pneumococcus has been found to be the single most predominant cause of community-acquired sporadic meningitis. According to them, research conducted in Kano found pneumococci to account for 46.4% of CAP, meningitis, and bacteraemia (Iliyasu et al., 2014).

The World Health Organization (WHO) estimates that 1.6 million people, including up to 1 million children <5 years of age, die of PI annually (WHO, 2007a), with developing countries bearing the greatest burden (Iliyasu, 2011; Iliyasu et al., 2014). Onyemelukwe and Greenwood reported an overall mortality of 39% in the 1980s in Zaria. Previously, Baird and Tugwell in Zaria reported a mortality rate of 51% and 48%, respectively. In a recent study by Falade *et al*. in Ibadan, Nigeria, eight out of the nine cases with culture-proven pneumococcal meningitis died (Falade, Lagunju, Bakare, Odekanmi and Adegbola, 2009; Iliyasu et al., 2014). In another study, Adetifa, Antonio, Okoromah, Ebruke, Inem, Nsekpong, Bojang and Adegbola (2012) found the prevalence of pneumococcal carriage to be 52.5% in Nigeria and the carriage was higher in children compared to adults (67.4% vs. 26%), highest (≈90%) in infants aged <9 months and reduced significantly with increasing age.

Yellow fever

Yellow fever (YF) is a viral disease, found in tropical regions of Africa and the Americas. It principally affects humans and monkeys and is transmitted via the bite of *Aedes* mosquitoes. It can produce devastating outbreaks, which can be prevented and controlled by mass vaccination campaigns (World Health Organization, 2016). After a few days of being bitten by an infected mosquito, sub-clinical infection, non-specific illness, or influenza-like symptoms can develop. The latter can culminate in the vomiting of blackish blood, one of the two hallmark symptoms of the disease. A few days later, in about 15% of cases, bleeding occurs from several sites, accompanied by painful convulsions and failure of several organ systems, notably the liver, kidneys, and heart (Plotkin et al., 2008). This stage is also marked by jaundice – the second hallmark symptom – that colours the skin a deep yellow. About 20–50% of people with severe disease die from the disease. Children and elderly people run the greatest risk of death from yellow fever (WHO, UNICEF and World Bank, 2009). There is no specific treatment for yellow fever. Vaccination is highly recommended as a preventive measure for travellers to, and people living in, endemic countries. The vaccine is safe and effective. A single injection offers protection for at least 10 years, or even for life.

Between the 1940s and the 1960s, extensive vaccination campaigns were undertaken in several African countries that led to the virtual eradication of epidemics for more than 40 years (World Health Organization, 2007b).

Yellow fever occurs in the tropics and subtropics of Africa and Latin America, where the natural host of the YF virus lives in forested areas. Given a favourable combination of factors, the virus escapes from its jungle (sylvatic) cycle and is transmitted to humans. Devastating epidemics occur in areas with dense populations of non-immunised subjects and large numbers of infected mosquito vectors, for example in towns. The diminution of regular immunization campaigns, limited immunization coverage among successive cohorts of children and fewer vector control programmes have certainly contributed to the resurgence of YF since the late 1980s. Significant efforts have nevertheless been made in recent years to control the risk of epidemics. Of the 23 African countries considered to be at high risk, 83% have incorporated the YF vaccine into their routine immunization programmes (WHO, 2007b). However, the resurgence of YF is also closely connected with changes in the modern world and the interaction of various economic, climatic, social and political factors. Besides, certain factors influence more specifically on the epidemiological situation of YF in Africa, such as urbanization and migration (WHO, 2007b; WHO, 2016).

For more than a decade, yellow fever has not been a disease that threatens life, however, low immunisation coverage, many populations are at risk. According to a World Health Organisation report, to date, about 12 countries with large non-immune populations are at high risk of yellow fever outbreak. For example, the last yellow fever outbreak in Nigeria occurred 14 years ago, but it took 10 years to control the transmission of the virus in the population. With the low vaccine coverage of children under 14 years old, the number of children at risk in Nigeria has been estimated at 23 million, for those children in urban areas only. Immunising the urban populations in these high-risk countries would require vaccinating approximately 100 million people (World Health Organisation. 2016).

Compounding factors for emergence and resurgence of YF

Yellow fever has been subjected to partial control for decades, but there are signs that case numbers are now increasing globally, with the risk of local epidemic outbreaks (Karunamoorthi, 2013; Rogers, Wilson, Hay and Graham, 2006). The agent of YF, yellow fever virus, can cause devastating epidemics of potentially fatal, haemorrhagic disease. However, the risk of major YF epidemics, especially in densely populated, poor urban settings in Africa has greatly increased due to: (1) reinvasion of urban settings by the mosquito vector of YF, *Ae. aegypti*; (2) rapid urbanisation, particularly in parts of Africa, with populations shifting from rural to predominantly urban; and (3) waning immunisation coverage. Consequently, YF is considered an emerging, or re-emerging disease of considerable importance (Gardner and Ryman, 2010; Karunamoorthi, 2013).

Clinical signs and symptoms

Yellow fever is the original Viral Haemorrhagic Fever (VHF), a pansystemic viral sepsis with viraemia, fever, prostration, hepatic, renal, and myocardial injury, haemorrhage, shock, and high lethality. Patients with yellow fever suffer from a terrifying and untreatable a clinical disease as yellow fever is responsible for 1000-fold more illness and death than Ebola. Yellow fever stands apart from Ebola and other VHFs in its severity of the hepatic injury and the universal appearance of jaundice (Karunamoorthi, 2013). It is difficult to distinguish YF clinically from many other tropical diseases and often impossible when the condition is mild or atypical. The clinical symptoms associated with the early stages of YF infection are indistinguishable from those of malaria, and where the two diseases coexist, YF should not be ruled out even in the absence of jaundice or the finding of malaria parasites in a blood smear (Karunamoorthi, 2013). The clinical disease varies from non-specific abortive illness to fatal haemorrhagic fever. Disease onset is typically abrupt, with fever, chills, malaise, headache, lower back pain, generalised myalgia, nausea, and dizziness. On physical examination, the patient is febrile and appears acutely ill, with congestion of the conjunctivae and face and relative bradycardia with respect to the height of fever (Faget's sign). The average fever is 39^0 C and lasts for 3.3 days (Karunamoorthi, 2013).

2.6 Policies on Vaccine-Preventable Diseases in Nigeria

Policies on Vaccine-Preventable Diseases (VPDs) exist in Nigeria. They were either created nationally or adopted from international policy tools to give strategic directions to different issues on vaccination, which would eventually lead to an improvement in the health status of children in Nigeria.

The National Health Policy

The Nigeria National Health Policy represents the collective will of the government and people of the country to provide a comprehensive health care system that is based on primary health care. It describes the goals, structure, strategy, and policy direction of the health care delivery system in Nigeria. It defines the roles and responsibilities of the three tiers of government without neglecting the non-governmental actors. One of the cardinals focus of the policy is the Child Health Policy. Moreover, the overall goal of child health policy "shall be the development and adaptation of technologies and approaches aimed at the protection and promotion of health of children and ensure survival and healthy growth and development".

However, as laudable as this policy is, no section of it provides for the adoption of innovation aimed at improving immunisation appointment keeping such as the use of mobile telephone or reminder SMS for the uptake of routine immunisation at the primary health care facilities throughout the country. Adoption of this innovation is germane to reducing missed immunisation opportunity by mothers of infants in order to improve the immunisation status of Nigerian children.

National Child Health Policy

According to the National Child Health Policy (2006), the current health situation in Nigeria, as in many developing countries, is unsatisfactory, with women and children, particularly those in rural areas, being most affected (Federal Ministry of Health, 2006). Childhood mortality rates in Nigeria are one of the highest in the world. According to the Nigeria Demographic Health Survey (NDHS) of 2003, the under-five and infant mortality rates are 201 and 100 per 1000 live births respectively. Neonatal mortality contributes to a major part of these deaths at 48 per 1000 live births (National Population Policy 2004). However, in the 2013 NDHS report, infant and under-five mortality rates dropped to 69 and 128 deaths per 1,000 live births respectively. At these mortality levels, one in every 15 Nigerian children dies before reaching age 1; one in every eight does not survive to his or her fifth birthday (National Population Commission (NPC) [Nigeria] and ICF International, 2014).

It was reported that major causes of mortality in Nigerian children include malaria, vaccine-preventable diseases, diarrhoea, acute respiratory infections and malnutrition (Ezeonwu, Chima, Oguonu, Ikefuna, and Nwafor, 2014; Federal Ministry of Health, 2011). Mortality in the newborn contributes about half of the infant mortality. One of the targets of the Millennium Development Goals (MDGs) is to reduce under-5 mortality to 64 deaths per 1,000 live births and infant mortality to 30 deaths per 1,000 live births by 2015 (Federal Republic of Nigeria, 2010). Programmes designed to increase the proportion of births attended by skilled health personnel, to increase immunisations against vaccine-preventable diseases, to provide early care and treatment to sick children, and to upgrade the status of women through education and enhanced participation in the labour force can all help to improve the probability of survival of young children (National Population Commission (NPC) [Nigeria] and ICF International, 2014). Despite efforts tailored towards achieving this goal, the target was not achieved by 2015 especially with cases of missed immunisation appointment, high immunisation dropout rate, which are results of various underlying factors (Adebayo et al., 2012). Moreover, the policy did not state what innovation should be put in place to prevent missing immunisation appointments.

As stated in Anyene (2014), politics is relevant to the development of the health system especially in the context of routine immunisation. Questions regarding what policies to adopt with regard to health issues such as routine immunisation have political underlining. Policies regarding the primary health care system within which routine immunisation is undertaken in Nigeria is linked to politics. Political issues such as the leadership of Local Government Areas (LGAs), allocation to the LGAs etc. These factors largely affect this policy as laudable as it is. In principle, it creates the framework for the improvement of child health services but in practice, it is a different story.

The Nigeria National Health Act 2014

The former President of the Federal Republic of Nigeria, Dr Goodluck Jonathan, signed Nigeria's National Health Bill, which has become an Act, into law on December 9, 2014. The aim of the Act is to establish a framework for the Regulation, Development and Management of a National Health Systems, to set standards for rendering health services in the Federation and other matters concerned therewith. The Act is set to achieve the Universal Health Coverage and meet the Millennium Development Goals (MDGs) target. The Act also provides for the elimination of quacks from the professionalism and provides basic health funds needed by Nigerians. The Act was enacted for providing healthcare insurance to a certain class of people who are actually deprived. The Act seeks to help Nigeria reduce maternal and infant mortality rate by 2015. More women that are pregnant would have access to free delivery services while their children are assured of standard paediatric services in the nation's health facilities.

The Act provides that there would be improved funding of health care services at the grassroots so that people do not have to travel a long distance to access medical services. Through this Act, State governments can also participate in improving health centres through a counterpart fund that would enable them to benefit from the consolidated funds. The Act also provides for a cut down on medical tourism, which is plaguing the health sector of the country. It states that ailments that can be treated in Nigeria will no longer be referred abroad. The Act has provisions that tackle the vexatious issue of medical tourism and its current negative impact on Nigeria and gross abuse of tax payer's money on account of the incessant foreign medical trips by political and public office holders in search of foreign medical attention that can effectively be treated in Nigeria. Nigeria loses 800 million dollars annually to foreign medical trips.

The Act also stipulates that basic health care provision fund shall be financed from Federal Government Annual Grant of not less than 1% of its Consolidated Revenue Fund and grants by international donor partners. The funds shall be managed by three national entities as follows:

1. The National Health Care Development Agency which will manage 45% of the fund to be disbursed through each State and the Federal Capital Territory (FCT) Primary Health Care Development Board for the provision of essential drugs, vaccines and consumables.

2. The National Health Insurance Scheme which will manage 50% of the fund for the of a basic minimum package of health facilities

3. The Federal Ministry of Health will manage 5% of the fund for the provision of a basic minimum package of health facilities.

As of 2015, 28 States, the FCT, and their Local Government Areas have established State Primary Health Care Development Agencies in readiness for the implementation of this Act. The Act is also for the purpose of providing health care insurance for a certain class of people who are actually deprived. The Act also provides that the NHIS would provide health coverage, which will cover pregnant women, children who are under five years, the elderly and the physically challenged persons. The Act also provides that part of the funds would be used to train nurses and midwives. The new Nigeria National Health Act, however, lacks clear strategies aimed at improving routine immunisation programmes/services at the Primary Health Care level.

Thus, the policy and guidelines mandating every state to establish a State Primary Health Care Development Agencies (SPHCDA) have been adopted, but the rollout has been slow. If this is implemented, the Primary Health Care facility will be adequately funded and monitored for improved routine immunisation services. Although this Act creates a "basic health care provision fund" in terms of the substantial financial investment in human resources, infrastructure, equipment, transportation, drugs, etc. at PHC level. The success or failure will depend on the institutional readiness of the State Primary Health Care Development Agency and the timely release of money into the fund, as many of the State government are yet to buy into this initiative.

The Millennium Development Goals

The United Nations General Assembly, in September 2000, adopted the Millennium Declaration, establishing a global partnership of countries and development partners committed to eight voluntary development goals, to be achieved by 2015. Representing ambitious moral and practical commitments, the Millennium Development Goals (MDGs) (United Nations, 2015a) called for action to: (1) eradicate extreme poverty and hunger; (2) achieve universal primary education; (3) promote gender equality and empower women; (4) reduce child mortality; (5) improve maternal health; (6) combat HIV/AIDS, malaria and other diseases; (7) ensure environmental sustainability; and (8) develop a global partnership for development. Three of the eight MDGs are focused on health, while health is also a component of several other MDGs (nutrition, water and sanitation) (United Nations, 2015b). There has been unprecedented mobilisation of resources around MDG-related activities across a wide spectrum of global and national initiatives and the development community has convened on a regular basis to assess progress.

Health in the MDGs: Achievements

Consequent on these efforts, significant progress made on the specific health-related goals and targets, MDG 4, MDG 5 and MDG 6, is encouraging. Child mortality has fallen by 53% and maternal mortality by 43%. Even though this is a cause for celebration, both declines fall well short of the MDG targets of two-thirds and three-quarters reductions from the 1990 levels. Regional progress has also been uneven and substantial inequalities remain within and across countries (World Health Organization, 2015).

Although none of the child-related goals stipulated how routine immunisation can be improved, however, this initiative led to several interventions on the eradication of vaccine-preventable diseases were implemented with a view of achieving the goals including supports from donor agencies and development partners.

The Sustainable Development Goals

In September 2015, there was a shift from The Millennium Development Goals to The Sustainable Development Goals (SDGs). At the United Nations' Sustainable Development Summit held on 25 September 2015, world leaders adopted the 2030 Agenda for Sustainable Development, a set of 17 Sustainable Development Goals (SDGs) to end poverty, fight inequality and injustice, and tackle climate change by 2030 (United Nations, 2015).

According to the United Nations, the Sustainable Development Goals (SDGs) are a new, universal set of goals, targets and indicators that UN member states will be expected to use to frame their agendas and political policies over the next 15 years. The SDGs follow and expand the Millennium Development Goals (MDGs), which were agreed by governments in 2001 to guide development activities till the end of 2015 (United Nations, 2015; *The Guardian*, 2015).

The proposed 17 goals are: 1) End poverty in all its forms everywhere, 2) End hunger, achieve food security and improved nutrition, and promote sustainable agriculture, 3) Ensure healthy lives and promote well-being for all at all ages, 4) Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, 5) Achieve gender equality and empower all women and girls, 6) Ensure availability and sustainable management of water and sanitation for all, 7) Ensure access to affordable, reliable, sustainable and modern energy for all, 8) Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all, 9) Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation, 10) Reduce inequality within and among countries, 11) Make cities and human settlements inclusive, safe, resilient and sustainable, 12) Ensure sustainable consumption and production patterns, 13) Take urgent action to combat climate change and its impacts, 14) Conserve and sustainably use the oceans, seas and marine resources for sustainable development, 15) Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss, 16) Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels, 17) Strengthen the means of implementation and revitalise the global partnership for sustainable development (United Nations, 2015).

There are 13 targets under Goal 3, all of which focused on ensuring healthy lives and promoting well-being for all at all ages. The emphasis here is on target 3.2 - By 2030, end preventable deaths of new-born babies and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortalities to at least as low as 25 per 1,000 live births. However, much cannot be said of SDGs as the indicators for measuring progress and outputs are still being developed by an expert group. Each indicator is being assessed for its feasibility, suitability and relevance, and roughly two for each target are expected. The indicators are due to be finalised in March 2016 (United Nations, 2015).

It is being speculated that, given an enabling environment and with the involvement of public and private providers of health services, the policy document would help to facilitate design and implementation of programmes, which aimed at improving goals, related to child health and in particular, programmes targeting the elimination of vaccine-preventable diseases.

The National Policy on Public Private Partnership for Health in Nigeria

The goal of the National Policy on Public Private Partnership for Health in Nigeria is "to strengthen the national health system in order to provide effective, efficient, quality, accessible and affordable health service. The goal for public-private partnerships in health care provision is to promote and maintain all forms of partnership and collaboration between the public establishments and the private sector with a view to attaining and sustaining the desired level of health development in Nigeria, (as reflected in the MDGs, and other national policy targets)" (Federal Ministry of Health, 2005) shows a glimmer of hope.

The primary objectives of the National Public Private Partnership Policy in Health are to i. Build confidence and trust in the public and private health sectors, ii. Harness confidence and trust in the public and private sectors for the attainment of Millennium Development Goals, and other National Health Policy targets, iii. Promote and sustain equity, efficiency, accessibility and quality in health care provisioning through the collaborative relationships between the public and private sectors. Other objectives are to identify areas of need in which collaborations and partnerships are desired on a long and short-term basis; develop the regulatory framework for public and private interactions and collaborations in health care delivery in the country; facilitate universal access to a Minimum Health Package; support capacity building across the public and private sectors in health care provisioning; contribute to the sustainability of the overall health system; build the National Health Management Information System (NHMIS) and underscore the contribution/roles of each of the sectors/partners in the partnership to health care delivery (Federal Ministry of Health, 2005).

As lofty as this policy is, however, none of the objectives indicated how immunisation could be improved and neither did they address infant health directly. Specifically, there was no mention of integration of mHealth into routine immunisation service delivery at the Primary Health Care level (Federal Ministry of Health, 2005).

2.7. Routine Immunisation Coverage in Nigeria

At the end of 2011, Nigeria was estimated to have a population of 167 million with a growth rate of 3.2 per cent (Ophori et al., 2014; National Population Commission (NPC) [Nigeria] and ICF International, 2014) projected to between 188 million and 221 million by 2020 (National Population Commission, Nigeria, 2016). The Expanded Programme on Immunisation (EPI), introduced in 1978 with the aim of providing routine immunisation to children less than the age of two years, recorded initial but intermittent successes. The optimum level was recorded by the early 1990s with the country achieving universal childhood immunization coverage of 81.5%. However, since that period of success, Nigeria has witnessed a gradual but consistent reduction in immunization coverage. By 1996, the national data showed less than 30% coverage for all antigens, and this decreased to 12.9% in 2003 (Ophori et al., 2014; Babalola and Olabisi, 2004). This figure, which is consistent with the 2003 national immunisation coverage survey figures, is among the lowest in the world and explains the poor health status of children in the country. It is the worst in the West African sub-region, only better than Sierra Leone.

The vision of EPI in Nigeria is to improve the health of Nigerian children by eradicating all the six killer diseases, which are polio, measles, diphtheria, whooping cough, tuberculosis, and yellow fever. Between 1985 and 1990, as outlined in the national health plan for that period, the objectives of EPI were to strengthen immunisation, accelerate disease control and introduce new vaccines, relevant technologies and tools. In 1995 in line with the above, Nigeria became a signatory to the World Health Assembly, adopted the World Health Assembly Resolution (WHAR) and United Nations General Assembly Special Session (UNGASS) goals for all countries to achieve by 2005 which include: (i) polio eradication, (ii) measles mortality reduction and, (iii) Maternal and Neonatal Tetanus Elimination (MNTE). Nigeria also adopted the Millennium Development Goals (MDGs) calling for a two-thirds reduction in child mortality. In addition to the above, the country ratified the United Nations General Assembly Special Session (UNGASS) goals urging that by 2010 Nigeria should (i) ensure full immunisation of children under one year of age at 90% coverage nationally with at least 80% coverage in every district or equivalent administrative unit, and (ii) vitamin A deficiency elimination.

In 1998 following from the above, Nigeria laid out the core activities of EPI policies which included the following: (i) monitoring of the performance, quality and safety of the immunization system through indicators; (ii) assessment of the current burden of vaccine-preventable diseases as well as the "future" burden of vaccine-preventable diseases in terms of sickness, death and disability, as well as the economic burden; (iii) assessment of the impact of vaccination strategies, through on-going epidemiological surveillance and reliable laboratory confirmation, as well as impact assessments in Nigeria; (iv) monitoring of the national immunization policies, particularly the vaccines used in the country and the target population for these vaccines (immunisation schedules); and (v) monitoring of the overall proportion of children and women who are vaccinated (immunization coverage) and ensuring that all districts of the country are well covered with vaccination. In 2000, following the African Regional Summit on EPI held in Harare in November 1999, the Federal Ministry of Health specifically stated its policies on the country's initial visions for EPI as follows:

(i) ***Immunisation System Strengthening***: By the year 2004, Nigeria should achieve the EPI district-focused plan and attain 80% DPT3 coverage in all the states of the federation. The specific policy also stated that the government should ensure increased funding for EPI.

(ii) ***Accelerated Disease Control***: By the year 2004, there should be no case of acute flaccid paralysis associated with wild poliovirus in Nigeria. As for measles,

by the year 2004, the country should have reduced measles morbidity by 90% and measles mortality by 95% while the coverage for yellow fever is expected to increase to at least 80%.

(iii) ***Innovations***: By the year 2004, Nigeria should include vitamin A and hepatitis B (HB) in its national immunisation programmes; and the vaccination coverage should not be less than 80% as with other antigens. Under the new technology drive, the country should adopt the multi-dose vial policy (MDVP) and vaccine vial monitor (VVM) and introduce new methods for monitoring its use (Ophori et al., 2014; Obioha, Ajala and Matobo, 2010).

Ophori et al. (2014) reported that UNICEF's estimates of routine immunisation coverage per antigen provide information on only four antigens in Nigeria. These are BCG (TB), DPT (Diphtheria, Pertussis and Tetanus), polio and measles (Table 2.3). The Nigeria national demographic surveys in 2003, 2008 and 2013 provide data on the percentage of children age 12-23 months who received specific vaccines at any time before the survey (although vaccination card or the mother's report shows very low figures).

Table 2.4: National immunisation coverage by antigen

Vaccine/ Year	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
BCG	68	64	58	51	57	62	76	65	53	52	49	45
DTP1	70	64	58	51	56	60	73	63	52	49	48	46
DTP3	56	49	46	42	48	54	63	53	42	40	36	33
Hib3	56	49	45	10	0	0	0	0	0	0	0	0
MCV1	54	51	47	42	49	56	64	53	41	44	41	37
Polio 3	55	49	46	42	48	54	66	60	54	46	45	43
YFV	54	51	47	24	38	50	69	50	51	44	36	21

Source: UNICEF-Despite major progress, the full potential of immunisation continues to elude many of the world's children. Available at https://data.unicef.org/topic/child-health/immunization/

According to UNICEF data between 1995 and 2005, BCG coverage in Nigeria witnessed a decline from 80% in 1990 to 42% in 1995 and fluctuated between 43% in 1996 and 60% in 2003. In 1997, BCG recorded 53%. Thus, the target of at least 80% coverage as indicated in EPI policy in Nigeria could not be met, just as it was still not met in 2005. The BCG coverage shows over 24% increase from the 52% coverage recorded in 2006 against the 76% coverage for 2009 and over 53% from the 23% coverage in 2003. The highest BCG coverage was reported in Enugu State with 99.6%, while the lowest was reported in Kano State with 35.23%.

The EPI policy in Nigeria stipulated that by 2004 no community in the country should have or report cases of diphtheria. Data collected show that this vision is not yet realised. In 1990, DPT had coverage of 56%. It dropped to 31% in 1995 and to 26% in 1996. Furthermore, it ranged between 25% in 1997 and 45% in 2005. Apart from 56% in 1990, the peak between 1995 and 2005 was 45% recorded in 1997. Although the national DPT3 coverage stands at 67.73%, there was an almost 95% increase in coverage in 2010 as against the 36.3% coverage recorded in 2006. This figure is applicable not only to the national figure but also across all the zones. The southeast zone with coverage of 91.18% presents the highest figure, while the northeast zone with 46.16% presents the lowest. The DPT3 coverage by States shows that Enugu state had the highest DPT3 coverage of 98.21%, while Taraba State showed the lowest DPT3 coverage with 15.63% (UNICEF, 2006; Ophori et al., 2014).

In 1990, polio coverage was 55%. This dropped to 31.5% in 1995 and, between 1996 and 1999; it dropped to between 26% and 19%. In 2000, it increased to 26% and continued to rise to 45% in 2005. These results show that the country's target of eradicating polio in Nigeria by the year 2004, through 95% coverage was not met. Oral polio vaccine (OPV3) coverage shows a national figure of 73.95% coverage with the southeast zone at 86.63% as the highest and the northeast zone with 60.2 as the lowest rate. The trend shows a drop from 38.60% in 2003 to 36.70% in 2006 and an increase to 73.95% in 2010. The OPV3 coverage by states shows that Enugu state recorded the highest coverage with 99.11%, while Taraba State recorded the lowest with 18.75% (UNICEF, 2006; Ophori et al., 2014). The good news today is that Nigeria has been declared polio-free by the WHO.

As reported by Ophori et al (2014), measles' coverage was 54% in 1990 and dropped to 44% in 1995. It further dropped to 38% in 1996. The peak coverage was 69% in 1997, which later dropped to 40% in 1998 and to 35% in 1999. Since 1999, there was no significant change over the years, except in 2004 and 2005 when the coverage dropped to 32%. In addition, the poor coverage of measles between 1998 and 2005 was blamed on vaccine shortages and administrative problems, as it applied to Polio coverage between in 1996, 1999 and 2000 when Polio recorded 26%, 19% and 26% respectively

(Obioha, Ajala and Matobo, 2010). However, the coverage for measles also showed a rise from 25.30% in 2003 to 32.70% in 2006 and 63.55% in 2010. Looking at the zones, the data show 82.35% coverage in the southeast, 74.40% in the South South and 47.15% in the northeast as the lowest. The measles coverage by state shows that Enugu State had measles coverage of 97.77%; Zamfara State had a median coverage of 65.48%, while Kano State recorded the lowest coverage of 16.48% (Ophori et al., 2014).

It could thus be inferred that the downward trend in the coverage of all the antigens in Nigeria appears to be associated with political problems. These political problems included low government commitment to ensuring the fulfilment of EPI policy (UNICEF, 2006; Ophori et al., 2014). It also included over-centralization in the administration of EPI at the federal level of governance in Nigeria.

The figure below shows the estimated number of children who had not received 3 doses of diphtheria-tetanus-pertussis vaccine (DTP) during the first year of life among 10 countries (Nigeria inclusive) with the largest number of children incompletely vaccinated with DTP, by country, and cumulative percentage of all incompletely vaccinated children worldwide during 2012. Among the 22.6 million children who did not receive three DTP doses (DTP3) during the first year of life, 16.3 million (72%) lived in 10 countries, among which 12.4 million (55%) lived in three countries: 30% in India (72% DTP3 coverage), 17% in Nigeria (41% DTP3 coverage), and 7% in Indonesia (64% DTP3 coverage) (CDC, 2013).

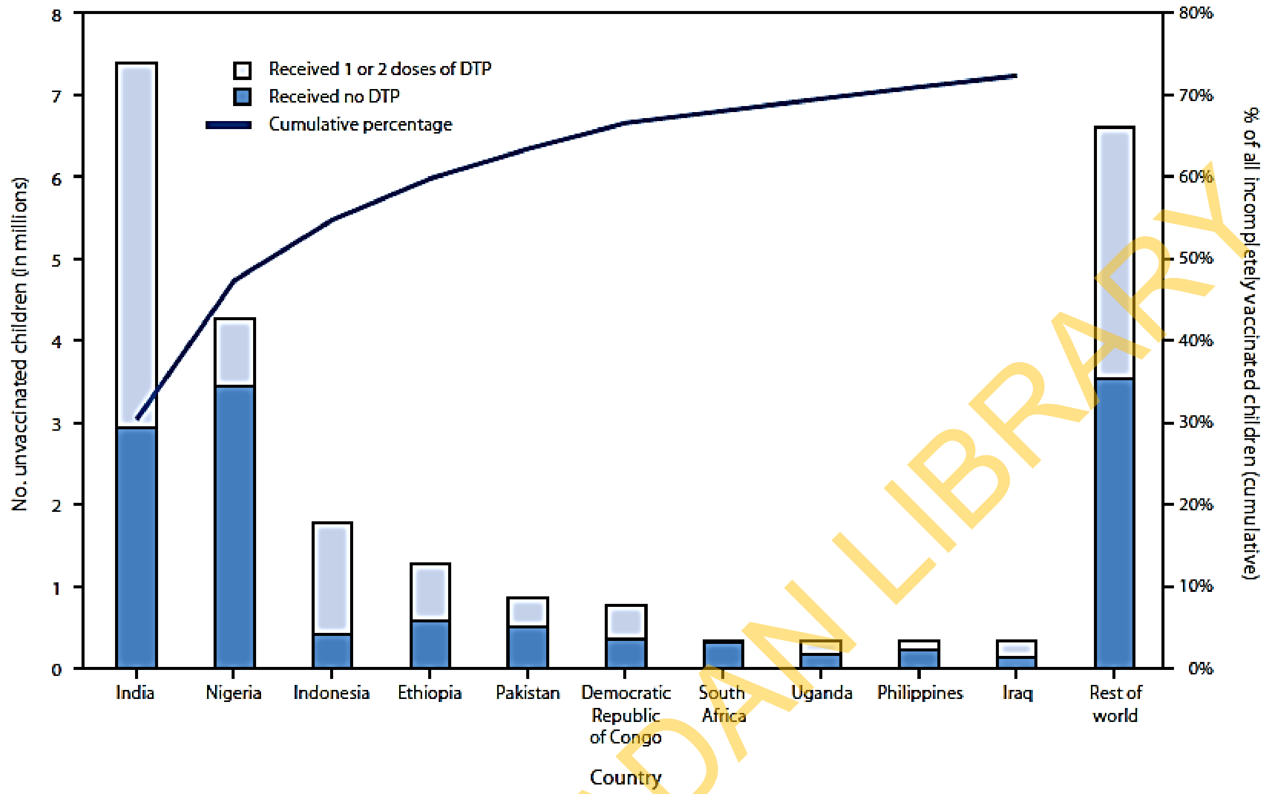

Figure 2.1: Estimated number of children who had not received 3 doses of diphtheria-tetanus-pertussis vaccine (DTP) during the first year of life among 10 countries with the largest number of children incompletely vaccinated with DTP, by country, and cumulative percentage of all incompletely vaccinated children — worldwide, 2012.

Source: CDC Mortality and Morbidity Report Weekly, 2013.

2.8. Challenges to Delivery of Vaccine-Preventable Diseases Services

Factors Influencing Routine Immunisation Uptake and Completion

Reasons some children missed routine immunisation

According to a UNICEF report, in 2013 alone, 21.6 million children were not vaccinated. Children who missed vaccinations are often the most deprived. They typically also lack food and clean water, live in poor housing, do not go to school and cannot access even basic health care (United Nations Children's Fund, 2014). According to this report, gaps in immunisation affect children in rural and urban areas, and in poor and middle-income countries. The report has it that conflict can also make it impossible for vaccinators to reach children. Others are excluded because they are from ethnic minorities, or live deep in city slums, where health services operate poorly – if at all. Religious or traditional beliefs can lead some communities to refuse vaccination, while others, such as nomads, refugees or migrants, are continuously on the move. Over 70 per cent of children who did not receive the three recommended doses of the combined diphtheria, tetanus, pertussis (DTP3) vaccine, live in Africa and South-East Asia (United Nations Children's Fund, 2014).

Reasons for incomplete vaccination and non-uptake of immunisation services are poorly understood. However, a report prepared for WHO by IMMUNIZATIONbasics Project (2009) and presented at WHO Strategic Advisory Group of Experts (SAGE) has provided insight. The report listed the reasons for dropouts (children who began but did not complete their basic series) and left outs (children with no immunisation) and the factors responsible with non-immunisation of children under the following sub-heads:

1. Factors attributable to immunisation system such as: distance (travel conditions/access), health staff motivation, lack of resources and other logistics, false contraindications (e.g., sick children, baby too old, use of all opportunities (e.g., refusal to vaccinate eligible child), reliability (e.g., lack of supplies), appropriateness of time (e.g., immunisation starting late and ending early), waiting time, illegal charges or indirect costs and so on.
2. Factors due to communication and information such as lack of promotion/follow-up of routine immunisation/health communication
3. Family characteristics such as income/socioeconomic status, recent/seasonal migrants and education (maternal and paternal)
4. Parental attitudes/knowledge such as parental practical knowledge, fear of side effects, conflicting priorities, religious/cultural/social beliefs/norms and rumours, perception about importance of vaccination to the health of the child, perceived efficacy of vaccine, lack of interest/motivation, lost/unavailable health card, demand/acceptability of vaccines, autonomy of women/father/mother-in-law pressurising against/husbands refusal and so on (IMMUNIZATIONbasics Project, 2009).

Each of the reasons for incomplete vaccination and non-uptake of immunisation services are discussed in detail below:

Factors attributable to immunisation system

Distance (travel conditions/access), health staff motivation, lack of resources and other logistics, false contraindications (e.g., sick children, baby too old, use of all opportunities (e.g., refusal to vaccinate eligible child), reliability (e.g., lack of supplies), appropriateness of time (e.g., immunisation starting late and ending early), waiting time, illegal charges or indirect costs and so on are reasons for dropout attributable to immunisation system.

However, the most prominent factor affecting routine immunisation uptake and timely completion is service inaccessibility. This is as an important cause of partial or under-vaccination. Babalola and Adewuyi in their study across six states in Nigeria, more than one third of mothers claimed distance/access as a factor to incomplete vaccination and non-uptake of immunisation services, which is similar to 43% in Siaya, Kenya, and 30% in Liberia (Vonasek, Bajunirwe, Jacobson, Twesigye, Dahm, Grant, et al., 2016; Babalola and Adewuyi, 2005; Fields, 1992; Bender and Maculey, 1998). Sheldon and Alons (2003) in a study found the distance to services to be the major obstacle to vaccination. In a related study in Senegal, it was found that 71% of children completely vaccinated lived less than 10 km from the nearest health centre, while in remote villages only 10% of children were completely vaccinated (Health Access International, 1999).

It has been argued that although difficult access is a key barrier to vaccination in many, settings, especially rural areas, this factor (as others) does not always affect families equally. For instance, distance does not discourage families that are sufficiently motivated from getting their children immunised, although it is a barrier that is too difficult to overcome for other less motivated families (Indian Market Research Bureau, 1987; IMMUNIZATIONbasics, 2009). It is worth considering that in many countries, BCG and DPT1 rates, which can be considered as indicators of access, are over 80 or 90%, yet full coverage rates are significantly lower. Therefore, it is possible that when asked, some respondents offer difficult to access as a convenient explanation of non-vaccination of their children. Any number of additional factors – such as bad experiences at the vaccination site, misinformation, and fears – may be equally important but are left unsaid (IMMUNIZATIONbasics, 2009).

Another important factor for low uptake and non-completion of routine immunisation among mothers of infants is poor healthcare workers' motivation, performance/competence and attitudes. Attitudes and behaviours of healthcare workers such as treating mothers in an unfriendly, disrespectful, or even abusive manner are frequently cited as discouraging children's vaccination. Healthcare workers reportedly screamed at mothers who forgot the child's card, missed a scheduled vaccination appointment, or had a dirty, poorly dressed, or malnourished child. Mothers felt humiliated and discouraged from returning (e.g. in Ethiopia, Zimbabwe, Niger, Kenya, Bangladesh, West Africa, Uganda, Benin, Nigeria and Syria (Vonasek et al., 2016; IMMUNIZATIONbasics, 2009).

In addition, long hours of waiting before being attended to is another factor. In a related study in the Dominican Republic, most mothers (90%) said that the staff treated them well, however, they complained about waiting too long for service and wasting trips because the needed vaccine or vaccinator was absent (IMMUNIZATIONbasics, 2009). Even where extreme behaviour is not normal, it a common practice to find healthcare workers giving little information and communicating poorly with mothers, so that some mothers leave not knowing when to return and what to do about side effects. In a study in Liberia, more than one-third of mothers pointed out that they were not informed about the return date (Pillsbury, 1990). In a report on factors influencing immunisation intake and timely completion by mothers of infant, it was reported that healthcare workers in Niger and Burkina Faso did not effectively communicate essential information to mothers before or during vaccination encounters (IMMUNIZATIONbasics, 2009).

Favin, Steinglass, Fields, Banerjee and Sawhney (2012) reported that inadequate resources or logistic such as vaccine stock-outs and/or cold chain problems caused unavailability of vaccination. Thus, many mothers who missed work travelled long distances, waited for long hours, and then denied service, naturally, they are less likely to return for vaccination. Vaccine stock-outs are primarily caused by a lack of funding or storage capacity, or poor ordering and distribution skills and systems. Favin et al (2012) reported one of the document provided evidence of a vicious cycle in Guinea in which public facilities lacked drugs, driving most people to private providers, which reduced resources for immunisation since facilities gained a portion of their funding through providing curative care. In addition, they reported that most populace in Somalia and Kenya became less likely to seek vaccination because of health facilities' frequent stock-outs of medicines or failure to offer curative and other services at the time and place of vaccination (Favin et al., 2012).

Ophori et al. (2014) also pointed out that, over the years Nigeria has received huge quantities of cold chain equipment. Despite this support, much of the cold chain appears to be beyond repair. At the state level, cold stores are poorly equipped and badly managed. More than half of the refrigeration equipment is either broken or worn out.

Yahya (2007) reported that in the eight states visited, 47% of the installed solar fridges were broken and $205,000 worth of solar equipment remained uninstalled at the time of his study.

Factors due to communication and information

Communicating and disseminating information about important health issues and available health care services play an important role in behaviour change efforts. Literature showed that some parents whose children were not completely immunised suggested lack of promotion or follow-up of routine immunisation as a reason for not getting their children immunised (Favin et al., 2012; IMMUNIZATIONbasics Project, 2009). There are several campaigns outreaches through the use of mass media and significant social mobilisation aimed at promoting participation in polio campaigns, yet there are parents who reported that they did not receive any messages about routine vaccination programmes (IMMUNIZATIONbasics Project, 2009).

There are divergent opinions about the types and quality of information given to mothers during immunisation visits. There are mixed reports in this regards. Reports showed that most mothers leave health facilities without getting important information about return visits, and side effects of various antigens. Of note is reported in Zambia, where there is high demand for immunisation because of the involvement of Neighbourhood Health Committees, local leaders, churches, schools, and opinion leaders. Social mobilization committees established for immunisation campaigns have been transformed to support routine immunisation (Favin et al., 2012; IMMUNIZATIONbasics Project, 2009).

Family characteristics

Another important factor affecting immunisation uptake and timely completion are the family characteristics such as family income/socioeconomic status, recent/seasonal migrants and education level of parents. In most countries, the government provides vaccines and the services are made free of charge to the populace in order to reduce the economic burden on the families in an attempt to vaccinate their children. Where clients travelled a through a distance to access services in distant facilities, transportation costs were highlighted as a barrier to vaccination by the majority of the clients (Favin et al., 2012; IMMUNIZATIONbasics Project, 2009).

According to IMMUNIZATIONbasics Project (2009), some health centres, particularly in West Africa and Bangladesh may charge a nominal fee in order to replace vaccination card, and some even charge a small fee for the initial card. Unofficial payments are mentioned occasionally. However, it does not appear to be a common occurrence in most countries (Gilson and McIntyre, 2005; Partnerships for Health Reform. 1999).

Migration is one of the common phenomena in poor, developing, war-torn and disaster-stricken countries. New urban migrants may have challenges and be overwhelmed by their new environment and thus the need to earn money. As a result of this, preventive services such as immunisation are not a priority (Bhanot, Agarwal and Srivastava, 2004; MacLeod, Browne, Baldé, Gyapong, Houinato, Jallow, Koumare, N'Diaye and Hill, 2000; Ministry of Health, 2004). In Vietnam for instance, the government through the Ministry of Health found that migrants from rural areas, fishermen, and homeless children were often missed in surveys, not registered, had poor health knowledge, and low access to immunisation and other services (Ministry of Health, 2004). Also in India, new migrants in a district, Lucknow, had not heard about the information needed to get their children immunised (Nath, Singh, Awasthi, Bhushan and Kumar, 2007).

Seasonal migrants/or nomadic herdsmen – people who move to villages for harvesting or come temporarily to urban areas/or move to areas where there is good vegetation for animals – are also likely to have under-vaccinated children. In West Africa, some mothers live in urban areas but must stay in rural villages for 4 to 6 months a year for the main agricultural season work (Millimouno, Diallo, Fairhead and Leach, 2006). Such movement makes it hard to obtain services in either area. In urban Lucknow, the most common reason for partial immunization was that one parent had temporarily migrated to earn money (Nath, Singh, Awasthi, Bhushan and Kumar, 2007).

Several studies supported the notion that parents' education, especially mothers' education, is a predictive factor for appropriate utilisation of health services, including immunisation (Ibnouf, Van den Borne and Maarse, 2007; IMMUNIZATIONbasics Project, 2009; Patra, 2005). However, the relationship is not always consistent, e.g. as reported in IMMUNIZATIONbasics Project (2009), in one Kenya study fathers' education correlated well with vaccination in urban areas and mothers' education in rural areas. In Nigeria, educated people were less likely to immunize their children than illiterates (Babalola and Adewuyi, 2005). In four countries in West Africa, education did not seem to affect EPI coverage in a clear-cut way; duration of residence was a much more powerful factor (MacLeod, Browne, Baldé, Gyapong, Houinato, Jallow, Koumare, N'Diaye and Hill, 2000). Some more educated men in Dhaka felt vaccination to be un-

Islamic because it implied a lack of trust in God (Blanchet T. 1989). In more developed countries, pockets of resistance to vaccination are most likely to be among the best-educated and particular religious groups (IMMUNIZATIONbasics Project, 2009).

Of import is the issue surrounding religion in Nigeria. One of the greatest challenges to the acceptance of immunisation is a religion, in particular among the northern Nigerian Muslims. Generally, the Muslims in the northern part of the country has low immunisation coverage, the least being 6% (Northwest) and the highest being 44.6% (Southeast). In Ekiti State (Southwest), for example, the northeast and west of Ekiti, with a stronger Islamic influence, has low immunisation coverage and poor educational attainment. Christians have 24.2% immunisation coverage as compared to only 8.8% for Muslims (Ankrah and Nwaigwe, 2005).

Parental attitudes/knowledge

Many authors of literature on child health most especially studies on routine immunisation were of the view that some mothers need a good understanding of vaccine-preventable diseases, how a vaccination works, and the vaccination schedule in order to be motivated and able to get their children vaccinated timely. In some studies, (for example, Ibnouf, Van den Borne and Maarse, 2007; Babalola and Adewuyi, 2005), strong correlations between scientific knowledge and good immunisation status was established; however, many well-implemented studies found relatively high immunisation coverage among families with extremely low scientific understanding of immunisation (AlConde, 2002; Bukenya, 1998; Leach, 2006; Raharjo and Corner, 1989; Sheldon and Alons, 2003). The bulk of evidence indicates that such scientific knowledge is not essential. The truly important parental perceptions and knowledge appear to be appreciation of the basic concept that vaccination is good for their child's health and prevents a number of specific diseases, that multiple visits are required for protection, and when and where which child needs to be seen next (e.g. AlConde, 2002; Sheldon and Alons, 2003).

Evidence of this is shown in the Mozambique, Uganda, Rwanda and other studies. As the Uganda study summarizes, there are very low levels of community knowledge and understanding of the "scientific" foundation of immunisation, but despite this, over 90% of mothers and fathers "believe immunization is important… [there is] massive goodwill in the midst of lack of knowledge" (IMMUNIZATIONbasics Project, 2009). Rwandan mothers and other family members had only a modest level of correct knowledge regarding diseases, the schedule, etc., but vaccination rates were very high. Incorrect knowledge as to the preventive role of routine immunisation is widespread in Nigeria. Quantitative research conducted in six states in 2004 revealed that in rural Enugu, diarrhoea, fever, convulsion, vomiting and malaria are believed to be vaccine-preventable diseases, while in rural and urban Kano, malaria, teething problems, vomiting, convulsion and pneumonia are listed among VPDs. During a pilot community research in 2005, a number of immunisation key decision-makers and caregivers in Katsina State indicated that, only polio immunisation is required; that once a child has received its polio 'drops', it is immunised against all childhood illnesses, including those for which there is no vaccine available, e.g. acute respiratory infection (Ophori et al., 2014; Feilden Battersby Analysts, 2005). Oluwadare reported that people who are least likely to demonstrate high levels of correct knowledge include people who do not use public facilities for the treatment of common illnesses, those who lack easy access to public health facilities, and illiterates (Oluwadare, 2009).

From the foregoing review, positive attitude towards immunisation seems to be most essential. This is terms of parents' belief that vaccination is good for their child's health and prevents various diseases and their practical knowledge about services; that multiple visits are required for protection and when and where the child needs to go.

Another important factor that affects the uptake and timely completion of routine immunisation is the fear of side effects. Most mothers mention the fear of side effects as a reason for not vaccinating their children (Favin, 2012; Negussie, Kassahun, Assegid and Hagan, 2015). In some cases, if an older sibling or acquaintance's child had side effects, parents refused vaccinations for younger children. A few documents mention that side effects become an issue when fathers or (Favin, 2012).

2.9. The Prospect and Challenges of eHealth in Public Health Interventions

Eysenbach, most frequently cited, gave a definition of eHealth in 2001 thus:

> "e-health is defined as an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related

> technologies. In a broader sense, the term characterises not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networking, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology" (Eysenbach, 2001).

This definition acknowledges that e-Health encompasses more than just "Internet and Medicine". As such, the "e" in e-health does not only stand for "electronic," but implies a number of other "e's," (Pannu and Tomar, 2010). Internet as a medium of communication could help in coordinating the efforts to provide decentralised health services throughout a country under one umbrella. Promoting preventive care and self-care using the internet could alleviate the financial burden on government due to rising healthcare delivery costs while increasing the efficacy of health care delivery.

The 10-e's in "e-health"

In an attempt to elucidate the concept of 'eHealth', Eysenbach (2001) suggested 10 essential e's of 'eHealth'. These are explained further below:

Efficiency - one of the promises of e-health is to increase efficiency in health care, thereby decreasing costs. One possible way of decreasing costs would be by avoiding duplicative or unnecessary diagnostic or therapeutic interventions, through enhanced communication possibilities between health care establishments, and through patient involvement.

Enhancing the quality of care - increasing efficiency involves not only reducing costs but at the same time, improving quality. E-health may enhance the quality of health care for example by allowing comparisons between different providers, involving consumers as additional power for quality assurance, and directing patient streams to the best quality providers.

Evidence-based - e-health interventions should be evidence-based in the sense that their effectiveness and efficiency should not be assumed but proven by rigorous scientific evaluation. Much work still has to be done in this area.

Empowerment of consumers and patients - by making the knowledge bases of medicine and personal electronic records accessible to consumers over the Internet, e-health opens new avenues for patient-centred medicine and enables evidence-based patient choice.

Encouragement of a new relationship - between the patient and the health professional, towards a true partnership, in which decisions are made in a shared manner.

Education of physicians - through online sources (continuing medical education) and consumers (health education, tailored preventive information for consumers)

Enabling information exchange and communication - in a standardized way between health care establishments.

Extending the scope of health care beyond its conventional boundaries - this is meant in both a geographical sense as well as in a conceptual sense. eHealth enables consumers to easily obtain health services online from global providers. These services can range from simple advice to more complex interventions or products such as pharmaceuticals.

Ethics - e-health involves new forms of patient-physician interaction and poses new challenges and threats to ethical issues such as online professional practice, informed consent, privacy and equity issues.

Equity - making make health care more equitable is one of the promises of e-health, but at the same time there is a considerable threat that e-health may deepen the gap between the "haves" and "have-nots". People, who do not have the money, skills, and access to computers and networks, cannot use a computer effectively. As a result, these patient populations (which would actually benefit the most from health information) are those who are the least likely to benefit from advances in information technology, unless political measures ensure equitable access for all. The digital divide currently runs between rural vs. urban populations, rich vs. poor, young vs. old, male vs. female people, and between neglected/rare vs. common diseases.

In addition to these 10 essential e's, Eysenbach (2001) stressed that e-health should also be easy-to-use, entertaining (no one will use something that is boring!) and exciting - and it should definitely exist.

2.10. mHealth

A review of the literature shows that the adoption of mobile devices has occurred at an extremely rapid rate (Marshall, Lewis and Whittaker, 2013; Curioso and Mechael, 2010). Uptake has been particularly high in emerging markets, where limited landline infrastructure has led to greater reliance on mobile networks for everyday communication and tasks (Mechael, 2009). As adoption of mobile technologies has grown, so has the number of health-related programs reliant on mobile technology applications. In Marshall, Lewis and Whittaker (2013), a recent World Health Organisation (WHO) survey of all member states found that 83 per cent of member states reported at least one mHealth initiative in their country and most reported the implementation of four or more (WHO, 2011b). mHealth solutions have often been recommended for addressing some of the needs and challenges of health information systems. While growth in mHealth applications has been rapid, a simultaneous increase in evaluation has not been seen (Schweitzer and Synowiec, 2012; WHO, 2011b). In the report of the independent expert group on information and accountability for women and children's health (WHO, 2012), the fourth set of recommendations relates to accelerating the uptake and evaluation of eHealth and mHealth technologies: the authors note that the potential to accelerate improvements in women and children's health is great (WHO, 2012).

Mobile health, more commonly known as mHealth, incorporates a wide range of programs. Although definitions vary, the World Health Organization's Global Observatory for eHealth defines mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices" (WHO 2011).

Mobile phone penetration has experienced a rapid increase in developing countries over the past decade. Of the 5.3 billion mobile phone subscriptions held worldwide, 3.8 billion of those, or 73 per cent, represent individuals living in developing countries. Nearly 90 per cent of the world is now covered by a wireless signal, ensuring that formerly isolated individuals, such as farmers in rural areas or herders or cattle rearers in remote places have the potential to access these technologies and communicate globally (Lemaire 2011). As mobile phone ownership and penetration have increased, so has the advent of applications of the use of mobile technology to deliver programs and services in a wide variety of areas. With applications in education, agriculture and banking, mobile technologies overcome traditional challenges of resource limitations and lagging infrastructure development. They also provide economic benefits to the country. One study by London Business School estimated that a 10 per cent difference in mobile device penetration levels over the entire sample period (1980–2003) implies a 0.6 per cent difference in growth rates between otherwise identical developing nations (Waverman 2005).

mHealth has been incorporated into the field of healthcare in an attempt to address the wide variety of challenges facing developing country systems, such as skilled worker shortages; a lack of timely reporting for surveillance and diagnostics; an influx of counterfeit drugs; poor treatment adherence; and poor inventory and supply chain management (Marshall, Lewis and Whittaker, 2013; Lemaire 2011). The WHO survey of member states found that over 80 per cent of these countries reported at least one mHealth initiative in their country, while some reported as many as six. Although mHealth encompasses a variety of mobile devices (e.g. tablets, patient monitoring devices), this study focused on mobile phones only. MHealth programmes make use of several aspects of mobile phone technology; a specification of the needs of the target users is presented in Table 2.4 (Marshall, Lewis and Whittaker, 2013; WHO, 2011b).

Table 2.5: Types of mHealth applications

Type of communication	Level of interaction	
	One-way	Two-way
Text messaging	- Appointment reminders - Treatment reminders - Health promotion - Emergency notifications* - Surveillance* - Community mobilisation	- Appointment confirmations - Treatment compliance - Patient diagnosis (using algorithms) - Patient records*
Voice services	- Automated health information lines	- Health call centres / staffed infolines - Emergency toll-free lines - Mobile telemedicine - Patient monitoring*
Voice and video services		- Mobile telemedicine - Emergency services
Internet connection	- Health promotion - Information initiatives*	- Population surveys* - Patient monitoring* - Surveillance* - Patient records* - Civil registration and vital statistics* - Decision-support systems*

(* denotes direct Health Information Systems applications)

Sources: Fjeldsoe et al. 2009; Lim et al. 2008; Cole-Lewis & Kershaw 2010; Krishna et al. 2009; WHO 2011b; Marshall et al., 2013

Literature reveals that of all these types of communication, text messaging has been the most widely adopted application of mHealth, the reason suggested by many being its ease of use, low cost, and public interests (Marshall et al, 2013; Cole-Lewis and Kershaw, 2010; Terry 2008). Text messaging is also more accessible than other mobile health technologies with approximately 98 per cent of mobile phones worldwide have text messaging capability (Lasica, 2007; Krishna et al., 2009; Terry, 2008); programmes using this technology are more likely to reach a wider population base. Mobile technologies may be used by patients, healthcare providers, the general population, or a combination of all involved parties. When used by the general population, services tend to be more simplistic in nature: awareness messages, treatment and/or appointment reminders, or helplines (WHO 2011b). Healthcare workers may use the technologies for more advanced purposes, such as patient surveys, population surveys (e.g. vaccination rates), diagnosis algorithms, and mobile telemedicine (Marshall, Lewis and Whittaker, 2013; WHO 2011b).

Reasons for Use of mHealth Applications

According to Marshall, Lewis and Whittaker (2013), mHealth applications are useful because they capitalize on existing mobile phone infrastructure and on an audience already familiar with the technology. They also offer a way to communicate with younger generations, whose uptake of mobile technologies and rates of access far exceed any other generation (Marshall et al, 2013; Cole-Lewis and Kershaw, 2010; Levine 2011; Gold et al., 2011; Whittaker et al., 2009). MHealth communication is often interactive, empowering users with the knowledge and the ability to self-monitor ailments and illnesses (Cole-Lewis and Kershaw, 2010; Bakshi et al., 2011; Moskowitz et al., 2009; Cocosila et al., 2009; Sidney et al., 2011). MHealth applications can also overcome the traditional geographical barriers that rural residents have faced (Vital Wave Consulting 2009a; Hanauer et al., 2009), reducing delays in diagnosis, treatment, and outbreak communications (Marshall et al, 2013; Kahn et al., 2010).

Traditional types of ICT, such as landlines and desktop computers, are not as easy to implement as their costs and infrastructural needs are much higher (Mishra and Singh, 2008). They have much higher costs because landlines require the installation of telephone wires while desktop computers require significant electrical resources and cannot easily be transported from site to site. Given the large size of rural areas in developing countries with limited infrastructure and healthcare access, mobile technologies offer a method to overcome these challenges (Mishra and Singh, 2008). Their unique ability to serve areas lacking in landline infrastructure can be particularly helpful in relation to disease surveillance because mobile GPS technologies can assist in the triangulation of outbreaks and epidemics (Morris, 2009; Kelly et al., 2013). The new generation of smartphones, with built-in GPS capacity, have proven to be particularly useful in this regard, as they can automatically feed data with GPS coordinates into information systems, allowing real-time mapping and monitoring of hotspots (Kelly et al., 2013).

Mobile technologies are most useful for short messages and/or services. In the case of longer interactions, such as complex diagnoses or long-form surveys, paper- and in-person services may still be preferable (Tomlinson et al., 2009). Mobile technologies will not remove the need for patient-provider interaction; however, they can reduce the burden on health services by answering easy queries and providing automated resources for simple health questions (WHO 2011b). Mobile technologies may offer large cost-saving opportunities for healthcare systems that are frequently overburdened and underfunded (Schweitzer and Synowiec, 2012), but the criteria for realising these benefits are not well analysed and articulated. It is estimated that 57 countries currently face critical shortages of doctors, nurses and midwives (WHO, 2008). Furthermore, healthcare workers are disproportionately located in urban areas, and often lack skills and training (Vital Wave Consulting, 2009a). Mobile technologies offer a low-cost solution to minimising these challenges. They enable healthcare workers to receive training electronically, minimising time and cost requirements for travel (DeRenzi et al. 2012); they also allow healthcare workers to communicate electronically with people in rural areas, giving them access to medical knowledge in the absence of a locally available healthcare worker (Chang et al., 2011). Although these technologies will not permanently alleviate the health worker shortage, they can minimise the current burden and assist in the development of future health workers, potentially in a more cost-effective manner (Marshall et al, 2013; Schweitzer and Synowiec, 2012).

MHealth applications can also create vast pools of data, which can be analysed for planning and policy work while streamlining programs and increasing efficiency (Patnaik et al. 2009; Tomlinson et al. 2009). If used to collect data, mHealth applications can create automatic processes for checking and analysing data quality, avoiding paper-based systems that rarely result in analysable data (Mechael 2009). Linking mHealth applications also minimises the risk of data duplication, resulting in greater efficiencies and less opportunity for data to be lost in piles of paper (WHO 2011b). Reducing the amount of time spent on paperwork increases the time a healthcare worker can spend providing treatment and/or care to people, which in turn leads to greater job satisfaction (Vital Wave Consulting 2009a). MHealth applications can also be engineered to provide instructions and checks on the accuracy of data collection, increasing the rigour of available data (Vital Wave Consulting, 2009a; Marshall et al, 2013).

Literature reveals also that more rigorous data allow for an informed planning process at all levels of government, and increases the likelihood that resources are properly allocated. Data can be monitored in real time, providing frequent updates on whether or not a health program or region is meeting performance goals, and identifying areas requiring additional attention (Marshall et al, 2013; Broens et al., 2007). Datasets can also be combined with other commonly collected indicators such as demography, health infrastructure, financial management, and geo-referenced data (Sinha, 2010; Kelly et al., 2013) to assist in the development of decision-support tools and allow for forecasts that are more accurate, models and simulations. The data can be easily aggregated and reported to the public, leading to greater transparency and increasing public confidence in the government and/or funders (Sinha, 2010; Michael, 2009; Marshall et al, 2013).

Finally, the use of mHealth for data collection increases the autonomy of the healthcare workers collecting the data, and their ability to connect with colleagues in other regions, or even other countries (DeRenzi et al. 2012). Where healthcare workers once had limited connections and often made decisions in isolation, they can now access a wealth of information and statistics that guide them through the decision-making process (Vital Wave Consulting 2009a). They can use interactive tools that provide feedback on the adequacy of data collected, and measure these data against previously reported statistics or goals. They also have the opportunity to connect with colleagues, sharing data and asking for guidance in their healthcare delivery (Marshall et al, 2013; Knight and Holt, 2010).

mHealth applications can streamline data collection processes at minimal cost by increasing the evidence base for healthcare policies; offering numerous opportunities for evaluation and development; empowering healthcare workers and communities with timely, well-communicated health information; enabling early detection and response to outbreaks and other emerging health problems; and ensuring transparency and accountability (Marshall, Lewis and Whittaker, 2013; Sinha, 2010; Michael, 2009; WHO, 2011b; Schweitzer and Synowiec, 2012).

In summary, mHealth applications support healthcare delivery in a wide variety of ways. Some applications function simply as electronic health-promotion campaigns (Marshall et al, 2013; Danis et al., 2010; Moskowitz et al., 2009). Others offer several healthcare services, such as awareness, treatment reminders and data collection (Chen et al., 2008;

Sidney et al., 2011). Major reports summarising such applications have categorised these applications broadly by the type of service(s) offered by the program (Vital Wave Consulting, 2009a; WHO, 2011b; Michael 2009; Michael et al., 2010). However, there is no consensus on the categorisation of mHealth applications; some use a minimal number of categories (Vital Wave Consulting, 2009a), while others break down mHealth projects into a much larger number of service types (Marshall, Lewis and Whittaker, 2013; WHO 2011b).

2.11. Nigerian Mobile Phone Market

Since mobile communications services were first introduced in Nigeria in 2001, the market has grown rapidly, extending connectivity to over 83 million unique subscribers, or 45% of the population today (GSMA Intelligence, 2015). The mobile market is competitive with four main operators – MTN, Globacom, Airtel and Etisalat – each offering both 2G and 3G services, and 4G services are being rolled out by smaller operators such as Smile, Spectranet and Swift. Only 0.2% of Nigerians have access to fixed telephone lines. Therefore, for the majority of Nigerians, mobile phone presented their first opportunity to have access to communications services. The role of mobile in delivering economic and social impacts in Nigeria is widely recognised (GSMA Intelligence, 2015).

Ownership of Mobile Phones

The current trend in Nigeria today is to purchase multi-sim devices, which enable the use of at least two SIMS into one device. Most Nigerians desire to remain connected and within reach, however, they refuse to depend on one Mobile carrier. The reason being if one particular carrier fails they can easily switch to the second one, thus remaining connected. The problem of coverage comes into sharper view when mobile access is viewed through the urban versus rural lens. Nigeria's population is split roughly 50:50 between urban and rural areas, but mobile penetration is much lower outside of cities (Figure 2.2). More striking still is a north-south divide within the country, with southern regions (including major metropolises such as Lagos) well ahead of the north in access to mobile phones within a household [Figure 2.3] (GSMA Intelligence, 2014).

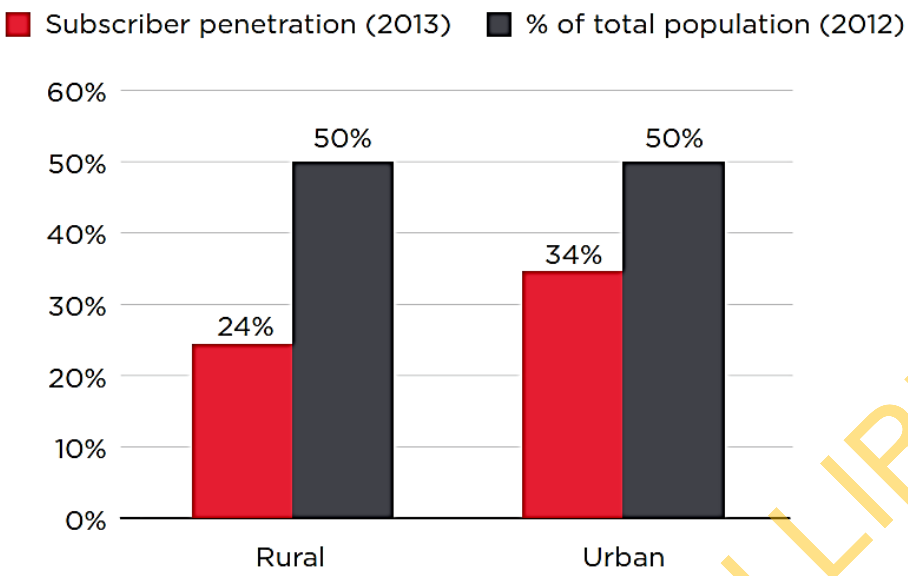

Figure 2.2: Gap in rural vs urban penetration

Source: Nigeria Bureau of Statistics, GSMA Intelligence, 2014

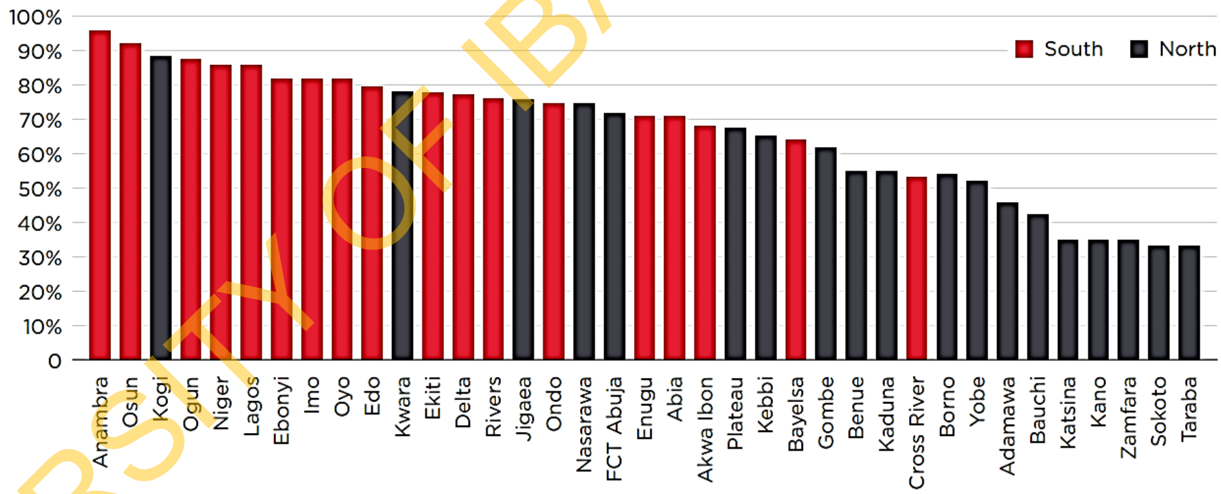

Figure 2.3: Access to mobile phones — North-South divide

Source: GSMA Intelligence, *2014*. *(Access is defined as ownership or access to mobile without ownership)*

According to GSMA Intelligence, expanding mobile telephone network coverage to rural areas is a complex issue. Geographic terrain and vast distances, lack of electricity and road access, and continued security threats are all challenges to investment in rural coverage (including new sites and backhaul) despite Nigeria's position as a fast-growing economy (GSMA Intelligence, 2014). The regulator, Nigerian Communication

Commission (NCC), has set a goal of 60% rural penetration by 2015, with an increase to universal levels by 2017. While this is ambitious, the seeds on the demand side have largely been laid – household access to mobile phones is already high, with sharing amongst multiple individuals' common practice, particularly in rural areas among lower-income populations. Indeed, the mobile phone as a category is near ubiquitous on this basis (only radio is more widespread), with the broadcast TV still behind, and PCs and the internet lower still as a result of a paucity of fixed broadband infrastructure (Figure 2.4) (GSMA Intelligence, 2014).

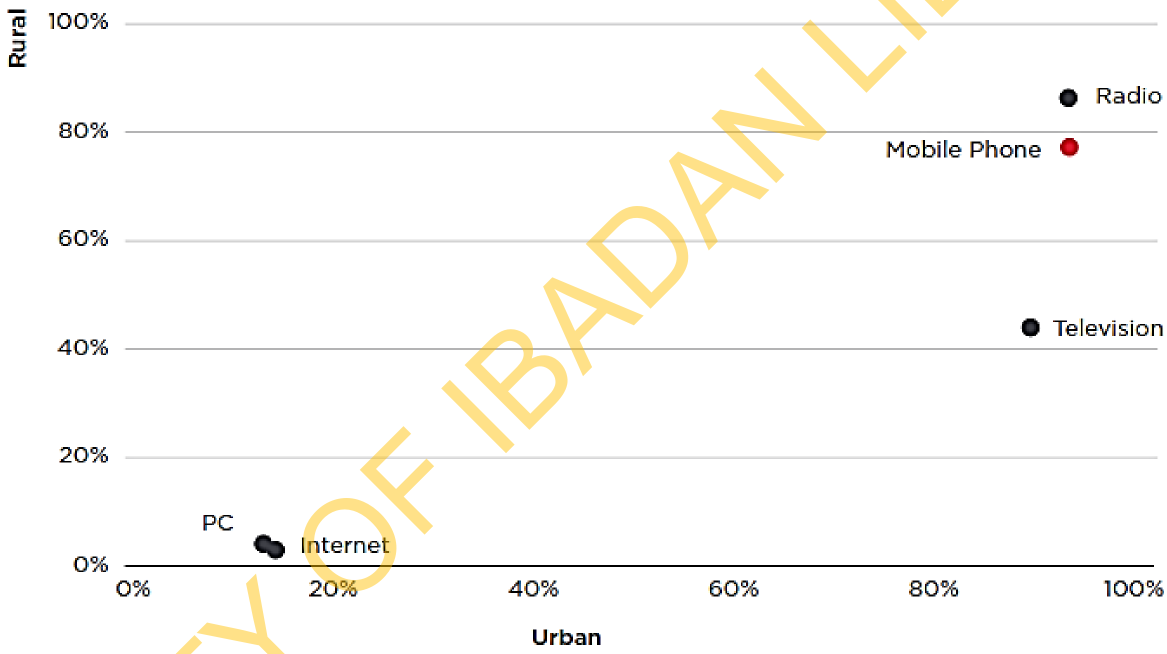

Figure 2.4: Household access to communication technology in Nigeria, 2012

*Source: Nigeria Bureau of Statistics (2013) *, GSMA Intelligence, 2014*

(** Based on Living Standard Measurement Study (LSMS) conducted by National Bureau of Statistics through bi-annual surveys administered on a sample of households selected from 22,000 households surveyed in General household survey*)

2.12 Review of Relevant Empirical Studies

Prospect and Challenges of mHealth and Mobile Phone Text Messages in Public Health Interventions

There is increased usage of mobile phones with Short Messaging Service (SMS) applications in interventions to deliver health care services. Short Messaging Service has peculiar attributes, which makes it particularly suitable for use in health care. Moreover, text-messaging interventions are uniquely suited for underserved populations. This section highlights some key findings on interventions on the uses and benefits of SMS text applications in health care service delivery. In summary, these interventions are categorised into three major areas namely (Table 2.5):

i. Uses of SMS to enhance the efficiency of service delivery
ii. Uses of SMS to improve diagnosis, treatment and rehabilitation of illness
iii. Uses of SMS in public health programmes

i. Uses of SMS to enhance the efficiency of health care service delivery

Mobile text messaging communication, in particular, has proven to be an effective way to foster desired behaviour change in patients and improve the way in which care is delivered. Review of literature shows that there are myriads of ways SMS is used in enhancing the efficiency of health care service delivery; some of these are highlighted below.

a) Appointment Reminders

Atun, Sittampalam and Mohan (2005) reported that missed appointments in England led to substantial cost not only for many health systems but also particularly for the national health system (NHS). These costs are due to the direct costs involved in arranging the appointment and the opportunity cost of missed appointments. For instance, a survey of 683 general practice (GP) surgeries indicated that in 2005, around 10,234,361 GP and 4,949,517 practice-nurse appointments were missed and each year the number of missed appointments was increasing. In 84% of the practices, surveyed missed appointments were a problem: this lengthened waiting times for GP appointments and adversely affected the ability of the practice to reach performance targets. A large majority of the GPs believed that patients missed appointments as they forgot they had an appointment. Almost all (98%) felt that missed appointments wasted NHS resources, while 87% felt these affected efficient running of the NHS – such was the feeling that 71% of the GPs would consider deregistering patients who repeatedly missed appointments, while many (66%) thought introduction of charges for missed appointments might help address this problem (Atun et al., 2005; Curtis and Netten, 2003).

According to the report, the estimated cost of a GP appointment is £18, while that for a nurse is £7 (Atun et al., 2005). Thus, in England, the annual direct cost of missed appointments to the NHS is £180 million for GP appointments and £34 million for practice nurse appointments (Atun et al., 2005; Curtis and Netten, 2003). Hence, in England, missed appointments cost the NHS £789 million a year. In order to reduce the extent of the problem, the Department of Health (DOH) in England issued a Missed Appointment Guidance, which identifies ways in which GP surgeries can improve attendance rates for hospital and GP appointments (Department of Health [DOH] UK, 2004).

In an attempt to address this problem, a number of pilot trials, which use mobile phone SMS to remind patients to attend NHS appointments had been launched in England since 2003. Some of these pilots have already reported success or benefits (Atun et al., 2005; DOH, 2004); while others identified organisational factors, which enable or hinder uptake and diffusion of the SMS based reminders. Service uptake, which is negatively influenced by lack of administrative staff time to 'sell the benefits' of SMS reminders to patients and time taken to fill in forms, can be enhanced when clinicians are involved in 'signing up' patients to the scheme (Anon, 2004a).

SMS-based reminders are now used in appointments in imaging diagnostics (Anon, 2004b), paediatrics, sexually transmitted illness, antenatal clinics, adolescent health (for example for the morning after pill), mental health, dental services, rheumatology (to remind patients to attend urine and blood tests for drug monitoring) and blood transfusions (Atun et al., 2005; Anon, 2004b).

b) Improving Communication between Healthcare Workers

Short Messaging Service has been identified as a useful communication tool between surgeons with enhanced coordination of patient care, improved efficiency of administrative activities, greater accuracy of messages, and even increased responsiveness to urgent cases. Communication problems between health care professionals were observed to be one of the factors that lead to errors within healthcare systems, which adversely affect patient's well-being (Atun et al, 2005; Zinn, 1995). According to Atun et al (2005), it was noted then that much of the clinical information used by doctors come from peers, personal notes on patients or diagnostic tests. Doctors prefer to seek the opinion of experts rather than consult guidelines, manuals or computer- aided decision systems. SMS is now used to enhance communication among healthcare workers (Atun et al, 2005; Connecting for Health, 2004; Sherry, Colloridi and Warnke 2002).

c) Monitoring Safety of Healthcare Workers

Health service workers often face threats to their personal safety due to the abusive behaviour of patients, contact with biological hazards, and in natural disasters or accidents. In the NHS in England, over 95,000 instances of violent or abusive behaviour towards NHS staff were reported in 2002-03 (Gomm, 2004). An interesting SMS application was developed in England where midwives use a mobile phone to inform a computer system of their location details at the start of a visit. If there is no update within a certain time limit, the computer will generate an SMS text message to confirm the safety of the midwife. If there is no response to the SMS, team leaders, managers or the police are contacted (Anon, 2003a). Following the introduction of the system, a large majority of the midwives said that they felt safer when working alone in the community (Gomm, 2004).

d) Managing Queues

It has been observed that long waiting times and queuing when accessing health care services most time lead to customer dissatisfaction. Hence, efficient waiting times, as well as queue management, is critical to improving service quality and user satisfaction (Atun et al, 2005; Davis and Heineke, 1994; Pierce, Rogers, Sharp and Musulin, M. 1990; Jones, P. and Dent, M. 1994). A hospital in England has instituted a system whereby patients who are waiting to collect their dispensed drugs are sent an SMS message to inform them when their prescription is ready for collection (Anon, 1998). This has provided much flexibility to the patients who do not have to waste time sitting and waiting and can return any time during the day to collect their medication (Atun et al, 2005).

e) Improving administrative efficiency of health financing organizations

Interventions such as SMS are being used to increase administrative efficiency in healthcare financing organisations. For example, in the Philippines, the government

Health Insurance Corporation began to use SMS to inform its 64 million beneficiaries, including those who work abroad, of their status and entitlements (Anon, 2005a). In India, a health insurance company which has launched an SMS facility for enquiries and alerts on claims reports cost savings and a reduction in claim processing time from 23 to seven days (Bajaj Allianz, 2015).

f) Contacting Blood Donors

Text messaging is being used to invite teenagers to donate blood, and to collect information on blood groups of individuals to develop a database so that donors can be contacted in emergencies when blood (particularly of rare groups) is needed (The Times of India, 2013; PRNewswire, 2004; Anon, 2003b). In addition, in India, evidence shows that when a blood centre issued an SMS based request to potential donors for blood to help a young patient with leukaemia, 150 calls were received offering donations within an hour (Anon, 2005b).

g) Enhancing access to disabled people

Lauruska and Kubilinskas (2002) reported that people with disabilities, such as those with deafness or those who are mute, could benefit from SMS-based applications to contact emergency services. Text messaging services to contact emergency and health services have been launched in England, Northern Ireland (Anon, 2005c) and Hong Kong (Anon, 2004c).

ii. Uses of SMS to improve diagnosis, treatment and rehabilitation of illness

a. Remote Diagnosis

Experience with remote diagnostics using SMS applications is limited but SMS has been used in combination with a well-established monitoring system to estimate the severity of stutter in children living in rural Australia (Atun et al, 2005; Anon. 2005d).

b. Improving Adherence to Health Advice and Medication

Adherence is the extent to which a patient's actions are consistent with the advice given by his/her doctor or nurse. In Bloom (2001) and (Schroeder, Ebrahim, Fahey, Montgomery and Peters, 2002), non-adherence to prescribed treatment was estimated to be around 50%, but particularly problematic for long-term conditions which require daily medication. This usually leads to adverse health consequences for patients and creates substantial costs to the health system as patients who do not adhere to their treatment are often hospitalised due to relapse of their condition and interruption of treatment for infections, which leads to the emergence of resistant strains. SMS reminders are used to prompt patients to take medication at the correct time and encourage completion of treatment regimens for a wide range of conditions, such as acne (Anon, 2005e), asthma (Yun and Arriaga, 2013), diabetes (Ferrer-Roca, Burbano, Cárdenas, Pulido and Diaz-Cardama, 2004; McMahon, Gomes, Hohne, Hu, Levine and Conlin, 2005), tuberculosis (Anon, 2005f), and AIDS (Harris, Furberg, Martin et al., 2013; Lewis, Uhrig, Bann et al., 2012; Uhrig, Harris, Furberg, Bann, Coomes, Williams and Lewis, 2011) as well as to remind teenagers to take their contraceptive medication (Johns Hopkins Medicine, 2015) and other patients to fill repeat prescriptions (Anon, 2014).

An innovative scheme in England, which has the highest rate of teenage pregnancies in Western Europe, used coded messages to ensure confidentiality when reminding teenagers to take their prescribed oral contraceptive pill (British Broadcasting Corporation, 2003). In South Africa, SMS reminders have not only been used to enhance adherence to treatment in patients with tuberculosis (Bediang, Stoll, Elia, Abena, Nolna, Chastonay, and Geissbuhler, 2014; Nglazi, Bekker, Wood, Hussey, and Wiysonge, 2013) and AIDS (Anon, 2008; Alert -Net. 2005), but also in the latter to monitor treatment adherence levels.

Neville, Greene, McLeod, Tracy and Surie (2002) conducted a cohort study in Scotland in a cohort of 32 young adult asthma patients which used SMS text messages written in ‘txtspk’ from a fictitious friend ‘Max’ (e.g. “yo dude, it's maxed reminding U2 take ur inhaler”) accompanied by a stream of celebrity gossip and horoscope messages was reported to be successful – with participants describing the service as acceptable, and reporting that they had developed a rapport with the fictitious character ‘Max’ (Neville et al, 2002).

A double-blind randomized clinical trial in Spain, which involved 26 primary health care centres, analysed the effect of printed information followed by two SMS text messages (on lifestyle or to reminds to take the medication), on adherence and lifestyle changes in patients with hypertension. Outcomes in the intervention group were compared with those in the control group, which were not sent text messages. Statistically, there was no difference in the rate of non-adherence in both groups, which was around 15%, but the intervention group achieved better control of blood pressure and body weight reduction (Marquez Contreras, de la Figuera von Wichmann, Gil Guillen, Ylla-Catala, Figueras, Balana and Naval, 2004).

According to Vilella, Bayas, Diaz, Guinovart, Diez, Simó, Muñoz and Cerezo (2004), a case-control study from Spain, which involved patients given Hepatitis A and B vaccines levels compared adherence to immunisation schedules in patients who received text reminder for follow up vaccination with the control group who were not sent a reminder. The adherence level in the intervention group was higher than that in the control group and this difference was statistically significant (Vilella et al., 2004). In a related study in Australia, a randomised control trial involving HIV positive individuals receiving antiretroviral therapy compared adherence levels before and after an intervention which included one-to-one individualized patient education and regimen analysis, with a choice of a variety of aids to improve adherence to medication including a dosette box, text messaging at each scheduled dose and programmable medication alarm. The results show that after the intervention there was a statistically significant decline in the number of missed doses as compared with pre-intervention period (Fairley, Levy, Rayner, Allardice, Costello, Thomas, McArthur, Kong, and Mijch, 2003).

c. Monitoring of Illness and Medical Interventions

World Health Organisation (2005) noted that effective monitoring of medical conditions, especially chronic illness, improves health outcomes and reduces health care costs. SMS applications are being used in a variety of settings to enable monitoring of acute and chronic conditions as well as monitoring effect of medical interventions. For example, a rheumatologist implemented a reporting system that uses SMS where patients who have had corticosteroid injections to inflamed joints of soft tissue report whether injections have been beneficial (for example in alleviating pain or improving movement). This has enabled remote monitoring and reduced need for follow-up outpatient appointments, thereby reducing costs (Pal, 2003). SMS applications have also been used in South Africa to monitor HIV positive individuals receiving anti-retroviral drugs, where side effects are reported directly by patients to health workers (Pérez, Hwang, Bygrave and Venables, 2015). In Italy, SMS applications have enabled cancer patients to systematically report their symptoms to doctors from home thereby reducing the need to be hospitalised for monitoring (Atun et al., 2005). Moreover, SMS has enabled improved self-monitoring by diabetic patients and more regular reporting to clinicians in England, France and Thailand (Atun et al., 2005).

A novel application linked to the monitoring of patients in intensive care involves nurses sending alerts to clinicians via SMS when certain changes are detected in the physiological status of the patient – the clinician is informed about the status of critical patients more rapidly than with the use of pagers, thereby enabling rapid response (Chen, Ma and Liou, 2002). Furthermore, a cohort study in Denmark evaluated the feasibility and impact of using SMS to enhance self-care of asthma by reminding patients to take medication, note symptoms, measure peak flow rate and complete SMS-based asthma diary to send to clinicians. The study found that patients were able to use the SMS diary and were enthusiastic about it, as it gave them a greater sense of control over their condition (Anhøj and Møldrup, 2004).

A randomised control trial, which compared an intervention group of patients who were asked to regularly monitor their asthma and send their peak flow results to their clinician on a daily basis via SMS with a matched control group who were advised to monitor but without using SMS, found that the symptom profile in the intervention group was significantly better than that in the control group. The intervention was found to be acceptable to patients (Atun et al., 2005).

A prospective intervention study which compared health outcomes in diabetic patients given a mobile phone to send text message on their daily glucose level to a database with once weekly advice by clinicians with matched controls who received standard management (i.e. routine outpatient visit once every three months) was not able to demonstrate statistically significant difference in outcomes, but in a subgroup of patients who most actively used SMS, there was a small statistically significant improvement, which suggests that motivation to self-care is critical for the improvement of glycaemic control (Kirwan., Vandelanotte, Fenning, and Duncan, 2013; Vähätalo, Virtamo, Viikari and Rönnemaa, 2004).

In contrast, a prospective cohort study in Korea which trained diabetic patients to report their blood glucose levels via a web-based system or SMS and receive instructions on adjustment of medication dosage via the web showed that diabetes control (as measured by HbA1c level) had improved following the intervention as compared with levels at the start of the study, and this improvement was statistically significant (Kwon, Cho, Kim, Lee, Song, Oh, Han, Kim, Cha, Lee, Son, Kang, Lee and Yoon, 2004). Another cohort study of diabetes management by SMS reported that overall user satisfaction and acceptance was very good, and additional costs were not high (Ferrer-Roca, Cárdenas, Diaz-Cardama and Pulido, 2004).

d. Provision of Psychological Support

As indicated in several kinds of literature, management of certain conditions, such as bulimia, can be improved if there are continuity and immediacy of support from health professionals. In other conditions where interaction between the patient and the outside world is restricted (for example in immuno-suppressed patients or those with an infection that requires isolation), support and interaction with other sufferers, family, friends and peers can have a beneficial therapeutic effect. Text messaging may be beneficial in such settings.

Several interventions have been used to encourage young people to access counsellors to seek support on a range of issues, such as bulimia (Hazelwood, 2008; Walsh, 2004), chronic illness, managing stress during end-of-year exams, and to receive advice on health or relationship problems (Atun et al., 2005). A randomised controlled trial from Scotland used SMS to support young people with diabetes between clinic visits by providing a system called 'Sweet Talk' which utilizes a process of sequential goal setting to influence health behaviour, help patients set self-management goals and to improve glycaemic control. The study results show statistically significant improvement in diabetes control (as measured by metabolic control and self-efficacy) in the intervention group of patients using "Sweet Talk", as compared with those who received standard care (Franklin, Waller, Pagliari, and Greene, 2003; Franklin, Waller, Pagliari and Greene, 2006; Franklin and Greene, 2007). A study, which focused on bulimia nervosa, employed observational methods and explored acceptability and feasibility of SMS based psychological support. The results suggest SMS intervention as an appropriate intervention for providing aftercare following discharge from the hospital (Bauer, Percevic, Okon, Meermann, and Kordy, 2003).

e. Communicating results of Diagnostic Tests

In recent times, it has been found that traditional approaches used to communicate diagnostic results are time-consuming and inefficient as these often require the patients to return to the provider unit in person to receive the results. Text messaging interventions has been used in more developed countries to communicate results of in-vitro diagnostic tests (such as blood or microbiology tests) (Gurol-Urganci, de Jongh, Vodopivec-Jamsek, Car, Atun, 2012; Atun, Sittampalam, 2006; Lim, Haar, and Morgan, 2008; Menon-Johansson, McNaught, Mandalia and Sullivan, 2006) and radiological imaging such as breast cancer screening (Lamont, 2005) or screening for sexually transmitted infection (Lovitt, 2005; Bradbeer and Mears, 2003). In less developed countries, where there are access barriers, SMS has been used more efficiently to send results to clinics in rural areas (Wright, 2001). Text messaging has also been used to expedite communication to employers of occupational health examination results on foreign workers (Gurol-Urganci et al., 2012; Atun, 2006).

iii. Uses of SMS in Public Health Programmes

a) Contact Tracing and Partner Notification for communicable diseases

Sexually transmitted infections (STIs) are some of the major public health problems in both industrialised and developing countries as the incidence and prevalence are both increasing. Partner notification (also termed partner management or contact tracing) is an important public health activity to control STIs, as the sexual partners of people with STI are likely to be infected but asymptomatic and not seek care (World Health Organisation, 2015; Centers for Disease Control and Prevention [CDC], 2005). Text messages applications are being used to notify partners of individuals with STIs (Swendeman and Rotheram-Borus, 2010), but also to strengthen control efforts for major global public health problems such as tuberculosis, HIV and SARS (Déglise, Suggs and Odermatt, 2012; Nsubuga, White, Thacker, et al. 2006; Vital Wave Consulting, 2009). A text alert service named “SARS Contact Tracing SMS” was launched by StarHub and the Singapore Tourism Board, to trace persons in case of future SARS outbreaks in Singapore (Anon, 2003).

Tomnay, Pitts and Fairley (2005) reported that, clients attending an STI clinic in Melbourne found calls or SMS text messages to mobile telephones as acceptable and efficient means to contact their recent sexual partners, especially if provided with details of a website which had information on the STI to which he/she had been potentially exposed (Tomnay, Pitts and Fairley, 2005). Alternatively, the text message can be sent by the clinic to the client (or the index case) to be forwarded to their partner(s) – thereby maintaining the anonymity of the partner (Newell, 2001). Newell further described how text messaging was used to reach the partner of a client, which had earlier attended the STI clinic and diagnosed to have an infection. Although the partner was not aware of the reason why his girlfriend had attended an STI clinic, the text message he received from her contained details of the diagnosis code: which was used to initiate appropriate treatment. Thus, SMS may be considered as an adjunct to contact slips for contact tracing in genito-urinary clinics (Newell, 2001).

b) Communicating Health Information to the Public

Short Messaging Service is particularly useful for rapid communication of health information to the general public, for example, for public health emergencies due to an outbreak of communicable diseases like Ebola, avian influenza, meningitis, or particular client groups for example, when a large group of patients are inadvertently exposed to an infectious agent (such as hepatitis B, or HIV). It is also a very useful tool when large numbers of people need to be reached to rapidly recall harmful food products or pharmaceuticals (Revere, Calhoun, Baseman and Oberle, 2015; Baseman, Revere, Painter, Toyoji, Thiede, and Duchin, 2013; Déglise, Suggs and Odermatt, 2012b; and Bisco, 2005).

In 2005, the Ministry of Health in Indonesia launched a hotline to enable the general public to rapidly report disease outbreaks, to lodge personal complaints about health services and also to receive and disseminate information on epidemics, such as SARS and avian flu (Anon, 2005g) or natural disasters, such as *tsunamis* (Anon, 2005h). Similarly, SMS is being used in Malaysia, South Korea and the UK to alert the public to natural disasters (*The Star Newspaper*, 2005; Anon, 2005i) or to warn on food safety (Anon, 2005j), to inform population in Spain of extreme weather conditions (Anon, 2005k), and in Dubai to send health information to citizens (Gulf News, 2004).

Short Messaging Service has also been used in public awareness campaigns in India to inform and educate the public on WHO tuberculosis control strategy; in Kenya, Nigeria and Mali, to inform the public on HIV and malaria control programmes (De´glise, Suggs and Odermatt, 2012a); and in Iraq to support a polio vaccination campaign targeting nearly 5 million children across the country (Anon, 2005l). During the SARS crisis, a mobile operator in Hong Kong sent messages to citizens, informing them of precautions which helped reduce the risk of exposure to SARS virus (America's Network, 2003).

The SMS-based mass messaging can also be used to effectively target particular geographic areas or population segments. For example, following floods in India, people in Mumbai exposed to flood waters were sent text messages, which advised them to prophylactically take 200 mg of the antibiotic Doxycycline to prevent leptospirosis infection (D'Silva, 2005). In the UK, NHS Direct Interactive uses text messages to provide health promotion advice and information to people with long-term conditions such as asthma and diabetes (Colledge, Car, Donnelly and Majeed, A. 2008). Similarly, other UK health organisations use text messages to target people in rural areas (Déglise, Suggs and Odermatt, 2012a); provide health promotion information to students (Vital Wave Consulting. 2009; Blackburn and Blatnik, 2013; Chen, Fang, Chen and Dai, 2008); confidential health information to school children (World Health Organization, 2011) and teenagers; sexual health advice and anti-smoking education to adolescents; mental health promotion to young people aged 15 to 25 years; information on pollen count to asthmatics or hay fever sufferers; as well as alerts on high levels of smog and air pollution to high risk groups (Déglise, Suggs and Odermatt, 2012a).

c) Use of SMS in Smoking Cessation Programmes

Short Message Service has been used in Australia, New Zealand, Spain and the UK to provide health education, anti-smoking campaigns and to assist behavioural change in people who are trying to quit smoking (Chamberlain, O'Mara-Eves, Oliver, Caird, Perlen, Eades and Thomas, 2013; Abroms, Whittaker, Free, Mendel Van Alstyne, Schindler-Ruwisch, 2015).

A randomised control trial in New Zealand, which assessed the effectiveness of SMS in smoking cessation programmes, found that the number of people who stopped smoking in the intervention group were significantly higher than that in the control group which did not receive SMS based support (Rodgers, Corbett, Bramley, Riddell, Wills, Lin, and Jones, 2005). A follow-up study by the same team found that this intervention was as effective for Maori as well as non-Maori participants (Bramley, Riddell, Whittaker, Corbett, Lin, Wills, Jones and Rodgers, 2005). A cohort study in the US, which assessed smoking cessation among college students using a Web and text-messaging programme, reported comparable or superior cessation rates to those achieved in minimal-contact or self-help smoking-cessation interventions (Obermayer, Riley, Asif and Jean-Mary, 2004). In conclusion, studies reviewed from the literature demonstrate wide use of SMS-based applications with benefits in health outcomes. These studies also show that SMS-based healthcare applications are acceptable to patients: thus, it can be concluded that SMS can be used to develop new service delivery models.

Table 2.6: Studies Examining the Use of Text Messaging Technology in Health Care Service Delivery

Author	Country	Target behaviour	Study design	Objective	Result
Greaney et al., 2012	Boston, USA	Change in behavioural cancer risk factors	A cluster randomized controlled trial by Healthy Directions 2 to promote change in multiple behavioural cancer risk factors. Participants were randomized to receive automated reminders, with participants selecting modality. (n=598)	To examine the association between participants' characteristics and preferred reminder modality.	28% of participants selected SMS reminder younger participants (OR=0.97, 95% CI=(0.95, 0.99), p<0.01), those most comfortable with computers (very uncomfortable OR=0.54, 95% CI=(0.29, 1.01), p≤0.05: referent group = very comfortable), and those who frequently sent/received text messages (never OR=0.09 CI=(0.04, 0.16) p<0.01; 1-3 times/month OR=0.38, 95% CI=(0.15, 0.93) p=0.04: referent group=1-5 times/week) were more likely to choose SMS.
Spoelstra et al., (2015)	USA	Adherence to oral anticancer agents	A longitudinal randomized, controlled trial in two community cancer centres in the midwestern United States and a national speciality pharmacy. (n=80)	To determine proof of concept of a mobile health (mHealth) intervention delivering text messages (texts) to self-manage among patients prescribed oral anticancer agents (OAs) and to examine preliminary efficacy on symptoms and medication adherence.	Fewer symptoms were found in the intervention group with a moderate effect size. Adherence was higher in the text group using medical record and prescription data (n = 26) with greater relative dose intensity of moderate to large effect size. Proof of concept and preliminary efficacy of a mHealth intervention using texts to promote self-management for patients prescribed OAs was demonstrated
Youl et al., (2015)	Australia	Skin self-examination behaviours - cancer	A randomised, attention control trial using a computer-generated number list to the skin self-examination (N=176), sun protection (N=187), or	To test the impact of a theory-based, SMS (text message)-delivered behavioural intervention (Healthy Text) targeting	One year after baseline, the sun protection (mean change 0.12; P=0.030) and skin self-examination groups (mean change 0.12; P=0.035) had significantly greater improvement in their sun

			attention control (N=183) text messages group. (n=546)	sun protection or skin self-examination behaviours compared to attention control.	protection habits (SPH) index compared to the attention control group (reference mean change 0.02). The Healthy Text intervention was effective in inducing significant improvements in sun protection and any type of skin self-examination behaviours.
Altuwaijri et al., 2012	Saudi	Clinic attendance	Pre- and post- observational studies conducted at King Abdulaziz Medical City and National Guard Health Affairs, Riyadh, Kingdom of Saudi Arabia from January 2010 and March 2010. (n=16) Clinic attendance	To measure the effect of integrating short messaging service (SMS) reminders with an electronic medical record (EMR) system on non-attendance rates in outpatient clinics in a Saudi hospital.	The mean non-attendance rates for the 16 outpatient clinics during 2008 were 23.9% (SD 0.0578) and for 2009 were 19.8% (SD 0.0386) with a 4.1% ($p < 0.001$, T-value = 4.81) reduction rate. Integrating SMS reminders with EMR systems showed a positive effect on the reduction of the non-attended appointments at King Abdulaziz Medical City, Riyadh, Kingdom of Saudi Arabia
Odeny et al., 2012	Kenya	Clinic attendance	A two-arm, parallel, randomized controlled trial at 12 sites in Nyanza province. Participants received daily SMS text messages for seven days (n = 600) or usual care (n = 600) (n=1200)	Evaluated the effect of short message service (SMS) text messages on attendance at this important visit	Text messaging resulted in a modest improvement in attendance at the 7-day post-operative clinic visit following adult male circumcision.
Downer et al., 2005	Australia	Clinic attendance	Cohort study with a historical control of Royal Children's Hospital, Melbourne, Victoria in September (trial group) or August (control group), 2004. (n=2864)	To evaluate the effect of appointment reminders sent as short message service (SMS) text messages to patients' mobile telephones on attendance at outpatient clinics.	The Failure to Attend (FTA) rate for individual clinics was 12%-16% for the trial group, and 19%-39% for the control group. Overall FTA rate was significantly lower in the trial group than in the control group (14.2% v 23.4%; $P < 0.001$).

Prasad and Anand , 2012	India	Clinic attendance - Dental health	The study was conducted at ITS-CDSR in the Departments of Prosthodontics, Endodontics, Orthodontics and Paedodontics. Patients attending these departments for a period of 4 months and those who had provided a contact mobile number were sent an SMS reminder (n=316; 206 test group and 110 control group)	To evaluate the effect of appointment reminders, sent as SMS text messages to patients' mobile telephones, on attendance at outpatient clinics at the ITS Centre for Dental Studies and Research (ITS-CDSR), Muradnagar, Ghaziabad, Uttar Pradesh	The rate of attendance on time was found to be significantly higher in the test group (79.2%) than in the control group (35.5%). The study results indicate that sending appointment reminders as text messages to patients is an effective strategy to reduce nonattendance rates.
Perry, 2011	Scotland	Clinic attendance - Dental health	Pre and post implementing the SMS text reminders were assessed on appointments attendant rate for dentists using automated SMS text reminders set up through practice management software at Kirkcaldy Dental Access Centre.	To assess whether the use of Short Message Service (SMS) text reminders sent to patients prior to their dental appointments improved attendance rates for two dentists at a dental access centre in Kirkcaldy, Fife, Scotland.	The use of SMS text reminders resulted in a statistically significant reduction in the number of failed attendances at appointments for the two dentists.
Foley and O'Neil l, 2009	Scotland	Clinic attendance - Dental health	Comparative study of patients scheduled to attend an outpatient appointment at the Dept. Paediatric Dentistry, Edinburgh Dental Institute, Scotland, during October 2007, who were sent a reminder SMS text 24hr prior to their appointment compared to the control group selected from October 2006. (n=709)	To evaluate the operational and financial efficacy of sending short message service (SMS) mobile telephone text message to patients with outpatient clinic appointments.	There was a reduction in the failure to attend (FTA) rate for the specialist paediatric staff dentists from 29.2% to 24.4% for 2006 and 2007 respectively. The use of SMS text messages as a reminder may reduce the failure to attend rate for outpatient paediatric dental appointments.
Franklin et al., (2006)	Scotland	Diabetes management	A randomized controlled trial (n=126)	To assess Sweet Talk, a text-messaging support system designed to	Sweet Talk was associated with improvement in diabetes self-efficacy (conventional therapy 56.0 ± 13.7,

				enhance self-efficacy, facilitate uptake of intensive insulin therapy and improve glycaemic control in paediatric patients with Type 1 diabetes.	conventional therapy plus Sweet Talk 62.1 ± 6.6, 95% CI +2.6, +7.5, P = 0.003) and self-reported adherence (conventional therapy 70.4 ± 20.0, conventional therapy plus Sweet Talk 77.2 ± 16.1, 95% CI +0.4, +17.4, P = 0.042). When surveyed, 82% of patients felt that Sweet Talk had improved their diabetes self-management and 90% wanted to continue receiving messages.
Bin Abbas et al., (2015)	Saudi Arabia	Diabetes management	Patients were selected in a hospital setting and provided with daily educational, reminding SMS messages for four months. (n=100)	To evaluate the effect of mobile phone short message service (SMS) on glycaemic control in Saudi patients with type 2 diabetes	There was a significant improvement in patients' knowledge, mean fasting blood glucose level and mean HbA1c decreased. Mobile phone text messaging increased adherence to diabetes therapy and improved the clinical outcome in Saudi patients with type 2 diabetes.
Haddad et al., 2014	Iraqi	Diabetes management	Feasibility study on the utility of short message services (SMSs) to support newly diagnosed type 2 diabetes adults (n=50)	To evaluate the feasibility and utility of short message services (SMSs) to support Iraqi adults with newly diagnosed type 2 diabetes.	Changes in knowledge score were correlated with post-intervention HbA1c (r=-0.341, P=0.027). This study demonstrates SMSs are acceptable, cost-effective, and feasible in supporting diabetes care in the challenging, resource-poor environment of modern-day Iraq.
Shapiro et al. (2010)	USA	Eating disorder management	Non-blinded, uncontrolled pilot trial to examine a text-messaging program for self-monitoring symptoms of bulimia nervosa within the context of cognitive-behavioural therapy (n=31)	Adherence to self-monitoring symptoms of bulimia nervosa	87% of participants adhered to self-monitoring and reported good acceptability.

Lua and Neni, 2013	Malaysia	Epilepsy health education	Comparative study of outpatients from three hospitals randomised into two groups: intervention and control. (n=136)	To evaluate an epilepsy education programme based on text messaging (SMS)	The intervention patients reported better awareness, knowledge and attitudes (AKA) levels during follow-up compared to the control patients ($P < 0.05$). There was also significantly better medication adherence and clinic attendance in the intervention group ($P < 0.05$). The results suggest that the addition of the MEES to conventional epilepsy education is effective in improving AKA
Orr and King (2015)	Australia	Healthy behaviour	This meta-analysis used a random-effects model to synthesise 38 randomised controlled trials that investigated the efficacy of SMS messages to enhance healthy behaviour. (n = 19,641)	To investigated the efficacy of SMS messages to enhance healthy behaviour	SMS messages had a small, positive, significant effect ($g = 0.291$) on a broad range of healthy behaviour. This effect was maximised when multiple SMS messages per day were used ($g = 0.395$) compared to using lower frequencies (daily, multiple per week and once off) ($g = 0.244$).
de Lepper et al., 2013	Uganda	Healthy behaviour-health education quizzes	A cohort study of employees of two companies and their community networks	To retrospectively assess the response patterns of participants in free SMS health education quizzes	The response chance declined with every additional day after sending an incentive via SMS (Hazard Ratio 0.993, CI 95% 0.981-0.984). Network providers had a substantial effect on response behaviour. Interactive SMS programs are a fast method to reach the target population and incentives increase response rates.
Kaoaiem et al., 2012	Thailand	Healthy behaviour-safe sex practice	A quasi-experimental design comparing two-study groups; the study and control groups via matched for background characteristics to pre	To evaluate the program of "Squad Leader Mentors through Short Message Services on Mobile	There were significant changes in overall scores of knowledge of safe sex and STIs. Benefits of using SMS and squad leaders that acted as mentors in

			and post changes in knowledge, attitudes, and safe sex practice over a six-month period.	Phones" in improving the required knowledge, attitudes, and safe sex practice among conscript groups.	the study groups (p-value < 0.001**) were observed. The safe sex practices in the study group showed a significant increase in condom use with risky partners such as sex workers and other men (p-value < 0.001**)
Pfaeffli Dale et al., (2015)	New Zealand	Heart disease management	A 2-arm, parallel, randomized controlled trial was conducted in New Zealand adults diagnosed with CHD. The intervention group received a personalized 24-week mHealth program, framed in social cognitive theory, sent by fully automated daily short message service (SMS) text messages and a supporting website. (n=123) (intervention =61 and control =62)	To investigate the effectiveness of an mHealth-delivered comprehensive CR program (Text4Heart) to improve adherence to recommended lifestyle behaviours (smoking cessation, physical activity, healthy diet, and non-harmful alcohol use) in addition to usual care (traditional CR).	A significant treatment effect in favour of the intervention was observed for the primary outcome at 3 months (AOR 2.55, 95% CI 1.12-5.84; P=.03), but not at 6 months (AOR 1.93, 95% CI 0.83-4.53; P=.13). The intervention group reported significantly greater medication adherence score (mean difference: 0.58, 95% CI 0.19-0.97; P=.004).
Leon et al., (2015)	Cape Town, South Africa	Heart disease management	An individually-randomised controlled trial in a primary care clinic in Cape Town (2012-14)	To test the effect of an adherence support intervention delivered via SMS-texts, on blood pressure control and adherence to medication, for hypertensive patients.	The intervention appeared to coincide with their readiness for change and provided practical and emotional support for improving adherence behaviour. Adherence support for treatment of raised blood pressure, delivered via SMS-text message on the patient's own phone, was found to be acceptable, relevant and helpful, even for those who already had their own reminder systems in place.

Alsaleh et al., 2012	Jordan	Heart disease management	A study protocol for a randomised controlled trial of adult patients with coronary heart disease who are clinically stable are able to perform physical activity and who has access to a mobile telephone were randomly allocated to control or intervention group. The behavioural intervention was compared with usual care in increasing physical activity levels among patients.	To outlines the study protocol for a trial which is currently underway, to examine the effect of a behavioural change intervention delivered through individualised consultation calls and motivational reminder text messages on the level of physical activity among patients with coronary heart disease.	It is hypothesised that behavioural intervention delivered through tailored individualised consultation supported by motivational SMS Text message reminders will help CHD patients to increase their level of PA.
Xiao et al., 2014	China	HIV – ART adherence	A cross-sectional survey (n=801)	To understand the acceptability of short message service (SMS) as a reminder for improving antiretroviral therapy (ART) adherence and determine the factors associated with willingness to accept SMS among people living HIV (PLH) in China	SMS as a reminder for improving ART adherence is acceptable and for a high proportion of PLH in China, reminder messages through mobile phones would be useful for increasing compliance with HIV regimens.
Mbuagbaw et al., 2012	Cameroon	HIV – ART adherence	The Cameroon Mobile Phone SMS (CAMPS) trial that enrolled and randomized HIV-positive adults on ART, aged 21 years and above to receive a weekly standardized motivational text	To investigates the use of motivational mobile phone text messages (SMS) to improve adherence to antiretroviral therapy (ART) over six months.	Standardized motivational mobile phone text messages did not significantly improve adherence to ART in this study. Other types of messaging or longer-term studies are recommended.

			message versus usual care alone (n=200; 101 in the intervention group and 99 in the control group)		
Chib et al., 2012	Uganda	HIV/AIDS testing	A pilot study to explored the efficacy of a mHealth campaign using SMS	To investigate the efficacy of a mHealth campaign using SMS as a platform to disseminate and measure HIV/AIDS knowledge, and to promote HIV/AIDS testing at clinics in rural Uganda.	The campaign had proportionately limited success in increasing knowledge levels on a mass scale. The results suggest that it is important to be conservative when considering the potential overall effect of SMS-based programs.
Mbuagbaw et al., 2012	Cameroon	HIV-ART adherence	A qualitative study using focus groups to explore the views and experiences of HIV patients on HAART with adherence reminders, especially the text message (SMS [short message service])	To explore the views and experiences of HIV patients on HAART with adherence reminders using SMS.	Overall, text messaging was viewed positively as a tool with a dual function of reminder and motivator. Messages coming from the attending physician may have a stronger impact. However, there is a need to consider the content and timing of SMS, taking into account technical challenges and privacy
Rodrigues et al., 2012	India	HIV-ART adherence	A Quasi-experimental cohort study of HIV-infected individuals from Bangalore, India, who were on antiretroviral therapy between April and July 2010. (n=150)	To assess the influence of mobile phone reminders on adherence to antiretroviral therapy in South India.	Mobile phone reminders may improve medication adherence in HIV infected individuals in this setting, the effect of which was found to persist for at least 6 months after cessation of the intervention.
Ghadieh et al., 2015	Beirut, Lebanon	Immunisation uptake	A randomized controlled trial using an automated computer randomization system into six equal groups, receiving short phone calls, short text messaging system (SMS-text) or e-	To compare the effect of three different types of a patient reminder system on adulthood Streptococcus	The various reminders increased vaccination rate to 14.9%: 16.5% of the short phone calls group, 7.2% of the SMS-text group and 5.7% of the e-mail group took the vaccine. The

			mails each with or without patient education and targeted at patients aged 40 and older eligible for pneumococcal vaccine, but did not receive it yet (89.5% of 3072 patients) based on their electronic medical records in a family medicine centre in Beirut. (n= 3072 patients; Intervention group = 1380)	pneumoniae immunization in a primary care setting.	vaccination rate was independent of the age, associated education message and the predisposing condition.
Ateudjieu et al., 2014	Cameroon	Immunisation uptake	A randomised control trial of health facilities that met the inclusion criteria was randomly assigned to receive: (i) a weekly standardized SMS, (ii) a weekly standardized supervisory visit or (iii) no intervention. (n = 348 health facilities)	To assess the effect of (i) sending weekly SMS, or (ii) weekly supervisory visits on AEFI reporting rate during a meningitis immunization campaign conducted in Cameroon in 2012 using meningitis A conjugate vaccine (MenAfriVac™).	The effect of SMS led to some increase in AEFI reporting rate compared to the control group, but the difference was not statistically significant [RR=1.4(0.8-1.6); p=0.07)]. Supervision was more effective than SMS or routine surveillance in improving AEFI reporting rate.
Cundill et al., (2015)	Tanzania	Malaria management (rapid diagnostic tests)	A three-arm stratified cluster-randomised trial was conducted in 36 primary healthcare facilities from September 2010 to March 2012 within two rural districts in northeast Tanzania where malaria transmission has been declining.	To determine the effect of training with SMS on prescriber and patient-oriented behavioural interventions to improve the use of malaria rapid diagnostic tests	Small group training with SMS was associated with an incremental and sustained improvement in prescriber adherence to RDT results and reducing over-prescribing of anti-malaria to close to zero.
Jones et al., 2012	Kenya	Malaria management	A cluster-randomized controlled trial consisting of intervention involving sending text messages about paediatric outpatient malaria case-management accompanied by	To investigate the perceptions and experiences of health workers involved in a cluster-randomized controlled trial of a novel	The results showed high acceptance of all components of the intervention, with the active delivery of information in an on the job setting, the ready availability of new and stored text messages and the perception of being kept 'up to date' as

			"motivating" quotes to health workers' mobile phones for 26 weeks (n=119)	intervention to improve health worker malaria case-management in 107 government health facilities in Kenya.	important factors influencing practice. It was inferred that in this intervention the SMS messages were operating primarily at the action and maintenance stages of behaviour change achieving their effect by creating an enabling environment and providing a prompt to action for the implementation of case management practices that had already been accepted as the clinical norm by the health workers.
Lakkis et al., 2011	USA	Mammogram screening	A randomized controlled trial conducted in 2010 among females aged between 40 and 75, benefiting from the Health Insurance Plan at the American University of Beirut, whose cell phone numbers were available in their electronic medical records, and who did not do a mammogram in the past 2 years. (n=385)	To compare the effect of two different types of short text message service (SMS-text) reminders on the uptake of a screening mammogram.	30.7% (59) of subgroup 1 and 31.6% (61) of subgroup 2 underwent a mammogram screening test during the 6 months follow up interval post-intervention (Chi-square test, p-value ≥ 0.05). There was no difference between the response rates in the two subgroups. A brief invitation SMS-text message for screening mammogram was found to be as effective as a detailed informative one.
Piette et al., 2015	USA	Medication adherence	We used Monte Carlo simulations to estimate the relative impact of an intervention using RL to adopt SMS adherence support messages in order to more effectively address each non-adherent patient's adherence barriers, e.g., forgetfulness versus side effect concerns.	Simulations of text messaging (SMS) for improving medication adherence to demonstrate the benefits of interventions using reinforcement learning (RL)	RL could produce a 5-14% absolute improvement in adherence compared to current approaches. RL systems could make mHealth services more effective.

Sims et al., 2012	United Kingdom	Clinic attendance - mental health	A pilot intervention at four community mental health clinics in London between March and June of 2008 (N=648), 2009 (N=1,081), and 2010 (N=1,088) to test reminder messages on appointment attendance.	To examined the effect of short message service (SMS), or text message, reminders on the attendance of appointments at four community mental health clinics in London	SMS-based technology can offer a time-, labour, and cost-efficient strategy for encouraging engagement with psychiatric outpatient services. There was a reduction of 25% to 28% in missed outpatient clinic appointments, which can translate to national cost savings of more than £150 million, or $245 million, per year, and likely have clinical benefits as well.
Khorshid et al., 2014	Iran	Iron supplementation - nutrition	A randomized controlled trial was conducted on pregnant women referred from public health centres in Ahvaz. (n=116)	Examined the effect of SMS text messages on compliance with iron supplementation among pregnant women	Most women in the intervention group (94%) had high compliance with iron supplements compared to the control group (66%); this difference was significant (P = 0.003). Although haemoglobin, haematocrit and ferritin decreased significantly in each group, there was no significant difference between them. Using SMS reminders is an efficient way of improving compliance of women with iron supplementation during pregnancy.
Jiang et al., 2014	China	Infant feeding practices - nutrition	A quasi-experimental design with follow-up measures scheduled at 4 community health centres in Shanghai, China. Two community health centres represented the intervention group, and 2 other community health centres represented the control group. Mothers in the intervention group received weekly SMS messages about infant feeding	To assess the effect of an SMS intervention on infant feeding practices.	Compared with the control group, the intervention group had a significantly longer median duration of EBF at 6 months (11.41 [95% CI, 10.25-12.57] vs 8.87 [95% CI, 7.84-9.89] weeks). An SMS intervention may be effective in promoting EBF, delaying the introduction of solid foods, increasing awareness of the World Health Organization breastfeeding guidelines,

			from the third trimester to 12 months' postpartum. (n=582)		and improving knowledge of appropriate infant feeding practices for new mothers.
Hebden et al., (2013)	Australia	Weight management - Obesity	TXT2BFiT is a nine-month two-arm parallel-group randomized controlled trial (n = 354)	To improving weight management and weight-related dietary and physical activity behaviours among young adults.	This mobile phone based program addresses an important gap in obesity prevention efforts to date.
Wang et al., (2015)	USA	Physical activities - Obesity	A Randomized Controlled Trial for 6 weeks (n=67)	To test the utility of a wearable sensor/device (Fitbit (®) One™; Fitbit Inc., San Francisco, CA) and short message service (SMS) text messaging prompts to increase PA in overweight and obese adults.	Secondary measures indicated the SMS text-messaging effect lasted for only 1 week: the intervention group increased by +1,266 steps (SE=491; p=0.01), +17.8 min/week MVPA (SE=8.5; p=0.04), and +38.3 min/week total PA (SE=15.9; p=0.02) compared with no changes in the comparison group, and these between-group differences were significant for steps (p=0.01), fairly/very active minutes (p<0.01), and total active minutes (p=0.02).
de Niet et al., 2012		Weight management - Obesity	After 3 months randomized controlled trial of behavioural lifestyle treatment of overweight and obese children randomly assigned to an intervention group receiving SMSMT for 9 months (n = 73) or to the control group (n = 68). (n=141)	To analyses whether self-monitoring of lifestyle behaviours through a short message service maintenance treatment (SMSMT) via mobile phones with personalized feedback positively affects weight, lifestyle behaviours and	SMSMT did not improve treatment outcomes. Controls gained temporarily in physical health scores (P = 0.01). The study did not find a positive effect of SMSMT on weight, eating behaviour or psychological well-being in obese children.

				psychological well-being in obese children	
Burn et al., (2015)	Australia	Physical activities	A cost-effectiveness analysis using a Markov model to estimate and compare the costs and consequences of MobileMums and usual care	To determine the cost-effectiveness of the MobileMums intervention. MobileMums is a 12-week programme, which assists mothers with young children to be more physically active, primarily through the use of personalised SMS text messages.	MobileMums has a 98% probability of being cost-effective at a cost-effectiveness threshold of 64 000 AUD. Varying modelling assumptions have little effect on this result. At a cost-effectiveness threshold of 64 000 AUD, MobileMums would likely be a cost-effective use of healthcare resources in Queensland, Australia.
Volcke et al. (2007)	Belgium	Medication adherence - Psychiatry	Non-blinded uncontrolled pilot trial to investigate the feasibility and patient/psychiatrist acceptability of a daily text messaging system reminding patients receiving quetiapine to take their medication (n=27).	Patients' response to text messages and acceptability of twice daily text messaging	16/24 patients were compliant with the system and 16/22 patients felt the frequency of text messages were acceptable
Bjørnholt et al. (2015)	Denmark	Medication adherence - Psychiatry	A randomized controlled trial including all non-acute referrals to an outpatient department for adolescent psychiatry within a group aged 15-20 years starting medical treatment.	To investigate whether text message reminders could improve medicine compliance amongst vulnerable young people with psychiatric disorders who were being treated in the outpatient department for child and adolescent psychiatry and who either are under or were to	This study does not show increased medicine compliance from the text message intervention group. Compliance was not associated with text message intervention in any of the drug interventions.

				commence medicinal treatment.	
Donaldson et al., (2009)	Australia	Clinic attendance - Psychiatry	A cross-sectional survey to assess the feasibility of using text message reminders in general adult psychiatry outpatient clinics (n=50).	The proportion of patients who agreed to be contacted by text message	76% of patients owned a mobile phone of which 74% remembered their mobile numbers and only 53% were agreeable to being contacted by text message
Whittaker et al., (2012)	United Kingdom	Smoking cessation	A meta-analysis of 4 randomised trials to determine whether mobile phone-based interventions are effective at helping smokers to quit (Total n=9000).	Smoking cessation	There was a significant increase in long-term quit rate; Relative Risk (RR) 1.71, 95% Confidence Intervals (CI) 1.47 to 1.99.
Free et al. (2009)	UK	Smoking cessation	Randomised controlled trial (txt2stop). (n=200)	To conduct a pilot randomised controlled trial of a mobile phone-based smoking cessation support intervention for the UK population.	The results at 4 weeks show a doubling of self-reported quitting relative risk (RR) 2.08 (95% CI 1.11 to 3.89), 26% vs 12%. The pooled effect estimate combining txt2stop and a previous New Zealand trial in the short term is RR 2.18 (95% CI 1.79 to 2.65).
Rodgers et al. (2005)	New Zealand	Smoking cessation	Randomised controlled trial randomised to an intervention group that received regular, personalised text messages providing smoking cessation advice, support, and distraction, or to a control group (n=1705)	To determine the effectiveness of a mobile phone text messaging smoking cessation programme.	This programme offers the potential for a new way to help young smokers to quit, being affordable, personalised, age-appropriate, and not location dependent
Chan et al., (2015)	Hong Kong	Smoking cessation	A block-randomized controlled trial allocated adult daily smokers to three groups: (i) The TEL group (n = 338) received a 5-min nurse-led telephone counselling; (ii) The SMS group (n = 335) received eight text messages through mobile phone and	To examine the effectiveness of brief interventions for smokers who joined Hong Kong Quit to Win Contest to quit smoking	The primary outcome was the self-reported 7-day point prevalence (PP) of tobacco abstinence at 6-month follow-up. The abstinence rate in the TEL, SMS and CONTROL group was 22.2, 20.6 and 20.3%, respectively (P

			(iii) The CONTROL group (n = 330) did not receive the above interventions. (n=1003)		for TEL versus CONTROL = 0.32; P for SMS versus CONTROL = 0.40).
Vilaplana et al., 2014	Spain	Smoking cessation	A comparative study consisting of two groups. The first group was made up of 104 patients (45.4% of the total) and followed a treatment that incorporated the S-PC tool, while the second one had 125 patients without the S-PC tool. (n=229)	To present a new programme that facilitates the management of people who want to quit smoking, implemented through an e-treatment software called S-PC (Smoker Patient Control).	74% of the S-PC group completed the treatment without relapses and remained abstinent three months after the completion of the treatment, understanding abstinence as being continuous (with no relapses allowed and co-oximetry below 1 ppm) from the day of stopping in contrast only 45.6% of the No S-PC group.
Ybarra et al., 2012	Turkey	Smoking cessation	A small-scale, parallel-group randomized controlled trial (RCT) conducted among adult daily smokers who were seriously thinking about quitting in the next 15 days. 76 to the SMS Turkey intervention group and 75 to the brochure control group. (n=151)	To assess cessation rates observed in SMS Turkey, a text messaging-based smoking cessation program for adult smokers in Ankara.	Three-month cessation trends were not significantly higher in the intervention group: 11% intervention vs 5% control had quit (χ (2) (1) =1.4, P=.24; R (2) =2.0, 95% CI 0.62-6.3). When the sample was stratified by sex, female intervention participants (14%, n=5) were significantly more likely to have quit at 3 months than female control participants (0%, n=0; χ (2) (1) =3.7, P=.05). Among light smokers (i.e., those smoking less than 20 cigarettes per day), intervention participants (17%, n=5) also were significantly more likely to have quit compared to control participants (0%, n=0; χ (2) (1) =5.3, P=.02).

2.13 Theoretical Framework

The Health Belief Model

Definition and Rationale for the Health Belief Model

The Health Belief Model is one of the most widely used conceptual frameworks for understanding health behaviour. Developed in the early 1950s, the model has been used with great success for almost half a century to promote greater condom use, seat belt use, medical compliance, and health screening use, to name a few behaviours.

The HBM attempts to predict health-related behaviour in terms of certain belief patterns. Emphasis is placed on the above-described categories. The model is used in explaining and predicting preventive health behaviour as well as sick-role and illness behaviour. The HBM has been applied to all study types of health behaviour. A person's motivation to undertake health behaviour can be divided into three main categories: individual perceptions, modifying behaviours, and the likelihood of action. Individual perceptions are factors that affect the perception of illness or disease; they deal with the importance of health to the individual, perceived susceptibility, and perceived severity. Modifying factors include demographic variables, perceived threat, and cues to action. The likelihood of action discusses factors in the probability of appropriate health behaviour; it is the likelihood of taking the recommended preventive health action. The combination of these factors causes a response that often manifests into action, provided it is accompanied by a rational alternative course of action.

Kelli McCormack Brown describes clearly the model

> "The Health Belief Model states that the perception of a personal health behaviour threat is itself influenced by at least three factors: general health values, which include interest and concern about health; specific health beliefs about vulnerability to a particular health threat; and beliefs about the consequences of the health problem. Once an individual perceives a threat to his/her health and is simultaneously cued to action, and his/her perceived benefits outweigh his/her perceived cost, then that individual is most likely to undertake the recommended preventive health action".

Key descriptors include:

Perceived Susceptibility **-** Perception of the likelihood of experiencing a condition that would adversely affect one's health. Individuals vary widely in their perception of susceptibility to a disease or condition. Those at the low end of the extreme deny the possibility of contracting an adverse condition. Individuals in a moderate category admit to a statistical possibility of disease susceptibility. Those individuals at the high extreme of susceptibility feel there is a real danger that they will experience an adverse condition or contract a given disease.

Perceived Severity **-** Beliefs a person holds concerning the effects a given disease or condition would have on one's state of affairs: physical, emotional, financial and psychological. These effects can be considered from the point of view of the difficulties that a disease would create. For instance, pain and discomfort, loss of work time, financial burdens, difficulties with family, relationships, and susceptibility to future conditions. It is important to include these emotional and financial burdens when considering the seriousness of a disease or condition.

Perceived Benefits of Taking Action **–** The extent to which a person believes there will be benefits to recommended action.

Barriers to Taking Action **–** The extent to which the treatment or preventive measure may be perceived as inconvenient, expensive, unpleasant, painful or upsetting. These characteristics may lead a person away from taking the desired action.

Cues to Action **–** Types of internal and external strategies/events that might be needed for the desired behaviour to occur.

- Provide an incentive to take action
- Provide a clear course of action to acceptable cost
- Enhance the feeling of competency to take action

Self-Efficacy - This refers to the level of a person's confidence in his or her ability to successfully perform the desired behaviour. This construct was added to the model most recently in mid-1980. Self-efficacy is a construct in many behavioural theories as it directly relates to whether a person performs the desired behaviour (Figure 2.5).

Rosenstack, Strecher and Becker (1988) pointed out that the Health Belief Model hypothesises that health-related action depends upon the simultaneous occurrences of three classes of factors:

1. The existence of sufficient motivation (or health concern) to make health issues salient or relevant.
2. The belief that one is susceptible (vulnerable) to a serious health problem or to the sequelae of that illness or condition. This is often termed, 'perceived threat'.
3. The belief that following a particular health recommendation would be beneficial in reducing the perceived threat, and at a subjectivity-acceptable cost.

Summary of the Health Belief Model

The Health Belief Model posits that people will take action to undergo health prevention behaviour when they are ready because they see it as beneficial, and what is to be gained is greater than the difficulty. Does the end justify the means? Readiness is determined by the degree to which one believes illness is likely. Perceived susceptibility may be influenced by proximity to an illness. For instance, someone with a family history of diabetes will more likely seek a blood test than someone who has no family history of the disease. Readiness is also determined by the consequences a health risk may impose. When perceived susceptibility is seen as likely and perceived severity of an illness is high, motivation increases. Conversely, motivation decreases as susceptibility seem unlikely and severity is viewed as inconsequential (Rosenstock, 1966). Once concluded that threat is likely and damage may be severe, action to prevent its occurrence is likely taken. The choice of action to reduce the health threat is reliant on the belief of its effectiveness. Will it work? At least one viable option to prevent illness must be accessible. The individual experiencing a decision process involving these variables is often unconscious of the cognitive process (Rosenstock, 1966). It is Rosenstock's (1966) opinion that emotional factors have more bearing on this event than do the intellectual. Despite a belief in the effectiveness of an action that may reduce the threat of illness, barriers preventing commitment to the action may arise. If the psychological readiness of an individual is high and the negative aspects of the course of action are relatively weak, the action is likely taken (Table 2.7).

Conversely, when readiness is low and negative aspects of the course of action are viewed as high, barriers are constructed preventing action. Considerations such as will it be painful? Will it upset family life? Will it place one's self and loved ones in a financial crisis? These questions raise barriers in the decision process. A significantly more difficult circumstance surfaces when both readiness and the negative aspects of the course of action are high (Rosenstock, 1966). In this circumstance, the HBM posits that individuals will demonstrate behaviour to both take action and avoid it. As a result, they may review alternatives and choose another action. If no other option is available, one of two reactions may occur: (1) they may psychologically distance themselves from the situation such as declaring the intention to change their behaviour "tomorrow". This allows for temporary psychological relief from the barrier and the perceived benefit. (2) They may experience increased fear and anxiety. If these negative feelings become great, enough irrational behaviour becomes possible. At this point, the presentation of any effective means ensuring good health may go unanswered (Rosenstock, 1966).

Even after all variables are in place indicating a high likelihood of positive health behaviour, people will sometimes still not take action. Rosenstock (1966) proposed that events can "trigger" individuals to take action toward prevention. Perceived susceptibility and severity are variables that affect readiness. Perceived benefits affect the course of action. However, as strong as these variables may be interpreted, there remains a possibility that an individual may still not demonstrate preventive health behaviour. A cue to action may be a solution. These cues could be internal such as physical discomfort or external, such as media communication. If the cue's influence matches or exceeds the level of readiness, the action is likely to be taken. Therefore, low readiness requires more highly intense cues, while high readiness requires less (Rosenstock, 1966).

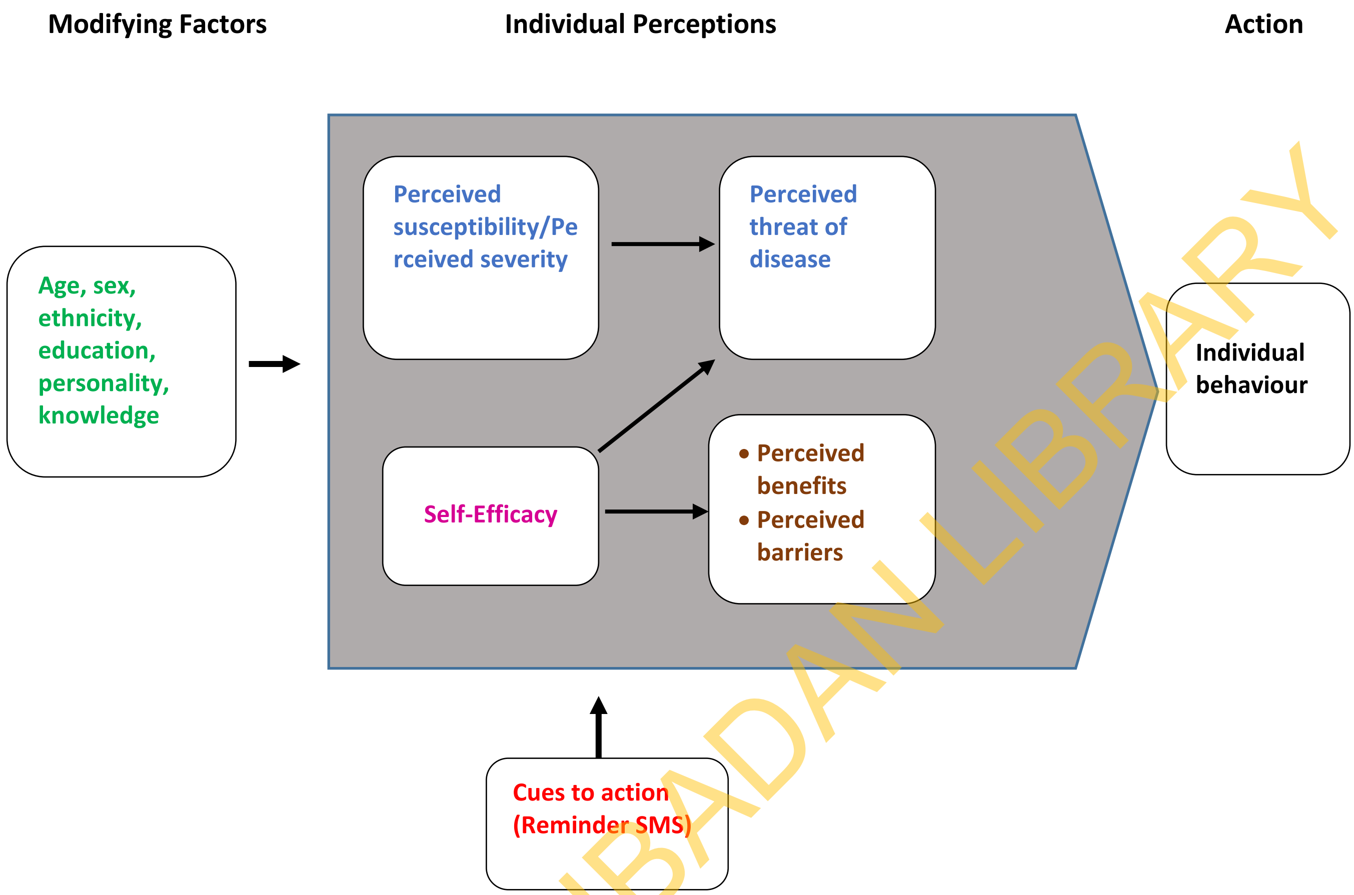

Figure 2.5: Health Belief Model

Applications of HBM to this study

The study considered the constructs of the framework to identify predictors of routine immunisation appointment keeping, uptake and timely completion of all scheduled routine immunisation intention. The Health Belief Model considers potential motivating factors such as perceived severity (mother of infant's perception or assessment of the seriousness of all vaccine-preventable diseases), perceived susceptibility (mother of infant's perception or assessment of risk of child getting or being infected with any of the vaccine-preventable diseases), expected benefits (mother of infant's perception or assessment of the positive rewards of adopting the behaviour – full and timely completion of antigens for all vaccine-preventable diseases), self-efficacy (mother of infant's perception or assessment of risk of child getting or being infected with any of the vaccine-preventable diseases), cue to action (the intervention, which is the text message reminders and sometimes mothers of infant social environment including significant others, observation learning of health behaviours of others), and perceived barriers (mother of infant misconception about routine immunisation.

The theoretical framework constructs or variables in Health Belief Model guided the researcher in the design of each of the instruments for data collection (focus group discussion guide, in-depth interview guide and the questionnaire) and the presentation of data. The instruments assessed or measured knowledge and attitude in relation to perceived severity and perceived susceptibility to vaccine-preventable diseases, expected benefits and barriers relating to routine immunisation; cue to action and self-efficacy which may predict multiple visits to a health facility to complete all antigens and willingness to adopt the use of text message reminders for routine immunisation.

Table 2.7: Summary of Application of the Health Belief Model to the Current Study on the Effect of Mobile Phone Text Message Reminders on Uptake of Routine Immunisation by Mothers of Infants

Concept	**Definition**	**Application**
Perceived Susceptibility	One's opinion of chances of getting a condition	These are nursing mothers or mothers of infants who at risk of any of the vaccine-preventable diseases, children not immunised are at risk of these diseases; largely due to mothers' perception – feelings that their children are not susceptible to any of these diseases.
Perceived Severity	One's opinion of how serious a condition and its consequences are	When mothers perceive any of the diseases to be severe and the consequences of not taking action could be permanent, this might likely influence their behaviour
Perceived Benefits	One's belief in the efficacy of the advised action to reduce the risk or seriousness of the impact	If mothers perceive the benefits of immunising their children, availability of vaccines especially if given free, the distance of health facilities not far from their homes, encouragement from healthcare workers, positive attitude of healthcare workers to mothers and trust in the vaccines, these have much influence on them.
Perceived Barriers	One's opinion of the tangible and psychological costs of the advised action	When barriers such as long-time of waiting, the complaint of no money for transportation, mothers too busy, lack of motivation and perceived negative effects or adverse effects of immunisation are taken care of this will lead mothers to ensure timely completion of all immunisation.
Cues to Action	Strategies to activate "readiness"	When mothers are equipped with detail information on what is to be done as their babies grow, and awareness is created on the need for the completion of immunisations for children, they are likely to take action. Moreover, sending reminders from time to time about routine immunisation clinic is another factor that may make mothers take action.
Self-Efficacy	Confidence in one's ability to take action	Provision of training, health education on the benefits of immunisation may influence mothers to take action.

Source: Adapted from Glanz, Rimer and Lewis, 2002.

CHAPTER THREE

METHODOLOGY

3.1 Research design

The quasi-experiment consisted of two assessments (baseline and end line) of two groups (intervention group and control group) (see Table 3.1).

Table 3.1: Timing of intervention and data collection for impact evaluations

Group	Time		
	Baseline	**Intervention (Nine months)**	**End line**
Intervention group (IG) Rural Primary Healthcare Centres [n=96]	**O_1**		**O_3**
Control group (CG) Rural Primary Healthcare Centres [n=96]	**O_2**		**O_4**

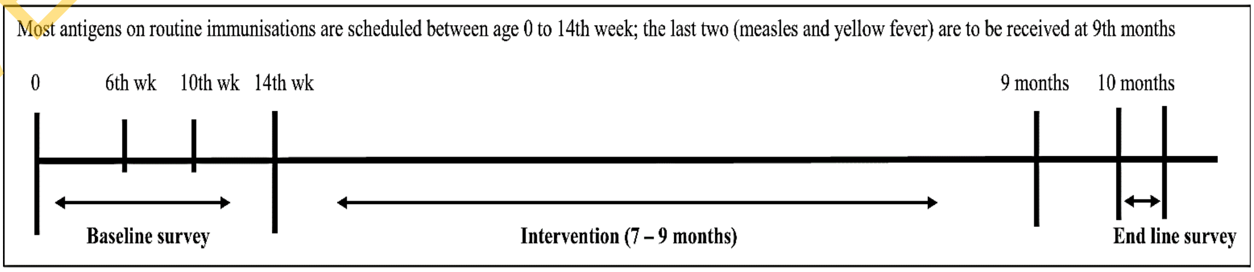

Figure 3.1: Research Timeline Schema

3.2 Study Population

The study population consisted of mothers of infants and pregnant women who were identified as close to delivery. The study took into consideration the place of delivery, whether the women gave birth to their children at home or outside the town. Mothers and their babies were enrolled no later than 2 months after delivery in facilities where they accessed routine immunisation services. After the third visit for routine immunisation (14th week), the mother and her baby were not expected to come back to the facility until when the baby is 9 months old. However, for the period between the 14th week and 9th month (about 6 months), mothers and infants were contacted and followed up the research team in their respective homes in the community (Figure 3.1).

3.2.1 Inclusion Criteria

Inclusion criteria for participating in the study were:

- Mothers whose infants were less than 2 months.
- Mothers' possession of at least one functional mobile phone (for both intervention and control groups).
- Mothers' ability to read English or Yoruba language.

3.2.2 Exclusion Criteria

Exclusion criteria for the study were:

- Mothers with infants who had health conditions that may interfere with the timely receipt of vaccinations. The health conditions that may interfere with timely receipt of vaccinations are immuno-suppressed infants, those with high-grade fever and convulsions.
- Mothers of children who attended the clinic on the day of the visit, but who were not residents or living in the area or town.

3.3 Description of the Study Areas

The study areas were Ibarapa North and Kajola Local Government Areas (LGAs), Oyo State, Nigeria. They are primarily rural LGAs and medically underserved communities/areas and settlements.

Ibarapa North Local Government Area

Ibarapa North Local Government Area, with the headquarters at Ayete, was carved out of the defunct Ifeloju LGA on 4 December 1996. It is bounded by Iwajowa LGA in the North, Iseyin and Ibarapa East to the East, Ibarapa Central to the South and Ogun State in the West. Other notable towns in the LGA are Tapa and Igangan. The Local Government Area has other villages and hamlets scattered all over it. Each of the towns had quite a number of villages. The LGA had a population of 100, 293 (male 51,272; female 49,021) at the 2006 census (National Population Commission, 2010). By political delimitation, Ibarapa North LGA consists of 10 political wards. The LGA is situated in Ibadan/Ibarapa Zonal Area of Oyo State and the people in the area are notably food crops farmers. Almost all the people in the various communities in the LGA were predominantly farmers while a few others were traders, civil servants and artisans. Farmers in this area were engaged in both subsistence and large-scale farming.

The LGA, which covers a landmass of about 1,229.803 square kilometres and the area borders with the rain forest belt to the South but, consists of rolling savannah with residual patches of forest growing near watercourses. Most of the land lies between 400 to 600 feet above sea level, but rocky outcrops rising to 1,000 feet occur here and there adding to the natural beauty of the landscape (Ogunlesi, Oyediran and Brieger, 1989). Ibarapa generally is located approximately 100 kilometres north of the coast of Lagos, and about 95 kilometres west of the State capital city, Ibadan (Duze, 1984). History has it that the people who formed the seven major towns that make up the Ibarapaland (Igangan, Tapa, Aiyete, Idere, Igboora, Eruwa and Lanlate) migrated to the Ibarapa area either having been dissidents of the Oyo empire where they have been affected by either the '*Kiriji*' Yoruba communal war or the trans-Atlantic and trans Saharan slave trade (Okonji, 2013; Ogunlesi, Oyediran and Brieger, 1989). However, in the case of Tapa, they were refugees from the jihad ridden Nupe of Northern Nigeria. The name of the community at large 'Ibarapa' was derived from a common plant known as '*Ibara*' also known as a melon.

The Ibarapa people are of the Yoruba ethnic stock and are originally involved in subsistence farming. The farmers usually travel to their farmlands or hamlets for five days where they maintain a second home, only to come back to their township home on weekends. The Ibarapa landscape was acknowledged by elite cities like Ibadan, Abeokuta and Lagos for immense production of melon known as '*Egusi*' and '*Gbaguda*' or '*Ege*' otherwise known as cassava and thus attracted a lot of patronages (Okonji, 2013; Ogunlesi, Oyediran and Brieger, 1989). Expectedly, the subsistence measure of farm production became overstretched as there was growing pressure to increase production. However, growth in the occupation carried with it several limitations including uninformed exchange system or market failure and diseases like *dracunculiasis* (guinea worm) which was once common in the locality. Thus, the socio-economic status of the area is that of poverty. Brieger and Kendall (1992) noted that further interventions were initiated from both local and foreign donor agencies especially in the area of public health and eradication of guinea worm disease in the bid to encourage these traditional farmers to achieve optimum production. However, in spite of the health development campaign, production remained low and the welfare of the people was on the decline (Guyer, 1997).

There are five Primary Health Care (PHC) facilities in the LGA and they all provide routine immunisation services. Routine immunisation is available weekly (Wednesday) in the Local Government Area. However, this service may or may not be reliable as most of the infrastructures in the cold chain systems (freezers, solar freezers, generators etc.) with which to operate an effective cold chain are non-functional. This picture is not peculiar to this LGA alone; almost all the LGAs in the state experience this situation. In addition, there are other health clinics and health post located across various political wards in the LGA. Moreover, there are few private hospitals and maternities many of which do not offer immunisation services. Other private healthcare providers are patent medicine vendors, chemists and traditional healers, who are well patronised by community members because of their proximity. There are about 42 primary schools (both public and private) and six secondary schools in the LGA.

Kajola Local Government Area

Kajola Local Government Area is the second study area with Okeho as its headquarters. Kajola Local Government Area, located in Oyo North Senatorial district, started as Okeho/Iganna District Council in the defunct Western Region in 1955 (Lawal, 1992). It metamorphosed into Kajola Local Government Area in 1976 as an aftermath of the Local Government reforms. Situated in a geographical area bordering on the upper course of Ogun River, Kajola Local Government Area is in the heart of rural savannah region of Oyo state. The Local Government Area has an estimated landmass of about 616.212 square kilometres. It has 17 towns and villages, which are divided into 11 wards. The 2006 population census put the figure of the Local Government Area at 200,528 persons (male-101.188; female-99,340) (National Population Commission, 2010). It is bounded in the North by Itesiwaju LGA, in the South by Iwajowa and Iseyin LGAs, in the East by Itesiwaju and Iseyin LGAs and in the West by Iwajowa LGA. While the major ethnic group in the local government is Yoruba, who co-exist peacefully with Fulani cattle rearers and other Nigerian ethnic groups such as the Igbos, Hausas, Ijaws, Igaras, Urhobos, Efiks, Gwaris and Tivs, among others who are mainly settler traders and farmers as well as immigrants from neighbouring countries like Republic of Benin and Togo. The major towns in the local government are Okeho (the Local Government Area headquarters), Ilero, Isemi-Ile, Ilua, Ayetoro-Oke, Isia, Iwere-Oke and Ilaji-Oke. The LGA has over 60 primary schools (public and private) and 20 secondary schools (public and private) (Lawal, 1992).

The Local Government Area has seven Primary Health Care (PHC) facilities including five, which provide routine immunisation services (PHC facilities with an emphasis in provision of routine immunisation), health clinics and health post. Routine immunisation is available weekly (every Tuesday) in the Local Government Area. However, this service may be unreliable as most of the infrastructures in the cold chain systems (freezers, solar freezers, generators etc.) with which to operate an effective cold chain are non-functional. This picture is not peculiar to this LGA alone; almost all the LGAs in the state experience this situation.

Of the five PHC facilities, three are the Subsidy Reinvestment and Empowerment Programme (SURE-P) supported facilities. The concept of SURE-P came up when the federal government in January 2012 made a decision to channel its own share of subsidy reinvestment funds into a combination of programmes to stimulate the economy and alleviate poverty through the provision of critical infrastructure and social safety net projects. The Maternal and Child Health (MCH) component of the Subsidy Reinvestment and Empowerment Programme (SURE-P) aspires to contribute to the reduction of maternal mortality and newborn morbidity, and place Nigeria on track to achieve the 4th and 5th Millennium Development Goals (MDGs), building on Nigeria's previous experience with the Midwives' Service Scheme. The SURE-P MCH Project provides a unique opportunity to focus on increasing access to maternal and child health services through the continuum of care for pregnant women and their newborn (National Primary Health Care Development Agency, 2015). With this programme, mothers were provided with the basic items for delivery of their babies and at were given the opportunity to visit the facilities whenever they felt they needed to. The incentive structures in the facilities motivated mothers to always visit the facilities. This had a very strong effect on the outcome of the intervention.

These facilities serve all wards in the LGA. In addition, there are private hospitals, maternities and one general hospital. Numerous patent medicine vendors, chemists and traditional medical practitioners also exist and are well patronised because of their proximity to people.

In an attempt to strengthen routine immunisation system service delivery, Oyo State government partnered with several governmental and non-governmental organisations such as Federal Ministry of Health, National Primary Health Care Development Agency, National Action Committees on AIDS, United Nations Children's Fund (UNICEF), the World Health Organisation (WHO), and Rotary International among others. In addition, there are several healthcare providers in the private sector; they are scattered across the State.

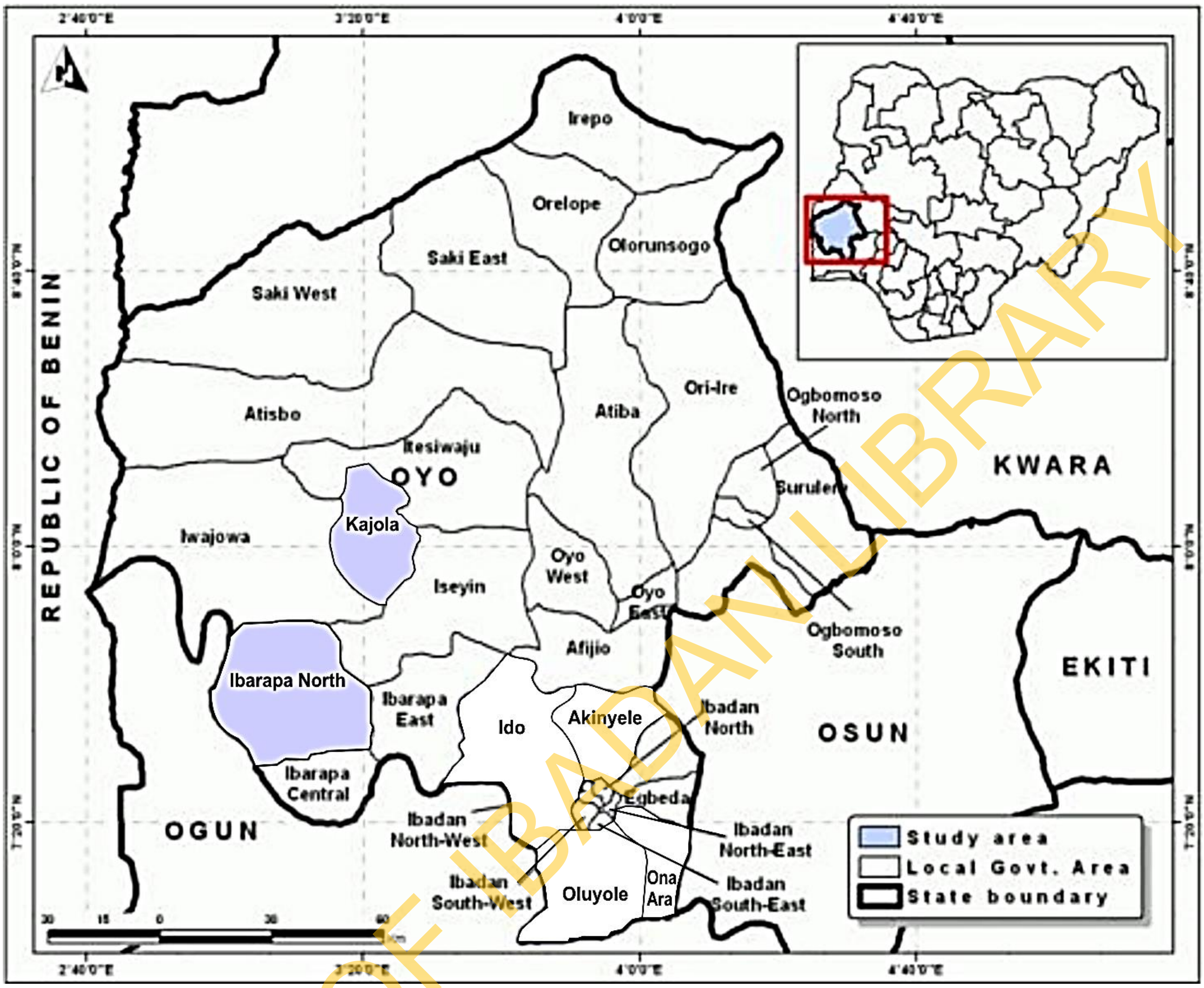

Figure 3.2: Map of Oyo State, Nigeria showing the study sites

(Source: Adetayo and Owolade, 2012)

3.4 Sample Size Calculation

Findings from previous studies showed that Short Messaging Services (SMS) could improve healthcare service delivery through appointment reminders and improve communication between healthcare workers. It improves diagnosis, prevention, treatment and rehabilitation by supporting adherence to medication, and monitoring illness and medical interventions. However, in Nigeria, the effectiveness of reminder SMS among mothers of infants in rural communities on routine immunisation clinic appointment keeping and timely completion of basic routine immunisations schedule has not been well documented. The study involved a comparison of the proportion of two groups (intervention and control groups). Thus, the sample size was calculated using this formula:

$$n = \frac{(Z\alpha + Z\beta)^2 \, (P_1 \, (1 - P_1) + (P_0 \, (1 - P_0)}{(P_1 - P_0)^2}$$

(Source: Kirkwood and Sterne, 2003; Lwanga and Lemeshow, 1991)

Where,

$Z\alpha$	=	Level of significance 5% ($Z\alpha$ at α = 5%) = 1.96
$Z\beta$	=	Power of the test ($Z\beta$ at the power of 80%) = 0.84
P_1	=	The proportion of the respondents in the exposed (intervention) group who are expected to complete all the basic childhood immunisations of their children (20 percentage point increase in the prevalence)
P_0	=	The proportion of the respondents in the unexposed (control) group who are expected to complete all the basic childhood immunisations of their children (16.8%) National Population Commission [NPC] [Nigeria] and ICF Macro, 2009

$$n = \frac{(1.96 + 0.84)^2 \, (0.368 \, (1 - 0.368) + (0.168 \, (1 - 0.168)}{(0.368 - 0.168)^2}$$

$$n = \frac{(7.84) \, (0.372352)}{0.04}$$

$$n = \frac{2.91923968}{0.04}$$

$n \sim 86$ (N = 172)

Adjusting for 10% attrition and non-response (Kirkwood and Sterne, 2003), a total sample size of 192 (Intervention group – 96; Control group – 96) was calculated for the study.

3.5 Sampling Technique

A multi-stage sampling (five) procedure was employed for this study.

First Stage

The 33 Local Government Areas (LGAs) in Oyo State were stratified into rural and urban LGAs. Rural areas were identified based on diverse criteria such as low population concentration, scattered settlement pattern, the predominance of primary production, few basic/social infrastructures, medically underserved etc. (Yusuf and Ukoje, 2010).

Second Stage

All the rural LGAs were classified as having high or low routine immunisation coverage based on routine immunisation coverage data obtained from the World Health Organisation office, Ibadan. Completion of three doses of diphtheria–pertussis–tetanus vaccine (DPT) and a single dose of measles vaccine was used to calculate vaccine coverage or dropout rate (Table 3.2). Usually, 80% coverage and 10% drop-out rates of the vaccines are used as cut-off levels for high immunisation coverage, while less than 80% coverage and more than 10% drop-out rates are cut off levels for low immunisation coverage. However, these values can change depending on variables for defining the target population such as wealth, gender and place of residence. For herd immunity to be achieved, at least 70% of the population must have been fully immunised against any disease. For the purpose of this study, 80% coverage and 10% dropout rates of the vaccines were used as cut-off levels for high immunisation coverage and rural LGAs coverage that fell outside these values were classified as LGAs with low immunisation coverage.

Third Stage

From the list of rural Local Government Areas, Kajola and Ibarapa North, two of the LGAs with high immunisation dropout rates were purposively selected. Kajola and Ibarapa North were allocated to Control Group (CG) and Intervention Group (IG), respectively by balloting.

Fourth Stage

In the third stage, ten health facilities (five in each group) with routine immunisation services in the selected Local Government Areas were listed. Only five PHC facilities provide routine immunisation services in each of the LGAs. Therefore, all five health facilities providing the services were selected, making 10 facilities.

Fifth Stage

Consenting mothers who delivered at each of the facilities and those who came to the facilities to access routine immunisation services were purposively selected. Mothers, as well as their infants, were contacted and their details were obtained. A list of mothers of infants who had at least one functional phones was generated (constituting the sampling frame) and from the list of mothers generated, every other mother was selected for participation in the study. In the end, 187 and 179 mothers of infants were selected for Control and Intervention groups respectively (Figure 3.3).

Table 3.2: Monthly Vaccination Coverages in Rural LGAs in Oyo State (March 2012)

S/No	LGA	Monthly surviving infants	BCG	DTP-1	DTP-2	DTP-3	Polio-0	Polio-1	Polio-2	Polio-3	Measles 1st dose	Dropout rate DTP-3/1	BCG-Measles
1	Afijio	547	97%	57%	30%	48%	8%	133%	74%	120%	133%	15%	-37%
2	Atisbo	451	123%	48%	23%	41%	59%	118%	88%	99%	171%	14%	-39%
3	Ibarapa Central	420	70%	52%	41%	34%	63%	67%	58%	45%	55%	34%	21%
4	Ibarapa East	482	183%	128%	66%	117%	11%	160%	100%	146%	127%	9%	30%
5	Ibarapa North	412	98%	40%	29%	43%	54%	45%	35%	35%	70%	-9%	28%
6	Irepo	499	77%	41%	33%	42%	23%	55%	46%	48%	84%	-3%	-10%
7	Itesiwaju	524	40%	54%	41%	43%	30%	100%	94%	84%	86%	21%	-116%
8	Iwajowa	420	93%	53%	50%	48%	97%	95%	89%	86%	87%	10%	7%
9	Kajola	819	84%	36%	26%	33%	44%	86%	82%	76%	64%	8%	24%
10	Ogo Oluwa	266	102%	56%	60%	58%	76%	108%	104%	105%	89%	-4%	13%
11	Olorunsogo	333	102%	98%	84%	77%	98%	95%	90%	74%	64%	21%	37%
12	Orelope	425	133%	66%	60%	64%	91%	95%	84%	91%	86%	4%	35%
13	Ori Ire	614	76%	60%	39%	49%	22%	54%	47%	50%	66%	19%	12%
14	Saki East	449	117%	39%	32%	33%	31%	63%	51%	59%	109%	13%	7%
15	Surulere	579	50%	56%	51%	48%	13%	74%	62%	60%	55%	15%	-11%

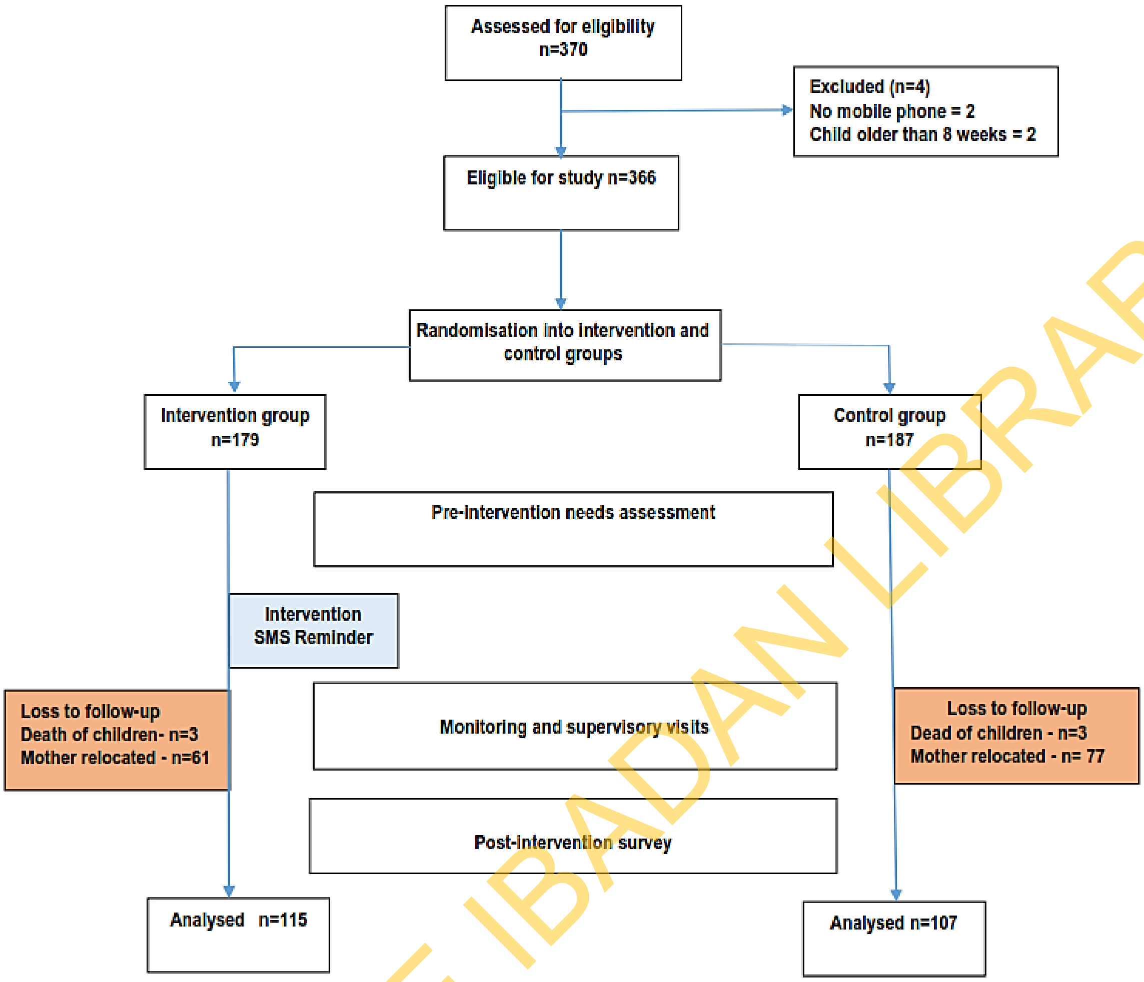

Figure 3.3: Flow chart of study sites

3.6 Study Variables

Independent variables

The independent variables include socio-demographic characteristics such as marital status, religion, highest education background, occupation, income, ethnic group, age, etc.; health education on immunisation schedule for infants, and SMS appointment reminders intervention for routine immunisation clinics.

Dependent variables

The following were the dependent variables: full and timely completion of basic routine immunisations [a. BCG (at birth), b. Polio (1st dose at birth, 2nd dose at 6 weeks, 3rd dose at 10 weeks, 4th dose at 14 weeks), c. Pentavalent (at 6, 10 & 14 weeks), d. IPV (14 weeks) e. Measles (at 9 months) f. Yellow fever (at 12 months]. The level of completion of these basic routine immunisations depends on the keeping of routine immunisation clinic appointment (on the expected date of immunisation).

3.7 Hypotheses

The following null hypotheses were formulated and tested:

H_0 1 There will be no significant difference at post-intervention between intervention and control groups in respect of the following:

a. Knowledge of routine immunisation

b. Attitude to routine immunisation

c. Timely completion of full basic immunisation schedules

3.8 Description of Intervention

3.8.1 Description of the type of messages developed

Visits were made to three health facilities in each LGA, some mothers who came to the clinic were contacted, and given information about the nature of the study, they were then invited to participate in a discussion. Three Focus Group Discussions (FGDs) were conducted among the selected mothers in each LGA (about mothers in each group). The focus of the discussion was about knowledge, attitude, factors influencing mothers to complete all immunisation schedules, mobile phone ownership, the pattern of use of mobile phone, and opinion on the use of text message reminders for routine immunisation appointment keeping and completion of scheduled immunisation. During the discussions, they were asked to suggest sample of messages to be sent to mothers of infants in order to remind them of their next immunisation appointments, the language that is most appropriate in sending the messages, time of the day when messages could be sent and a sample of words to be used as code for the message reminders.

All suggestions made were reviewed and tested among some mothers of infants (who are not part of the study) attending routine immunisation clinics in a similar but different LGA for clarity and comprehension. Responses of the mothers who are not part of the study were used to refine the intervention. Lastly, suggestions from mothers were categorised into the following themes: next routine immunisation appointments, benefits of keeping routine immunisation appointments, benefits of timely and full completion of all basic routine immunisations, effects of refusal/non-completion of all basic routine immunisations on children health and places or location of healthcare facilities with routine immunisation services. The mothers suggested several codes for sending the messages from which an appropriate code was developed '*Abiye lomo!'* meaning, "safe delivery" "mother and child will stay alive after delivery". The outcomes of this exercise were a factor in the design of the intervention.

3.8.2 Description of the process of delivery of the messages

The delivery of the intervention messages was in three stages. In the first stage, facilities for bulk SMS were sourced from the various company; the most cost-effective and friendly interface was sought. In the end, the researcher chose services provided by MEGANET NIGERIA LIMITED, an information, communication and technology company with core interest in solution development and the owner of 'www.smsafrica.com' platform that offers the opportunity to send messages to multiple contacts at the same time or scheduled time. The platform is internet-based and could be accessed as soon as one is connected to the internet. Necessary arrangements were made with the organisation followed by payment for the initial 100,000 units of bulk SMS. One unit of a bulk SMS is equal to 160 characters in a text message. Bulk SMS units of between 100,000 – 999,999 cost ₦1.45/1SMS. The more the quantity purchased, the lower the price. Secondly, this platform was tested over and over to be sure it worked perfectly. Thirdly, studies that adopted similar interventions were reviewed.

Lastly, mothers in the intervention group were enrolled and they received customised text messages reminder or reminder SMS coded '*Abiye lomo*' three times every week. They were also sent goodwill messages during festive periods. These SMS reminders were sent by the researcher using an Internet-based bulk SMS platform and sent at scheduled intervals to mobile telephones of respondents (mothers of infants) and significant others who are related to mothers (whose phone numbers was captured during an interview at baseline). The SMS focused on the need for mothers of infants to immunise children against basic vaccine-preventable diseases). Key messages sent were related to the following:

- Next routine immunisation appointments,
- Benefits of keeping routine immunisation appointments,

- Benefits of timely and full completion of all basic routine immunisations,
- The effects of refusal/non-completion of all basic routine immunisations on children health, and
- Places or location of healthcare facilities with routine immunisation services.

Beside the mobile phone numbers of mothers of infants, their other significant details were programmed into the bulk SMS platform. The investigator created an account for bulk SMS on a platform of one of the bulk SMS service providers. Respondents' phone numbers were stored in the contact list on the bulk SMS account. Messages designed were composed on the interface and scheduled to be delivered at specified date and time depending on respondents' immunisation clinic days. For mothers of infants in the intervention group, SMS reminders were programmed to be sent in two days-a days before and on the routine immunisation clinic day. The text messages were scheduled to be delivered to respondents in the intervention group daily between 7.00 am and 7.15 am. Mothers of infants in the intervention group were followed-up for about 12 months. The Research Assistant assigned to the health facility where each of the respondents was recruited made two home visits to each respondent.

Sustained monitoring and supervision of all activities were undertaken during the intervention phase to ensure that mothers in the intervention group got the messages sent to them. Messages sent over the bulk SMS platform were monitored and the same was verified during home visits in order to be sure that messages were delivered to the right person and timely too. For respondents who changed SIM cards for whatever reason or had a change of house address, they were traced to locate the respondents so that they were not lost to follow-up for data collection at the end line. During the second phase of a home visit, it is surprising to note that about 30% of respondents in each of the LGAs had migrated to urban centres in search of means of livelihood and three respondents in each of the LGAs lost their babies. The research team contacted some respondents who migrated, while a few others were unreachable.

Moreover, weekly data on the number of respondents who received SMS reminders were kept and those who could not be reached were noted by the investigator who later crosschecked from the concerned research team member on the correctness of such numbers. In all, three mobile phone numbers were unreachable with messages in the intervention LGA. The bulk SMS platform gave error messages that such numbers could not support bulk SMSs. This was possible and easy; reports on every message sent (delivered or not delivered) were automatically generated on the bulk SMS platform on the internet. Respondents with mobile phone numbers that could not be reached through SMS were traced to their various house addresses by Research Assistants to confirm the correctness of such phone numbers. Among the intervention group, there were about 15 respondents with bad phones or lines or those who lost theirs. Most of these gave the research team new numbers; however, three respondents gave alternative mobile phone numbers of their mothers and sisters. Messages sent to these significant others had the names of their respective respondents so that the messages were delivered timely. These reports were useful for process evaluation and monitoring (Table 3.3).

Mothers of infants in the control group were also followed-up for about six months. Monitoring and supervision of all activities were undertaken at the intervention phase to ensure that mothers in this group could be traced to the house addresses provided at baseline. About 10 respondents changed SIM cards or lost theirs, or had a change of house address. However, few of them were traced through their husbands' phone numbers documented earlier, while few others were traced to their new location through the assistance of their neighbours. All these efforts were made in order to minimise attrition. Moreover, visit their houses by research assistants assigned to them were made occasionally. Samples of key themes of the text messages sent are found in Appendix II.

Table 3.3: Summary of key themes and frequency of the text messages sent

S/№	Message theme	Number of time sent
1	Next routine immunisation appointments	90
2	Benefits of keeping routine immunisation appointments	64
3	Benefits of timely and full completion of all basic routine immunisations	78
4	The effects of refusal/non-completion of all basic routine immunisations on children health	52
5	Places or location of healthcare	40
	Total	324

For quality control, 10 research assistants were assigned to the ten health facilities, giving five research assistants for the five facilities in each of the intervention and control groups (Table 3.4). End line survey was conducted at the beginning of the 10th month in order to give mothers of infants enough time to complete the last two antigens (measles and yellow fever vaccines) for their infants (Figure 3.1).

Table 3.4: Quality Control for the Study

Research Assistant	Intervention Group (Ibarapa North Local Government Area)	Research Assistant	Control Group (Kajola Local Government Area)
RA 1	Primary Health Centre, Isamuni, Ayete	RA 6	Primary Health Centre, Ijo, Okeho
RA 2	Primary Health Centre, Igbo Osa, Tapa	RA 7	Primary Health Centre, Isia, Okeho
RA 3	Primary Health Centre, Tapa	RA 8	Primary Health Centre, Gbonje, Okeho
RA 4	Primary Health Centre, Oke-Ola, Igangan	RA 9	Primary Health Centre, (Sure P), Bode, Okeho
RA 5	Primary Health Centre (Six-bed), Igangan	RA 10	Primary Health Centre (Sure P), Agbagi, Ilero

As stated earlier, respondents (intervention and control groups) were recruited from 10 Primary Healthcare Centres (PHCs) (five PHCs in each group). They were followed-up to their respective communities by the research assistants assigned to the facilities where they registered their children for immunisation. This was intended to allow for ease of tracing respondents during the end line survey and to ultimately reduce possible attrition.

3.9 Instruments for Data Collection

A mixed method of data collection was adopted for the study.

Both qualitative (Focus Group Discussion sessions and Key Informant Interviews) and quantitative (review of immunisation cards and questionnaire) data were collected. Some of the data collected were triangulated. Mixed methods studies involved integration or combination of the qualitative and quantitative data methods rather than keeping them separate. The basic assumption is that integration leads to maximising the strengths of both qualitative and quantitative data and minimizing their weaknesses (Creswell and Plano Clark, 2011).

Qualitative Data

Focus Group Discussion Guide (for mothers of infants)

During the baseline survey, Focus Groups Discussion (FGD) guide was used as a tool to gain better insight into routine immunisation among mothers of infants who are aged between 0-2 months. Discussion questions focused on knowledge of mothers on immunisation schedules and benefits of full and timely completion of all immunisation were explored. In addition, factors influencing the uptake of routine immunisation such as beliefs, socio-economic factors, misconceptions, and attitudes of healthcare workers to patients were also investigated. Opinion/perception relating to the use of mobile phone through SMS in the delivery of immunisation appointment reminders as well as their suggestions were explored also (Appendix III).

Key Informant Interview Guide (for healthcare workers in the clinic)

Information was collected during baseline survey from healthcare workers (Chief Matron, Local Immunisation Officer and Staff Nurse or Community Health Officer as the case may be) who were directly involved in routine immunisation activities at the Local Government Area level. Key Informant Interview (KII) guide was used to facilitate discussions among these categories of healthcare workers on issues such as misconceptions about routine immunisation commonly held among mothers, socio-economic factors influencing completing all routine immunisation schedules, opinion/perception relating to the use of mobile phone SMS reminders for routine immunisation appointments as well as suggestions for expanding routine immunisation uptake and completion (Appendix IV).

Quantitative Data

Questionnaire (for mothers of infants)

The questionnaire was used to facilitate baseline and end line data collection among mothers of infants in the study areas (intervention and control groups). The questionnaire comprised an introduction, informed consent and eight sections: Section A - socio-demographics: Section B - immunisation status of the index child and Section C - knowledge on routine immunisation. Furthermore, Section D investigated factors influencing immunisation uptake; Section E - attitudes towards immunisation and Section F - mobile phone usage. Section G focused on the adoption of mobile phone SMS for immunisation service delivery by mothers of infants and lastly, Section H explored the influence of SMS reminders on routine immunisation clinic attendance for full and timely completion of basic childhood immunisation (Appendixes IV and V).

Review of Immunisation Card (index child immunisation card)

Routine immunisation proforma was employed in reviewing immunisation cards of all infants whose mothers were involved in the study. The cards were reviewed for completeness of all immunisation or otherwise. The information provided by mothers was authenticated through evidence or observations made from what was recorded in their children's immunisation cards (Appendixes IV and V).

Validity of Instruments

According to Babbie and Mouton (2001), validity refers to the extent to which an empirical measure adequately reflects the real meaning of the concepts under consideration. Several measures were taken to ensure that the instruments were valid. Experts such as medical sociologist, a consultant paediatrician, medical statisticians, an epidemiologist and health promotion and education specialists were consulted to review the instrument for face and content validity. The instruments drawn in English were translated to Yoruba, the language widely spoken in the study sites. Another person who is well versed in both English and Yoruba, to ensure that the instruments were well translated, later translated them back to English. This was done in order not to lose the meaning of the relevant concepts and question items in the instruments in the process of translation.

Prior to their administration, the draft instruments were field-tested for clarity and comprehension among a group of mothers in two LGAs in Oyo State. Pre-test exercise took place in Ibadan North East LGA [urban] and Ibarapa East LGA [rural]. The two LGAs with a comparable population and economic activities as the study sites were randomly selected from urban and rural categories. To determine the effectiveness of instruments for data collection, it is necessary to pre-test them before actually using them. The exercise was also helpful in determining the strengths and weaknesses of the questionnaire concerning question format, wording and order. Visits were made to the two-selected Local Government Areas for the pre-test. Letters of introduction from the department were given to the Directors, Primary Health Care in each of the LGAs. The letters intimated them with the purpose of the research and sought their permission to carry out pre-test in their LGAs. After the permission was granted, PHC facilities to be used were selected and their Matrons were equally contacted immediately.

For qualitative data, two FGDs and two KII were conducted in each LGA. For quantitative data, forty copies of the questionnaire were administered and forty immunisation cards were reviewed. The exercise took two days to be completed. Issues that were observed during the exercise such as the difficulty index, ambiguous statements or words, and misconception of the statement were addressed appropriately. However, the research team noted that the majority of the participants during the pre-test exercise were reluctant in giving their phone numbers for fear which they could not explain.

The results/findings from the pre-test were used in modifying the instruments. Some items were modified while few others that pre-test participants found difficult to comprehend or understand were removed completely from study instrument.

Reliability of Instruments

This study also has external validity, that is, the capacity to be generalised beyond the actual subjects in the study. The measurement of such generalisability of a study is done by statistical tests of inference. According to Babbie and Mouton (2001), reliability refers to whether a particular technique applied repeatedly to the same object, would yield the same results each time. They also stressed that pre-testing of research instruments is one of the sure means of protection against errors in research instruments. The purpose of this is essentially to determine whether the respondents understood questionnaire items. In addition, this will be helpful in determining whether there is a need for revising the format or presentation style of the questionnaire about sequencing and wording of the questions and the need for additional instruction (Araoye, 2003).

The two versions of the instrument i.e. the English and Yoruba versions were pre-tested among respondents in Ibadan North East and Ibarapa East LGAs between 22nd and 25th October 2012. Although Ibadan North East LGA is an urban LGA, the pre-test was done there in order to understand some dynamics in the characteristics of mothers in the urban and rural communities. Ibarapa East Local Government Area has similar characteristics with the study sites in that it is a rural LGA in terms of structure, economic activities, social amenities, infrastructural development, access to health facilities etc. To confirm the reliability of the instrument, analysis of pre-test data was done using Cronbach's Alpha correlation coefficient on IBM/Statistical Package for Social Sciences (SPSS) (http://www.spss.com). Alpha (Cronbach's) is a model of internal consistency, based on the average inter-item correlation. According to this approach, a result that shows a correlation coefficient of greater than 0.05 is reliable. Cronbach's Alpha of the pre-tested questionnaire was 0.804.

3.10 Training of Research Assistants

Research assistants (RAs) were trained three times – before each of the pre-test, baseline and end line surveys. During baseline and end line, twenty RAs and two supervisors were recruited and trained (10 RAs and 1 Supervisor per LGA) for the purpose of this study. Baseline survey training was conducted on July 4, 2014, and end line survey training was conducted on August 7, 2015. A training guide was developed for the exercise and used in training of the research team at pre-test, baseline and end line surveys. The training overall objective was to provide RAs and supervisors with the knowledge and skills required to carry out focus group discussion sessions, key informant interviews and administration of questionnaire for face-to-face interviews accurately and reliably. The training also focused on consistency in how questions are asked and how participants' responses are recorded, the consequences of poor-quality data and problem-solving in the field. The interactive method was adopted during the training and mock interviews were conducted among the team members before data collection. The whole exercise was to assure quality data collection in face-to-face interviews, as there were multiple data collectors sourced for the study.

3.11 Data Collection Process

A mixed method of data collection was used for the study. Both qualitative and quantitative data were collected. Four instruments designed for the study were used for data collection and these are Focus Groups Discussion guide, Key Informant Interviews guide (for qualitative data), questionnaire, and proforma for review of immunisation cards (for quantitative data).

Qualitative data

Focus Group Discussion at Baseline Survey

This was done during a baseline survey and a total of six focus groups discussion sessions were conducted. The sessions were conducted at venues provided by the healthcare workers in the various health facilities. These venues were also conducive for participants to discuss freely as they were free of distraction and noise. Each session lasted for a mean duration of 45 minutes with each session involving a group of discussants ranging from 6–10 mothers of infants who came for routine immunisation service. When contacted after health talk, the mothers indicated a willingness to participate in the discussion. A moderator conducted the discussion sessions, and a note taker documented key points from the discussions verbatim. After providing participants with detailed information on the purpose of the study and assurance of confidentiality of disclosed information, request for permission to use of digital voice recorder was made. Verbal consent was obtained from discussants prior to the commencement of each session. The use of digital voice recorder assisted in capturing all useful information provided during discussion. However, the participants' names were not requested. Instead, numbers were assigned to them for easy identification. The number assigned to each participant was not linked to any identifier but was only used for the discussion purpose only. An observer also monitored the group dynamism, interaction and non-verbal communication that displayed by each group. The discussion was highly interactive as discussants too aired their views on the issues raised for discussion. They were encouraged to feel free to disagree with one another if the need arose though without undermining one another's opinion.

Key Informant Interviews at Baseline Survey

At the baseline survey, six key informant interviews (KIIs) were conducted in the two Local Government Areas. The interviews were conducted among matrons, nurses, community health extension workers, and local immunisation officers. The interviews aimed to elicit information from frontline healthcare workers on the types of challenges mothers of infants faced in terms of routine immunisations in the rural areas, steps taken to overcome these challenges, use of text message reminders on routine immunisation and recommendations/suggestions on what can be done to improve the situation.

When contacted, the frontline healthcare workers consented to be interviewed after adequate information was provided to them and assurance of confidentiality of disclosed information was given. Verbal consents were obtained from them. KIIs were undertaken by experienced interviewers who are competent users of English and Yoruba, the two major languages spoken by government workers in the areas. In order to maintain the confidentiality of the participants, they were informed that their names were not required during the interview and that they should feel free to express their opinions, as no information provided by them will be traced to them. The moderator encouraged participants to speak. They were informed that there were no right or wrong answers. Request for permission for use of digital voice recorder was made with the explanation that the device will assist in capturing all useful information provided during the interviews. Following an introduction and detailed information, interviews were conducted and interviewers made note of verbal and non-verbal communications. The interviews took place in the interviewees' offices where there was little or no distraction. Each KII lasted approximately 50 minutes. The interviews were interactive and the interviewees aired their opinions and made useful suggestions.

Quantitative data

Questionnaire (for mothers of infants)

At baseline, respondents were contacted at the facilities where they came for routine immunisation and invited to participate in the study after enough information about the study was provided to them. Verbal consent was obtained from those who agreed to participate in the study. Research assistants monitored by supervisors and the investigator administered questionnaire designed for mothers of infants.

At the end line, many of the respondents recruited were followed-up to their respective homes. At this stage, interviews were conducted in their home. The questionnaire administration during this stage involved the following steps:

i. Contact tracing of the recruited respondents

ii. Request for assistance on how to locate the respondents that could not be traced to their initial addresses provided

iii. Administration of questionnaire to respondents

iv. Review of the administered questionnaire for completeness

Record review of respondents' children immunisation card

After the intervention, routine immunisation cards of the respondents' children were reviewed. The assumption was that by the end of the intervention, all respondents would have completed their children's routine immunisation appointments and therefore obtained all antigens scheduled for routine immunisation. The routine immunisation card (or vaccination card) is a small card that contains socio-demographic information about the child and his or her immunisation history.

The review of immunisation cards was done during the administration of the questionnaire to mothers of infants. Socio-demographics of index children were obtained as well as their immunisation status. Beyond what the respondents said or reported, evidence, which showed the true immunisation status of the respondents' children, were captured from the routine immunisation card. However, the information in the immunisation card may not be a true reflection on the immunisation status of such child; it is possible that frontline healthcare workers might forget to update the card at every visit or there may be a possibility that mothers left the cards at home. This notwithstanding, information obtained was treated as reflecting the true immunisation status of the child.

3.12 Analytical Framework

The qualitative analysis involved the analysis of qualitative data such as text data or transcripts from FGD sessions and Key Informant Interviews. Unlike quantitative analysis, which is statistics are driven and largely independent of the researcher, qualitative analysis is heavily dependent on the researcher's analytic and integrative skills and personal knowledge of the social context where the data was collected. In this sub-section, emphasis on qualitative analysis is "sense-making" or understanding a phenomenon, rather than predicting or explaining issues such as routine immunisation, attitude of mothers of infants attending RI clinics towards routine immunisation, factors influencing completion of routine immunisation, use of mobile telephone in improving completion of all routine immunisation and willingness of mothers to adopt reminder text messages for reminding mothers about keeping routine immunisation appointments. The themes developed for the analysis around which discussion was based were knowledge about routine immunisation, factors influencing immunisation completion, the attitude of mothers towards routine immunisation, the pattern of use of mobile phones and adoption of mobile phone reminder SMS for improving immunisation service delivery.

Conversely, the numeric data collected for the study were analysed quantitatively using descriptive and inferential statistical tools (Epidata for data entry and IBM SPSS for analysis). Descriptive analysis refers to statistically describing, aggregating, and presenting the constructs of interest or associations between these constructs. Inferential analysis refers to the statistical testing of hypotheses. Data collected from mothers of infants who visited facilities for routine immunisation clinics using a validated questionnaire and record on respondents' children immunisation cards were reviewed.

The five research questions and the hypotheses were subjected to parametric statistics. There are two classes of parametric statistical tests: descriptive and inferential. Descriptive tests revealed the 'shape' of the data in the sense of how the values of a variable were distributed. Inferential tests suggested results from the sample to the population of mothers of infants or women of reproductive age in the rural areas. A distinction was also made between the numbers of variables considered in relation to each other.

Univariate analysis – which analyses the qualities of one variable at a time – was used to answer all research questions through descriptive tests (mean, median and standard deviation).

Statistical test tools such as Chi-square test, t-test and Analysis of Variance (ANOVA) were employed in testing the hypotheses. Inferences were drawn based on the p-value in order to establish whether the results were simply occasioned by chance or that they are truly representative of the population. All the hypotheses that predicted a significant difference between the Intervention Group and Control Group in respect of: (a) knowledge of routine immunisation, (b) attitude towards routine immunisation and, (c) timely completion of full basic immunisation schedules for biological children were tested using a two-tailed t-test, Chi-square test and ANOVA.

Data analysis was done putting into consideration key variables relating to the perception of vulnerability, perception of severity, factors (positive and negative) influencing certain behaviours, cue to action and self-efficacy relating routine immunisation and willingness to use/adoption of text message reminders as conceptualised in the Health Belief Model. These were structured in the research questions and specific objectives and were reported. The report was presented for the two groups at baseline and end line survey. The research questions were answered based on the findings and the hypotheses were tested.

3.13 Data Management and Analysis

Data management is one of the cornerstones of any research. Management of data for this study ensures that the data analyses and reporting were complete, correct, and verifiable i. e. done in such a way that the whole analysis or a part of it can be repeated later. Data entry was carefully performed to ensure that all data captured were accounted for and secured in a passworded computer for analysis. Another important step taken at this stage was ensuring the confidentiality of the data and preventing unauthorised access to these data.

The IBM Statistical Package for Social Sciences (SPSS) version 22 software, which is an integrated software package for data management, analysis, and reporting, was employed for data entry, analysis and documentation. Descriptive and inferential statistical analyses were done using IBM Statistical Package for Social Sciences (SPSS) version 22. SPSS was selected to analyse the data for two important reasons: 1) this software is a flexible package that can accommodate a very large number of variables, and 2) SPSS allows for data management, e.g., adding variables and observations, recoding variables, etc. and graphical utilities. Every data entered into the computer were backed up in external saving devices.

Qualitative Data

Transcription and translation of qualitative information collected through voice recorders from the Yoruba language (the language of the study areas) to the English language were executed. The transcribed documents were word-processed thereafter. The data were then cleaned by reading through them all over and ATLAS Ti® (version 7) software was used to facilitate data analysis. Codes were developed for each of the research tools and entered into software for coding of all the primary documents. After coding of all interviews, outputs were generated for each instrument and these were pooled together. Content analyses of the identified themes were done based on the research objectives of the study which focused on the knowledge about routine immunisation, factors influencing routine immunisation, the attitude of mothers towards routine immunisation, use of the mobile phone in enhancing in improving uptake and completeness of routine immunisation and other suggestions for improving routine immunisation services.

Quantitative Data

Quantitative data were edited and a coding guide/data dictionary was developed for open-ended questionnaire items. This was to facilitate uniformity in data entry, as there were two data clerks. The data collected using the questionnaire were entered into the computer through IBM SPSS. The data were analysed with appropriate parametric and non-parametric tests using IBM SPSS® for Windows version 22. The data were analysed using means, standard deviations, t-tests, Chi-square tests, and analysis of variance.

Guided by the research questions and null hypotheses at $p=0.05$, quantitative data were analysed using descriptive (mean, median, standard deviation) and inferential (Chi-square test, t-test, multivariate analysis) statistics. Analysis and comparison of data were implemented at four levels viz: 1. baseline – assessment of intervention and control groups, 2. end line – assessment of intervention and control groups, 3. comparison of baseline and end line assessment of intervention group and, 4. comparison of baseline and end line of the control group.

Knowledge Scale

Knowledge of routine immunisation was measured on a 25-point scale and 50th percentile was used for categorisation of the scores. Scores ≥ 13 were categorised as good knowledge of routine immunisation while scores less than 13 were classified as poor knowledge.

Attitudinal Scale

Likewise, the attitude of mothers of infants towards routine immunisation was measured on a 7-point scale. Respondents who scored 4 and above were classified as positive attitude, while scores of less than 4, were regarded as a negative attitude.

Record Review of Respondents' Children Immunisation Card

Review of immunisation records from index child immunisation card alongside the administration of the questionnaire was done. This served two purposes: 1. to authenticate the accuracy of information provided by mothers and 2. to document immunisation status of respondents' children at the end of the intervention. Data generated from the cards were matched with responses of respective mothers.

After the analyses, comparison of results of the quantitative and qualitative analysis was triangulated as shown in Figure 3.4.

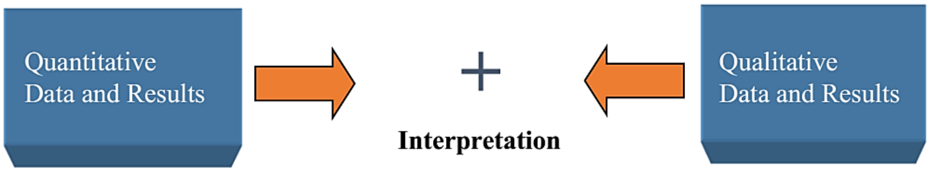

Figure 3.4: Concurrent Triangulation Design

3.14 Ethical Considerations

The study followed the basic ethical principles guiding research involving human participants. Ethical approval was obtained from the Oyo State Research Ethical Review Committee, Ministry of Health, Secretariat, Ibadan (Appendix V). Adequate information regarding the purpose of the study was provided in their local language to mothers of infants who came to routine immunisation clinics. They were also informed that participation in the study was voluntary. Among mothers of infants who indicated interest to participate in the study, informed consent was obtained. Efforts were made to protect the privacy of the respondents and they were assured of the confidentiality of the information they provided. Additional information on ethical considerations for this study is provided in Appendix VI.

3.15 Limitation of the study

The study also had several limitations. First, the study was limited by its small sample size as evidenced in the high attrition rate in both the Control and Intervention groups. Monitoring mechanism was put in place to ensure that the text messages were delivered to the respondents in the Intervention Group and almost all of them received the reminder SMS. Despite that, many of the respondents were neither available to complete the immunisation schedule for their children nor available to complete the study. Many 'mothers' from the study site migrated to urban centres where their business activities were located. It was observed that most of the so-called mothers in these communities were not legally married; they got pregnant and left the community after delivery. Several attempts were made to reach those who were reachable through phone calls. Despite that, they could not leave their businesses to be a part of a research project in which they are enrolled.

Secondly, although there are records of reminder text messages being delivered successfully, the investigator could not verify beyond the reports given by the respondents whether the reminder text messages were received, opened and read, or relayed to them in the case of reception by significant others who received reminder text messages on their behalf. Information on those activities would be useful for per protocol analyses, although it is not important for this quasi-experiment, which was designed to investigate the effectiveness of the intervention. The information provided by respondents was taken as the truth since there are no other means of validating information provided. It could be suggested that poor socio-economic status was largely responsible for the high attrition rate in the two study sites.

Another factor that constituted a challenge to the study was the federal government intervention programme known as Subsidy Reinvestment and Empowerment Programme (SURE-P). The programme was being implemented in three of the five health facilities used for the study as Control. The programme was not considered at the initial stage of the study. The SURE-P MCH Project provides a unique opportunity to focus on increasing access to maternal and child health services through the continuum of care for pregnant women and their newborn (National Primary Health Care Development Agency, 2015). Through this programme, mothers were provided with the basic items they needed for delivery of their babies and were allowed to visit the facilities whenever the felt the need to do so. The incentive structures provided by the programme motivated mothers to always visit the facilities; it provided a number of incentive mechanisms that motivated mothers to always return to the clinic. This had a very strong effect on the outcome of the study. Therefore, SURE-P was a major contaminant in the Control group. Little or nothing could be done about this as baseline data were collected before this discovery.

Another challenge was the ease with which SIM card is acquired. It was found that some respondents changed their SIM cards often. That made it difficult to reach them with the reminder text messages. Furthermore, the use of house number for contact tracing in the two study sites was difficult. The areas are primarily rural where houses are identified by compound name instead of house number. As a result, some of the respondents could not be located.

It was also observed that many of the community members especially those who were recruited into the study at the Intervention sites were reluctant at some point during monitoring until end line data were collected. Efforts made to understand the reasons for their reluctance revealed that a non-native was murdered in a community for ritual purposes. The incident made everyone in the community to be apprehensive especially towards strangers. It was also found that some community members were indebted to some micro-finance banks. As a result, they went into hiding. All these, which were beyond the control of the researcher, largely, affected the outcome of the intervention. Efforts were made to persuade some respondents that the research has nothing to do with banking or commercial activities. Few gatekeepers such as primary health care workers, leaders of commercial motorcycle riders and transporters were contacted to speak with community members on the purpose of the study. This yielded little success.

CHAPTER FOUR

RESULTS

4.1 Baseline Assessment of Control and Intervention Groups

Qualitative findings

Respondents' Knowledge about Routine Immunisation

Routine immunisation knowledge items assessed at baseline were related to vaccine-preventable diseases, immunisation schedule, benefits of immunisation etc. This section highlights qualitative findings on respondents' knowledge about routine immunisation. Opinions and views show a similar trend across intervention and control groups in this regard, indicating that some discussants have low knowledge of routine immunisation. Few participants across the two study sites were able to explain correctly, what routine immunisation means; many of them could not explain what routine immunisation means correctly. Below are some of the views shared by some discussants:

> *"Immunisation gives children strength and protects them from unwanted diseases such as polio".* (A participant in the control group)

> *"Immunisation is good for children and it is good to complete it"* (A participant in the intervention group)

> *"Immunisation is good and is important because it protects and prevents children from diseases".* (A participant in the control group)

> *"Immunisation is good for the infants such that it protects children from leprosy, malaria, yellow fever etc."* (Another participant in the control group)

Most discussants correctly explained the routine immunisation schedule and identified the recipients of the antigens. However, some diseases which routine immunisation antigens were not meant for were mentioned. According to some of the discussants:

> *"Routine immunisation prevents malaria, typhoid, tuberculosis, leprosy, body ache, yellow fever, catarrh, measles and tetanus".* (A mother in the Control group)

"Immunisation prevents malaria, yellow fever, measles and temperature". (A participant among the Intervention group)

"It prevents polio, 'arun eyi', it prevents cholera, it prevents eye problem" (A mother among the Intervention group)

Most discussants indicated that routine immunisation is beneficial to children in that it makes them healthy and prevents them from being infected with 'diseases'. According to some of the discussants:

"It will make the child healthy"

"It will prevent the child from being infected with diseases" (Two mothers in the Control group)

"It protects and prevents the child from contracting diseases" (A participant in the Intervention group)

Similar opinions were also expressed in the two groups on the consequences of failure to receive or complete immunisation. According to some of the discussants, when mothers fail to complete routine immunisation, their children are prone to some diseases, which can affect their health. As some of the discussants pointed out:

"It can result in lack of strength for the child to grow when he/she ought to. The child might be prone to measles. However, when the child receives immunisation, it may not occur or reduce the effect of measles on the child". (A mother among the Intervention group)

"It will make the child sick or contracting diseases like leprosy and malaria". (A participant, Control group)

"It will make the child unhealthy". (A participant, Intervention group)

"Consequences of failure to immunise a child is that unwanted sickness could spring up". (A participant in the Control group)

The discussants expressed as well similar views on what mothers with sick children who are due for another shot of routine immunisation should do. When asked whether a sick child should be immunised or not, most discussants displayed poor knowledge of how to handle the situation. Most discussants were of the opinion that a sick child should not be brought for immunisation. They also pointed out that the sick child could take the immunisation when he or she gets better. A few discussants added further that whenever such happens, the healthcare workers do reprimand them for missing immunisation appointments. According to some discussants:

> "*If the immunisation is missed, then we try to take it the following week. The health facility does ask why we missed it and they will give it to the child if it is available on the day*". (A mother in the Control group)

> "*The head of the facility will blame us for not bringing the child and then ensure that the child receive the immunization*" (Another participant among the Control group)

> "*They always talk, they will talk and ask us why we did not come on the appointment date, and then we will explain to them.*" (A participant in the Intervention group)

However, few discussants have a different opinion. They pointed out that efforts are made to make sure the sick child gets the immunisation he or she is due for. According to one of the discussants:

> "*She ought to bring the child for immunisation no matter the situation. They will give him/her adequate care or drug*" (A mother in the Intervention group)

> "*We do make sure that they were given*" (A mother in the Control group)

Factors Influencing Routine Immunisation Uptake and Completion

During FGD sessions, participants were asked to share their opinions and views on the factors influencing routine immunisation uptake and completion among mothers. When asked about the factors that encouraged mothers to take their children for routine immunisation, some discussants were of the view that attention received whenever they attend routine immunisation appointments encouraged them to keep future appointments. According to some discussants:

> "*They take care of and attend to our children on time; the attitude of the health workers towards us in correcting us is good, encouraging us etc.*" (A participant in the Intervention group)

"*They play with us and correct us with love and jokingly ask us why we come late. Sometimes, they ask us to sing and they play with our children and dance*". (A participant, Control group)

Few other discussants explained that the health talk and health education provided during routine immunisation clinics always encouraged them to keep routine immunisation appointments. In some of the discussants' words:

"*We are always encouraged by the various songs and words of encouragement and pieces of advice given by the health workers on how to take good care of our children*". (A participant in the Control group)

"*Because the health workers always educate us on something we do not know or understand about child health*". (A participant in the Control group)

Some of the barriers that are likely to militate against completion of all routine immunisation schedules mentioned by discussants are side effects of vaccination, forgetfulness, distance, negative experience of mothers on previous immunisation and negative attitude of some healthcare workers. According to some discussants:

"*The swelling of the injected part (the hand) normally discourages some mothers before, but not now, some don't have time*". (A participant in the Intervention group)

"*Some mothers do complain of the side effects they experienced when the child is immunised and this, as a result, discourage them from completing the immunisation*". (A participant in the Control group)

"*When mothers do not remember the time or date of next immunisation . . .*" (A mother in the Intervention group)

"*Distance barrier*". (A participant in the Control group)

"*If the child reacts to the immunisation negatively as in having side effects . . .*" (Another participant in the Control group)

"*If the health workers failed to attend to the mothers appropriately . . .*" (A participant in the Intervention group)

However, few discussants expressed the view that there are no barriers to mothers completing all routine immunisation. According to one of these discussants:

"*No, no barriers.*" (A participant in the Intervention group)

"*No, they don't delay or waste time at all; they answer us as we come*". (Another participant in the Intervention group)

There were divergent opinions on ways of identifying mothers who are likely to complete all routine immunisation. Some discussants were of the view that when mothers who do not come to routine immunisation clinics are invited and see how children who are immunised grow and look healthy, they might be encouraged to attend the clinic.

"*If the mothers who fail to present their children witness and see children that have completed the immunisation and how healthy they are, this will push them to complete immunisation for their children*". (A participant in the Control group)

Some discussants also opined that the experience of mothers at the initial stage would predict whether they are likely to complete all immunisation or not. One of the discussants noted that:

"*The reaction of the mothers towards the immunized child will tell. For instance, a mother might not be pleased with the cry of his/her child when being given injection*". (A participant in the Intervention group)

It is to be noted that some other discussants were of the view that it will be difficult to identify mothers who are not likely to complete their children's routine immunisation. According to a few of them:

"*We cannot recognize them unless if they signify.*" (A participant in the Intervention group)

"*We don't know.*" (A participant in the Control group)

Adoption of Reminder SMS for Routine Immunisation Service Delivery

Discussants were asked about their opinions on the possibility of using mobile phones SMS to remind mothers about routine immunisation appointments. Most discussants were of the opinion that mobile phones can be used to remind mothers about their next routine immunisation appointments. They pointed out that sending reminder text messages to mothers about the next immunisation appointments of their children will help a lot in ensuring full and timely completion of all routine immunisation schedules. According to some discussants:

> "*We would be happy if the government can uptake this.*" (A participant in the Control group)

> "*It will help a lot.*" (A participant in the Control group)

> "*It is good.*" (A participant in the Intervention group)

When asked about the timing and frequency of the messages, discussants differ in their opinions on this. According to some of them, such messages could be sent to remind mother a week before the routine immunisation day, while others were of the view that reminder messages could be sent to mothers a day before the date and the morning of the routine immunisation day. Below are some of the views expressed by the discussants:

> "*Messages could be sent as they wish*". (A mother in the Intervention group)

> "*It could be sent a week before the date*". (A participant in the Control group)

> "*The messages could be sent in the night before the immunisation day*". (A participant in the Intervention group)

> "*It could be sent on the immunisation day (morning)*". (A participant in the Control group)

> "*Messages could be sent at night, around 6.00 p.m.*". (A participant in the Intervention group)

When asked on the frequency and timing of messages to be sent, discussants suggested that messages could be sent to mothers as those in charge deem fit. One of the discussants pointed out that:

> *"As they wish, the message should be presented or sent".* (A participant in the Intervention group)

> *"Messages can be sent to mothers like two times".* (A participant in the Intervention group)

> *"Well, I feel messages could be sent before that day and early in the morning of the day".* (A participant in the Intervention group)

> *"Twice in a week (Monday and Tuesday)".* (A participant in the Control group)

"The message could be sent on Monday night as a reminder and on Tuesday morning before the clinic day". (A participant in the Control group)

However, there was a consensus among the discussants on the most appropriate language to use in sending reminder messages to the mother. Most participants were of the view that either Yoruba or English can be used in sending SMS to mothers. According to one of the participants:

"*The message could be in Yoruba or English can be used depending on the individuals*". (Participants in both the Intervention and Control group)

Below are some suggestions made by discussants on the type and sample of messages, which could be sent to mothers:

"*The message format could be typed this way: "be prepared for your child's immunisation today*". (A participant in the Control group)

"*Do not forget next week is immunisation*". (A participant in the Intervention group)

"*Hello, I hope you did not forget your appointment date*". (A participant in the Control group)

Opinions of mothers of infants were sought on the means through which healthcare workers in the facilities remind them of immunisation appointments. Specifically, they were asked also whether healthcare workers use mobile phones to contact mothers about immunisation. The general response was that healthcare workers have not been using mobile phones to remind them of their next routine immunisation appointments. Some discussants who expressed this view were quoted below:

"*They do not use their mobile telephone to contact us on the issue relating to immunisation*". (A participant in the Intervention group)

"*They don't use their mobile telephones to remind or contact us about immunisation*". (A participant in the Intervention group)

"*We know the date of next immunisation through the card they gave us in the clinic*". (A mother in the Control group)

In-Depth Interviews with Frontline workers

Frontline healthcare workers working within the health facilities in the study areas expressed their opinions on some issues relating to routine immunisation uptake in their facilities as well as their dispositions to the use of mobile phone reminder SMS to assist mothers in the completion of routine immunisations for their children.

According to some participants interviewed factors, which they felt, were responsible for mothers of infants not bringing their children for routine immunization were multifaceted. Among these factors are care-free attitude, low level of knowledge, lessness,

> "*They are lazy; mothers are lazy in bringing their children to the facility for immunisation*". (A Community Health Extention Worker in the Intervention site)

> "*One of the factors is the attitude of the mothers and secondly, epileptic power supply to freeze the vaccines*" (A Monitoring and Evaluation Officer, in the Control site)

> "*Attitude of the mothers, for example, they complained of no money to transport themselves to the clinic and again, the challenges on the part of health workers (rather, health facility) due to unavailability of vaccines*" (A Chief Matron in the Control site)

Efforts made in the facility to reduce each of these problems

> "*We send our Health Assistants who know their house to inform them to come to the clinic that we are expecting them. If we did not see any of them during the clinic day, we check from the register and ask someone who knows the mother's house to check on her*". (A Community Health Extention Worker in the Intervention site)

> "*Liaising with the community leaders to sensitize them*" (A Chief Matron in the Control site)

Efforts made in the facility when mothers of infants fail to present their children for routine immunization as at when due

> "*Each time we noticed that the mother failed to turn up whenever they come to the clinic, we do advise and encourage them on the need to take it so imperative and bring their children for immunisation*" (A Monitoring and Evaluation Officer, in the Control site)

> "*We do embark on a home visit to know where the problem lies*". (A Matron in the Control site)

> "*We visit at home or send their husbands to them whenever we them on the room*". (A healthcare worker in the Intervention site)

On the outcome of these efforts, some healthcare workers noted,

> "*Infants mothers have been coming regularly and promptly*" (A healthcare worker in the Control site

> "*The outcome of this effort is that some mothers do turn up at the facility to bring their children for immunisation, about 70% do turn up eventually*" (A healthcare worker in a facility at Intervention site)

Suggestions for improving immunisation in this facility

> "*I am encouraging the government to always ensure that routine immunization is being sponsored and financed regularly. Moreover, the government should try to provide more staff to replace those that have retired from the service*" (A Matron in the Control site)

> "*First and foremost, the State government should help to give geostat that is needed here. Secondly, the government should provide solar freezer to solve the problem of poor power supply, recruitment of more qualified staff, engaging staff in training and workshop to make them more effective and efficient*" (A Monitoring and Evaluation Officer, in the Control site)

> "*Maybe government can supply petty things that can attract mothers to compensate them so they can always come back to the clinic to complete their immunisation. That will always entice other mothers too*" (A healthcare worker in a facility at Intervention site)

Use of mobile telephone and SMS in health care service delivery

When asked whether healthcare workers use their personal mobile phone in reminding mothers about immunisation clinic appointment either through phone calls or reminder SMS, most healthcare workers pointed out that their mobile phone is used for personal communication and no mother is reminded of their clinic appointment through that medium. As noted by some participants interviewed,

> "*Health workers use their phone for personal things since they are the owner; they choose to use it for what pleases them. I don't use my phone to remind when they come for the clinic today, we used to inform them of their next appointment*". (A healthcare worker in a facility at Intervention site)

4.2.1 Socio-Demographic Characteristics of Respondents

This chapter highlights the results of both qualitative and quantitative data collected from baseline and end line surveys. They are presented based on the specific objectives of the study. The first section highlights findings from FGD sessions and the baseline survey in both the experimental and control groups.

Almost all the respondents (98.4%) in the Control group and all the respondents (100%) in the Intervention group were married at baseline. Most respondents (66.3% and 66.5%) in Control and Intervention groups respectively were of the Islamic faith. More than half of the respondents in the Control group (59.9%) and 64.2% of those in the Intervention group had secondary education while only 17.1% and 5.6% in the Control and Intervention groups respectively had a university education. In terms of occupation, 43.9% of the respondents in the Control and 52.5% in the Intervention groups were traders. Those who were artisans were 28.3% and 36.3% in the Control and Intervention groups respectively.

Furthermore, majority of the respondents in the two groups were Yoruba (Control 94.7%, Intervention 96.6%). Most respondents, 33.7% and 39.7% of the Control and Intervention groups respectively were within the 21-25-year age bracket. They were followed by respondents in the 26-30-year age bracket with 29.4% in the Control group and 24.6% in the Intervention group. Most respondents, 64.7% and 72.2% of the Control and Intervention groups respectively, gave birth to more than one child alive. In addition, most respondents (Control group, 59.9%; Intervention group, 63.7%) currently have 1-2 children. Most respondents (Control group, 33.2% and Intervention group, 39.1%) were within 21-25 years' age bracket when they gave birth to the index child. Within the Control group, most respondents indicated that health workers (75.4%), media (48.7%) and friends and neighbours (35.3%) were their sources of information on routine immunisation. However, among the Intervention group, health workers (20.7%) and spouse (20.1%) were reported to be their major sources of information. More than half of the index children were male, 51.3% and 52.5% for Control and Intervention groups respectively. Among the respondents in the Control group, most index children (36.4%) were first born. However, among the respondents in the Intervention group, most index children (34.6%) were second born (Table 4.1).

Table 4.1: Frequency distribution of Respondents Socio-Demographic Characteristics

Demographic Characteristics	Control (N=187)		Intervention (N=179)	
	№	%	№	%
Marital status				
Married	184	98.4	179	100
Others	3	1.6	0	0
Religion				
Christianity	63	33.7	60	33.5
Islam	124	66.3	119	66.5
Highest education background				
No formal education	3	1.6	5	2.8
Primary education	40	21.4	49	27.4
Secondary education	112	59.9	115	64.2
Tertiary education	32	17.1	10	5.6
Main occupation				
Trader	82	43.9	94	52.5
Civil servants	19	10.2	4	2.2
Artisan	53	28.3	65	36.3
Farmer	3	1.6	5	2.8
Unemployed	1	0.5	4	2.2
Health worker	13	7.0	1	0.6
Full house wife	13	7.0	5	2.8
Apprentice	1	0.5	1	0.6
Average income from all sources				
<N10000	116	62.0	84	57.9
N20000-N29000	55	31.3	54	37.2
N30000-N39000	9	5.1	3	2.1
N40000-N49000	1	0.6	0	0
N50000-N59000	4	2.3	4	2.8
>=N60000	2	1.1	0	0

Ethnic group				
Hausa	1	0.5	1	0.6
Igbo	8	4.3	1	0.6
Yoruba	177	94.7	173	96.6
Others ††	1	0.5	0	0
Age as at the last birthday				
<=20 years	25	13.4	42	23.5
21-25 years	63	33.7	71	39.7
26-30 years	55	29.4	44	24.6
31-35 years	26	13.9	15	8.4
>35 years	18	9.6	7	3.9
Mean age (in years)	27.1		25.1	
SD	5.8		5.4	
Number of children given birth to alive				
One child	66	35.3	49	27.4
More than one child	121	64.7	130	72.6

Table 4.1: Frequency distribution of Respondents Socio-Demographic Characteristics (cont'd)

Demographic Characteristics	Control (N=187)		Intervention (N=179)	
	№	%	№	%
Number of children currently have				
1-2	112	59.9	114	63.7
3-4	54	28.9	54	30.2
≥5	21	11.2	11	6.1
Number of children less than 12 months (in case of multiple births)				
1	186	99.5	165	92.2
2	2	0.5	14	7.8
Age when this child was born				
≤20 years	29	15.5	34	19.0
21-25 years	62	33.2	70	39.1
26-30 years	52	27.8	48	26.8
31-35 years	28	15.0	19	10.6
>35 years	16	8.6	8	4.5
Mean age	26.9 years		25.7 years	
SD	6.0 years		5.6 years	
Source of information on immunisation †††				
Health workers	141	75.4	37	20.7
Public announcement/town crier	25	13.4	1	0.6
Church and mosque	26	13.9	0	0
Media	91	48.7	16	8.9
Friends and neighbours	66	35.3	2	1.1
Spouse	14	7.5	36	20.1
Self-awareness	1	0.5	19	10.6
Sex of the index child				

Male	96	51.3	94	52.5
Female	91	48.7	85	47.5
Index child birth order				
First	68	36.4	51	28.5
Second	43	23.0	62	34.6
Third	27	14.4	34	19.0
Fourth	28	15.0	21	11.7
Others††††	38	20.3	11	6.1

† Others include singles and separated
†† Others include Egede
††† Multiple responses
†††† Others include mothers with more than four children

4.2.2 Respondents' Children Immunisation Status

At the baseline stage, most of the respondents reported that their children did not receive the following vaccines: DPT 2, DPT 3, OPV 2, OPV 3, HBV 1, HBV 2, HBV 3, Pentavalent, Measles and Yellow fever. Most mothers in the two groups have immunised their children with age-specific antigens. For examples, 96.8%, 31.6% and 86.1% mothers in the control group reported having immunised their children with BCG, DPT1 and OPV1 antigens respectively. Likewise, in the Intervention group, 87.7%, 26.1% and 64.2% mothers reported having immunised their children with BCG, DPT1 and OPV1 antigens respectively. Only a few mothers in the two groups (Control group, 6.4%; Intervention group, 3.4%) reported having missed at least one immunisation appointment (for details, Table 4.2).

Table 4.2: Respondents' Children Immunisation Status

Vaccine Received	Control (N=187)				Intervention (N=179)			
	Reported		Observed		Reported		Observed	
	Yes	No	Yes	No	Yes	No	Yes	No
	%	%	%	%	%	%	%	%
BCG	96.8	3.2	95.2	4.8	87.7	12.3	74.9	25.1
DPT 1	31.6	68.4	29.9	70.1	26.3	73.7	17.4	82.6
DPT 2	1.6	98.4	2.1	97.9	4.5	95.5	3.9	96.1
DPT 3	5.9	94.1	5.9	94.1	0.6	99.4	1.7	98.3
OPV 0	86.1	13.9	86.6	13.9	35.8	64.2	40.2	59.8
OPV 1	33.2	66.8	33.2	66.8	15.1	84.9	17.9	82.1
OPV 2	1.6	98.4	2.1	97.9	3.9	96.1	3.9	96.1
OPV 3	0.0	100	0.0	100	0.6	99.4	1.1	98.9
HBV 1	19.3	80.7	18.7	81.3	0.6	99.4	7.3	92.7
HBV 2	0.0	100	0.0	100	0.6	99.4	0.0	100.0
HBV 3	1.6	98.4	1.6	98.4	0.6	99.4	0.0	100.0
Pentavalent	44.4	55.6	43.3	56.7	14.5	85.5	17.9	82.1
Measles	0.5	99.5	0.5	99.5	2.8	97.2	2.8	97.2
Yellow Fever	0.0	100	0.0	100	0.0	100.0	0.0	100.0

Table 4.2: Respondents' Children Immunisation Status (cont'd)

Variable	Control (N=187)		Intervention (N=179)	
	№	%	№	%
Missed any immunisation				
Yes	12	6.4	6	3.4
No	175	93.6	173	96.6
Reason for missing immunisation **				
Mother not around	7	58.3	6	100
Not aware	2	16.7	0	0
Spouse did not allow	1	8.3	0	0
Experiences had immunising children **				
It prevents diseases	38	20.3	67	37.4
Baby crying and weak	13	7.0	36	20.1
Child had high temperature	30	16.0	18	10.0
Makes the child grow stronger and healthy	176	94.1	39	21.8
Weight loss and side effect pain	6	3.2	1	0.6
No adverse reaction	8	4.3	10	5.6
Baby fall sick	2	1.1	1	0.6
They have convulsion	0	0	0	0
Swelling	1	0.5	7	3.9
Loss of appetite	2	1.1	0	0
Fearful and crying	2	1.1	0	0
Heard about immunisation for children less than 12 months				
Yes	121	64.7	144	80.4
No	66	35.3	35	19.6
Know routine immunisation order				
Yes	32	17.1	112	62.6
No	155	82.9	67	37.4
	Correct %	**Incorrect %**	**Correct %**	**Incorrect %**
BCG - At birth	23.0	77.0	64.8	35.2
DPT- 6, 10 and 14 weeks after birth	13.4	86.6	36.9	63.1
Hepatitis B- At birth, 10 & 16 weeks after birth	11.2	88.8	47.5	52.5
OPV (Polio) - 6, 10 and 14 weeks	15.0	85.0	45.3	54.7
Measles – 9 months	7.0	93.0	27.9	72.1
Yellow fever – 9 months	5.9	94.1	27.4	72.6
Pentavalent – 6, 10 and 14 weeks	7.0	93.0	34.1	65.9

** Multiple responses

4.2.3 Respondents' Knowledge about Routine Immunisation

In the quantitative survey, routine immunisation knowledge was measured on a 25-point knowledge scale. At baseline, the mean knowledge score for the Control and Intervention group were 10.3±3.5 and 9.3±2.5, respectively. Other patterns of responses to these knowledge items were presented in Table 4.3. The details of the knowledge scores among the respondents in the Control and Intervention groups were presented later in the chapter and in the testing of hypotheses section.

Table 4.3: Respondents' Knowledge about Routine Immunisation

Diseases preventable by vaccines	Control (N=187)				Intervention (N=179)			
	Without Prompting		With Prompting		Without Prompting		With Prompting	
	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %
Malaria	66.3	33.7	33.2	66.8	79.9	20.1	24.6	75.4
Tuberculosis	51.9	48.1	46.5	53.5	53.6	46.4	50.3	49.7
Measles	53.5	46.5	45.5	54.5	54.7	45.3	46.9	53.1
Yellow fever	41.2	58.8	48.1	51.9	46.9	53.1	50.8	49.2
HIV	20.3	79.7	27.8	72.2	15.6	84.4	59.8	40.2
Poliomyelitis	48.1	51.9	49.2	50.8	51.4	48.6	46.4	53.6
Whooping cough	36.9	63.1	61.5	38.5	41.9	58.1	57.5	42.5
Tetanus	36.9	63.1	58.8	41.2	18.4	81.6	77.1	22.9
Diarrhoea	31.0	69.0	55.6	44.4	25.7	74.3	71.5	28.5

Table 4.3: Respondents' Knowledge about Routine Immunisation (cont'd)

Variable	Control (N=187) №	%	Intervention (N=179) №	%
Advantages of routine **				
It prevents children from all diseases	133	71.1	112	62.6
It makes them strong and fit	51	27.3	52	29.1
Makes the child sick and increase temperature	34	18.2	0	0
It makes the child fearful	38	20.3	0	0
Prevent them from malaria	25	13.4	15	8.4
Disadvantages with immunising infants **				
Children run temperature after immunisation	145	77.5	51	28.5
Some children fell ill/sick and unable to sleep	34	18.2	67	37.4
It makes some part of the body swollen with pus	8	4.3	5	2.8
It makes children fearful and cries	39	20.9	56	31.3
Loss of weight	1	0.5	0	0
Time of the day a child should be immunised				
Morning	185	98.9	168	93.9
Afternoon	0	0	0	0
Anytime	2	1.1	7	3.9
Have no idea	0	0	4	2.2
A sick child can be immunised				
Yes	138	73.8	73	40.8
No	49	26.2	106	59.2
Immunisation is healthy for a child				
Yes	182	97.3	175	97.8
No	5	2.7	4	2.2
Getting a child immunised for a particular disease prevents that child from that disease				
Yes	181	96.8	175	97.8
No	6	3.2	4	2.2
A child running temperature should be immunised				
Yes	136	72.7	66	36.9
No	51	27.3	113	63.1

** Multiple responses

4.2.4 Factors Influencing Routine Immunisation Uptake and Completion

At baseline, respondents mentioned some factors that can encourage mothers to complete routine immunisation for their children. Key among the factors mentioned by respondents in the Control group were availability of healthcare worker and services (45.5%), reminders through announcements in churches and mosques and other public places (38.0%), attachment of incentives to immunisation (39.0%), and mother's awareness of next routine immunisation appointment date (11.2%). In the Intervention group, knowing the benefits of immunisation (29.6%), availability of healthcare worker and services (43.6%), reminders through announcements in churches and mosques and other public places (13.4%), and mother's awareness of next routine immunisation appointment date (11.2%) were the major factors mentioned.

The factors that prevent mothers from completing routine immunisation for their children were classified into three major categories namely: lack of information, lack of motivation, and obstacles. On the issue of lack of information, most respondents in the Control group reported that when mothers are unaware of the need for immunisation (83.4%), unaware of the need to return for 2nd and 3rd doses of vaccine (83.4%), do not know the time of immunisation (77.0%), fear side effects/adverse reactions (82.4%), have wrong ideas about contraindications (82.4%), or when immunisation is postponed until another time (86.6%), they are not likely to complete all immunisation schedules. Similarly, in the Intervention group, respondents indicated that mothers are unlikely to complete routine immunisation schedules when they are unaware of the need for immunisation (60.9%), not aware of the need to return for 2nd or 3rd dose of antigen (56.4%), do not know the time of immunisation (44.7%), fear side effects/adverse reactions (58.1%) or have wrong ideas about contraindications (46.4%).

The factors that were classified as lack of motivation— which may discourage mothers from completing the immunisation schedules of their children— by respondents in the Control group include postponement of immunisation to another day (86.6%), lack of faith in immunisation (49.2%), and rumours (79.1%). In the same vein, respondents in the Intervention group reported that postponement of immunisation to another day (48.0%), lack of faith in immunisation (44.7%), and rumours (40.8%) are among the factors that may discourage mothers from completing the immunisation schedules of their children.

Furthermore, respondents in the Control group indicated that the following factors as constituting obstacles to completion of routine immunisation schedules: when the venue of immunisation is too far (79.1%), the time of immunisation is not convenient (77.5%), the vaccinator is absent (87.7%), vaccine is not available (88.2%), mothers are too busy (57.8%), there are family problems (73.3%), the child is sick (70.6%), sick child was taken to the clinic but was not vaccinated (73.8%), long time of waiting at the clinic before being attended to (85.0%), and attitude of health workers (77.0%). Likewise, the following are the key factors indicated by respondents in the Intervention group as constituting obstacles to completion of routine immunisation schedules: when the time of immunisation is not convenient (54.7%), the vaccinator is absent (50.3%), vaccines are not available (62.0%), mothers are too busy (70.9%), there are family problems including mother's illness (64.8%), the child is ill (68.7%), and the sick child was taken to the clinic but was not immunised (64.2%) (Table 4.4).

Table 4.4: Factors Influencing Routine Immunisation Uptake and Completion

Variable	Control (N=187)		Intervention (N=179)	
	№	%	№	%
Factors which make mothers complete immunisation for their infants**				
Knowing the benefits of immunisation	18	9.6	53	29.6
Mothers awareness of next appointment date	21	11.2	20	11.2
When health workers and services are available	85	45.5	78	43.6
Reminder through announcements in churches and mosque and other public places	71	38.0	24	13.4
When incentives are attached to immunisation	73	39.0	3	1.7
Support from spouse	25	13.4	1	0.5
If the services are free	1	0.5	0	0
Factors which prevent mothers to complete immunisation for their children less than 12 months (Reason)	**Yes %**	**No %**	**Yes %**	**No %**
Unaware of the need for immunisation	83.4	16.6	60.9	39.1
Unaware of the need to return for 2nd or 3rd dose	83.4	16.6	56.4	43.6
Don't know time of immunisation	77.0	23.0	44.7	55.3
Fear of side effects/adverse reactions	82.4	17.6	58.1	41.9
Wrong ideas about contraindications	82.4	17.6	46.4	53.6
Postponed until another time	86.6	13.4	48.0	52.0
No faith in immunisation	49.2	50.8	44.7	55.3
Rumours	79.1	20.9	40.8	59.2
Place of immunisation too far	79.1	20.9	43.6	56.4
Time of immunisation not convenient	77.5	22.5	54.7	45.3
Vaccinator absent	87.7	12.3	50.3	49.7
Vaccine not available	88.2	11.8	62.0	38.0
Mother too busy	57.8	42.2	70.9	29.1
Family problems including illness of the mother	73.3	26.7	64.8	35.2
Child ill, not brought to the clinic	70.6	29.4	68.7	31.3
Child ill, came but not given immunisation	73.8	26.2	64.2	35.8
Long waiting time	85.0	15.0	42.5	57.5
Attitude of health workers	77.0	23.0	41.9	58.1

** Multiple responses

Table 4.4: Factors Influencing Routine Immunisation Uptake and Completion (cont'd)

The most cogent of the reasons given	Control (N=187)		Intervention (N=179)	
	№	**%**	**№**	**%**
Mother too busy or sick	18	9.6	46	28.8
Unavailable of vaccine, health workers, and their attitude	43	23.0	45	28.1
Place and time of immunisation unknown	12	6.4	9	5.6
Wrong idea or rumour about immunisation	8	4.3	13	8.1
Family and work problem	3	1.6	7	4.5
Long waiting time	32	17.1	2	1.3
Problem of electricity	0	0	5	3.1
Fear of side effect on the baby	6	3.2	14	8.8
No or not aware of the need for it	22	11.8	4	2.5
Fear of side effect	9	4.8	1	0.6
Sick child	6	3.2	14	8.8

4.2.5 Respondents' Attitude towards Routine Immunisation

Attitudinal dispositions of respondents at baseline in both Control and Intervention groups towards routine immunisation were measured on a 7-point attitudinal scale. At baseline, the mean attitude score of respondents in the Control and Intervention group was 5.8 ± 1.3 and 5.3 ± 1.3, respectively. The pattern of responses to attitude statements and other details on respondents' attitude scores were presented in Table 4.5.

Table 4.5: Respondents' Attitude towards Routine Immunisation

Attitude Statement	Control (N=187) SA %	A %	D %	SD %	Intervention (N=179) SA %	A %	D %	SD %
Trust the safety of the vaccines used for immunising children	82.4	15.5	1.1	1.1	87.7	12.3	0.0	0.0
The notion that local herbs, "*agbo*", can equally prevent diseases for which children are vaccinated against	11.8	17.1	27.3	43.9	5.6	22.3	15.6	56.4
Whether a child is immunised or not, he will still fall sick of any of the vaccine-preventable diseases	7.5	44.4	27.3	20.9	15.6	16.2	40.2	27.9
Mind not at peace with immunisation, feel it is dangerous to children's health and wellbeing	13.9	4.8	52.4	28.9	5.6	7.8	29.1	57.5
Immunisation makes children sick, so it is not necessary for them	7.5	3.2	52.4	36.9	3.4	7.3	31.8	57.5
It is necessary to immunise children against any vaccine-preventable diseases, prayer to and faith in God is not enough to protect	32.1	23.0	20.3	24.6	40.2	28.5	10.1	21.2
Once a child is immunised, the child is safe and free from vaccine-preventable diseases	77.5	18.7	2.7	1.1	79.3	12.3	1.1	7.3

4.2.6 Usage of Mobile Phone by Respondents

At baseline, all respondents both in the Control and Intervention groups owned at least one mobile phone. This was one of the criteria for inclusion in the study. Among the respondents in the Control group, 63.6% had at least one active line; most (89.8%) knew how to open text messages on mobile phones; majority (96.3%) knew how to read text messages; 84.0% knew how to send messages: 44.4% used Yoruba language in reading or sending text messages; while 47.6% used Yoruba and English languages in reading or sending text messages. In addition, most respondents (72.7%) do not switch off their phone. Among those who do, most (20.3%) switched off their phones at night. Most respondents (86.1%) also reported experiences of network failure and this occurred mostly occasionally (90.3%).

Similarly, majority of respondents in the Intervention group (79.9%) had at least one active line; most (82.1%) knew how to open text messages on mobile phones, and 86.0% knew how to read text messages. Most respondents (78.8%) knew how to send text messages; 52.5% used the Yoruba language in reading or sending text messages while 42.5% respondents used Yoruba and English languages in reading or sending text messages. In addition, few respondents (18.4%) switched off their phone and this occurs mostly at night (90.9%). In addition, 87.7% of the respondents reported experiences of network failure and this occurs occasionally (63.7%) (Other details in Table 4.6).

Table 4.6: Usage of Mobile Phone by Respondents

	Control (N=187)		Intervention (N=179)	
	№	%	№	%
Number of mobile telephones possessed				
One	175	93.6	174	97.2
More than one	12	6.4	5	2.8
Number of active lines possessed				
One	119	63.6	143	79.9
More than one	68	36.4	36	20.1
Know how to open text messages on mobile phone				
Yes	168	89.8	147	82.1
No	19	10.2	32	17.9
Know how to read text messages on mobile phone				
Yes	180	96.3	154	86.0
No	7	3.7	25	14.0
Know how to send text messages on mobile phone				
Yes	157	84.0	141	78.8
No	30	16.0	38	21.2
The language used in reading or sending text messages on the phone				
English alone	14	7.5	7	3.9
Yoruba alone	83	44.4	94	52.5
Yoruba and English	89	47.6	76	42.5
Others *	1	0.5	2	1.1
Switch off phone(s)				
Yes	51	27.3	33	18.4
No	136	72.7	146	81.6
Time of the day mobile telephone is usually switched off				
Morning	2	2.4	0	0.0
Afternoon	2	3.6	1	3.0
Night	38	20.3	30	90.9
Occasionally	5	2.7	2	6.1
Experience network failure on mobile phone				
Yes	161	86.1	157	87.7
No	26	13.9	22	12.3
Frequency of network failure on mobile phone				
Always	7	4.3	14	8.9
Occasionally	149	90.3	100	63.7
Rarely	5	3.1	43	27.4

* Others include Ohori, Agatu

Table 4.6: Usage of Mobile Phone by Respondents (cont'd)

	Control (N=187) %	Intervention (N=179) %
Time of the day of network failure on mobile phone		
Morning	4.3	3.8
Afternoon	2.5	3.0
Night	6.2	1.5
Anytime	79.5	91.7
Other problem(s) experienced with mobile phone(s) **		
Electricity problem	70.0	34.1
Mouth piece and ringing problem	1.1	11.2
Battery problem	41.2	38.5
Phone screen and panel problem	12.3	2.8
Faulty phone	5.9	5.0
Phone charging point	0	0.6
Network problem	0	1.1
Phone messages	0	2.8
Unable to read	0	1.7
Blocked line	1.7	2.2
Experience any difficulty charging mobile phone		
Yes	20.9	50.3
No	79.1	49.7
If Yes, the frequency of mobile phone battery going flat		
Often	2.6	16.7
Occasionally	17.1	63.3
Rarely	0.5	20.0
The mobile phone is used mostly for **		
To make call	57.8	54.2
For text messaging	1.6	1.7
For call and text messaging	32.6	29.6
Playing games	1.1	0.6
For browsing	1.6	1.7
As touch light	2.1	2.2
Playing music	1.6	8.4
Others (specify)	0	1.7
Have access to use other people's phone in case the mobile phone does not work or out of service area	87.2	78.2
Yes	12.8	21.8
No		

** Multiple responses

4.2.7 Adoption of Reminder SMS for Routine Immunisation Service Delivery

When asked whether mobile phone could be effective in giving health and immunisation-related information to mothers, almost all respondents in the Control group (99.5%) answered in the affirmative compared with 82.7% respondents in the intervention group. The majority (94.1%) of the respondents in the group also agreed that receiving text message reminders about their children next routine immunisation appointment could encourage mothers to take their children for vaccination. At baseline, few (7.0%) respondents reported ever receiving text messages from healthcare workers about their children's routine immunisation appointments. On medium used to remind respondents about child's next date of immunisation, the respondents indicated health workers (54.5%) and public announcement on radio and through town criers (34.8%) as the major means through which they were reminded.

Among the respondents in the Intervention group also, most (82.7%) reported that the mobile phone could be effective in giving health and immunisation information to mothers. In addition, the majority (76.5%) of the respondents indicated that receiving text message reminders about their children's next routine immunisation appointment could encourage mothers to take their children for vaccination. At baseline, few (11.7%) respondents reported ever receiving text messages from healthcare workers about their children's routine immunisation appointment. On medium used to remind respondents about child's next date of immunisation, the respondents reported that health workers (77.1%) and public announcement on radio and through town criers (18.4%) are the major means through which they were reminded. Other details are highlighted in Table 4.7.

Table 4.7: Adoption of Reminder SMS for Routine Immunisation Service Delivery

	Control (N=187 %	Intervention (N=179) %
The mobile phone can be effective in giving health information to mothers on immunisation		
Yes	99.5	82.7
No	0.5	17.3
Receiving of text message reminder about children's next immunisation appointment can encourage mothers to take their children for vaccination		
Yes	94.1	76.5
No	5.9	23.5
Ever received text message from health workers about child's immunisation appointment		
Yes	7.0	11.7
No	93.0	88.3
The medium used to remind about child's next date of immunisation		
Health workers, health facility	54.5	77.1
Public announcement on radio and town crier	34.8	18.4
Text messages	3.2	1.1
Immunisation card	1.6	3.4
Neighbours/friends/co-workers	0.5	0
Received any reminder message about child's next immunisation appointment before coming to the clinic		
Yes	2.7	12.8
No	97.3	87.2
If Yes, it means that the reminders for the immunisation appointment are useful and effective		
Yes		
No	20.0	69.6
	80.0	30.4
Willingness to receive text message reminders for child's next immunisation appointment		
Yes	96.8	88.8
No	3.2	11.2
Language preference for reminder messages		
Yoruba	1.1	88.3
English	1.1	11.7

Table 4.7: Adoption of Reminder SMS for Routine Immunisation Service Delivery (cont'd)

	Control (N=187) %	Intervention (N=179) %
Difficulties currently encountered in receiving text messages		
Network problem	41.2	30.0
Cannot open it	47.6	48.7
Low battery	2.1	19.3
Difficulties currently encountered in reading text messages		
Network problem	0	30.0
Cannot open it	0	48.7
Low battery	9.1	19.3
Time of the day preferred most to receive immunisation reminders text messages		
Morning	13.4	35.8
Afternoon	3.2	10.6
Night	9.1	3.4
Any time of the day	70.6	50.3
How sending of text message reminders help to keep child's next immunisation appointment		
It is a good reminder and effective	50.3	60.9
The message should be constant, often,	50.3	4.5
It mobilises mothers	18.2	6.1
Listen to information on radio about immunisation		
Yes		
No	85.0	85.5
	15.0	14.5
If Yes, the frequency of listening to immunisation information on radio		
Often	26.9	41.0
Occasionally	62.6	59.0
Watch and listen to information about immunisation on television		
Yes	77.5	59.8
No	22.5	40.2
If Yes, the frequency of watching and listening to immunisation information on television		
Often	20.0	48.3
Occasionally	80.0	51.7

4.2.8 Effects of Reminder SMS for Routine Immunisation Clinic Attendance and Immunisation Completion

At baseline, no respondent was sent SMS reminder for routine immunisation appointment keeping. Respondents were recruited into the study at this stage. As expected, intervention (SMS reminders for routine immunisation appointment keeping) started some weeks after the recruitment. However, few respondents (Control, 4.8%; Intervention 12.3%) reported receiving SMS reminders of their children's clinic appointment for their children routine immunisation. On the frequency of the SMS sent, few respondents in the Intervention group (7.3%) reported having received it often.

Furthermore, majority of the respondents (Control, 90.9%; Intervention, 78.2%) indicated that neither their spouses nor any other member of their families received reminder SMS for routine immunisation appointment. In addition, the respondents were asked how they were reminded of their children's vaccination appointments. Most respondents, (56.1% and 50.3% for Control and Intervention groups, respectively), indicated that they knew the time to take their children to the clinic for routine immunisation. Moreover, 32.1% and 49.7% (Control and Intervention groups, respectively) also reported that clinic staff sometimes reminded them of their routine immunisation appointment date. None of the respondents in the Control and Intervention groups indicated completion of all immunisation schedules at baseline. This was so because, at this stage, none of the respondents was expected to have completed all immunisation schedule; infants whose mothers were recruited were between 0-2 months old. Other details were presented in Table 4.8.

Table 4.8: Effects of Reminder SMS for Routine Immunisation Clinic Attendance and Immunisation Completion

Statement	Control (N=187) №	%	Intervention (N=179) №	%
Received reminder SMS to come to the clinic for child's vaccination				
Yes	9	4.8	22	12.3
No	178	95.2	157	87.7
If Yes, the frequency of receiving the reminder SMS to come to the clinic for child's vaccination				
Often	0	0	13	7.3
Occasionally	187	0	166	92.7
Spouse or any other family member receive immunisation reminder SMS to remind to keep child's clinic appointments				
Yes	17	9.1	39	21.8
No	170	90.9	140	78.2
If Yes, frequency of reminder SMS to significant others to remind in keeping child's clinic appointments				
Often	8	4.3	32	80.0
Occasionally	8	4.3	8	20.0

	Control (N=187)				**Intervention (N=179)**			
	Yes		No		Yes		No	
Who usually reminds to come to the clinic for child's vaccination **	**№**	**%**	**№**	**%**	**№**	**%**	**№**	**%**
I know the time to come for the vaccination	105	56.1	82	43.9	90	50.3	89	49.7
Clinic staff	60	32.1	127	67.9	89	49.7	90	50.3
My spouse	33	17.6	154	82.4	47	26.3	132	73.7
SMS reminder	0	0	187	100	0	0	179	100

4.3 End line Assessment of Control and Intervention Groups

4.3.1 Socio-demographic Characteristics of Respondents

At the end line, findings showed that the study had a high attrition rate; of the 187 respondents recruited to the Control group at baseline, only 57.2% completed the study. Similarly, of the 179 respondents recruited to the Intervention group, 64.2% completed the study. However, the high attrition rate did not affect the quality of the data collected as minimum sample calculated for the study was still obtained.

All the respondents (100%) in the Control and Intervention groups were married. Most respondents (70.1% and 64.3%) in the Control and Intervention groups respectively were of the Islamic faith. More than half of the respondents in the Control group (57.0%) and 65.2% of those in the Intervention group had secondary education while only 25.2% and 7.8% in the Control and Intervention groups respectively had tertiary education. All the respondents indicated that they were engaged in one occupation or the other. Specifically, 37.4% of the respondents in the Control and 48.7% of those in the Intervention groups were traders. Respondents who were artisans in the Control and Intervention groups were 40.2% and 39.1% respectively. The results also showed that respondents who earned less or equal to N10, 000 average income from all sources were 40.7% and 50.0%, in the Control and Intervention groups respectively. Respondents who earned between N20, 000 and N29, 000 were 46.5% and 36.7% in the Control and Intervention groups respectively.

Furthermore, majority of the respondents in the two groups (Control 97.2%, Intervention 97.4%) were Yoruba. Moreover, the result showed that most of the respondents in the Control group (34.6%) were within the 26-30-years age bracket. Those in the 21-25 years' age bracket (27.1%) followed them. However, in the Intervention group, most respondents (46.1%) were within the 21-25 years' age bracket. They were followed by those in the 26-30 years' age bracket (21.7%). In relation to parity, most respondents (67.3% and 73.9% in the Control and Intervention groups respectively) had given birth to more than one child alive. In addition, most respondents (Control group, 57.9%; Intervention group, 56.5%) currently have 1-2 children. Most respondents in the Control group (30.8%) were between 26-30 years when they gave birth to the index child while most respondents in the Intervention group (43.5%) were between 21-25 years when they did. Most index children (50.5% and 53.0% for Control and Intervention groups respectively) were female. While most respondents (33.6%) in the control group indicated that their index children were first born, most respondents (29.6%) in the intervention group indicated that their index children were second born. Other details are highlighted in Table 4.9 and Figure 4.1.

Table 4.9: Socio-demographic Characteristics of Respondents

Demographic characteristics	Control (N=107)		Intervention (N=115)	
	№	%	№	%
Marital status				
Married	107	100.0	115	100.0
Religion				
Christianity	32	29.9	41	35.7
Islam	75	70.1	74	64.3
Main occupation				
Trader	40	37.4	56	48.7
Civil servant	1	0.9	6	5.2
Artisan	43	40.2	45	39.1
Farmer	0	0	4	3.5
Unemployed	2	1.9	3	2.6
Health worker	1	0.9	1	.9
Student	1	0.9	0	0
Full house wife	2	1.9	0	0
Apprentice	17	15.9	0	0
Teaching				
Average income from all sources				
≤10000	35	40.7	45	50.0
20000-29000	40	46.5	33	36.7
30000-39000	3	3.5	7	7.8
40000-49000	2	2.3	0	0
50000-59000	5	5.8	4	4.4
>=60000	1	1.2	1	1.1
Ethnic group				
Hausa	1	0.9	1	.9
Igbo	2	1.9	2	1.7
Yoruba	104	97.2	112	97.4
Age as at the last birthday				
<=20 years	9	8.4	17	14.8
21-25 years	29	27.1	53	46.1
26-30 years	37	34.6	25	21.7
31-35 years	23	21.5	15	13.0
>35 years	9	8.4	5	4.3
Mean age (in years)	28.3		26.3	
SD	5.5		5.6	
Number of children given birth to alive				
One child	35	32.7	30	26.1
More than one child	72	67.3	85	73.9

Table 4.9: Socio-demographic Characteristics of Respondents (Cont'd)

Demographic characteristics	Control (N=107) №	Control (N=107) %	Intervention (N=115) №	Intervention (N=115) %
Number of children currently have				
1-2	62	57.9	65	56.5
3-4	36	33.6	41	35.7
>=5	9	8.4	9	7.8
Number of children less than 12 months (in case of multiple births)				
1	1	100.0	111	96.5
2	0	0	4	3.5
Age when this child was born				
<=20 years	10	9.3	17	14.8
21-25 years	32	29.9	50	43.5
26-30 years	33	30.8	26	22.6
31-35 years	21	19.6	14	12.2
>35 years	11	10.3	8	7.0
Mean age (in years)	28.9		28.5	
SD	11.2		14.6	
Source of information on immunisation †				
Health workers	94	87.9	94	34.6
Public announcement/town crier	6	5.6	6	2.8
Church and mosque	18	16.8	18	11.2
Media	63	58.9	63	29.0
Friends and neighbours	15	14.0	15	2.8
Clinic/Hospitals	3	2.8	3	.9
Text Messages	2	1.9	2	1.9
Through the education line	1	0.9	1	.9
Through my parents	1	0.9	1	.9
Sex of the index child				
Male	53	49.5	54	47.0
Female	54	50.5	61	53.0
Index child birth order				
First	36	33.6	33	28.7
Second	25	23.4	34	29.6
Third	16	15.0	24	20.9
Fourth	20	18.7	15	13.0
Others††	10	9.3	9	7.8

† Multiple responses
†† Others include mothers with more than four children

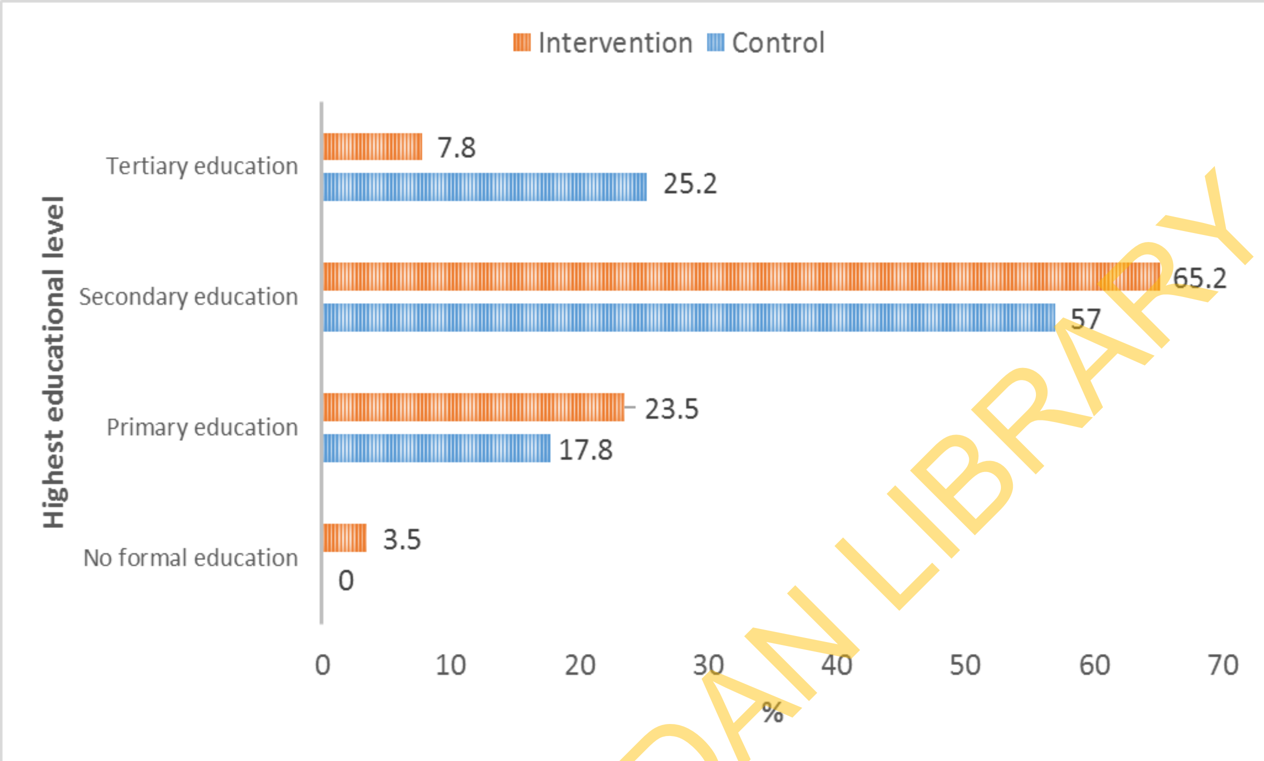

Figure 4.1: Respondents' Educational Background

4.3.2 Respondents' Children Immunisation Status

Highlights of the immunisation status of the index children were presented in this section. The three key antigens, which are used as measures for immunisation status of any child, are DPT3, measles and yellow fever. End line results show that among the children of mothers in the Control group, 25.2%, 69.2% and 72.9% obtained DPT3, measles, and yellow fever respectively. Among the children of respondents in the Intervention group, 33.0%, 71.3% and 71.3% obtained DPT3, measles, and yellow fever respectively (Figure 4.2).

However, when the immunisation cards of respondents were checked, there were variations between what the mothers reported and what the researcher observed. Among the respondents in the Control group, records show that 15.9%, 54.2% and 53.3% completed DPT3, measles, and yellow fever respectively. Among the respondents in the Intervention group also, 41.7%, 68.7% and 71.3% completed DPT3, measles, and yellow fever respectively (Figure 4.3). Other details of these results were presented in Table 4.10.

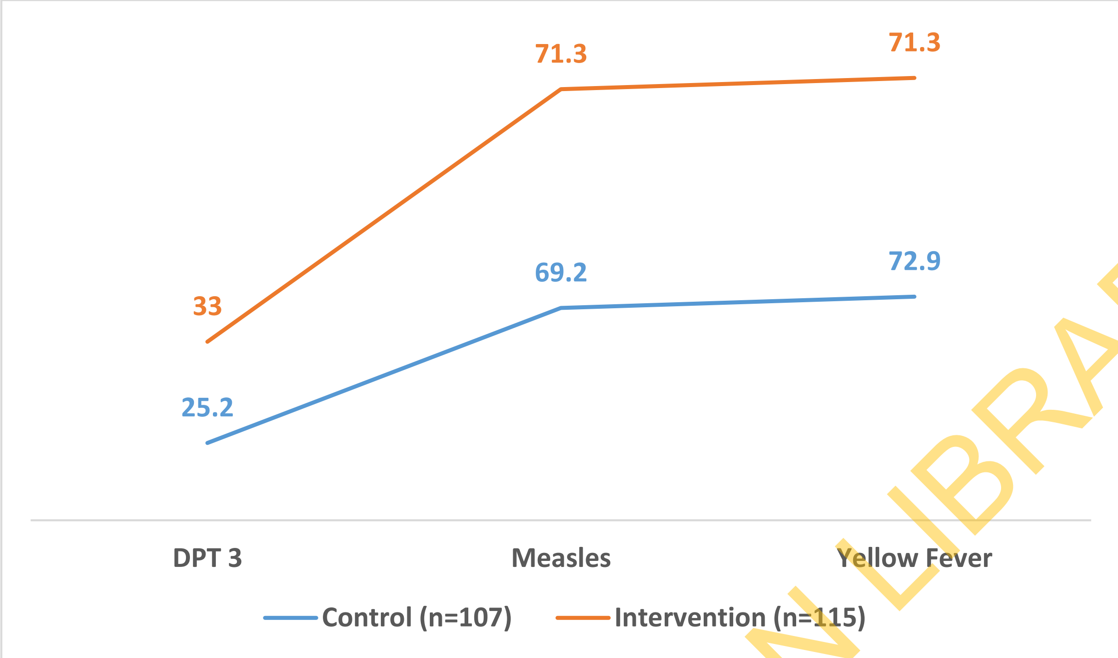

Figure 4.2: Respondents' Children Immunisation Status (Reported)

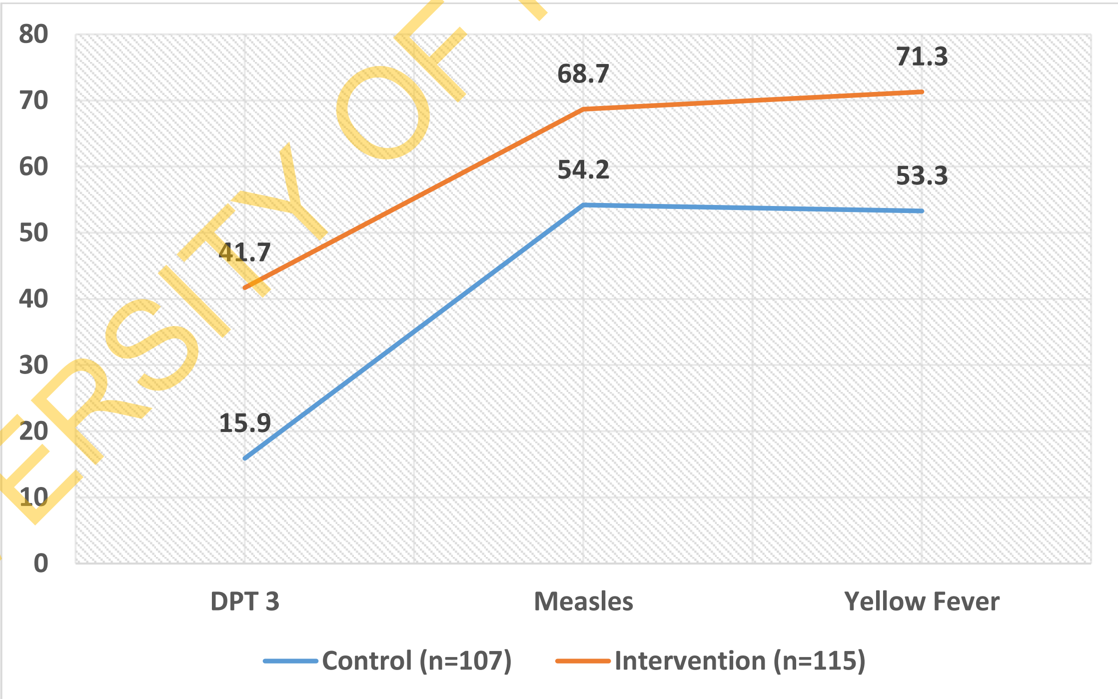

Figure 4.3: Respondents' Children Immunisation Status (observed in the card)

Table 4.10: Respondents' Children Immunisation Status

Variable	Control (N=107) %	Intervention (N=115) %
Missed any immunisation		
Yes	29.9	31.3
No	70.1	68.7
Reason for missing immunisation *		
Mother not around	81.3	81.7
Not aware	0.9	0
The spouse did not allow	0.9	0
Vaccine not available	1.9	3.5
Healthcare workers' strike action	0.9	0.9
Baby too small	13.1	8.7
Forgot date	1.9	0.9
Apathy	16.7	0.9
Experiences had immunising children *		
It prevents diseases	29.9	11.3
Baby crying and weak	38.3	32.2
The child had a high temperature	24.3	11.3
Makes child grow stronger, healthy, long life	87.9	26.0
Weight loss and side effect pain	8.4	7.8
No adverse reaction	8.4	3.5
Baby fall sick	6.5	6.1
Child had convulsion	0.9	0.9
Swelling	5.6	0.9

* Multiple responses

4.3.3 Respondents' Knowledge about Routine Immunisation

Routine immunisation knowledge items assessed at baseline were related to vaccine-preventable diseases when to immunise a child, benefits of immunisation etc. Results on the level of awareness show that most respondents in the Control and Intervention group (69.2% and 82.6%, respectively) had heard about routine immunisation before. On the order in which routine immunisation is being administered, most respondents in the Intervention group (80.0%) reported knowing routine immunisation order. However, most respondents in the Control group (64.5%) reported not to know routine immunisation order.

On a 25-point knowledge scale, the mean knowledge score for the Control and Intervention group were 13.1±4.0 and 12.9±2.8, respectively at the end line. Table 4.11 and Figure 4.4 highlight other detailed information about knowledge scores among the respondents in the two groups

Table 4.11: Respondents' Knowledge about Routine Immunisation

Variable	Control (N=107) %		Intervention (N=115) %	
Heard about immunisation for children less than 12 months				
Yes	69.2		82.6	
No	30.8		17.4	
Know routine immunisation order				
Yes	35.5		80.0	
No	64.5		20.0	
	Correct %	**Incorrect %**	**Correct %**	**Incorrect %**
BCG - At birth	59.8	40.2	95.7	4.3
DPT- 6, 10 and 14 weeks after birth	45.8	54.2	54.8	45.2
Hepatitis B- At birth, 10 & 16 weeks after birth	51.4	48.6	74.8	25.2
OPV (Polio) - 6, 10 and 14 weeks	54.2	45.8	76.5	23.5
Measles – 9 months	47.7	52.3	73.9	26.1
Yellow fever – 9 months	46.7	53.3	72.2	27.8
Pentavalent - 6, 10 and 14 weeks	45.8	54.2	73.0	27.0

Table 4.11: Respondents' Knowledge about Routine Immunisation (cont'd)

Diseases preventable by vaccines	Control (N=107) Without Prompting		Control (N=107) With Prompting		Intervention (N=115) Without Prompting		Intervention (N=115) With Prompting	
	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %
Malaria	85.0	15.0	8.4	91.6	81.7	18.3	32.2	67.8
Tuberculosis	83.2	16.8	13.1	86.9	28.7	71.3	41.7	58.3
Measles	78.5	21.5	16.8	83.2	47.8	52.2	44.3	55.7
Yellow fever	86.0	14.0	9.3	90.7	51.3	48.7	30.4	69.6
HIV	31.8	68.2	26.2	73.8	7.0	93.0	47.8	52.2
Poliomyelitis	76.6	23.4	17.8	82.2	49.6	50.4	31.3	68.7
Whooping cough	80.4	19.6	14.0	86.0	33.9	66.1	40.0	60.0
Tetanus	86.0	14.0	11.2	88.8	22.6	77.4	49.6	50.4
Diarrhoea	72.0	28.0	14.0	86.0	22.6	77.4	42.6	57.4

Table 4.11: Respondents' Knowledge about Routine Immunisation (cont'd)

Variable	Control (N=107) %	Intervention (N=115) %
Advantages of routine *		
It prevents children from all diseases	37.4	50.4
It makes them strong and fit	48.6	37.3
Prevents from malaria	0.9	5.2
Makes child sleep	27.1	0
Makes them healthy and peaceful	13.1	1.8
Makes them grow well	9.3	1.8
Reduces child mortality	1.9	0.9
Prevents Polio	0.9	1.8
Prevents measles	0.9	0
Prevents HIV	6.5	0
Disadvantages with immunising infants *		
Children run temperature after immunisation	57.9	26.8
Some children do fall sick and unable to sleep	21.5	15.5
It makes some part of the body swollen with pus	3.7	14.1
It makes children fearful and cries	9.3	1.4
Loss of weight	0.5	0
It can cause diseases, disability for children	18.7	2.8
Causes pains to the child	14.0	11.2
No disadvantages	32.7	16.9
Time of the day a child should be immunised		
Morning	94.4	95.7
Afternoon	3.7	
Anytime	0.9	2.6
Have no idea	0.9	1.7
A sick child can be immunised		
Yes	60.7	64.3
No	39.3	35.7
Immunisation is healthy for a child		
Yes	93.5	94.8
No	6.5	5.2
Getting a child immunised for a particular disease prevents that child from contracting that disease		
Yes	93.5	94.8
No	6.5	5.2
A child running temperature should be immunised		
Yes	50.5	74.8
No	49.5	25.2

* Multiple responses

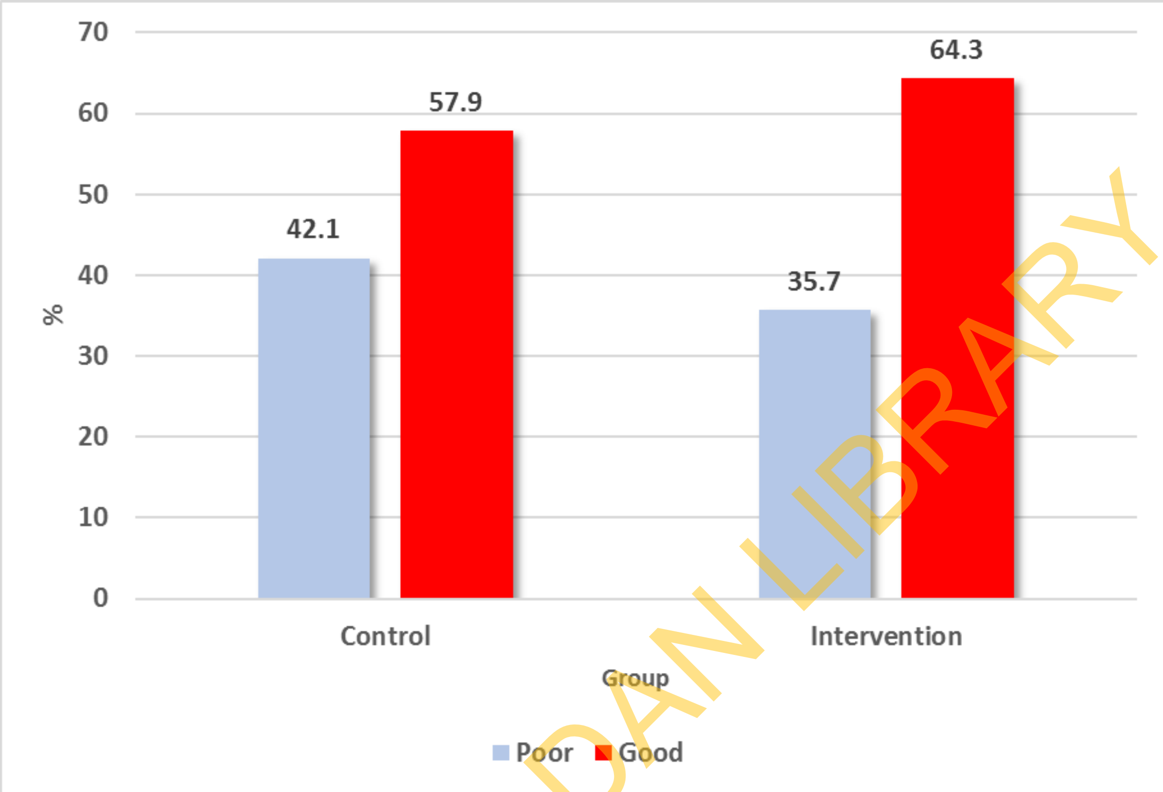

Figure 4.4: Respondents' Overall Knowledge Score

4.3.4 Factors Influencing Routine Immunisation Uptake and Completion

At the end line, the respondents indicated some factors, which can encourage mothers to complete their children's routine immunisation. Some of the factors mentioned by the respondents in the Control group were distance to health facilities (38.3%), knowing the benefits of immunisation (29.0%), availability of vaccine (15.9%), availability of healthcare worker and services (14.0%) and attitude/motivation of healthcare workers (11.2%). In the Intervention group, knowing the benefits of immunisation (56.5%), availability of healthcare worker and services (13.0%) and distance to healthcare facilities (9.6%) were the major factors mentioned.

Furthermore, the respondents also identified the factors that can prevent mothers from completing their children's routine immunisation. The factors were classified into three namely: lack of information, lack of motivation and other obstacles. On the issue of lack of information, most respondents in the Control group reported that mothers are unlikely to complete all immunisation schedules if they are unaware of the need for immunisation (78.5%); they are unaware of the need to return for 2nd and 3rd doses of vaccine (71.0%); they are unaware of the time of immunisation (66.4%); they are afraid of the side effects/adverse reactions (55.1%), or they are ignorant of contraindications (52.3%). Similarly, in the Intervention group, respondents indicated that if mothers are: unaware of the need for immunisation (60.9%), unaware of the need to return for 2nd and 3rd doses of vaccine (56.4%), unaware of the time of immunisation (44.7%), afraid of the side effects/adverse reactions (58.1%) or ignorant of contraindications (46.4%), they are not likely to complete all immunisation schedules.

The factors classified as lack of motivation, which may discourage mothers from completing their children's immunisation schedules, include the postponement of immunisation to another day (64.5%), lack of faith in immunisation (55.1%) and rumours (59.8%). Similarly, respondents in the Intervention group as well reported that postponement of immunisation to another day (48.0%), lack of faith in immunisation (44.7%) and rumours (40.8%) are factors that can demotivate mothers from completing their children's immunisation schedules.

In addition, respondents in the Control group indicated the following as obstacles to completing children's immunisation schedules: if the distance from the venue of immunisation is too far (66.4%), time of immunisation is not convenient (62.6%), vaccinator is absent (65.5%), vaccine is not available (67.3%), mothers are too busy (66.4%), there are family problems (72.0%), the child is sick (69.2%), mothers have to wait at the clinic for a long time before being attended to (68.2%) and carefree attitude of health workers (58.9%). Likewise, some factors classified as obstacles by respondents in the Intervention group include the following: time of immunisation is not convenient (54.7%), vaccinator is absent (50.3%), vaccine is not available (62.0%), mothers are too busy (70.9%), there are family problems (64.80%), the child is sick (68.7%), long time of waiting at the clinic before being attended to (42.5%) and the carefree attitude of health workers (41.9%) (Table 4.12).

Table 4.12: Factors Influencing Routine Immunisation Uptake and Completion

Variable	Control (N=107) %		Intervention (N=115) %	
Factors which make mothers complete immunisation for their infants*				
Distance to health facilities	38.3		9.6	
Knowing the benefits of immunisation	29.0		56.5	
Mother's awareness of next appointment	0.9		3.5	
When health workers and services are available	14.0		13.0	
Sick child	1.9			
Reminder through announcements in churches and mosque and other public places	2.8		2.6	
Attitude/motivation of the health workers	11.2		4.3	
When incentives are attached to immunisation	1.9			
Time factor and mother not busy	0.9		3.5	
Government making it mandatory	2.8		0.9	
Support from spouse	0		1.7	
Availability of vaccine	15.9		0.9	
If the services are free	0		0.9	
Factors which prevent mothers from completing immunisation for their children less than 12 months (Reason)*	**Yes** %	**No** %	**Yes** %	No %
Unaware of the need for immunisation	78.5	21.5	60.9	39.1
Unaware of the need to return for 2nd or 3rd dose	71.0	29.0	56.4	43.6
Don't know the time of immunisation	66.4	33.6	44.7	55.3
Fear of side effects/adverse reactions	55.1	44.9	58.1	41.9
Wrong ideas about contraindications	52.3	47.7	46.4	53.6
Postponed until another time	64.5	35.5	48.0	52.0
No faith in immunisation	54.2	45.8	44.7	55.3
Rumours	59.8	40.2	40.8	59.2
Place of immunisation too far	66.4	33.6	43.6	56.4
Time of immunisation not convenient	62.6	37.4	54.7	45.3
Vaccinator absent	65.4	34.6	50.3	49.7
Vaccine not available	67.3	32.7	62.0	38.0
Mother too busy	66.4	33.6	70.9	29.1
Family problems/ illness of mother	72.0	28.0	64.8	35.2
Child ill, not brought to the clinic	69.2	30.8	68.7	31.3
Child ill, came but not given immunisation	71.0	29.0	64.2	35.8
Long waiting time	68.2	31.8	42.5	57.5
The attitude of health workers	58.9	41.1	41.9	58.1

* Multiple responses

Table 4.12: Factors Influencing Routine Immunisation Uptake and Completion (cont'd)

Variable	Control (N=107) %	Intervention (N=115) %
Most cogent of the reasons given		
Mother too busy or sick	17.8	7.2
Unavailable of vaccine, health workers, and their attitude	23.4	22.7
Place and time of immunisation unknown	3.7	4.1
Wrong idea or rumour about immunisation	0.9	2.1
Family and work problem	15.9	4.1
Long waiting	7.5	11.3
Fear of side effect on the baby	2.8	
No or not aware of the need for it	2.8	12.4
Fear of side effect	0.9	5.1
Sick child	6.5	1.0
No money	0.9	11.3
No faith in the vaccine	4.7	9.3
No money	0	1.0

* Multiple responses

4.3.5 Respondents' Attitude towards Routine Immunisation

Majority of the respondents (Control, 71.0%; Intervention, 72.2%) expressed a high degree of trust in the safety of the vaccines used for immunising children. Most respondents (Control, 56.0% and Intervention, 35.0%) were of the view that local herbs "agbo" are not as potent as vaccines in preventing diseases against which children are vaccinated. The mean attitude scores of respondents in both Control and Intervention groups at end line were 5.5 ± 1.2 and 5.1 ± 1.6, respectively. Other details on the attitudes of respondents in the Control and Intervention groups were presented in Table 4.13 and Figure 4.5.

Table 4.13: Respondents' Attitude towards Routine Immunisation

	Control (N=107)				Intervention (N=115)			
	SA %	A %	D %	SD %	SA %	A %	D %	SD %
Trust the safety of the vaccines used for immunising children	71.0	24.3	1.9	0.0	72.2	22.6	3.5	1.7
The notion that local herbs "*agbo*", can equally prevent diseases for which children are vaccinated against	4.7	10.3	28.0	56.1	18.3	20.0	28.7	35.0
Whether a child is immunised or not, he will still fall sick of any of the vaccine-preventable diseases	14.0	54.2	26.2	4.7	33.0	14.8	31.3	20.9
Mind not at peace with immunisation, feel it is dangerous to children's health and wellbeing	7.5	11.2	45.8	33.6	13.9	11.3	34.8	40.0
Immunisation makes children sick, so it is not necessary for them	4.7	1.9	28.0	63.6	13.0	7.8	35.7	43.5
It is necessary to immunise children against any vaccine-preventable diseases, prayer to and faith in God is not enough to protect	23.4	50.5	17.8	7.5	44.3	27.8	20.9	7.0
Once a child is immunised, the child is safe and free from these diseases preventable by vaccines	66.4	29.0	2.8	0.9	46.9	36.5	11.3	5.2

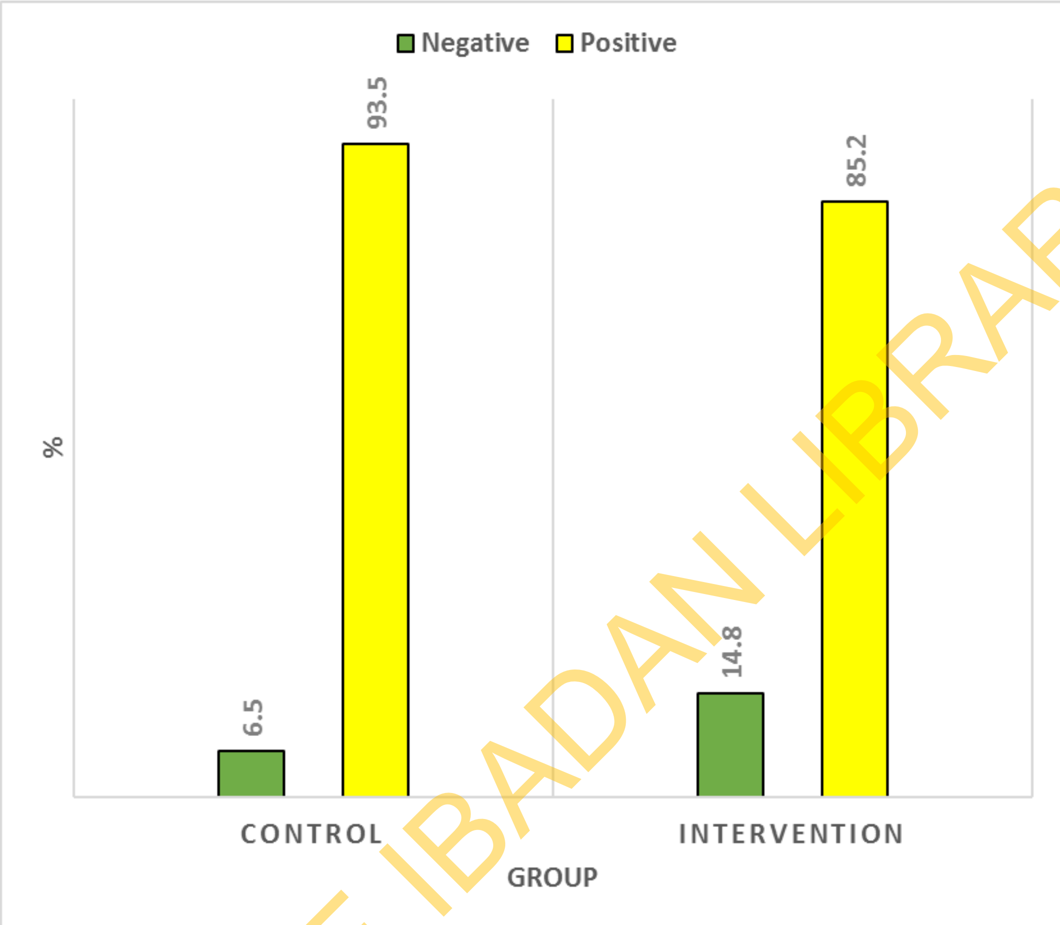

Figure 4.5: Respondents' Overall Attitude Score at End Line

4.3.6 Usage of Mobile Phones

Results showed that all respondents (Control and Intervention groups) owned at least one mobile phone. Among the Control group, 79.9% had at least one active line, most (85.0%) knew how to open text messages on mobile phones, the majority (85.0%) knew how to read text messages, and 82.2% of them knew how to send text messages. In addition, 34.6% of respondents used the Yoruba language in reading or sending text messages while 49.5% of respondents used Yoruba and English languages is reading or sending text messages. Moreover, a few respondents (27.1%) switched off their phones. Of those who switched off their phones, most did so at night (18.7%). Most respondents (86.9%) also experienced network failure and it occurred occasionally (51.4%).

Similarly, majority of the respondents in the Intervention group (60.0%) had at least one active line, most (86.1%) knew how to open text messages on mobile phones and 86.1% knew how to read text messages. Most respondents (68.8%) knew how to send messages. Moreover, 55.6% of respondents used the Yoruba language in reading or sending text messages while 36.5% of respondents used Yoruba and English languages in reading or sending text messages. In addition, a few respondents (26.1%) switched off their phones and mostly at night (52.5%). In addition, 83.5% of the respondents reported experiences of network failure and it occurred occasionally (64.9%) (Other details in Table 4.14).

Table 4.14: Usage of Mobile Phones

	Control (N=107) %	Intervention (N=115) %
Number of mobile telephones possessed		
One	89.7	95.7
More than one	10.3	4.3
Number of active lines possessed		
One	79.9	60.0
More than one	20.1	40.0
Know how to open text messages on mobile phone		
Yes	85.0	86.1
No	15.0	13.9
Know how to read text messages on mobile phone		
Yes	85.0	86.1
No	15.0	13.9
Know how to send text messages on mobile phone		
Yes	82.2	67.8
No	17.8	32.2
The language used in reading or sending text messages on your phone		
English alone	8.4	1.7
Yoruba alone	34.6	55.6
Yoruba and English	49.5	36.5
Others	4.6	6.1
Switch off your phone(s) at any time		
Yes	27.1	26.1
No	72.9	73.9
Time of the day mobile telephone is usually switched off your		
Morning	1.9	15.0
Afternoon	0.9	2.5
Night	18.7	52.5
Occasionally	8.4	30.0
Experience network failure on mobile phone	86.9	83.5
Yes	13.1	16.5
No		
Frequency of network failure on mobile phone		
Always	2.8	9.3
Occasionally	51.4	64.9
Rarely	34.6	25.8

Table 4.14: Usage of Mobile Phones (cont'd)

	Control (N=107) %	Intervention (N=115) %
Time of the day mobile phone experiences network failure		
Morning	0.9	2.1
Afternoon	0.9	2.1
Night	1.9	1.1
Anytime	82.2	94.7
Other problem(s) associated with using a mobile phone(s)		
Electricity problem	23.4	16.5
Mouthpiece and ringing problem	0.9	0.9
Battery problem	32.7	27.8
Phone screen and panel problem	5.6	0
Faulty phone	0.9	7.0
Phone charging point	3.7	4.3
Network problem	0.0	0.9
Phone messages	9.3	1.7
Unable to read	7.5	0.9
Blocked line	0.9	1.7
Experience any difficulty charging mobile phone		
Yes	31.8	34.8
No	68.2	65.2
If Yes, the frequency of mobile phone battery going flat		
Often	0.9	10.9
Occasionally	12.1	63.0
Rarely	19.6	26.1
What mobile phone is used for mostly		
To make call	80.4	37.3
For text messaging	0	2.6
For call and text messaging	15.9	28.7
Playing game	0	1.7
For browsing	0	0
As touch light	0	0.9
Playing music	1.9	6.1
Others (specify)	1.9	22.6
Have access to use other people's phone in case the mobile phone does not work or is out of service area		
Yes	86.0	81.7
No	14.0	18.3

4.3.7 Adoption of Reminder SMS for Routine Immunisation Service Delivery

When the willingness of the respondents towards adopting mobile phone SMS reminders for routine immunisation service delivery was assessed, majority of the respondents in the Control group (71.0%) indicated that mobile phone could be effective in giving immunisation information to mothers. Most respondents (63.6%) indicated that receiving text message reminders about their children's next routine immunisation appointment could encourage mothers to keep the appointment. However, at the end line, none of the respondents in the Control group reported ever receiving text messages from healthcare workers about their children's routine immunisation appointment. Health workers (78.5%) constituted the major medium through which mothers were reminded of their children's routine immunisation appointment.

In addition, among the respondents in the Intervention group, most (81.7%) reported that a mobile phone could be effective in giving immunisation information to mothers. The majority (88.7%) indicated that receiving text message reminders about their children's next routine immunisation appointment could encourage mothers to keep the appointment. At the end line, most respondents (68.7%) reported that they received text messages from healthcare workers reminding them of their children's routine immunisation appointment. As a result, a text message (44.3%) became the major means through which the respondents were reminded about their children's next date of immunisation. Other details are highlighted in Table 4.15.

Table 4.15: Adoption of Reminder SMS for Routine Immunisation Service Delivery

	Control (N=107) %	Intervention (N=115) %
The mobile phone can be effective in giving immunisation information to mothers		
Yes	71.0	81.7
No	29.0	18.3
Receiving text message reminder about children's next immunisation appointment can encourage mothers to take their children for vaccination		
Yes	63.6	88.7
No	36.4	11.3
Ever received text message from health workers about child's immunisation appointment		
Yes	0.0	68.7
No	100	31.3
The medium used in reminding about child's next immunisation date		
Health workers, health facility	78.5	13.9
Public announcement on radio and through the town crier	0.9	0
Text messages	0.0	44.3
Immunisation card	1.9	2.6
Neighbours/friends/co-workers	11.2	0.9
Media	0.9	0.9
Received any reminder message about child's next immunisation appointment before coming to the clinic		
Yes	0.0	71.3
No	100	28.7
If Yes, it means that the reminders for the immunisation appointment are useful and effective		
Yes	0	68.7
No	0	31.3
Willingness to receive text message reminders for child's next immunisation appointment		
Yes	94.4	88.7
No	5.6	11.3
Language preference for reminder messages		
Yoruba	84.1	90.5
English	30.8	8.7
Others **	3.7	0.9

Table 4.15: Adoption of Reminder SMS for Routine Immunisation Service Delivery (cont'd)

	Control (N=107) %	Intervention (N=115) %
Difficulties currently encountered in receiving text messages		
Network problem	6.5	11.3
Cannot open it	0.9	6.1
Low battery	0.9	7.0
Difficulties currently encountered in reading text messages		
No network	0	18.3
Can't open it	0	6.1
Low battery	5.6	7.0
Time of the day preferred most to receive immunisation reminders text messages		
Morning	39.3	20.0
Afternoon	0.9	0.9
Night	4.7	4.3
Any time of the day	47.7	74.8
How sending text message reminders help to keep child's next immunisation appointment		
It is a good reminder and effective	91.6	23.5
The message should be constant, often,	0.9	5.2
It mobilises mothers	0	17.4
Listen to information on radio about immunisation		
Yes	66.4	79.1
No	33.6	20.9
If Yes, the frequency of listening to immunisation information on radio		
Often	14.0	40.0
Occasionally	86.0	60.0
Watch and listen to information about immunisation on television		
Yes	44.9	48.7
No	44.9	51.3
If Yes, the frequency of watching and listening to immunisation information on television		
Often	14.6	35.7
Occasionally	85.4	64.3

4.3.8 Effects of Reminder SMS for Routine Immunisation Clinic Attendance and Immunisation Completion

During the intervention phase, all respondents in the Intervention group were sent SMS reminders for ensuring routine immunisation appointment keeping. Results showed that no respondent in the Control group reported receiving any intervention (SMS reminders for routine immunisation appointment keeping). Of special note, few respondents (12.1%) reported that their spouses or other family members received SMS reminder of routine immunisation appointment. Of those few significant others who received SMS reminder of routine immunisation appointment, 69.2% received such SMS occasionally. In addition, some respondents in this group indicated that they were reminded of their appointments by clinic staff (77.6%). However, 61.7% of respondents believed that personal knowledge of vaccination schedules was their major reminder of their children's routine immunisation appointments. Most respondents (76.6%) reported also to have completed all immunisation schedules for their children and 65.4% reported to have completed all vaccination as and when due. However, the records in immunisation cards of respondents showed that only 58.9% actually completed all routine immunisation schedules. Among those who failed to complete their children's immunisation schedules, 18.7% indicated that the failure was caused by ignorance.

Conversely, the results showed that respondents in the Intervention group received SMS reminders throughout the intervention period. However, only 79.1% reported that they received SMS reminding them of their children's routine immunisation. The majority (75.8%) of those who received the reminder SMS indicated that they received the messages often. Moreover, 67.8% reported that their spouses and other members of their family also received the same text messages. Respondents also pointed out that reminder SMS (43.5%), clinic staff during clinic appointments (36.5%) and personal knowledge of vaccination schedules were the major means through which they were reminded of their children's immunisation appointments. Most of the respondents (73.9%) also reported that they had completed their children's immunisation schedules and 72.2% reported that they completed all vaccinations as and when due. However, the records in immunisation cards of the respondents showed that only 60.9% of respondents actually completed all routine immunisation schedules. Those who admitted not completing the immunisation schedules attributed the failure to non-availability or sickness of the mothers (Table 4.16 and Figures 4.6 and 4.7).

Table 4.16: Effects of Reminder SMS for Routine Immunisation Clinic Attendance and Immunisation Completion

	Control (N=107) %	Intervention (N=115) %
Received reminder SMS to come to the clinic for child's vaccination		
Yes	0	79.1
No	100	20.9
If Yes, the frequency of receiving the reminder SMS to come to the clinic for child's vaccination		
Often	0	75.8
Occasionally	0	19.8
Others	0	3.2
Spouse or any other family member received immunisation reminder SMS to remind to keep child's clinic appointments		
Yes	12.1	67.8
No	87.9	32.2
If Yes, the frequency of reminder SMS to significant others on keeping child's clinic appointments	30.8	81.0
Often	69.2	19.0
Occasionally		
If immunisation not completed, how many vaccines are left		
1	4.0	31.6
2	44.0	31.6
3	12.0	15.8
4	16.0	10.5
More than four	24.0	10.5
If completed all child's immunisation schedules, was it completed as and when due		
Yes	65.4	72.2
No	34.6	27.8
Completion of immunisation in card		
Yes	64.5	77.4
No	35.5	22.6

Table 4.16: Effects of Reminder SMS for Routine Immunisation Clinic Attendance and Immunisation Completion (cont'd)

Post intervention – Observation from immunisation card	Control (N=107) %	Intervention (N=115) %
Respondent's child completed all immunisation		
Yes	58.9	60.9
No	41.1	39.1
If NO, how many immunisations were not completed		
1	4.5	11.1
2	6.8	17.8
3	9.1	6.7
4	9.1	6.7
More than four	9.1	8.9
Reasons for incomplete immunisation		
Forgot date of appointment	0.9	4.4
Vaccine not available/enough	0	11.1
The attitude of health workers	0	4.4
Mothers' attitude towards vaccines	2.8	8.9
Ignorance	18.7	4.4
Mother not around/sick	0	24.4
Distance/No money for transportation	1.9	8.9
Others **	0.9	31.1

** Others include long waiting time, no faith in vaccines, family problem, side effects, sick child, time not convenient, baby not old enough, and loss of immunisation card.

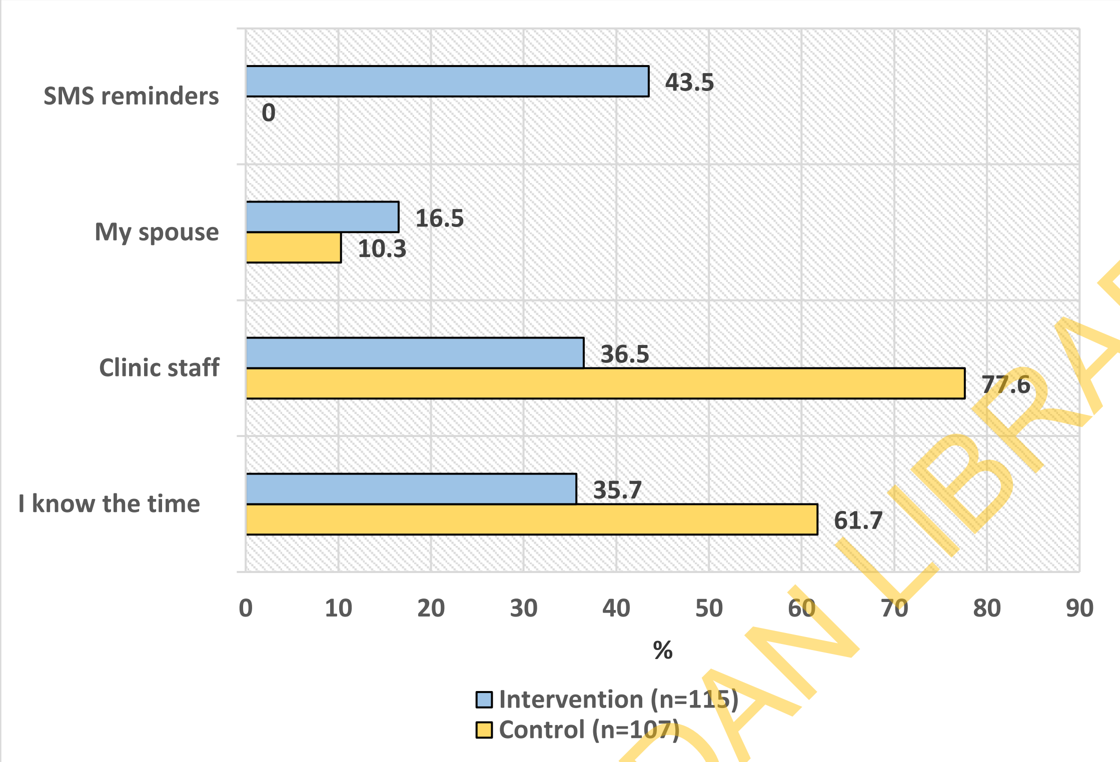

Figure 4.6: Ways mothers were usually reminded about the clinic for child's vaccination

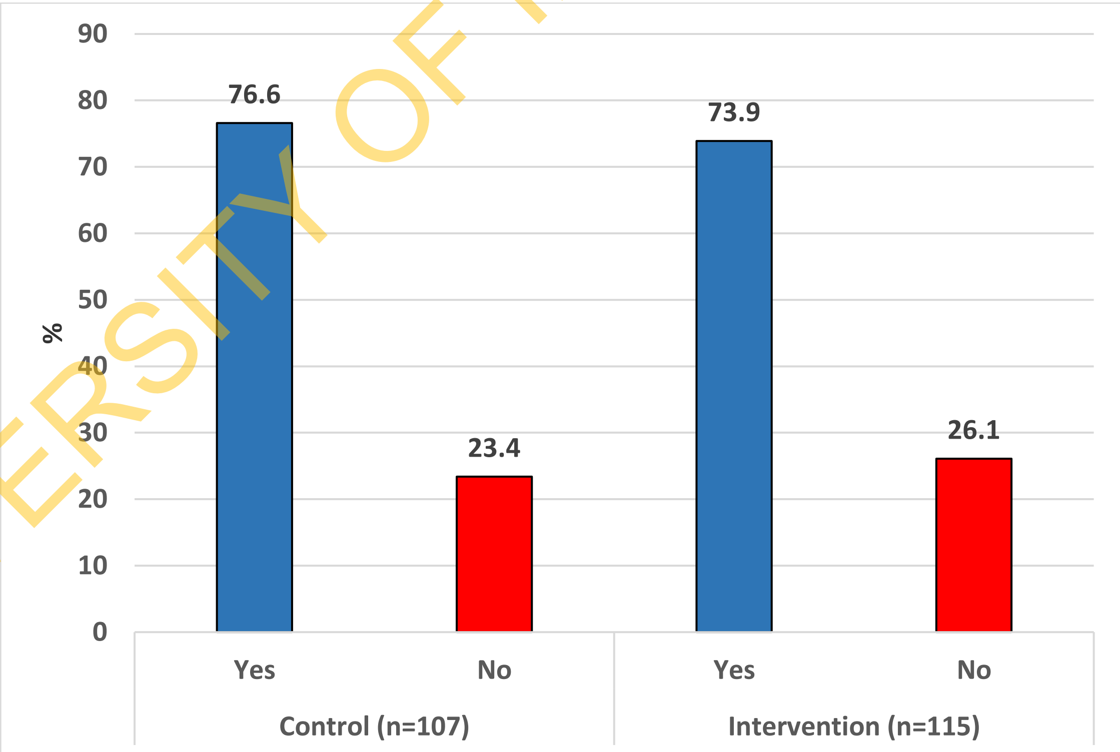

Figure 4.7: Completion of all immunisation schedules for the child (reported by respondents)

4.4 Knowledge about Routine Immunisation

Highlights of knowledge scores of the respondents in the Control and Intervention groups were presented in Table 4.17. At baseline, the majority of the respondents (Control, 92.5%; Intervention, 72.2%) had poor knowledge of routine immunisation in terms of identifying vaccine-preventable diseases, benefits etc. However, at the end line, the knowledge of respondents had increased (Control, 57.9%; Intervention, 64.3%) (Table 4.17).

When the baseline knowledge scores of the respondents in the control group who completed the study were matched with their end line knowledge scores, no significant difference was found (Table 4.18). Also, matching the baseline and end line knowledge scores of the respondents in the intervention group who completed the study did not produce any significant difference (p=0.05) (Table 4.19).

Table 4.17: Respondents' Overall Knowledge Scores on Routine Immunisation

Knowledge score	Control (N=107)		Intervention (N=115)	
	Baseline	End line	Baseline	End line
	%	%	%	%
Poor	92.5	42.1	72.2	35.7
Good	7.5	57.9	27.8	64.3
Total	100	100	100	100

Comparison of Knowledge Scores Respondents at Baseline and End line

Comparison of knowledge scores of respondents at baseline and end line in both Control and Intervention groups was made. Respondents' level of knowledge about routine immunisation at baseline was very low, especially in the Control group. This might not be unconnected to the fact that some mothers at that point were experiencing parity for the first time. It could also be that the level of knowledge was poor because many of the respondents are not educated enough to be able to acquire technical information about routine immunisation (Table 4.18).

Furthermore, after the intervention, the respondents in the Intervention group performed below their knowledge scores at baseline. However, the difference in knowledge scores at baseline and end line between the two groups was not significant. Although the intervention did not target an increase in knowledge, the messages sent to the respondents in the Intervention group ought to aid their knowledge of routine immunisation and vaccine-preventable diseases (Table 4.18).

Table 4.18: Comparison of Knowledge Scores Respondents at Baseline and End Line

		Knowledge score – End Line		Total	X^2	p-value
		Poor	Good			
Intervention group	№	41	74	115	0.958	0.328
	Baseline (%)	35.7%	64.3%	100.0%		
	End Line (%)	47.7%	54.4%	51.8%		
Control group	№	45	62	107		
	Baseline (%)	42.1%	57.9%	100.0%		
	End Line (%)	52.3%	45.6%	48.2%		
Total	№	86	136	222		
	Baseline (%)	38.7%	61.3%	100.0%		
	End Line (%)	100.0%	100.0%	100.0%		

4.5 Respondents' Attitude towards Routine Immunisation

Highlights of respondents' attitudinal scores among those in the Control and Intervention groups were presented in Table 4.19. At baseline, the majority of the respondents (Control, 90.7%; Intervention, 95.7%) had positive attitudes towards routine immunisation. At the end line, more respondents in the Control group (100%) had positive towards routine immunisation than those in the Intervention group (85.2%) (Table 4.19).

Table 4. 19: Respondents' Overall Attitude Scores on Routine Immunisation

Attitude score	Control (N=107)				Intervention (N=115)			
	Baseline		End line		Baseline		End line	
	№	%	№	%	№	%	№	%
Negative	10	9.3	7	6.5	5	4.3	17	14.8
Positive	97	90.7	100	93.5	110	95.7	98	85.2
Total	107	100	107	100	115	100	115	100

Comparison of Attitude Scores of Respondents at Baseline and End line

When attitudinal scores of all respondents at baseline were compared with their scores at the end line, a significant difference was found between the Control group and the Intervention group (Table 4.20).

Table 4.20: Comparison of Respondents' Attitude Scores at Baseline and End Line

		Attitude score – End Line		Total	X^2	p-value
		Negative	**Positive**			
Intervention group	№	17	98	115	3.904	0.048
	Baseline (%)	14.8%	85.2%	100.0%		
	End Line (%)	70.8%	49.5%	51.8%		
Control group	№	7	100	107		
	Baseline (%)	6.5%	93.5%	100.0%		
	End Line (%)	29.2%	50.5%	48.2%		
Total	№	24	198	222		
	Baseline (%)	10.8%	89.2%	100.0%		
	End Line (%)	100.0%	100.0%	100.0%		

4.6 Completion of Routine Immunisation Schedules among Respondents who Received Reminder SMS

SMS reminders on various issues such as the importance of timely completion of all routine immunisation schedules, benefits of immunising children completely, and keeping immunisation appointments were sent to all respondents in the Intervention group. However, few respondents reported that they did not receive the reminder SMS until the end of the intervention. Table 4.21 highlights the proportion of respondents who received the reminder SMS and completed their children's routine immunisation schedules and those who did not receive SMS reminders and yet completed their children's routine immunisation schedules. Of the 91 respondents who reported to have received SMS reminders, 87.1% reported having completed all their children's immunisation schedules. Similarly, among the 24 respondents who did not receive reminder SMSs, 12.9% reported having completed their children's routine immunisation schedules. Therefore, there was a significant association between SMS reminders and respondents' completion of their children's routine immunisation schedules (p=0.05) (Table 4.21).

However, the information contained in the immunisation cards of respondents' children is not consistent with the reports given by the respondents. Records in the cards showed that of those who indicated that they received reminder SMSs 85.7% completely and fully vaccinated their children. Among those who did not receive reminder SMSs, only 14.3% completely and fully immunised their children against vaccine-preventable diseases. Therefore, a significant association was found between SMS reminder and respondents' completion of their children's routine immunisation schedules (p=0.05) (Table 4.22).

Table 4.21: Completion of Routine Immunisation Schedules among Respondents who Received Reminder SMS (Reported by respondents)

			Received reminder SMS to come to the clinic		Total	X²	p-value
			Yes	No			
Completed the immunisation schedule for your child	Yes	№	74	11	85	12.402	0.000
		%	87.1%	12.9%	100%		
	No	№	17	13	30		
		%	56.7%	43.3%	100%		
Total		№	91	24	115		
		%	79.1%	20.9%	100%		

Table 4.22: Completion of Routine Immunisation Schedules among Respondents who Received Reminder SMS (Observed in the immunisation cards)

			Received reminder SMS to come to the clinic		Total	X²	p-value
			Yes	No			
Completed the immunisation schedule for your child	Yes	№	60	10	70	4.696	0.030
		%	85.7%	14.3%	100%		
	No	№	31	14	45		
		%	68.9%	31.1%	100%		
Total		№	91	24	115		
		%	79.1%	20.9%	100%		

4.7 Testing of Hypotheses

The decision rule applied was that if the p-value computed was less or equal to the cut-off p-value of 0.05, the null hypotheses will be rejected in favour of the alternative hypothesis and vice versa. To evaluate the effects of reminder SMSs on primary outcome measures of knowledge of routine immunisation, immunisation appointments keeping, and timely completion of all routine immunisation schedules for biological children of respondents, the following were tested:

There is no significant difference between intervention and control groups with respect to the following:

a. Knowledge of routine immunisation,
b. Attitude to routine immunisation, and
c. Timely completion of full basic immunisation schedules for biological children.

In testing these hypotheses, independent sample t-test and Chi-square test were conducted at 0.05 level of significance. The result of independent sample t-test for statistical significance showed that at post-intervention, there was a significant difference in respondents' knowledge about routine immunisation between respondents in the control and intervention groups (p=0.000) (Table 4.23). Based on this value, the researcher rejected the null hypothesis. Thus, it could be inferred that the intervention had an influence on the knowledge of routine immunisation among the respondents in the Intervention group. The difference in the mean of knowledge scores of the two group was significant.

Table 4.23: Testing Hypothesis on Knowledge of routine immunisation

Survey/Group		**№**	**Mean**	**Std. Dev.**	**df**	**t**	**p-value**
Knowledge score - Baseline	**Intervention**	115	10.3	3.5	220	2.438	0.016
	Control	107	9.3	2.5			
	Intervention	115	12.9	2.8	220	3.893	0.000

Knowledge score - End line	**Control**	107	13.1	4.0			

Attitude towards Routine Immunisation

The result of the Chi-square test for statistical significance showed that at post-intervention, there was no significant difference in attitude to routine immunisation between respondents in the control and intervention groups (p=0.019). Based on this value, the null hypothesis was rejected. There was a significant difference between the Intervention and Control groups, thus the intervention had an influence on the attitude of respondents in the Intervention group to routine immunisation (Table 4.24).

Table 4.24: Attitude towards Routine Immunisation

Survey/Group		**№**	**Mean**	**Std. Dev.**	**df**	**t**	**p-value**
Attitude score – Baseline	**Intervention**	115	5.8	1.3	220	2.649	0.009
	Control	107	5.3	1.3			
Attitude score – End line	**Intervention**	115	5.1	1.6	220	-2.370	0.019
	Control	107	5.5	1.2			

Timely Completion of Full Basic Immunisation Schedules for Biological Children

The result of Chi-square test for statistical significance showed that at the end line, there was no significant difference between respondents in the Control and Intervention groups on timely completion of full routine immunisation schedules for biological children [from reported (p=0.639) and evidence (p=762)]. Based on this value, the researcher did not reject the null hypothesis. It could be inferred that the intervention had little or no influence on the timely completion of routine immunisation schedules in the Intervention group (Tables 4.25 and 4.26).

Table 4.25: Timely Completion of Full Basic Immunisation Schedules for Biological Children (as reported by respondents)

Group	Completed all immunisation (Reported)		Total	X^2	Df	p-value
	Yes (%)	No (%)				
Intervention	85 (73.9)	30 (26.1)	115 (100)	0.220	1	0.639
Control	82 (76.6)	25 (23.4)	107 (100)			
Total	167 (75.2)	55 (24.8)	222 (100)			

Table 4.26: Timely Completion of Full Basic Immunisation Schedules for Biological Children (evidence from immunisation cards)

Group	Completed all immunisation (Evidence)		Total	X^2	Df	p-value
	Yes (%)	No (%)				
Intervention	70 (60.9)	45 (39.1)	115 (100)	0.091	1	0.762
Control	63 (58.9)	44 (41.1)	107 (100)			
Total	133 (59.9)	89 (40.1)	222 (100)			

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Discussion

The broad objective of this study was to investigate the effectiveness of routine immunisation appointment reminder text messages sent to mothers of infants and the changes in mothers' uptake and timely completion of immunisation. The intervention involved sending a series of text messages or SMS to mothers reminding them of their children's next routine immunisation appointment and the importance of keeping the appointment. The intervention lasted for about 10 months. A key finding from the study is presented in this section.

5.1.1 Respondents' Children Immunisation Status

In this study, at baseline, none of the mothers or respondents completed all routine immunisation. However, at the end line, many respondents did not complete the routine immunisation schedules for their children. Completion of all routine immunisation schedules for children swas due at nine months when mothers are expected to return to the routine immunisation clinic for measles and yellow fever antigens. From what the respondents reported and the evidence available in their children's immunisation cards, the immunisation status of the children of the respondents in the Intervention group was incomplete prior to and even after reminder messages were sent to them about routine immunisation appointments. This finding is similar to the finding of a study conducted by Ali, Pongpanich, Kumar, Ghaffar, Murred and Safdar (2015) which reported less than 20% fully immunised infants in the Intervention and Control groups. Routine immunisation coverage was reported to be very low in all the sites. In a similar study, Anjum, Reddy, Monica, Rao, Abbas and Sushma's (2015) study also found that not all the children of the respondents in the Intervention group were timely and fully immunised as some still missed their routine immunisation appointments for various reasons.

5.1.2 Respondents' Knowledge about Routine Immunisation

Findings from this study showed that knowledge about routine immunisation among most respondents in both Control and Intervention groups was poor at baseline. Poor knowledge displayed might not be unexpected as some respondents just experienced parity for the first time. However, at the end line, there was an improvement in knowledge among the respondents inthe Intervention group, although the increase in knowledge was not significant. This could be because of other interventions or health education strategies going on in the communities that the investigator was not aware of. These findings were similar to that of Rainey, Watkins, Ryman, Sandhu, Bo and Banerjee's (2011) study that found that parental knowledge of vaccination accounted for 22% of reasons for under-immunisation in developing countries. Their study also reported that most participants lacked the knowledge that vaccinations prevent diseases but shared the misconception that vaccinations cause harm or are not effective.

Bangladesh shared some attributes with Nigeria in that not all efforts made by the two countries to stop the spread of polioviruses for instance, within their borders had yielded the desired results. In similar studies conducted in Bangladesh, Azmi and Prakash (2015) and Nisar, Mirza and Qadri (2010) found that majority of their study participants had poor or inadequate knowledge of routine immunisation and diseases they are meant to prevent. In another study, which evaluated knowledge of mothers regarding the immunisation, Angelillo, Ricciardi, Rossi, Pantisano, Langiano and Pavia (1999) reported that lack of knowledge prevents Italian mothers from playing an effective role in the eradication of vaccine-preventable diseases in Italy. The study found also that only half of the respondents could identify all the mandatory vaccines for infants. Of even greater concern is that only 20% knew that pertussis, measles, mumps, and rubella were diseases that are vaccine-preventable in children. Selvaraj, Sarkar and Daya's (2014) study, however, found that among mothers who participated in the study, about one-third had knowledge about pentavalent vaccine, vaccine knowledge was higher for polio (94.4%) followed by measles and DPT (77–79%). This is contrary to the present findings.

5.1.3 Factors Influencing Immunisation Uptake

Findings from this study showed that more than one third of the respondents in the Control and Intervention groups did not complete all routine immunisation schedules of their wards due to factors such as distance to health facilities, ignorance about the benefits of vaccination, non-availability of vaccine or vaccinators, attitude/motivation of healthcare workers, mothers' lack of awareness of the need to return for 2nd and 3rd doses of vaccine, fear of side effects/adverse reactions, wrong ideas about contraindications, and mothers' illness or non-availability. All these factors were however classified into three categories namely: lack of information, lack of motivation and obstacles.

These findings were similar to those of Abdulraheem et al. (2011) which reported that parents' objection, disagreement or concern about how safe immunisation is for children, the remoteness of health facility location, and long waiting time at a health facility are the most common reasons for partial immunisation. In addition, Jedege and Owumi's study explored the reasons why some mothers did not attend vaccination clinics or complete their children's immunisation schedules (Jedege and Owumi, 2013). The study found that although women in the study area knew the importance of immunisation, many of them were constrained by certain factors, which made them sometimes miss immunisation schedules. The factors include mothers who travelled often; those who forgot immunisation days; those whose schedules were busy such as traders; and those who needed the permission of their husbands.

Findings from this study are also similar to Adebayo, Oladokun and Akinbami's study on immunisation coverage in a rural community in South Western Nigeria (Adebayo, Oladokun and Akinbami, 2012). The study took place in rural communities and one of the areas of focus was on factors influencing immunisation completion. The authors categorised major reasons for incomplete immunisation into three: obstacles, lack of information, and lack of motivation. They also pointed out that obstacle in all accounted for most instances (72.3%) of failure to immunise children. Next to obstacles were lack of information (23.5%), and motivation (4.2%) in that order. In this current study, one of the strategies to overcome the lack of motivation was the use of reminder text messages, which were sent to educate and remind my mothers for about a year. Other studies (Rahji and Ndikom, 2013; Babalola and Adewuyi; 2005) also reported similar findings that compliance to the uptake of routine immunization antigens depended on the aforementioned factors. Therefore, the identified thus constitute the major factors influencing compliance with immunisation regimen in the area of study.

5.1.4 Respondents' Attitude towards Routine Immunisation

Most vaccines in the childhood immunization schedule require two or more doses for development of an adequate and persistent antibody response. For instance, some respondents did not understand the importance of administration of multi-doses of the same vaccine given at intervals to child immunity. As a result, such parents may think that only the first shot of the vaccine is sufficient to develop immunity and protect their children. As reported in the tables, there are other factors mentioned by respondents, which revealed the misconceptions they had about routine immunisation. Even though the findings of this study revealed that mothers in the two groups had positive attitudes towards immunisation, none of the attitudinal variables was a strong predictor of child immunisation schedule completion, just as had been observed by some other studies. In this study, the mean total score of respondents' attitudes towards routine immunisation in both Control and Intervention groups were high, indicating a very favourable attitude. However, Zelaya-Bonilla, Mata-Gamarra and Mills-Booth (1985) have warned that a positive attitude is not a guarantee of full immunisation. Mothers may sometimes not complete the vaccination schedule despite their positive attitude because of their poor understanding of the concept of vaccination, which health personnel do not take time to explain to them clearly. Just as was obtained in this study, Yawn, Xia, Edmondson, Jacobson and Jacobsen (2000) identified mothers' fear of side effects as an important factor that contributed to under-immunisation. As observed by Taylor, Darden, Brooks, Hendricks, Wasserman and Bocian (2000), data from this study show that no attitudinal variable was associated with completion or non-completion of various vaccine antigens, which, possibly was confounded by other unmeasured socio-cultural factors.

Furthermore, a good number of mothers in the two groups acknowledged that their major source of immunisation information was the healthcare workers. This finding suggests that mothers trust healthcare workers as the most important source of information on immunisation. This important opportunity should also instil a sense of responsibility for healthcare workers. Healthcare workers need to be mindful of this because mothers are likely to comply with whatever they tell them. However, few other mothers showed their displeasure about the attitudinal disposition of some healthcare workers which serve as a barrier to completing vaccine antigen. This suggests also that the attitude of healthcare workers especially the frontline healthcare workers, largely, has influence mothers' decision on their children's immunisation. Therefore, they need to be friendly to all clients and potential clients in the community as their attitude can predict whether community members will utilise any service provided by them.

5.1.5 Usage of Mobile Phones

The expansion and adoption of new methods of communication provide new opportunities for delivering health behaviour change interventions. Mobile telephones are reaching people in Africa's cities, towns, villages, and the countryside more rapidly than anywhere else in the world (Lestera and Karanja, 2008; Anon. 2005, The Economist). In recent past, mobile phone communication featured in most aspects of patients' personal lives and business, but not their health management. This study, therefore, extended the use of the mobile phone to addressing the challenges that prevent mothers from completing their children's routine immunisation schedules.

Results from this study at baseline and end line data showed some commonality in the patterns of use of phone among the respondents in the Control and Intervention groups. All the respondents in both the Control and Intervention groups owned at least one mobile phone. This is similar to the finding of Wakadha, Chandir, Were, Rubin, Obor, Levine et al. (2013) in their study on the feasibility of using mobile-phone based SMS reminders and conditional cash transfers to improve timely immunization in rural Kenya. They found that all their respondents had access to at least one phone, which could be used to send SMS relating to immunisation of their infants. A study conducted by Sadoh and Okungbowa (2014) also reported a similar finding. Between the two groups, all respondents had at least one active line and, knew how to open, read and send text messages on mobile phones. This finding is similar to that of Kebede, Zeleke, Asemahagn and Fritz (2015) which reported that aboutthree-quarters of the respondents indicated that they had a personal cell phone. Results also showed that about one-third of the respondents used the Yoruba language, which is the local language of the study area, in reading or sending text messages. About half of the respondents also used Yoruba and English languages in reading or sending text messages. This finding is at variance with the finding of Balogun et al. (2012) that almost all the respondents in their study in a tertiary health facility preferred to receive future text messages in English.

Result also showed that most respondents in the Intervention and Control groups used their mobile phones primarily to make a call. However, about one-third of the respondents in the Intervention group also added that they used their phone to receive or send text messages. Beyond making calls and sending messages, the respondents also used their mobile phones for other purposes such as listening to music and radio, and as a torch. This finding is similar to that of Kebede, Zeleke, Asemahagn and Fritz (2015) which reported that among the respondents who owned a cell phone, beyond making calls, more than 70% reported using the alarm function of their cell phone as a medication reminder.

As pointed out by Patrick, Griswold, Raab and Intille (2008), mobile phones support a variety of technical functions, most basically voice and short message services (SMS or text messages), which enable two-way communication in real time or near-real time. They are changing the way health professionals communicate with their patients. Some of the impacts of mobile phones on personal health are self-evident. An example of such is the greater ease with which health professionals and patients can reach and leave messages for one another because of fewer barriers related to the time of day or location. Another instance of such is the personal nature of the mobile phone which most of the time restricts access to it to an individual. This provides an opportunity to improve outreach for sensitive medical issues such as a reminder of medical appointments or information on laboratory results.

5.1.6 Adoption of Reminder SMS for Routine Immunisation Service Delivery

It is a fact that text messages do not just close the communications gap; they also close the immunisation coverage gap. Findings from this study showed that majority of the respondents in both groups believed that mobile phone could be effective in giving health information on immunisation to mothers. Most respondents also indicated that receiving reminder text messages about their children's routine immunisation appointments could reinforce mothers' attitude to always keep their children's immunisation appointment. This finding is similar to that of Balogun et al. (2012) that most respondents were willing to receive reminder SMS about their children's immunisation. In the same vein, Sadoh and Okungbowa (2014) who studied Nigerian mothers' opinion on reminder/recall for immunization found that majority of the mothers (80.3%) could read and that 62.6% of them agreed that mothers should be reminded of their children's immunisation appointments. Kebede et al. (2015) also found that about half of the respondents in their study indicated their willingness to be contacted by their clinics through text messages. They pointed out further that if they were contacted through this medium, their adherence to medication could improve. This finding is also consistent with findings in quantitative and qualitative studies in the United States of America (Szilagyi, Bordley, Vann, Chelminski, Kraus, Margolis and Rodewald, 2000; Ahlers-Schmidt, Chesser, Hart, Pascal, Nguyen, Wittler, 2010; Kharbanda, Stockwell, Fox and Rickert, 2009).

Furthermore, Kaewkungwal, Apidechkul, Jandee, Khamsiriwatchara, Lawpoolsri, Sawang et al. (2015) noted that mobile technology, particularly the use of smartphone systems, has already been employed as a vehicle for global health care innovation, in terms of facilitating behavioural change and improving health care. The benefits of such innovations include improved access to and quality of care, patient management, and health outcomes among underserved populations (Nations High Commissioner for Refugees, 2011).

5.1.7 Effects of Reminder SMS for Routine Immunisation Clinic Attendance and Immunisation Completion

The main objective of this study was to evaluate how effective using Short Messaging Service (SMS) to remind mothers of their children's next vaccine dose or immunisation appointment was in ensuring completion of immunisation schedules.

Several studies reported that immunisation coverage among children living in rural hard-to-reach districts and medically underserved communities remains low (42%-60%). It has also been observed that non-compliance with vaccination schedules undermines the potential benefits of immunisation.

The baseline survey conducted for this current study served to determine if the two groups are similar and equivalent. The post-intervention results from the respondents in the Intervention group (a group who was sent reminder SMS for routine immunisation appointment keeping) revealed some unexpected outcomes. Not all respondents in the Intervention group reported to had received the reminder text messages despite the fact that these messages were sent. This finding is similar to that of Wakadha et al. (2013) that only 90% of their respondents with a follow-up survey reported that they received reminder SMS. They also found that three mothers did not receive the SMS on their designated phone and that another three mothers who were used other people's phones, as designated lines did not have the messages conveyed to them by the owners of the phones (Wakadha et al., 2013).

In addition, majority of the respondents in the Intervention group indicated that they received the reminder SMS often (three times weekly). This finding is similar to that of Wakadha et al. (2013) which reported that among respondents who received reminder SMS in their study, some reported having received four (44%) while others received three (13%), two (33%) and one (14%) reminder SMS. Moreover, most of the respondents reported that their spouses/significant other in the family also received the same SMS. This finding also is similar to Wakadha et al. (2013) finding that some respondents, especially respondents who do not have personal mobile phones, used significant others' phones to receive reminder SMS.

Important to the current study is the percentage of respondents in both Control and Intervention groups who completed all immunisation schedules timely. Results showed that majority of the respondents reported that they completed their children's immunisation schedules as and when due. However, the information extracted from the immunisation cards of the respondents' children was not consistent with what reported by the respondents. More than half of respondents in the two groups completed all routine immunisation schedules for their children, but they were in the Intervention group compared with the Control group. One would have expected all the children of respondents in the Intervention group to be fully immunised at the end line (post-intervention). However, the reverse was the case as about two-thirds respondents completed all the immunisation schedules. A review of literature on the effect of patient reminder/recall interventions on immunisation rates by Szilagyi et al. (2000) showed that not all the studies reviewed showed a similar result. Reminder/recall systems were found to be effective in 80% of all the studies reviewed, were generally effective for both children and adults and for both routine immunisations. For routine immunisations, 12 of 15 studies found positive effects, with improvement in immunisation rates ranging from 6 to 34 percentage points. Similarly, a review on the use of mobile phone text message reminders in health care services conducted by Kannisto, Koivunen and Välimäki (2014) shows that most of the studies reported improvement in the health outcomes measured.

Furthermore, the respondents identified non-availability of mothers on immunisation appointment days or illness of mothers as the most frequent reason for failure to complete all immunisation schedules. This finding is contrary to that of Balogun and colleagues (2012) that the most common reason given for missing clinic appointments was that mothers usually forget the immunisation appointments their children.

As suggested in the literature, non-immunisation or low immunisation rates could be partly attributable to the complexity of individuals and communities. The most common explanations for low immunisation rates are other priorities that compete with child immunisation, attitudinal disposition, apathy, working longer hours due to poverty, and being socially and legally alienated (Babalola and Fatusi, 2009; Global Immunisation Division; Centers for Disease Control Prevention Atlanta, 2009; Sawhney and Favin, 2009). Studies of trends in disparities in the complete immunisation indicate other critical factors including low parental education level, availability and ease of access to health care facilities, and commuting difficulties for rural and remote populations (Sawhney and Favin, 2009; Nath, Singh, Awasthi, Bhushan, Kumar and Singh, 2008; Semali, 2010).

However, this study found differences in culture, beliefs, attitude and socio-economic status in relation to the health care-seeking behaviours of the people in the rural areas, especially those in the Intervention group, to be a challenge. This contradicts the position maintained in documents from the grey literature for the World Health Organization (WHO), which identifies demographic or sociological characteristics as underlying or secondary determinants. The documents maintain that lack of communication, as well as efforts to distribute information promoting immunization, is the primary factor (Sawhney and Favin, 2009).

5.2 Summary

In summary, this study has some strengths. First, reminder text messages were sent according to the protocol to the majority of the respondents. This makes findings more generalizable. Second, by enrolling mothers of infants at health facilities, selection bias was minimised compared to what would have been if they were enrolled from home. Routine immunisation can only be given at health facilities, whether a woman delivered at the clinic, home or mission/TBA. Health facilities focus on timely completion of all schedules from the time mothers enrol their infants for first vaccination intervention.

It is important also to note that if the process used in this study is adopted for a study situated in rural areas, such intervention or programme would work. Information about possible cofounders, study population needed to prevent high attrition rate, and other technical details are very important for this intervention to work. All the factors that could work against successful implementation and outcomes of the intervention must be prevented.

5.3 Conclusion

The study gave insight into the types of preparation that must be put in place before any intervention study is undertaken in the rural areas. Such studies or programmes need to target the belief, attitude and knowledge of rural communities and make efforts to demystify whatever misconception they may have towards any health issue. In particular, counselling activities need to be initiated among these set of the population to gain their trust for the success of any programme is designed to improve infants' health in rural communities. Majority of the respondents who participated in the study in both study sites reported to have attained some level of education. However, that did not reflect much especially in the way they handled their children's routine immunisation appointments. It was also observed that a few Research Assistants recorded few dates of birth, mobile phone numbers and respondents' addresses incorrectly. The mistakes resulted in SMSs being sent at the wrong time or to the wrong phone. The mistakes also made it difficult to locate some respondents during monitoring of the research work although few of these respondents were traced and located; most of the Research Assistants were from these communities and therefore, are familiar with the locality. Consequently, the quality of training given to research assistants before any study on the importance of entering information correctly during data collection exercise cannot be overemphasised.

In some instances, husbands of some respondents disapproved of their wives' participation in the study when they suspected that their children were being used for an experiment. Therefore, extensive engagement of husbands in the community is important since this strategy extends beyond the traditional mother-child pair targeted for most immunisation-related interventions.

The technical challenge of information sharing between researcher desk with bulk SMS platform and respondents in the Intervention group in rural areas was managed. The strength of mobile telephone networks in the villages and towns varied, but all text messages were sent whenever a strong mobile telephone signal was available. Other research suggested that this kind of innovation can yield timely information for improving case management, delivering higher quality, validity, and reliability (Kaewkungwal et al., 2015; United Nations High Commissioner for Refugees (UNHCR), 2011; Hofstetter, Vargas, Kennedy, Kitayama and Stockwell, 2013). In a similar study of using smartphones to promote maternal and child health, mobile technologies were reported as an effective platform via provision of 6 core functionalities: (1) informing stakeholders, (2) training health providers, (3) enabling more accurate and precise self-monitoring, (4) delivering prompt reminders/supportive messages, (5) supporting effective service delivery over time, and (6) alerting care providers to specific cases (Rotheram-Borus, Tomlinson, Swendeman, Lee and Jones, 2012).

5.4 Implications of Findings for Health Promotion and Education

The findings of this study have implications for health promotion and education and these implications are discussed in this subsection. It was noted that knowledge about and attitude to routine immunisation and vaccine-preventable diseases in the two rural Local Government Areas were not satisfactory. Therefore, well-tailored information on the importance of routine immunisation and vaccine-preventable diseases disseminated through public enlightenment and one-on-one contact in health facilities is needed. Public enlightenment materials that can be considered useful are leaflets, posters, radio jingles, billboards, radio drama and street campaigns aimed at increasing the awareness and knowledge and at improving the attitude of mothers of infants to issues associated with vaccine-preventable diseases. Although many of these public enlightenment materials are already being used in the State, more efforts and strategies are needed to reach the rural areas with messages that specifically address their cultures and belief systems. The role of public enlightenment will be to upgrade people's knowledge relating to the prevention of the disease, the pivotal role of communication in routine immunisation appointment keeping and timely completion of all routine immunisation schedules. Public enlightenment is also needed to facilitate the demystification of certain diseases and the negative effects of vaccines on children.

It was noted that while stakeholders have key roles to play in enhancing the positive outcome of routine immunisation, they were not doing enough to support appointment keeping and timely completion of routine immunisation schedules. Advocacy is needed to gain the support of this category of people. It will enable them to contribute to attaining full and timely completion of routine immunisation schedules through provisions of various forms of support. The targets of the advocacy efforts should include the following: respondents' spouses, employers of labour, women leaders in markets, various associations, community heads and the wider community. When these people lend their voices and supports, mothers of infants can be better assisted to keep routine immunisation appointments promptly even when they are out of town.

5.5 Recommendations

With the foregoing discussion in mind, the following recommendations are made:

1. As the study revealed unsatisfactory levels of knowledge on routine immunisation among respondents with unsatisfactory levels of completion rate of routine immunisation (especially DPT3, Measles and Yellow Fever), there is an urgent need to investigate into the dynamics and factors influencing routine immunisation dropout rates in rural communities in Nigeria. This will be compliment by other interventions that will be tested in these communities.

2. Since the study revealed unsatisfactory levels of knowledge on routine immunisation among respondents with the use of reminder SMSs on various health issues on routine immunisation, interventions on improving knowledge using mHealth might not be the most appropriate medium. It is therefore recommended that, in programming and

planning of health promotion and education interventions, this should be given consideration.

3. Based on the findings from this study, reminder text messages were effective in improving knowledge and completion of routine immunisation among mothers of infants in the intervention group, therefore, its use among frontline health workers in all Primary Healthcare Centres with routine immunisation services is recommended.

4. Using the lessons learned from this study in establishing a mobile phone-based system to send SMS, it is therefore recommended that, further investigation can be done on the impact of this intervention/innovation on timely and full completion of all routine immunisation schedules (especially measles and yellow fever which are usually given at 9 months) in a larger quasi-experimental design in other rural Local Government Areas in Oyo State or in another state.

   Although there is a high level of interest in and excitement about mHealth programmes in Africa (Gencer, 2011; Gaarder, Glassman and Todd, 2010), the evidence documenting their effectiveness in Nigeria is insufficient. Such evidence will serve as a basis of the investment, time and effort that will be necessary to introduce and, then, potentially scale-up these programmes.

5. As the study revealed the role played by significant others (spouse, relations and healthcare workers) in reminding them about their immunisation appointments, it therefore recommended that social support be incorporated into routine immunisation programme for timely and full completion of all immunisations.

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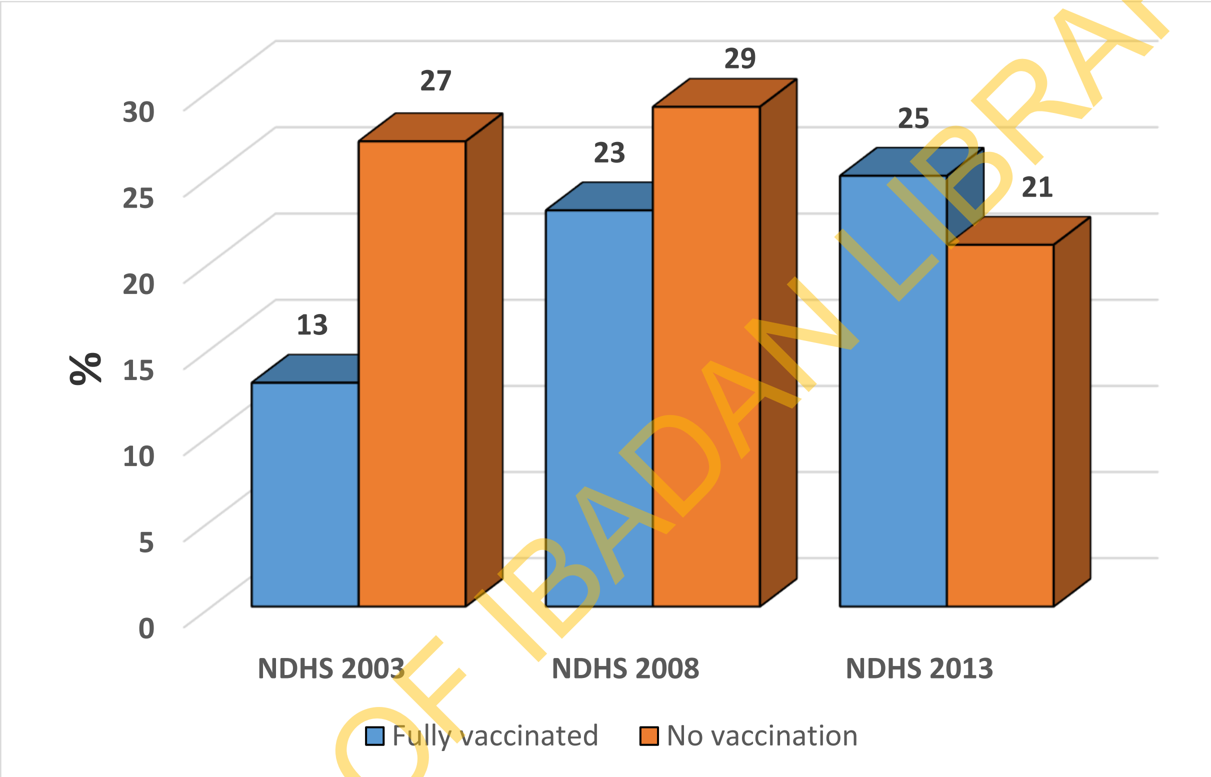
APPENDIX I

Trend in Nigeria's immunisation coverage 2003-2013



Source: National Population Commission (NPC) [Nigeria] and ICF International, 2014)

APPENDIX II

Samples of messages sent over a period of 10 months

S/№	Message in English Language	Message (Yoruba Language translation)
1	Come for the remaining immunisation schedules for your child. This is important to protect them against Polio. God, who gave us this child Will protect him/her. Wishing you safe nurturing!	*E wa gba abere tabi atola ajesara eyi to ku fun omo yin. O se pataki lati daabo bo won lowo aisan romolapa romolese. Oluwa to fun wa lomo A fun wa wo o. Abiye o!*
2	Don't forget to immunise your child as at when due. This is important for the health of your child	*Mase gbagbe lati gba abere ajesara fun omo re pe lasiko ti o ye. O se pataki fun ilera omo re. Abiye lomo wa!*
3	Bring your child for immunisation, it will protect them from diseases that can be prevented by vaccination. Abiye lomo!	*E gbe omo yin wa fun abere tabi atola ajesara, yio da aabo bo won lowo arun ti a le dena pelu abere tabi atola ajesara.*
4	Remember your child's next immunisation appointment (Compliments of the season. As we celebrate, remember to keep your child's next immunisation appointment. It's important for you to complete his or immunisation	*E ranti asiko ti a da fun igbabere tabi atola ajesara omo yin. (Eku odun o, aseyi se eemi. Bi a nti se popo sinsin odun, e ranti lati fi asiko ti a da fun igbabere tabi atola ajesara omo yin sokan.*
5	Today is your child's immunisation; remember to go to the nearest health centre to complete your child's immunisation. It will protect him or her from diseases.	*Oni ni ojo igbabere ajesara omo yin, e ranti lati lo si ile iwosan alabode ti o wa nitosi yin lati se eyi. Yio daabo bo lowo awon aarun ti pomode ni rewerewe.*
6	Immunisation reminder. Remember to go to the health centre to complete your child's immunisation. It'll protect him or her from diseases.	*Irani leti abere ajesara. E ranti lati lo si ile iwosan alabode lati lo gba abere ajesara omo yin ti o ku. Yio daabo bo o lowo aisan.*
7	Care for a child is so important; remember to go for the remaining immunisation antigens. S/he will be protected from vaccine-preventable diseases. We shall all have safe nurturing.	*Itoju omo se pataki, ranti lati gba abere tabi atola ajesara to ku fun omo re. Yio dabo bo awon omo wa lowo arun romo lapa romo lese. Abiye lomo wa o!*
8	We shall all have safe delivery. Mothers of infants, remember to complete all your children immunisation schedule at the nearest Primary Healthcare Centre either in Ayete, Tapa or Igangan. We shall nurture our children to survive.	*Abiye lomo o. Eyin mama olomo wewe, e ma gbagbe lati lo gba abere ajesara fun omo yin ni Ile Iwosan Ijoba Ibile to wa ni Ayete, Tapa tabi Igangan. Bibi o, abiye.*
9	Health is wealth; please ensure that you complete all scheduled immunisation for your child. Protect your child; complete all vaccination due for them.	*Ilera loro, eri wipe e gba abere tabi atola ajesara omo yin pe. E da abo bo omo yin, egba gbogbo abere tabi atola ajesara omo yin pe. Abiye lomo wa o.*

10	Do not forget to complete all routine immunisation for your child in any of the PHC facilities in Ayete, Tapa or Igangan. It is important for your child to be fully immunised.	*E ranti lati lo gba abere ajesara tabi atola ajesara eyi to ku fun omo re ni Ile Iwosan Ijoba Ibile to wa ni Ayete, Tapa tabi Igangan. O se pataki fun awon omo wa.*
11	Protect your child; complete all immunisation schedules for your child. Today is immunisation clinic day; don't forget to get him or her vaccinated at the nearest health facility. Wishing you safe nurturing	*E da abo bo omo yin, e gba abere tabi atola ajesara omo yin pe. Oni ni ojo abere ajesara miran, e ma gbagbe lati lo gba a ni ile iwosan ijoba. Abiye lomo wa o.*
12	Tomorrow is another routine immunisation clinic day at the healthcare facilities in Ayete, Tapa or Igangan. Safe nurturing.	*Abiye lomo o. Ola ni ojo miran fun gbigba abere tabi atola ajesara fun awon omode ni Ile Iwosan Ijoba Ibile to wa ni Ayete, Tapa tabi Igangan. Bibi o, abiye! (Wishing you safe delivery.*
13	Do you know that there is danger in apathy towards routine immunisation for children? Make haste to ensure that all immunisation schedules are completed.	*Nje e mo wipe ewu wa ninu ailakasi abere ajesara to ku fun awon omode. E mase jafara lati ri daju wipe e gba gbogbo abere ajesara ti o ba ye fun awon omode. Abiye!*
14	Remember to check your child's immunisation card in order to ensure that you keep in your child's next immunisation appointment.	*E ranti lati ye kaadi abere ajesara omo yin wo lati mo igba ti o ye ki o lo gba abere tabi atola ajesara to ku. Abiye lomo wa o!*
15	Children health is important; ensure that your children get full and timely completion of all immunisation.	*Eto ilera awon omode se pataki, e ri daju wipe awon omode gba gbogbo abere ajesara lasiko. Omo lere aye. Abiye lomo!*
16	Happy weekend, wishing you many more in good health. Health is wealth, pleasure ensure that all vaccination for your child are taken on time. Wishing you safe nurturing.	*E ku isinmi loni, opo re la o se pelu alaafia ninu ola nla. Ilera loro, eri daju wipe e ranti gba gbogbo abere tabi atola ajesara omo yin pe. Abiye lomo wa o!*
17	Greetings, may the Lord reward all our labour. Remember to check immunisation card of your child to know the next routine immunisation appointment for him/her.	*E ku ise oni, Olorun yio fi ere sise wa. E ranti lati ye kaadi abere ajesara omo yin wo lati mo igba ti o ye ki o lo gba abere tabi atola ajesara to ku. Abiye lomo o!*
18	Dear mother, please don't forget to keep your child's next immunisation appointment. It's important that you complete his/her immunisation schedule. Abiye lomo!	*Eyin mama, e jowo ema gbagbe lati fi ojo abere tabi itola ajesara omo yin sokan. O se pataki lati gba gbogbo abere ajesara yi lasiko*
19	It is 9 months now; remember to check your child's immunisation card to know the date for your child's immunisation appointment.	*Osu kesan ti pe bayi, E ranti lati ye kaadi abere ajesara omo yin wo lati mo igba ti o yio lo gba abere tabi atola ajesara to ku. Abiye lomo o!*
20	Mothers of infants, this is the ninth month. Today is another clinic day for routine immunisation; remember to take	*Eyin mama omode, osu mesan ti pe bayi! Oni ni ojo miran fun abere ajesara, e ranti lati gbe omo yin wa gba abere tabi atola*

	your child to the clinic to complete all routine immunisation schedules. We shall nurture our children to live.	*ajesara eyi to ku fun omo yin. O se pataki lati daabo bo won lowo aisan awon omode. Abiye lomo wa o!*
21	Dear mother, please don't forget to keep your child's next immunisation appointment if you have not done so. It's about the 9th month, the time schedule for measles and yellow fever vaccines for your child. It is important. Abiye lomo!	*Eyin mama olomo wewe, e jowo e ma gbagbe lati lo gba abere tabi atola ajesara ti oku tie eko ba ti se be. Osun mesan tip e bayi, asiko ti to lati gba abere ajesara igbana. eyi ati iba ponju poto fun omo yin. Eyi se Pataki*
22	Dear mother of infant, remember to check your child's immunisation card. It is the ninth month now since you started routine immunisation and it is time to go for measles and yellow fever immunisation in order to complete all routine immunisation. This is important for all our children	*Eyin mama omode, e ranti lati ye kaadi abere ajesara omo yin wo. Osu kesan tipe bayi, akoko niyi lati gba abere ajesara arun 'ẹyi' ati arun 'iba ponju ponto' ti e ko ba ti gba won. Eyi se pataki fun awon omode ti ko ti pe odun kan. Abiye lomo wa o!*

APPENDIX III

Focus Group Discussion Guide (Mothers with Infants)

EFFECT OF MOBILE TELEPHONE REMINDER TEXT MESSAGES ON MOTHERS' KNOWLEDGE AND COMPLETION OF ROUTINE IMMUNISATION IN RURAL AREAS OF OYO STATE, NIGERIA.

Introduction

I am a graduate student from the Department of Health Promotion and Education, College of Medicine, University of Ibadan. I am conducting a research on the effects of mobile telephone text message reminders on the completion of immunisation schedule by mothers with infants (children less 0 – 2 months) in rural Primary Health Care (PHC) facilities in Oyo State. The purpose of this research is to assess the effectiveness of using mobile telephone text messages in reminding mothers ofthe infant for the uptake of immunisation schedules of their infant children. The study is focusing on infant mothers who attend primary health facilities in Oyo state. The findings from this study will be helpful in designing interventions aimed at improving routine immunisation coverage with the use of mobile technologies as a means of reducing the occurrence of health conditions and death resulting from vaccine-preventable diseases.

Your participation in this interview is voluntary and your answers to all the questions that I will ask you will be kept secret. There is no right or wrong answer so you are encouraged to make your contributions. I shall be grateful if you are honest in answering all the questions. Whatever is learnt will be useful for future plan. The discussion will take about 35 minutes and you are free to terminate the discussion at any point you wish without any repercussion. I do not require your name for this interview but whatever information you supply will be kept confidential. My colleague here is ...., we will like to request your permission to take note during this discussion and we will also like to take permission to record the discussions in a tape recorder to ensure that we do not forget useful information that you are giving us.

Do you agree to take part in this discussion? 1. Yes [ ] 2. No [ ]

If you agree to take part, can we start the discussions now? 1. Yes [ ] 2. No [ ]

Name of Health Facility: ---

LGA: …………………………………… Location:

…………………………………

Q.1 What do we understand by immunisation?

Probe for - types of immunisation (routine, National Immunisation Days etc)

- schedule for routine immunisation
- the age group of recipients

Q.2 What diseases do immunisation received prevent?

Probe for - names of diseases

- the age each of the immunisation is received
- locations where immunisation can be received
- the perceived benefits of completing immunisation

Q. 3 Why is it necessary for mothers of children less than 1 year to attend the immunisation of their child?

Probe for - consequences of failure to do so

- infant mortality indices due to vaccine-preventable diseases

Q.4 Name the places where routine immunisation services are provided for mothers in this area?

Probe for - names of public and private health centres providing immunisation

- names of other immunisation providers

Q.5 What do mothers do with sick children who were due for immunisation?

Probe for - missed opportunities

- how the facility head in charge deal with the situation?

Q.6 How can mothers who may not have completed their children's immunisation be recognised?

Q.7 What are factors that encourage mothers of children less than 1 year in taking their children for immunisation?

Probe for - the factor which encourages them most?

Q. 8. What are the barriers that mothers of children 0 -2 months old encountered in getting their children immunised?

Probe for - religious beliefs

- rumours about immunisation
- time spent on health talks before immunisation
- crowd control during immunisation
- the time utilized for immunisation sessions
- other hindrances

Q. 9. How can one know

(a) mothers, who are likely to complete their immunisation?
(b) mothers, who are NOT likely to complete their immunisation?

Q. 10. What is your opinion on the use of the mobile telephone for reminding mothers about the immunisation schedule for their children?

Probe for

- Examples of messages that could be sent?
- Language preferred
- Time of the day to send
- How many times to be sent
- Days of the week to send

Q. 11. How has healthcare workers been using mobile telephones to contact mothers of children who are less 1 year relating to immunisation?

We have come to the end of this discussion.
Thank you for participation in this discussion.

APPENDIX IV

<u>Key Informant Interview Guide for Health Care Workers</u>

EFFECT OF MOBILE TELEPHONE REMINDER TEXT MESSAGES ON MOTHERS' KNOWLEDGE AND COMPLETION OF ROUTINE IMMUNISATION IN RURAL AREAS OF OYO STATE, NIGERIA.

<u>Introduction</u>

I am a graduate student from the Department of Health Promotion and Education, College of Medicine, University of Ibadan. I am conducting a research on the effects of mobile telephone text message reminders on the completion of immunisation schedule by mothers with infants (children 0-2 months) in rural Primary Health Care (PHC) facilities in Oyo State. The purpose of this research is to assess the effectiveness of using mobile telephone text messages in reminding mothers of the infant for the uptake of immunisation schedules of their infant children. The study is focusing on infant mothers who attend primary health facilities in Oyo state. The findings from this study will be helpful in understanding issues about routine immunisation uptake and timely completion of all immunisation. Moreover, I will like to find out your opinion on the use of SMS reminders through mobile technologies as a mean of increasing full and timely completion of all immunisation in an attempt to forestall the occurrence of health conditions and death resulting from vaccine-preventable diseases.

Your participation in this interview is voluntary and your answers to all the questions that I will ask you will be kept secret. There is no right or wrong answer so you are encouraged to make your contributions. I shall be grateful if you are honest in answering all the questions. Whatever is learnt will be useful for future plan. The discussion will take about 30 minutes and you are free to terminate the discussion at any point you wish without any repercussion. I do not require your name for this interview but whatever information you supply will be kept confidential.

Thank you for your cooperation.

a. Are you willing to participate in the study? 1. Yes ☐ 2. No ☐
b. IF NO TO (sa) above, STOP INTERVIEW and thank respondents.

Section A: Socio-demographic information

LGA: 1. Kajola ☐ 2. Ibarapa North ☐

Location: ……………………………………………

1. What is your position/post in this facility?
2. What is your highest educational qualification?
3. What are your roles in this facility?

Section B: Factors affecting immunisation delivery

4. What types of immunisation services do you render in this facility?
5. How often do you conduct routine immunisation?
6. What factors do you think are responsible for mothers of infants not bringing their children for routine immunisation?

   Probe for

   a. Factors relating to the facilities

   b. Factors relating to mothers

   c. Other factors
7. What has been done in this facility to reduce each of these problems?

   a. Factors relating to the facilities

   b. Factors relating to mothers

   c. Other factors
8. What is done in this facility when mothers of infants fail to present their children for routine immunisation as at when due?
9. What has been the outcome of these efforts?
10. Which of your efforts has not been successful? And why?
11. Have you received training on your present job in the last 12 months? If Yes, describe it.
12. Have you received any training on immunisation in your present job in the last 12 months (Describe it)?
13. What are your suggestions for improving immunisation in this facility?

Section C: Use of mobile telephone and SMS in health care

14. What do the health workers in this facility use their mobile telephones during working hours?
15. Are mobile telephones used by the health workers in this facility for reminding mothers with children less 0 -2 months old for next immunisation appointment for their children?
16. What has been the outcome of these efforts?
17. Do mothers use mobile phones to reach health care workers in this health facility relating to the immunisation of their children?
18. If Yes, what proportion of mothers?
19. What types of information do they request for?

20. Would you support the use of mobile telephone text messaging to remind mothers with children less than 1 year about the next immunisation appointment for their children?
21. Who should pay for it?

Thank you for taking part in this important study.

APPENDIX V

Ethical Approval from Oyo State Research Ethical Review Committee

TELEGRAMS................ TELEPHONE................

OYO STATE: THE PACESETTER

MINISTRY OF HEALTH

DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION

PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No. ....

All communications should be addressed to the Honorable Commissioner quoting

Our Ref. No. AD 13/ 479/ 573

3rd February, 2014

The Principal Investigator,
Department of Health Promotion and Education,
College of Medicine,
University of Ibadan,
Ibadan

Attention: Dipeolu .I. Oluwafemi

Ethical Approval for the Implementation of your Research Proposal in Oyo State

This acknowledges the receipt of the corrected version of your Research Proposal titled: "Effects of Mobile Phone Messaging Intervention for Uptake of Five Basic Childhood Immunisations by Mothers in Oyo State."

2. The committee has noted your compliance with all the ethical concerns raised in the initial review of the proposal. In the light of this, I am pleased to convey to you the approval of committee for the implementation of the Research Proposal in Oyo State, Nigeria.

3. Please note that the committee will monitor closely and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of the findings as this will help in policy making in the health sector.

4. Wishing you all the best.

OYO STATE RESEARCH ETHICAL REVIEW COMMITTEE
Signature & Date
MINISTRY OF HEALTH, IBADAN

Sola Akande (Dr)
Director, Planning, Research & Statistics
Secretary, Oyo State, Research Ethical Review Committee

APPENDIX VI

INFORMED CONSENT

EFFECT OF MOBILE TELEPHONE REMINDER TEXT MESSAGES ON MOTHERS' KNOWLEDGE AND COMPLETION OF ROUTINE IMMUNISATION IN RURAL AREAS OF OYO STATE, NIGERIA.

Consent form for Survey Respondent

Name of Investigator: Isaac Oluwafemi Dipeolu

Name of Institution: University of Ibadan

Greetings. My name is Isaac Oluwafemi Dipeolu and I am a graduate student of the Department of Health Promotion and Education, College of Medicine, University of Ibadan. I am conducting a research study on "The Effects of Mobile Phone Text Message Reminders on the Completion of Routine Immunisation by Mothers of Infants in Oyo State, Nigeria". Based on the findings from this study, it will contribute to knowledge about the potentials of using mobile phone application for increasing immunisation uptake and timely completion of routine immunisations. This study has implications for policy development and formulation also.

Purpose of the Study and Study Requirements

What was the study all about? Participants were informed that the purpose of the study was to investigate the "Effects of Text Message Reminders on the Completion of Routine Immunisations in Selected Rural Local Government Areas, Oyo State, Nigeria". Participants were also informed that the researcher was interested in learning on how the opportunity of availability of mobile phone could be used in reminding mothers of infants about their immunisation appointment keeping. It is hoped that this has potentials in reducing missed appointments and then reducing the number of children affected or dying from vaccine-preventable disease.

Why have I been invited to take part?

Mothers of infants were invited to take part in the study because they are key players with regards to immunisation of their children and issues about immunisation appointment keeping, missed immunisation schedules and timely completion of immunisation evolve around them.

What will happen taking part?

Participants who agreed to take part in the study were given informed consent form which they read and have understood the content of the form, they indicated their interest in participating in the research by signing or thumb printing. Some participants gave verbal consent. They were informed that after signing the informed consent, they will also be asked to respond to questions about routine immunisation and the use of the mobile phone.

How long will interview last?

This took between 1 and 1½ hours.

They were also informed that they will be contacted again as the study was for about a year.

Risks

What are the risks of the study? Physical or psychosocial harm to participants while participating in this study was minimal. An inconvenience may be the time and effort taken to be a participant. They were informed also that they may experience a little fatigue during the interview. Participants were likely to find one or more questions asked to be upsetting or sensitive. They were informed that they do not have to respond to any question that makes them uncomfortable. The interview could be ended at any time without penalty or loss of any benefits to which you are entitled.

Benefits

What are the benefits of participating? There was no immediate benefit directly in monetary or other terms from participating in this study. However, participants may find an indirect benefit in knowing they participated in an important study where the results may create opportunities for improving routine immunisation service delivery to mothers. However, participants were given 250 kg pack of detergent in appreciation of their time for participation.

Confidentiality

Will participation in the study be kept confidential? The information that was collected during the study will be kept private. No one will be told that they had participated in the study. The study team will make every effort to protect your privacy and maintain the confidentiality of all the information provided. Name or other identifiers were not included in reports from this study. Data were stored in locked shelves and a computer dedicated to this study that only the study team can access.

Voluntariness

What are the rights of a research participant? Participation in this study is completely voluntary. Anyone who decided not to participate will not lose any existing benefits to which they are entitled. Anyone who agreed to participate in this study may end their participation at any time without penalty or loss of existing benefits to which they are entitled. Also, anyone who decided to take part in the study is free to skip any questions. Participants are free to withdraw at any time without affecting their relationship with immunisation clinic staff or the researchers.

Who to contact

If you have any question you may ask those now or later. If you wish to ask questions later, you may contact any of the following:

Isaac Oluwafemi Dipeolu
Address: Department of Health Promotion and Education, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan.
+234 803 833 8118
e-mail: oludipeolu@yahoo.com

or

Prof. Oladimeji Oladepo
Address: Department of Health Promotion and Education, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan.
+234 803 326 3302
e-mail: oladepod@yahoo.com

Certificate of Consent for Qualitative Study

I have been invited to take part in the research on the knowledge, uptake and timely completion of immunisation schedule by mothers with infants in selected primary healthcare facilities in Oyo state through reminder SMS. I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions I asked had been answered to my satisfaction. I consent voluntarily to be a participant in this study and understand that I have the right to withdraw from the interview at any time without in any way affecting my medical care.

Print name of Respondent	Date and Signature of Respondent
………………………………..	…………………………………..
	------/ -----/ ------------ (dd/mm/yy)

Print Name of Researcher/Moderator Date and Signature of researcher/moderator

--- --

------/ -----/ ------------ (dd/mm/yy)

APPENDIX VII

S №.................

QUESTIONNAIRE FOR MOTHERS WITH INFANTS

EFFECT OF MOBILE TELEPHONE REMINDER TEXT MESSAGES ON MOTHERS' KNOWLEDGE AND COMPLETION OF ROUTINE IMMUNISATION IN RURAL AREAS OF OYO STATE, NIGERIA.

Dear respondent,
I am a graduate student from the Department of Health Promotion and Education, Faculty of Public Health, College of Medicine, University of Ibadan. I am conducting a research on the "EFFECT OF MOBILE TELEPHONE REMINDER TEXT MESSAGES ON MOTHERS' KNOWLEDGE AND COMPLETION OF ROUTINE IMMUNISATION IN RURAL AREAS OF OYO STATE, NIGERIA." in rural Primary Health Care (PHC) facilities in Oyo State. The purpose of this research is to assess the effectiveness of using mobile telephone text messages in reminding mothers of an infant of routine immunisation appointment of their infants. The study is focusing on infant mothers who attend primary health facilities in selected rural areas in Oyo state. The findings from this study will be helpful in designing interventions aimed at improving routine immunisation coverage with the use of mobile technologies as a means to reducingthe occurrence of health conditions and death resulting from these vaccine-preventable diseases.

Your participation in this interview is voluntary and your answers to all the questions that I will ask you will be kept secret. There is no right or wrong answer so you are encouraged to make your contributions. I shall be grateful if you are honest in answering all the questions. Whatever is learnt will be useful for future plan. The discussion will take about 35 minutes and you are free to terminate the discussion at any point you wish without any repercussion. I do not require your name for this interview but whatever information you supply will be kept confidential.

I have given permission by Mr/Mrs/Miss. ________________________________ to collect data on my behalf. The study will take place in the form of an interviewer-administered survey. In the case of any enquiries, please do not hesitate to contact me or my supervisor, Prof. Oladimeji Oladepo.

Contact Details:

Oluwafemi Dipeolu	Prof. Oladimeji Oladepo
08038338118; 08181956343	08033263302
oludipeolu@yahoo.com	oladepod@yahoo.com

Thank you for your cooperation.

a. I will like to know whether you have a child or children less than 1-year-old. 1. Yes ☐ 2. No ☐

b. I will like to know if you have a personal mobile phone. 1. Yes ☐ 2. No ☐ **(IF "NO" GO TO item "d" below)**

Respondent's phone number(s)	
Significant others' phone number(s)	

c. If YES to a & b above, are you willing to participate in the study? 1. Yes ☐ 2. No ☐

d. IF NO TO a, b and c, STOP THE INTERVIEW! Explain to the respondent that the interview is meant for mothers who have children less than a 12-month-old and personal mobile phone. Thank respondents.

LGA: 1. Ibarapa North ☐ 2. Kajola ☐

Health facility location: ……………………………………………………………………

House address:

……………………………………………………………………………………………………

Date of interview: |__|__|__|__|__|__|__|__|

Section A: Socio-demographic information

Instruction: Please tick the appropriate response to the item in the box provided. Only one answer should be chosen unless otherwise stated.

1	What is your current marital status?					
	1. Married	2. Single	3. Separated	4. Divorced	5. Widowed	
2	What is your religion?					
	1. Christianity	2. Islam	3. Traditional religion	4. Others (specify)		
3	What is your highest educational qualification?					
	1. No formal education	2. Primary school not completed	3. Primary school completed	4. Arabic/Quranic	5. Secondary school not completed	
	6. Secondary school completed	9. NCE	10. Bachelor/HND	11. Posgtraduate		
4	What is your main occupation?					
5	How much is your average income from all sources in a month?					
6	What is your ethnic group?					
	1. Hausa	2. Ibo	3. Yoruba	4. Others (specify)		
7	How old are you as at last birthday? |__|__| Years					
8	How many children have you given birth to alive? |__|__|					
9	How many children do you currently have? |__|__|	**If children are more than 1, answer Q 19. If not, skip Q19**				
10	How many of these children are less than 12 months (in case of twins)?					
11	How old were you when you gave birth to this child (ren) less than 12 months?					

12	Where do you get information on health issues generally? 1. 2. 3.					
13	What is the sex of this child?					
	1. Male	2. Female	If twins, let the mother select one by balloting			
14	What is this child's birth order?					
	1. First	2. Second	3. Third	4. Fourth	5. Others (specify)	

Section B: Current Immunisation Status of Child					
<u>Instruction</u>: Now I am going to be asking you questions about this child who is less than 12 months					
15	How many immunisations has he/she received?				
	Vaccine	**Given**		**Evidence (in card)**	
		1. Yes	**2. No**	**1. Yes**	**2. No**
	BCG – (*against tuberculosis i. e. an injection in the left shoulder of the left forearm or upper arm that caused a scar*)				
	DPT1 – (*an injection in the thigh or buttocks*)				
	DPT2				
	DPT3				
	OPV0 – (*vaccination drops in the mouth to protect against polio in the health facility*)				
	OPV1				
	OPV2				
	OPV3				
	HBV1				
	HBV2				
	HBV3				
	Pentavalent (DPT + Hep B + Hib)				
	Measles – (*vaccination injection given at given at 9 months or older to prevent measles*)				
	Yellow Fever				
16	If this child (name) had received any immunisation where was he or she given the immunisation? (Name of health facility)				
17	Has your child (name) missed any immunisation?				
	1. Yes	2. No			
18	If Yes, why did the child miss the(se) immunisaton(s)?				
19	What are your experiences while immunising your other children before this child?				
	1				
	2				
	3				

	Section C. Knowledge about Immunisation		
	<u>Instruction</u>: For items in this section, please tick either Yes or No in the space provided. For item 36, tick as many answers as are needed.		
20	Have you heard about immunisation for children less than 12 months?		
	1. Yes	2. No	
21	What types of diseases are preventable through immunisation? **(Please tick as many as possible)**		
		Without prompting 1. Yes, 2. No	**With prompting** 1. Yes, 2. No
	i. Malaria		
	ii. Tuberculosis		
	iii. Measles		
	iv. Yellow fever		
	v. HIV		
	vi. Poliomyelitis		
	vii. Whooping cough		
	viii. Tetanus		
	ix. Diarrhoea		
22	Have you heard about routine immunisation for children less than 12 months?		
	1. Yes	2. No	
23	Do you know the order in which immunisation for children less than 1 year should be taken and the timing (immunisation schedule)?		
	1. Yes	2. No	
24	If Yes, list the immunisation schedule (order and timing). **ONLY MENTION THE VACCINE, DO NOT MENTION THE ORDER AND TIME. MARK CORRECT IF THE ORDER AND TIME OF EACH VACCINE IS MENTIONED CORRECTLY, OTHERWISE MARK IT INCORRECT.**		
	Vaccine	**Order and Time**	**1. Correct, 0. Incorrect**
	i. BCG	At birth	
	ii. DPT	6, 10 and 14 weeks after birth	
	iii. Hepatitis B	At birth, 10 and 16 weeks after birth	
	iv. OPV (Polio)	6, 10 and 14 weeks	
	v. Measles	9 months	
	vi. Yellow fever	9 months	
	vii. Pentavalent (DPT + Hep B + Hib)	6 weeks, 10 weeks and 14 weeks	
25	What are 2 advantages of immunising children less than 12 months?		
	1.		
	2.		
26	What are 2 disadvantages with immunising children less than 12 months?		
	1.		
	2.		
27	What time of the day should a child be immunised?		
	1. Morning / 2. Afternoon / 3. Anytime / 4. Don't know		

28	Should a sick child be immunised?			
	1. Yes	2. No		
29	Does immunisation make a child to have long life?			
	1. Yes	2. No		
30	Can getting a child immunised for a particular disease prevent that child from that disease?			
	1. Yes	2. No		
31	Should a child running temperature be immunised?			
	1. Yes	2. No		

Section D: Factors Influencing Immunisation Uptake

*<u>Instruction</u>: Some factors **promote** or act as **barriers** to uptake and completion of immunisation. Please let me know your opinions on the following factors.*

32	What factors can **<u>make</u>** mothers to complete immunisation for their children less than 12 months?				
	1.				
	2.				
	3.				
	4.				
33	What factors can **<u>prevent</u>** mothers of infants not to complete immunisation for their children less than 12 months?				
		Reason	1. Yes	2. No	Category
	1	Unaware of the need for immunisation			Lack of information
	2	Unaware of the need to return for 2nd or 3rd dose			
	3	Place and/or time of immunisation unknown			
	4	Fear of side effects/adverse reactions			
	5	Wrong ideas about contraindications			
	6	Postponed until another time			Lack of motivation
	7	No faith in immunisation			
	8	Rumours			
	9	Place of immunisation too far			Obstacles
	10	Time of immunisation not convenient			
	11	Vaccinator absent			
	12	Vaccine not available			
	13	Mother too busy			
	14	Family problem including illness of mother			
	15	Child ill, not brought to the clinic			
	16	Child ill, brought but not given immunisation			
	17	Long waiting time			
	18	Attitude of health workers			
	19	Others (please specify)			
34	Among the reasons given above, which is the most cogent one?				

Section E: Attitude towards Immunisation						
Instruction: Here are some attitudinal statements about immunisation, please indicate whether you Strongly Agree (SA), Agree (A), Disagree (D) or Strongly Disagree (SD) with these statement.						
	Statement	**1 SA**	**2 A**	**3 D**	**4 SD**	**Code**
35	I can trust the safety of the vaccines used for immunising children					
36	I have this notion that local herbs, "agbo", can equally prevent diseases for which children are vaccinated against					
37	I am sure that whether a child is immunised or not, he will still fall sick of any of the immunisable diseases					
38	My mind is not at peace with immunisation, I feel it is dangerous to children's health and wellbeing					
39	I am of the opinion that immunisation makes children sick, so it is not necessary for them					
40	It is necessary to immunise children against any immunisable diseases, prayer to and faith in God is not enough to protect					
41	I am of the opinion that once a child is immunised, the child is safe and free from these diseases preventable by vaccines					

Section F: Usage of Mobile Phone						
Instruction: For items in this section, please respond appropriately or tick either Yes or No in the space provided.						
42	How many mobile telephones do you have? __|__					
43	How many active lines do you have? __|__					
44	Do you know how to open text messages on your mobile phone?					
	1. Yes	2. No				
45	Do you know how to read text messages on your mobile phone?					
	1. Yes	2. No				
46	Do you know how to send text messages on your mobile phone?					
	1. Yes	2. No				
47	In which language can you read or send text message on your phone?					
	1. English alone	2. Yoruba alone	3. Yoruba and English	4. Others		
48	Do you switch off your phone(s) at any time?					
	1. Yes	2. No			**If No, go to Q 50**	
49	If Yes, what time of the day do you usually switch off your mobile telephone?					
	1. Morning	2. Afternoon	3. Night	4. Occasionally	5.Others	
50	Do you experience network failure on your mobile telephone?					
	1. Yes	2. No			**If No, go to Q 52**	
51	How often do you experience network failure on your mobile telephone?					
	Frequency		**Time of the day**			

	1. Always 2. Occasionally 3. Rarely 4. Others		1. Morning 2. Afternoon 3. Night 4. Anytime		
52	What other problem(s) do you experience with your mobile telephone(s)? 1. 2. 3.				
53	Do you experience any difficulty charging your mobile telephone?				
	1. Yes	2. No			**If No, go to Q 55**
54	If Yes, how often does the battery of your mobile phone goes flat?				
	1. Often	2. Occasionally	3. Rarely		
55	What do you use your mobile telephone for mostly?				
	1. To make call	2. For text messaging	3. For call and text messaging	4. Playing game	
	5. For browsing	6. As touch light	7. Playing music	8. Others (specify)	
56	In case your mobile telephone does not work or out of service area, do you have access to use other people's phone?				
	1. Yes	2. No			

Section G: Adoption of Mobile Phone SMS Reminder for Immunisation Service Delivery				
<u>Instruction</u>: Please tick Yes or No for some of the statements below.				
57	Can mobile phone be effective in giving health information to mothers on immunisation?			
	1. Yes	2. No		
58	Will receiving of text message reminder about children's next immunisation appointment encourage mothers to take their children for vaccination?			
	1. Yes	2. No		
59	Have you ever received text message from health workers about your child's immunisation appointment?			
	1. Yes	2. No		
60	Presently, through which medium are you being reminded of your child's next date of immunisation?			
61	Have you received any reminder message about your child's next immunisation appointment before you come to the clinic?			
	1. Yes	2. No		**If No, go to Q 63**
62	If Yes, would you say that this reminder for the immunisation appointment is useful and effective?			
	1. Yes	2. No		
63	Are you willing to receive text message reminders for your child's next immunisation appointment?			
	1. Yes	2. No		
64	How should the message be framed? (Give an example) 1. 2.			

	3.
65	In what language should the reminder messages be framed? 1. 2. 3.
66	What difficulties do you currently encounter in
	(a) Receiving text messages?
	(b) Reading your text messages?
67	What time of the day will you prefer most to receive immunisation reminders by text messaging?
	1. Morning / 2. Afternoon / 3. Night / 4. Anytime of the day
68	How will the sending of text message reminders help you to keep your child's next immunisation appointment?
69	What do you consider as the challenge in using text message to remind you of your child's next immunisation appointment?
70	How do you think this challenge can be overcome?
71	Do you listen to information on immunisation on radio?
	1. Yes / 2. No
72	If Yes, how often do you listen to this information on radio?
	1. Often / 2. Occasionally
73	Do you watch and listen to information on immunisation on television?
	1. Yes / 2. No
74	If Yes, how often do you watch and listen to this information on television?
	1. Often / 2. Occasionally

Section H: Reminder SMS for Immunisation Clinic Attendance	
Instruction: Tick the appropriate Yes or No for each of the statements below.	
75	Did you receive reminder SMS to come to the clinic for the vaccination of your child? **If No, go to Q 77**
	1. Yes / 2. No
76	If **Yes**, how often do you receive this reminder SMS to come to the clinic for the vaccination of your child?
	1. Often / 2. Occasionally / 3. Others
77	Did your spouse or any other family member receive immunisation reminder SMS to remind you to keep your child clinic appointments? **If No, go to Q 79**
	1. Yes / 2. No
78	If **Yes**, how often does he or she receive this reminder SMS to remind you to keep your child clinic appointments?
	1. Often / 2. Occasionally
79	Who usually reminds you to come to the clinic for the vaccination of your child? ***(Please tick all that applies)***
	1. I know the time to come for the vaccination / 2. Clinic staff / 3. My spouse

	4. SMS reminder			5. Others (specify)			
80	Have you completed all the immunisation schedule for your child? **If Yes, go to Q 82**						
	1. Yes			2. No			
81	If No, how many vaccinations have you left?						
82	If you had completed all the immunisation schedule for your child, was it completed as at when due?						
	1. Yes	2. No		Evidence in card	1. Yes	2. No	

POST INTERVENTION ONLY

Attention: Please check the respondent's child immunisation card for evidence of complete and full immunisation!

<

83	Respondent's child complete all immunisation	1. Yes	2. No	
84	If No, how many immunisation were not completed			
85	Reasons for incomplete immunisation			

Thank you for your time and for taking part in this important study.

CHILD IMMUNISATION STATUS RECORD

Name of health facility: ___________________________________ **LGA**: _________________ **Child's clinic №**: ______

Child's name: _______________________________ **Date of birth**: ___________ **Sex**: 1. Male ☐ 2. Female ☐

Mother's name: _______________________________ **Mother's phone #s**: _______________________________

Type of vaccine	Appointment date for immunisation	Actual date immunisation administered	Complied to recommended appointment date 1. Yes 2. No	Age when immunised (in months)	Interval between recommended date and date immunisation was administered (in weeks)	Next appointment date	Immunisation status 1. Completed 2. Not completed	Age at immunisation completion (in months)
BCG								
Oral Polio Vaccine (OPV) 0								
Oral Polio Vaccine (OPV) 1								
Oral Polio Vaccine (OPV) 2								
Oral Polio Vaccine (OPV) 3								
Pentavalent 1								
Pentavalent 2								
Pentavalent 3								
Rotavirus 1								
Rotavirus 2								
Pneumococcal conjugate vaccine (PCV)1								
Pneumococcal conjugate vaccine (PCV) 2								
Pneumococcal conjugate vaccine (PCV) 3								
Measles								
Yellow fever								
Others								

APPENDIX VIII

Questionnaire (Yoruba Version)

IWE IBEERE FUN AWON IYA TI WON N GBE AWON OMO TI OJO ORI WON KOTO OSU MEJILA.

AWON IPA TI ATERANSE ERO IBARANISORO ALAGBELEWOKA N KO LORI AWON IYA NI IPINLE OYO FUN GBIGBA AWON ABERE AJESARA MARUN TOSE KOKO FUN AWON OMO-OWO.

Oludahun ni owon,
Mo je akeko jade lati agboni to n risi eko mumu agbega ba ilera ati ikeko re, eka to n risi ilera gbogbogbo, ile eko imo oogun oyinbo, ile iwe nla fasiti ilu Ibadan. Mo n se ise iwadi lori "Awon ipa ati ateranse ero ibanisoro alagbelewoka n ko lori awon iya ni Ipinle Oyo fun gbigba abere ajesara marun to se koko fun awon omo- owo". (Awon omo ti ojo ori won o to osun mejila) ni awon ile iwosan ijoba ibile ni ipinle Oyo. Pataki ise iwadi yi ni lati se agbeyewo ipa tojoju latari sise amulo ateranse ero ibanisoro alagbelewoka lati maafi ran awon iya ikoko leti gbigba abere ajesara ni sisentele fun awon omo won nigba toto ati nigba toye. Iwadi yi yio mo dale lori awon iya ikoko ti won n na awon ile iwosan ijoba ibile ni awon asayan ilu kereje ni Ipinle Oyo. Awon esi iwadi yi yio ma se iranlowo lori sise alakale awon ojutu latari mumu alekun ba abere ajesara gbigba ni sisentele kale-kako pelu lilo ero ibanisoro alagbelewoka gege bi ona lati mu adinku ba won ipenija fun ilera ati iku to n suyo latari awon aarun ti abere ati ogun le dena.

Kikopa yin nibi iforowanilenuwo yi yio ma je atinuwa ti awon idahun si gbogbo awon ti ma biyin yi o sije nkan asiri. Kosi eyikeyi idahun ti o je asadanu nitorina, e gbiyanju lati kopa tiyin. Ma mo loore, ti e bale fi otito inu dahun gbogbo awon ibeere naa. Eyikeyi eko tabi riko yio wulo fun erongba ojo ola. Iforojomitoro yi yio waye larin bi iseju marun-lelogbon ti aye si gbayin lati mopin ba iforojomitoro naa nigba kuugba ti o ba wuyin ti kosi nkan ti yio teyin re yo. Mi o nilo oruko yin fun isoro ngbesi yi sugbon eyikeyi oro teba so fun wa ni o ni lu sita.

Mo ti gba Ogbeni/Arabinrin/Omidan ______________________ laaye lati bami gba esi sile. Iwadi yi yio o waye gegebi eyi ti onibeere yi o maa se agbateru re. Fun eyikeyi iwadi ti o ba ruju, ejowo emo mikan lati kan si mi tabi Oludari/Alamojuto/Oga/Olutosona/Olubewo mi, Ojogbon Oladimeji Oladepo.

Bi esele kan siwa

Oluwafemi Dipeolu
08038338118,08181956343
oludipeolu@yahoo.com

Ojogbon Oladimeji Oladepo
08033263302
oladepod@yahoo.com

Ese fun ifowosowopo yin.
Mofe mo
(a) Yi o wumi lati mo boya eni omo lati awon omo ti ojo ori won o to odun kan.
(1) beeni (2) beeko
Mofe mo
(b) Yi o wumi lati mo boya eni ero alagbelewoka (1) beeni ☐ (2) beeko ☐ (toba je wipe 'BEEKO' elosi ibeere 'd' ni sale)

Nomba/awon nomba ero alagbelewo ka Oludahun											
Nomba/awon nomba ero alagbelewo ka Oluku re											

(c) To ba je beeni idahun si ibeere a ati b loke, se o wuyin lati kopa ninu iwadi yi?
(1) Beeni ☐ (2) Beeko ☐
(d) TO BA JE BEEKO ni idahun si ibeere a,b, ati c, DA IFOROWANILENUWO DURO! Se alaye fun Oludahun wipe iforowanilenuwo yiwa fun awonn iya to n gbe omo ti ojo ori won o ju osu mejila li lowo ti won si tun ni ero ibaranisoro alagbelewo ka. Dupe lowo awon Oludahun.

Agbegbe Ijoba-ibile (1) Ariwa ibarapa ☐ (2) Kajola ☐
Agbegbe Ile Iwosan Ijoba Ibile ________________

Ijuwe Ilegbe ________________

Ojo iforowanilenuwo ________________

IPIN A: LABARI NIPA ARA ENI

Ilana: Jowo fagi le idahun to ba ye si ibeere ninu aye ti apese. Idahun kan ni ale mu ayafi ti ko baribe mo.

1	Kini ipo igbeyawo yin lowolowo? (i) Mo ti gbeyawo (2) mi o ti gbeyawo (3) Awa lotooto (4) Ati kora wa (5) opo ni mi	☐
2	Kini esin yin? (1) Igbagbo (2) Imonle (3) Esin Abalaye (4) Omiran (daruko e)	☐
3	Kini ipele eko yin togaju? (1) mi o lo ilewe (2) Mi o ka ilewe alakobere ja (3) Mo ka ilewe alakobere ja (4) Mo lo ile kewu (5) mi o ka ilewe girama ja (6) Mo ka ilewe girama ja (7) Eko olukoni agba (8) mo keko fasiti ati gbogbo nise (poli) (9) mo keko gboye	
4	Kini ise te n se?	
5	Kini afojuda owo to n wole fun yin ni gbogbo ona losu?	
6	Eya wo ni yin? (1) Hausa (2) Ibo (3) Yoruba (4) Omiran (daruko e)	☐
7	Omo odun melo ni yin ni ojo ibi yin tokoja? ☐ Odun	
8	Omo melo leti bi laaye ?	☐☐
9	Melo ni awon omo yin bayi? ☐☐ Ti awon omo yin baju eyokan lo, ki e dahun ibeere ookandinlogun, bi beeko ki e fo ibeere ookandinlogun	
10	Melo ninu awon omo yi ni o tipe osu mejila (ti ibeji bawa)?	☐
11	Omo odun melo ni yin nigbati ebi awon omo ti ojo won ko to osu mejila? Odun	☐☐
12	Nibo leti gbo nipa awon isoro to n koju ilera lapapo?	

	1 2 3
13	Ako n babo ni omo yi? (1) ako (2) abo (3) to ba je ibeji, je iya o mu lokokan
14	Omo kelo ni omo yi ? (1) akobi (2) elekeji (3) eleketa (4) elekerin (5) omiran (daruko e)

IPIN B: IPO ABERE AJESARA OMO LOWOLOWO

ILANA: Nibayi mama ni ibeere nipa omo ti ko to osu mejila lo yi

15	Abeere ajesara melo ni oti gba?				
	Abere ati ogun	Otigba		Eri (ninu kaadi)	
		(1). beeni	(2). beeko	(1). beeni	(2). beeko
	BCG - (to n dena iko fee otumo si abeere to ma n da apa si ejika apa alaafia)				
	DPT 1 – (abeere ta ma n gba si itan tabi idi)				
	DPT 2				
	DPT 3				
	OPVO – (ogun ta n kan senu ni ile iwosan ijoba ibile lati dena romolapa-romolese)				
	OPV 1 (to n dena romolapa-romolese)				
	OPV 2				
	OPV 3				
	HBV 1 (to n dena jedojedo)				
	HBV 2				
	HBV 3				
	Pentavelenti (marunlokan): (DPT + HepB + Hib)				
	Misusi : (Abere ti won fun omo ni dede osu mesan tabi jubeelo lati dena igbona)				
	Abere to n dena iba ponju-ponto				
16	Ti omo yi (oruko omo naa) bati gba abere ajesara yi, nibo niwon ti fun ni abere ajesara naa (daruko ilewosan ibile naa)				
17	Se omo re (oruko omo naa) ti pa abere ajesara kankan je?				
	(1).Beeni	(2) Beeko			
18	To baje beeni, kilode ti omo yii fi pa abere/awon abere ajesara yi je?				
19	Kini awon iriri yin nigbati e n gba abere ajesara fun waon omo yin yoku tiwon saju omo yi?				
	(1)				
	(2)				
	(3)				

	IPIN D: IMO NIPA ABEERE AJESARA		
	Ilana: Fun awon ibeere ni ipin yi, jowo falasi boya beeni tabi beeko ninu aaye ti ati pese. Fun ibeere kerindinlogoji, emu opolopo awon idahun gege bi won ba seye		
20	Se eti gbo nipa abeere ajesara fun awon omo ti ojo ori won o ti to osu mejila		
	(1). Beeni	(2). Beeko	
21	Iru awon aarun wo ni abere ajesara ma n dena? (Jowo fala si iyekiye idahun bi obati rorun si)		
		(1). Beeni (2). Beeko	(1). Beeni (2). Beeko
	i. Iba		
	ii. Iko fee		
	iii. Igbona		
	iv. Iba Ponju-ponto		
	v. Kokoro aarun kogboogun		
	vi. Romolapa-romolese		
	vii. Iko gbefun-gbefun		
	viii. Eran pa		
	ix. Igbegbuuru		
22.	Se eti gbo ni pa abere ajesara ti oni sisentele fun awon omo ti ojo ori won o to osu mejila ?		
	1. Beeni	2. Beeko	
23	Se emo gbedeke asiko ati sisentele bi otiseye ki a ma gba abere ajesara fun awon omo ti ojo ori won o to odun kan (asiko fun gbigba abere ajesara) ?		
	1. Beeni	2. Beeko	
24	To ba je beeni, eso gbedeke asiko fun gbigba abere ajesara (ni sisentele ati asiko won). EDARUKO AWON OGUN ATI ABERE NIKAN, EMON SO BIWON SE TELE RA ATI ASIKO WON. EFALA SI WIPE ORIBE TI O BAJE WIPE A TO IKOKAN AWON ABERE ATI OOGUN YI NI SISENTELE PELU ASIKO WON. BI BE BAKO LORI KI E FALA SI WIPE KO RIBE		
	Abeere	Sisentele ati Asiko	1. Oribe 2. Koribe
	i. 'BCG'	Ni asiko ti a bimo	
	ii. 'DPT'	Ose 6, 10 ati 14 leyin ti a ti bimo	
	iii. Abere jedojedo	Asiko ti a bimo, ose kewa ati kerindinlogun leyin ti a ti bimo	
	iv. 'OPV' (Romolapa-romolese)	Ose kefa, kewa ati kerinla	
	v. Abere igbona	Osu kesan	
	vi. Abere iba ponju-ponto	Osu kesan	
	vii. Abere Marun-lokan (DPT + HepB + Hib)	Osu kefa, Ose kewa ati Ose Kerinla	
25	Kini awon anfaani meji towa fun gbigba abere ajesara fun awon omo ti ojo ori won koto osu mejila?		
	1.		
	2.		
26	Kini awon aleebu meji towa pelu gbigba abere ajesara fun awon omo ti ojo ori won koto osu mejila?		
	1.		

	2.
27	Asiko wo ninu ojo loye ki a gba abere ajesara fun omo?
	1. Aaro 2. Osan 3. Igba kuugba 4. Mi o mo
28	Se oye ki a gba abere ajesara fun omo ti arare koya?
	1. Beeni 2. Beeko
29	Se abere ajesara ma n jeki emi omo o gun?
	1. Beeni 2. Beeko
30	Se gbigba abere ajesara fun omo lori kan le dena omo omo naa lati ma ni aarun naa?
	1. Beeni 2. Beeko
31	Se ale gba abere ajesara fun omo ti ara re ba n gbona?
	1. Beeni 2. Beeko

IPIN E: AWON NKAN IWURI FUN GBIGBA ABERE AJESARA

ILANA: Awon okunfa to n mu ilosiwaju tabi mu akude ba gbigba ati gbigba abere ajesara pari. EJowo jeki n mo awon ero yin lori awon okunfa wonyi

32	Kini awon okunfa tole jeki awon iya o gba abere ajesara pari fun awon omo won ti ojo ori won koto osu mejila?
	1.
	2.
	3.
33	Kini awon okunfa tole kodina ki awon iya ikoko ma gba abere ajesara pari fun awon omo won ti ojo ori won koto osu mejila?

	Idi	1. Beeni	2. Beeko	Isori
1	Aigbo nipa inilo abere ajesara			Aisi Iroyin
2	Aigbo nipa inilo lati padalo fun elekeji ati eleketa			
3	Aimo nipa ibi ati/tabi asiko abere ajesara			
4	Eru awon aleebu/isesekise ti suyo leyin ore yin			
5	Awon ero odi nipa awon ami ti o le ma jeki abere ajesara je gbigba fun omo.			
6	Sunsun siwaju titi di asiko mi			Aisi Koriya
7	Kosi igbagbo ninu abere ajesara			
8	Iroyin eleje			
9	Ibi abere ajesara jina gan-an			
10	Asiko fun abere ajesara o rorun			
11	Kosi awon alabere ajesara			
12	Kosi awon abere nile			
13	Iya o ki n raaye rara			Awon nkan to n kodina
14	Isoro idile n pelu ailera ti iya			
15	Won o gbe aisan lo nse omo de ile iwosan			
16	Won gbe aisan to nse omo de ile iwosan sugbon won o fun ni abere ajesara			
17	Asiko ti a fi ma n duro ma n pe gan-an			
18	Isesi awon osise eleto ilera			
19	Awon n ka miran (Dakun safihan won)			

34		Laarin awon idi ti afunyin soke hun, ewo lose koko ju?			

IPIN Ë: ISESI WA SI ABERE AJESARA

ILANA: Eyi ni die ninu awon gbolohun to jemo isesi wa nipa abere ajesara, jowo se afihan to baje wipe o faramo gan-an(FG), ofaramo(O), o faramo(OF), tabi o faramo rara (OFR) awon gbolohun wonyii

Gbolohun		1 FG	2 O	3 OF	4 OFR	Isamin
35	Mo le fowo soya wipe awon oogun ati abere tiwon n lo lati fi fun awon omo ni ajesara ni won o lewu					
36	Mo n gba lero wipe awon egbo igi ibile ‘agbo’ naa le dena awon aarun ti a n fun awon omo ni abere fun lati kodina					
37	O dami loju wipe boya a gba abere ajesara fun omo tabi a o gbaa, omo naa yoo tun bo se aisan latari eyikeyi awon aarun ti ale gba abere ajesara fun					
38	Okan mi o bale lori abere ajesara, moro wipe olewu fun ilera ati igbaye-gbadun awon omo					
39	Ero okan mi ni wipe abere ajesara ma n mu awon omo saisan, nitori na iko wulo fun won					
40	Oye ki a fun awon omo ni abere ajesara lati kodina eyikeyi awon aarun ti ale gba abere ajesara si, adura naa ati igbagbo ninu Olorun ko to lati se idabobo.					
41	Ero okan mi ni wipe kete ti omo ba ti gba abere ajesara, omo naa tiri idabobo ti o siti mori bo lowo gbogbo awon aarun ti abere ati oogun le dena					

IPIN F: SISE AMULO ERO IBANISORO ALAGBELEWOKA

ILANA: Fun awon ibeere ni ipin yi, jowo dahun bi obaseto ati bioseye tabi falasi boya beeni tabi beeko ninu aaye ti a ti pese sile.

42	Melo ni awon ero ibaranisoro alagbelewoka teni?			
43	Melo ni awon opo ipe to n sise teni?			
44	Se emo bi eti le si awon ateranse lori ero ibaranisoro alagbelewoka yin?			
	1. Beeni	2. Beeko		
45	Se emo bi eti le ka awon ateranse lori ero ibaranisoro alagbelewoka yin?			
	1. Beeni	2. Beeko		
46	Se emo bi eti le fite awon ateranse aranse lori ero ibaranisoro alagbelewoka yin ?			
	1. Beeni	2. Beeko		
47	Ede wo ni e le ka tabi fite ateranse ranse lori ibaranisoro alagbelewoka yin ?			

	1. Eebo nikan	2. Yooba nikan	3. Yooba ati eebo	4Awon miran	
48	Se ema n pa ‘foonu’/awon ‘foonu’ yin igbakuugba?				
	1. Beeni	2. Beeko		Ti a baje beeko, ki e bosi ibeere aadota	
49	Ti o baje beeni, ni dede agogo melo ni ema n saaba pa ero alagbelewoka yin?				
	1. Beeni	2. Beeko	3. ale	4. ekokan	5. awon miiran
50	Se opo ipe ti jayin kule ri ni ori ero ibaranisoro alagbelewoka yin?				
	1. Beeni	2. Beeko		Ti o baje beeko, ki e bosi ibeere kejilelaadota	
51	Bi igba melo leti ri ijakule opo ipe lori ero ibaranisoro alagbelewoka yin?				
	Iye igba		Asiko ninu ojo		
	1. gbogboogba 2. lekookan 3. Ko wopo 4. Awon miran		1. Aaro 2. Osan 3. Ale 4.Nigba kuugba		
52	Isoro/awon isoro miran wo le tun ma n koju pelu ero/awon ero ibaranisoro alagbelewoka yin?				
	1 2 3				
53	Se e n koju isoro kankan latari gbigba ina sori ero ibaranisoro alagbelewoka yin?				
	1. Beeni	2. Beeko		Ti o baje beeko, ki e bosi ibeere karunlelaadota	
54	Ti o baje beeni, bi igba melo ni ‘batiri’ ero ibaranisoro alagbelewoka re ma mole?				
	1. ni igba gbogbo	2. Le kookan	3. ko wopo		
55	Kin e ma n saba lo ero ibaranisoro alagbelewoka yin fun?				
	1. lati fi pe	2. fun ateranse	3. fun ipe ati ateranse	4. gbigba ‘geemu’	
56	Ti o bati e je wipe ero ibanisoro alagbelewoka yin o ba sise tabi kosi ni ibi ti otile sise, se eni anfaani lati lo ‘foonu’ awon eniyan miran?				
	1. Beeni	2. Beeko			

IPIN G: TITEWONBA ATERANSE LORI ERO ALAGBELEWOKA FUN IRANILETI ATI PIPESE ABERE AJESARA GBIGBA			
ILANA: Dakun falasi beeni tabi beeko fun die ninu awon gbolohun isale yi			
57	Se ero ibaranisoro alagbelewoka le ko ipa lori funfun awon iya ni labari lori ilera towa nini abere ajesara?		
	1. Beeni	2. Beeko	
58	Nje gbigba ateranse fun iranti nipa ojo miran lati gba abere ajesara fun awon omo le wu awon iya lori lati mu awon omo won lo fun gbigba abere ajesara?		
	1. Beeni	2. Beeko	
59	Se eti gba ateranse lati odo awon eleto ilera nipa gbedeke ojo aberere ajesara fun omo yin ri?		
	1. Beeni	2. Beeko	
60	Lowolowo yi, ona wo ni e ma n gba se iranti ojo abere ajesara miran fun omo yin?		

	1. Beeni	2. Beeko		
61	Se eti gba ateranse kankan to n ranyin leti ojo abere ajesara miran fun omo yin siwaju ki e to wa si ile iwosan?			
	1. Beeni	2. Beeko		Ti o baje beeko, ki e bosi ibere ketalelogota
62	Ti o baje Beeni, se eleso wipe iran ni leti fun gbedeke ojo abere ajesara yi wulo atiwipe o lapa?			
	1. Beeni	2. Beeko		
63	Se efee lati gba ateranse fun iranileti gbedeke ojo miran fun abere ajesara omo yin?			
	1. Beeni	2. Beeko		
64	Bawo ni ki akosile ateranse o se ri? (e fun wa ni apeere)			
	1 2 3			
65	Ede wo ni ki awon akosile ateranse fun iranileti yi le je?			
	1 2 3			
66	Kini awon isoro ti e n doju ko nipa			
	(a) Gbigba awon ateranse wole?			
	(b) Kika awon ateranse yin?			
67	Dede asiko wo ninu ojo ni o teyinlorun ju lati gba ateranse fun iranileti abere ajesara?			
	1. Aaro	2. Osan	3. Ale	4. Igbakuugba
68	Bawo ni tite ateranse ranse fun iranileti sele ran yin lowo lati fi gbedeke ojo abere ajesara omo yin tokan si okan?			
69	Kini eri gege bi ipeniya ninu mimo lo ateranse lati fi ran yin leti gbedeke ojo abere ajesara tokan?			
70	Bawo ni ese lero wipe eti le bori ipeniya yi?			
71	Se e ma n fetisi si labari nipa abere ajesara lori 'redio'			
	1. Beeni	2. Beeko		
72	Ti o baje beeni, bawo ni igba ti e ma n fi etisi latari yi se po to			
	1. Ni gbogbo igba	2. lekookan		
73	Se e ma n wo ati gbo labari nipa abere ajesara lori ero amohun-maworan?			
	1. Beeni	2. Beeko		
74	Ti o baje beeni, o to bi igba melo le fi ma n wo ati gbo labari yi lori ero amohun-maworan?			
	1. Ni gbogbo igba	2. Lekookan		
IPIN GB: ATERANSE FUN IRANILETI FUN AWON TIWON N LOI LE IWOSAN KEKERE FUN IBERE AJESARA				
ILANA: Fala eyi to ba je ninu beeni tabi beeko fun ikokan awon gbolohun isale yii				
75	Se e ma n gba ateranse fun iranileti lati wa si ile iwosan, fun gbigba abere ajesara fun omo yin? ti o ba je beeko, ki e bosi ibeere ketedinlogorin			
	1. Beeni	2. Beeko		
76	Ti o ba je wipe beeni, bi igba melo ni e ma n gba ateranse fun iranileti yi lati wa si ilewosan kekere fun abere ajesara omo yin?			
	1. Ni gbogbo igba	2. Lekookan	3. Awon miran	
77	Se oko yin tabi eni kankan ninu molebi yin ma n gbe ateranse fun iranileti abere abere ajesara lati ranyinleti lati fi gbedeke ile iwosan omo kekere yin sokan? ti o ba je beeko ki e bosi ibeere kokandinlogorin			

	1. Beeni	2. Beeko				
78	Ti o ba je beeni, bi igba melo ni eni naa ti gba ateranse fun iranileti yi lati fi ranyin leti lati gbedeke ojo ile iwosan kekere omo yin sokan?					
	1. Ni gbogbo igba	2. Lekookan				
79	Ta lo ma n saba ranyin leti lati wasile iwosan omo kekere fun abere ajesara omo yin? (jowo fala si gbogbo eleyi ti o ba jomo o)					
	1. mo mo igba to ye ki n wa fun abere ajesara	2. awon osise ile iwosan omo kekere	3. oko mi	4. Ateranse fun iranileti	5. Awon miran (se afihan won)	
80	Se eti gba gbogbo awon abere ajesara ti won lakale fun omo yin tan? Ti o ba je Beeni, ki e bosi ibeere kejilelogorin					
	1. Beeni	2. Beeko				
81	Ti o baje wipe Beeko, melo ni awon abere ti o seku?					
82	Ti e bati gba gbogbo abere ajesara ti won la kale fun omo yin tan, n je e si gba tan si igba to ye?					
	1. Beeni	2. Beeko		Se oni eri ninu 'kaadi'	1. Beeni	2. Beeko

LEYIN IWAOJUTU NIKAN

AKIYESI PATAKI: Ye kaadi abere ajesara omo oludahun wo fun eri nipa gbigba abere ajesara pari ati ni ekun rere.

83	Omo oludahun gba gbogbo abere ajesara pe	1. Beeni	2. Beeko	
84	Ti o baje wipe beeko, melo ni abere ajesara ni o gba pe			
85	Awon idi ti kofi gba abere ajesara pe			

E seun fun asiko yin ati fun kikopa ninu iwadi pataki yi.

AKIYESI
E le se akiesi pataki si ibi yi ati oju ewe niwaju.
E ranti lati fi nomba ibeere ti e n pakiesi lori re si akiesi pataki yin.