

**EVALUATION OF SMS AND STICKER REMINDERS IN  
REDUCING DROPOUT RATES IN ROUTINE CHILD  
IMMUNIZATION IN SELECTED DISTRICTS IN KENYA**

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**Evaluation of SMS and Sticker Reminders in Reducing Dropout Rates  
in Routine Child Immunization in Selected Districts in Kenya**

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Science in Applied Epidemiology in the Jomo Kenyatta University of  
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## DECLARATION

This Thesis is my original work and has not been presented for a Degree in any other university.

Signature: ..... Date: .....

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This thesis has been submitted for examination with our approval as supervisors.

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## **DEDICATION**

This work is dedicated to the parents taking their children for vaccinations despite the difficulties in Kenya.

To my parents, my wife, Halima and my children Raqiya, Aisha, Umulkheir and Abdullahi for their resilience all those years I was undertaking the study.

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## ACRONYMS AND ABBREVIATIONS

<b>BBC</b>	British Broadcasting cooperation
<b>BCG</b>	Bacillus Calmette–Guérin
<b>BPS</b>	Board of Post-Graduate Studies
<b>CDC</b>	Center for Disease Control
<b>DHIS</b>	District Health information system
<b>DPT</b>	Diphtheria Pertussis and Tetanus
<b>EPI</b>	Expanded Programme on Immunization
<b>ERC</b>	Ethical Review Committee
<b>FELTP</b>	Field Epidemiology and Laboratory Training Program
<b>FIC</b>	Full immunization coverage
<b>Hib</b>	<i>Haemophilus influenza B</i>
<b>HepB</b>	Hepatitis B
<b>KDHS</b>	Kenya Demographic and Health Survey
<b>KNBS</b>	Kenya National Bureau of Statistics
<b>J.K.U.A.T</b>	Jomo Kenyatta University of Agriculture and Technology
<b>KEMRI</b>	Kenya Medical Research Institute
<b>MCHC</b>	Maternal Child Health Clinic
<b>MDG</b>	Millennium Development Goal
<b>MOPHS</b>	Ministry of Public Health & Sanitation
<b>MYP</b>	Multi-Year Planner

<b>OPV</b>	Oral Polio Vaccine
<b>PCV</b>	Pneumococcal Vaccine
<b>SMS</b>	Short Messages Service
<b>SSC</b>	Scientific Steering Committee
<b>WHO</b>	World Health Organization

## **OPERATIONAL DEFINITION OF TERMS**

- Care giver:** Guardian, parent or any person who is responsible for taking of the child for immunization
- Dropout:** Returning for the next penta valent dose two weeks or more after the scheduled date
- Penta:** A combination of Diptheria, pertussis, Teatnus, hepatitis B and haemopgilus   influnza b vaccines given at 6, 10 and 14 weeks
- Sticker:** Adhesive sticker with message on when to return for the next vaccine

## ABSTRACT

Globally, vaccine preventable diseases are responsible for nearly 20% of deaths annually among children <5 years old. Worldwide, many children dropout from the vaccination program, are vaccinated late, or incompletely vaccinated. In Kenya while significant strides has been made by increasing DPT 3 coverage from 63% in 2000 to 81% in 2007, dropout rates still remain high with 27% of the districts in Kenya having >10% dropout rates in 2012. The effectiveness of text messaging and sticker reminders to reduce dropouts from the vaccination program was evaluated. The evaluation was conducted in three selected districts in Kenya: Machakos, Langata and Njoro. Three health facilities were selected in each district, and randomly allocated to send text messages or provide stickers reminding parents to bring their children for second and third dose of pentavalent vaccine, or to the control group (routine reminder) with next appointment date indicated on the well-child booklet. Children aged <12 months presenting for their first dose of pentavalent vaccine were enrolled. A dropout was defined as not returning for vaccination  $\geq 2$  weeks after scheduled date for third dose of pentavalent vaccine. Dropout rate was calculated as a percentage of the difference between first and third pentavalent dose. A total of 1,116 children were enrolled; 372 in each intervention and 372 controls between February and October 2014. Median age was 45 days old (range: 31-99 days), and 574 (51%) were male. There were 136 (12%) dropouts. Thirteen (4%) children dropped out among those who received text messages, 60 (16%) among who received sticker reminders, and 63 (17%) among the controls. Having a caregiver with below secondary education [Odds Ratio (OR) 1.8, 95% Confidence Interval (CI) 1.1-3.2], and residing >5km from health facility (OR 1.6, CI 1.0-2.7) were associated with higher odds of dropping out. Those who received text messages were less likely to drop out compared to controls (OR 0.2, CI 0.04-0.8). There was no statistical difference in dropout rates between those who received stickers and controls (OR 0.9, CI 0.5-1.6). The study found Text message reminders to be effective in reducing vaccination dropout rates in Kenya, low education level and distance >5km from facilities were associated

with missed vaccination. The study recommends the adoption of SMS reminders in routine childhood vaccination services in Kenya and strengthening of outreach services to cover hard to reach areas.



## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background Information

Over 12 million children under five years die every year worldwide, 3 million of them before they are even a week old. As many as 2 million of those deaths are from diseases that could be prevented by the vaccines already on offer through the Expanded Programme on Immunization (Foege, 1998). Immunization remains the most important public health intervention and a cost-effective strategy to reduce both the morbidity and mortality associated with infectious diseases, globally, vaccine preventable diseases are responsible for nearly 20% of the 8.8 million deaths annually among children under five years of age. (WHO, 2010).

Vaccination coverage is dependent on supply as well as demand for vaccines. Adequate supply can be maintained by procuring enough vaccines and assuring vaccines are readily available at health facilities with trained staff to give the vaccines and adequate equipment to safely store and maintain them. Demand for the vaccine can be complex, and depends on factors including caregiver knowledge and attitudes on seeking health service, diseases and vaccinations (Katz *et al*, 2004) as well as access to healthcare and vaccination facilities.

Significant strides have been made to increase vaccine coverage for routine childhood immunization in Kenya. In 2000, DPT 3 vaccine coverage was estimated at 63%, measles vaccine at 46%, and polio third dose vaccine at 63%. By 2007, national estimates reported DPT3 vaccine coverage at 81% measles at 80%, and polio third dose vaccine at 76% (KEPI MYP , 2006). Despite improvement of national estimates, many districts in Kenya continue to report low vaccination coverage. These deficiencies in vaccination coverage have resulted in several wild type poliomyelitis and measles outbreaks in the country. Low levels of education, long distances to the nearest health facilities, lack of knowledge on immunization and lack of staff are among the factors responsible for low immunization coverage ( Omutanyi & Mwanthi, 2005).

In Kenya healthcare facilities at the district level serve as immunization facilities for routine immunization. Caregivers who bring their children to the health facilities for routine immunization are given information about the type and timing of recommended follow-up immunizations. Some mothers do not bring their children back on schedule, leaving children at increased risk of infection. Table 1.1 shows the routine vaccination schedule in Kenya.

**Table 1.1: Routine vaccination schedule in Kenya**

<b>Age of Child</b>	<b>Vaccination recommended</b>
Birth	BCG, OPV 0
6 weeks	Penta1, OPV1, PCV1, Rota 1
10 weeks	Penta2, OPV2, PCV2, Rota 2
14 weeks	Penta3, OPV3, PCV3
9 months	Measles 1
18-24 Months	Measles 2

(WHO, 2012)

The access and ownership of mobile phones in Africa is rapidly rising (BBC NEWS, 2011). Mobile phones are increasingly being used for health applications (mHealth) and mobile money services (mMoney) (Kamanga *et al.*, 2010; Meankaew *et al.*, 2010; Onono *et al.*, 2011; Pop-Eleches *et al.*, 2011; Tamrat & Kachnowski, 2012). Some of these new applications could potentially be harnessed to administer interventions to achieve high, timely and sustainable immunization coverage. Short message services (SMSs) have been successfully employed for various health applications, such as promoting adherence to drug treatments for chronic diseases (Lester *et al.*, 2010; Strandbygaard *et al.*, 2010; Vervloet *et al.*, 2011), uptake of screening tests (de Tolly *et al.*, 2012; Dokkum *et al.*, 2012; Khokhar, 2009; Lakkis *et al.*, 2011), immunization coverage (Kharbanda *et al.*, 2011; Stockwell *et al.*, 2012), clinical appointment attendance (Guy *et al.*, 2012; Hasvold and Wootton, 2011), and training health workers in malaria treatment (Zurovac *et al.*, 2011).

## **1.2 Problem Statement**

Globally, vaccine preventable diseases are responsible for nearly 20% of deaths annually among children <5 years old. Worldwide, many children dropout from the vaccination program, are vaccinated late, or incompletely vaccinated.

Kenya has made significant strides in vaccination coverage for routine childhood immunization over the years, in 2000, DPT 3 vaccine coverage was estimated at 63%, measles vaccine at 46%, and polio third dose vaccine at 63%. By 2007, national estimates reported DPT3 vaccine coverage at 81% measles at 80%, and polio third dose vaccine at 76%. Although significant strides have been made in increasing vaccination coverage in Kenya including new initiatives of reaching every child in all districts the dropout rates still remain high with more than 27% of the districts in Kenya having >10% drop out rates (WHO, 2012). While few studies have been conducted on reasons for dropouts ( Kariuki, 2012; Ndiritu *et al.*, 2006) little or no evaluations of the strategies to reduce dropouts have been reported in Kenya. Therefore, this public health evaluation is intended to evaluate the effectiveness of enhanced reminders, such as SMS text messages and sticker reminders with the vaccination card, as strategies to reduce vaccination drop-out rates.

## **1.3 Justification**

Since the inception of the expanded program on immunization in 1974 in Kenya, vaccination coverage has continued to improve over the years with some districts

achieving the set targets however disparities exist between regions and districts. Despite the observed improvement in vaccination coverage, vaccination drop outs still poses a challenge and remains a threat to the gains made so far. Effective strategies are needed to address this high dropout rates in routine vaccination in Kenya.

This study aimed to identify an effective reminder system to improve vaccination coverage and reduce vaccine dropout rates in the routine vaccination program in Kenya. The identified strategy is expected to be adapted by policy decision makers in the Ministry of Health for strengthening the routine vaccination services in the country. If adopted the intervention is likely to benefit the government in that by reducing vaccination dropouts and increasing vaccination coverage the government will have met its international obligations, vaccine preventable disease outbreaks are prevented there by reducing morbidity and mortality which will lead to reduction in the cost of responding to this outbreaks.it will also reduce the cost of treatment for the family and reduce time spent out of work attending to sick children in hospitals.

#### **1.4 Research Questions**

1. What is the effectiveness of SMS reminders in reducing vaccination dropout compared to the control group?
2. What is the effectiveness of sticker reminders in reducing vaccination dropout compared to the control group?

3. What are the factors influencing missed vaccinations among children <12 months in the three selected Districts?

### **1.5 Hypothesis**

1. SMS reminders are effective in reducing vaccination dropout rates
2. Sticker reminders are effective in reducing vaccination dropout rates

### **1.6 General Objective**

To evaluate the effectiveness of SMS and Sticker reminders in reducing dropout rates in routine child immunization in selected Districts in Kenya.

### **1.7 Specific Objectives**

1. To determine the effectiveness of SMS text messages in reducing vaccination dropout rates in three selected districts in Kenya
2. To determine the effectiveness of sticker reminders in reducing vaccination dropout rates in three selected districts in Kenya.
3. To determine factors associated with missed vaccinations among children 12 months in three selected districts in Kenya.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Public Health Importance of Vaccination

Vaccination has made enormous contributions to public health, including the eradication of only one dreaded disease, small pox, and elimination of poliomyelitis from all but a handful of countries (Foege, 1998). It is estimated that between two and three million child deaths are averted annually through vaccination against diphtheria, tetanus, pertussis and measles and many more future deaths averted in older groups (600,000 future deaths prevented annually through hepatitis B vaccination). However, vaccine-preventable diseases are still responsible for about 17% of global total mortality in children under five years of age (Black *et al.*, 2010).

The dual goals of childhood immunization are to protect individual children from disease by vaccinating them as early as possible and to protect communities from disease outbreaks by vaccinating adequate numbers. This goal of “protecting the herd” has highlighted the need for programs at scale for several decades. It has also made immunization a very visible intervention (Seide, 2005). Immunization is completely dependent on both supplies and services. There is no intervention without vaccines and vaccinators and without maintenance of a cold chain from central to peripheral areas. Centralization of certain functions, even during this time of health reform, is therefore another characteristic of childhood immunization (Siede, 2005).

In 1974, when the Expanded Programme on Immunization was launched by the World Health Organization (WHO), less than 5% of the world's children were immunized against the initial six target diseases of Diphtheria, tetanus, whooping cough, polio, measles, and tuberculosis during their first year of life. By 1990 and again in the most recent statistics (after a slight interim drop in coverage), almost 80% of the 130 million children born each year were immunized before their first birthday, an achievement involving over 500 million immunization contacts with children throughout the year. Within two decades the EPI was preventing the deaths of at least 3 million children a year. In addition, at least 750,000 fewer children were blinded, crippled, mentally retarded, or otherwise disabled (WHO, 1996).

Millennium Development Goal (MDG) 4 is to reduce child mortality by two thirds between 1990 and 2015, while progress has been made this goal stills remains unachieved. Immunization plays a key part in attaining this. Immunization has saved the lives of millions of children in the three decades since the launch of the Expanded Programme on Immunization (EPI) in 1974. Yet over 27 million children below the age of one and 40 million pregnant women worldwide are still overlooked by routine immunization services. As a result, vaccine-preventable diseases are estimated to cause more than 2 million deaths every year. These include 1.4 million deaths of children under five, and of these, the 395,000 who currently die from measles, the 290,000 who fall to pertussis (whooping cough) and the 257,000 who perish as a result of neonatal tetanus (Wim *et al*, 2005.).



## **2.2: Global Immunization Coverage**

Global immunization coverage has greatly increased since WHO's Expanded Programme on Immunization began in 1974. In 2003, global DTP3 (three doses of the diphtheria-tetanus-pertussis combination vaccine) coverage was 78% up from 20% in 1980. However, 27 million children worldwide were not reached by DTP3 in 2003, including 9.9 million in South Asia and 9.6 million in sub-Saharan Africa. Those who miss out on routine vaccination programs tend to be people living in remote locations, urban slums and border areas. They also include indigenous groups, displaced populations, those lacking access to vaccination because of various social barriers, those lacking awareness or motivation to be vaccinated and those who refuse. In 2008 WHO estimated 1.5 million of deaths among children under 5 years were due to diseases that could have been prevented by routine vaccinations. This represents 17% of global mortality in under 5 year of age, pneumococcal contributing the highest percentage of 32%, measles 8%, Haemophilus influenza type b and pertussis contributing 13% each (Black *et al.*, 2010).

In 2006, of the 157 WHO member states defined as "developing", only 42 (27%) had three doses of diphtheria-pertussis-tetanus (DPT) coverage greater than 80% in all districts (UNICEF, 2011). At the same time, new opportunities exist to strengthen immunization coverage in developing countries, such as increased funding through platforms such as the Global Immunization Vision and Strategy (GIVS), as well as novel ideas for integration with other health services. These recent developments have

encouraged a macro-analytic approach to ensure that systems function so that children receive needed vaccines. While these new approaches are welcomed, at the micro level, immunization service delivery in health facilities needs to be strengthened. Immunization programs need continued support with proven strategies and fresh approaches to reduce the incidence of diseases that may be prevented through the use of traditional vaccines, and to permit the effective introduction of new vaccines. In Kenya the routine immunization offers protection against 10 preventable diseases in the EPI schedule (polio, BCG,DPT/HepB/Hib, Rota, PCV and measles) (WHO, 2012) and yellow fever being given to selected districts. Plans are underway to include HPV vaccine in the national schedule soon.

### **2.3 Immunization coverage in Kenya**

In 2000, DTP3 vaccine coverage was estimated at 63%, measles vaccine at 46%, and polio third dose vaccine at 63%. By 2007, national estimates reported DTP3 vaccine coverage at 81% measles at 80%, and polio third dose vaccine at 76% (KEPI MYP, 2006). Despite improvement of national estimates, many districts in Kenya continue to report very low vaccination coverage and high dropout rates.

According to the Kenya demographics and Health survey (KDHS, 2008-2009) 77 % of children aged 12-23 months are fully vaccinated at any time before the survey. Only 3 % of children have not received any vaccines. Looking at coverage for specific vaccines, 96% of children have received the BCG vaccination, 96 % the first DPT-HepB-Hib dose, and 96 % the first polio dose (Polio 1). Coverage declines for subsequent doses,

with 86 % of children receiving the recommended three doses of DPT-HepB-Hib and 88 % receiving all three doses of polio. The decline in coverage levels reflects dropout rates of 10 % for DPT-HepB-Hib (Pentavalent) and 9 % for polio. The proportion of children 12- 23 months vaccinated against measles is 85 % compared with 73 %t in 2003 (KNBS, 2010).

#### **2.4 Vaccination Dropouts in Kenya**

In 2011 alone 27% of the districts in Kenya (41/153) had DPT dropout rates of >10% a figure that indicates undesired level of dropout.(WHO, 2012). Dropout refers to people who begin the immunization schedule but never complete it. This is evaluated as the difference between the first antigen in the schedule that the caregiver brings the child for (penta 1 measures access to initial immunization services) and a later antigen (penta3 or measles which measures utilizations of immunization services).

A couple of studies carried out have documented various reasons for vaccination dropouts among them Long distances to health facilities, poor state of the roads, attitude and knowledge regarding immunization (Omutayi & Mwanthi, 2005), forgetfulness and age of the mother (Kariuki, 2009) and number of children within the family, place of birth, and advice on next visit (Maina *et al.*, 2013), insufficient and irregular vaccination sessions, lack of adequate outreach sessions, and health care attitudes towards clients (Amin *et al* 2013). A study in Baringo also found nomadism, place of birth, distance from facility and family size as predictors complete vaccinations (Elizabeth *et al.*, 2015).

These findings indicate that while the supply side of vaccines may have been addressed, accessibility, infrastructure and the demand side are still main factors that hinder vaccination coverage as well as the high dropout rates in vaccination.

## **2.5 Strategies to Increase Vaccination Coverage Kenya**

Both globally and locally a number of successful strategies on increasing access to immunization services and scaling up vaccine coverage have been adapted, however only a few of this strategy have been documented in developing countries. In Ghana, non-health workers conducted door-to-door visits and referred all children less than five years of age to routine immunization clinics. In addition, a health worker conducted home visits for children who failed to finish their immunization series. Over a six-month period (7/1991–2/1992), the percentage of FIC increased from 60% to 85% in the intervention group, whereas in the control group coverage increased from 61% to 67% (Brugha & Kevany, 1996).

In Kenya, school buildings were utilized as immunization centers, with an educational component provided by schoolchildren who circulated immunization information within their communities. Furthermore, mobile teams were used to increase access. Coverage outcomes varied according to population density. In high population density areas, the percentage of full immunization coverage (FIC) increased from 54% to 82% and in low density areas it increased from 25% to 57% over an unspecified period. Coverage at

follow-up in comparison high density areas was 69% compared to the 82% and in low population density areas 27% compared to the 57% (WHO, 1977).

The access and ownership of mobile phones in Kenya is rapidly rising, Mobile phones are increasingly being used for health applications (mHealth) (Kamanga *et al.*, 2010; Meankaew *et al.*, 2010; Onono *et al.*, 2011; Pop-Eleches *et al.*, 2011; Tamrat & Kachnowski, 2012). Some of these new applications could potentially be harnessed to administer interventions to achieve high, timely and sustainable immunization coverage. Most recently study in Western Kenya showed that mobile phone-based strategies are a potentially useful platform to deliver reminders and cash transfers. Follow-up studies were recommended to provide evidence for the effectiveness of these strategies in improving vaccine coverage and timeliness.(Wakadha *et al.*, 2013). A Similar study in Zimbabwe found significant higher vaccination coverage among SMS intervention group of 96% and 95% at 10 and 14 weeks compared to 80% and 75% for the non-intervention group for OPV, Penta and PCV antigens (Bangure *et al* 2015). Most recently a study in Nigeria also reported 98.6% vaccination coverage for phone based reminders compared to 57.3% coverage for the non-intervention group confirming further the effectiveness of SMS based reminders in reducing vaccination dropouts in childhood immunization programs (Brown *et al* 2016).

The second strategy used stickers with return dates as a way of reminding caregivers on when to return for the next vaccination. Sticker placed at strategic places within the household is likely to remind the caregivers every time they come in to contact with

sticker and have the potential of reducing vaccination dropouts. Although there is limited studies on sticker reminders, a study carried out in Ethiopia Between October 1991 and February 1992 to evaluate the effectiveness of sticker reminder in reducing dropout rates found a significant reduction in immunization dropout rates using stickers than the control group (relative risk = 0.68; P 0.01)(Berhane & Pickering 1993).

## **CHAPTER THREE**

### **MATERIALS AND METHODS**

#### **3.1 Study Area**

District selection was based on pentavalent vaccine coverage for 2012. Districts with >10% dropout rates for the third pentavalent dose were considered for inclusion in the study. In 2012, 34 districts with dropout rates >10% were identified. Among these, districts with small populations of children <1 year were excluded, as were districts with hard to reach and security concerns due to limited resource and the short period to carry out the study. Six Districts with dropout rates ranging from 13-27% with both rural and urban settings were identified, and subjected to simple random sampling to select three districts. The three Districts selected for the study are Machakos, Njoro and Langata districts of Kenya (Appendix 4).

Machakos District is in Machakos County. The District covers an area of 6,281.4 kmsq, most of which is semi-arid. The district has a population of 199,211(KNBS, 2009) and live births of 13,271 (DHIS, 2012). There are 56 health facilities, of which 22 are government facilities that include 19 dispensaries, two health centers and one level 5 hospital. In 2012, the district had coverage for first and third dose of pentavalent vaccine of 85% and 74%, respectively; with a dropout rate of 13% (DHIS 2012). The full immunization coverage stood at 77%. Three health facilities were selected randomly to participate in this study.

Langata district is a district in Nairobi County, and host one of the largest slums in Kenya. The district has a population of 355,188 (KNBS, 2009) and live births of 12,402. The district has a total of 97 Health facilities, of which five are government facilities, 19 are non-governmental organizations, and the rest are private. In 2012 the district had coverage for first and third dose of pentavalent vaccine of 96% and 84% respectively; with a dropout rate of 13 % (DHIS). The full immunization coverage was 82% in 2012.

Njoro district is in Nakuru county, Rift valley province. The district covers an area of 313 square kilometers with an estimated population 100,000, and live births of 7,904 (DHIS 2012). There are 37 health facilities in the district; 14 are government facilities consisting of four health centers and 10 dispensaries. The remaining are either faith based or privately owned. In 2012 the district had coverage for first and third dose of pentavalent vaccine of 82% and 71% respectively; with a dropout rate of 13 %. The full immunization coverage was 74% in 2012. (DHIS, 2012).

### **3.2 Study Design**

An interventional study was conducted to evaluate two strategies for reminding caregivers to bring their children for immunization. In each of the study districts we randomly selected three high volume immunizing facilities. The three selected immunizing facilities within the three study districts were randomly assigned an



intervention arm. Therefore, in each of the districts there was an immunizing facility assigned to each intervention.

For children presenting to health facilities assigned to the sticker reminder strategy, the participant received two stickers with the dates when the next immunization is due (Appendix 5). One sticker was placed over the child's immunization booklet. The second sticker was given to the caregiver and instructed to place it in a visible area. The **figure 3.1** (Appendix 6) shows how each of the participants assigned to the sticker reminder strategy was followed through the three vaccine doses.

For children presenting to health facilities assigned to the SMS text message strategy, the caregivers were asked to provide a reliable mobile phone number where they can receive an SMS text message with a reminder to bring their child back for the next vaccination. The SMS text message was sent to participants two days prior to the scheduled date and on the morning on the scheduled vaccination date. The **figure 3.2** (appendix 7) shows how each of the participants' assigned to the SMS text message strategy was followed through the three vaccine doses.

For children presenting to health facilities assigned to provide current reminder practices, caregivers had the dates indicated on the immunization booklet and informing the caregiver when to return. Participant in this strategy served as the control group. The **figure 3.3** (Appendix 8) shows how each of the participants in the control strategy was followed through the three vaccine doses.

### **3.3 Study population**

Children <12 months of age brought to the immunizing health facilities in the selected districts for their first dose of pentavalent vaccine between February and July 2014 were enrolled into the study.

#### **3.3.1 Inclusion criteria**

- Any child below the age of 12 months brought to a participating immunizing facility in the selected district
- Child receiving first dose of the pentavalent vaccine
- Caregivers provided a reliable mobile phone number
- Caregivers agreed and signed the written informed consent.

#### **3.3.2 Exclusion criteria**

Any child not residing in the three study districts at the time of the study was excluded as well as caregivers without access to a reliable mobile phone number.

### **3.4 Sample Size Determination**

Using casagrande *et al* (1978) formula to Sample calculated size. Assuming dropout rates for the third dose of DPT of 15.6% (Kariuki 2009), study power of 80%, and confidence level of 95%, Two proportions were compared to detect a 15% decrease in the drop-out vaccination rates for each of the three strategies (Appendix 9: Table3.1).

One-sided test: Ho:  $P_1 = P_3$  versus Ha:  $P_1 > P_3$

**Variable**

A	Significance level=95% (1.65)
1-β	Power of the test=80% (0.842)
P <sub>1</sub>	Success proportion in arm 1=0.156 (15.6%)
P <sub>2</sub>	Success proportion in arm 2=0.136(13.26%)
R	Ratio of arm 2 to arm 1=1
M	Sample size for arm 1
N	Total sample size for arm 1 and 2

Define  $z_p$  be the upper 100(1-p) percentile of the standard normal distribution,

$m$  be the required sample size from the first population,

$rm$  be the required sample size from the second population,  $0 < r < \infty$

$$\delta = |P_2 - P_1|, \bar{P} = \frac{P_1 + rP_2}{r+1} \text{ and } Q = 1 - P$$

$$m = \frac{m^2}{4} \left[ 1 + \sqrt{1 + \frac{2(r+1)}{rm^2\delta}} \right]^2$$

$$\text{Where } m^2 = \frac{\left[ z_{1-\alpha} \sqrt{(r+1)PQ} + z_p \sqrt{(rP_1Q_1 + P_2Q_2)} \right]^2}{r\delta^2}$$

$$N = (r+1)m$$

Considering the above assumptions, a minimum sample size of 1,116 was used for the study, **372 participants per arm and 124 participants per facility.**

### **3.5 Sampling and assignment of intervention**

Health facilities within each of the districts with 10% or more dropout rates for the third pentavalent dose were listed and three facilities selected randomly in each district. Selected health facilities were assigned randomly to an intervention using computer generated random numbers in each of the Districts. Children were conveniently enrolled in the selected health facilities until the strategy-level target sample sizes was reached.

### **3.6 Data collection Tools**

A standardized paper-based questionnaire (Appendix 3) was administered face-to-face to the caregivers by the investigator/facility nurse. The questionnaire was administered in the local language. The questionnaire was used to gather basic demographic and epidemiological information, as well as information specific to the vaccination visit. The questionnaire was also used to establish a log of enrolled children with timing for follow-up.

### **3.7 Recruitment, Training of research assistants and Pilot testing**

One nurse was recruited from each participating facility with minimum education level of certificate in community nursing and working in MCH clinic full time as the research assistants. One-day training for research assistants was conducted by the principal investigator at district level in each of the districts a week prior to start of the study; the training addressed ethical issues in research and skills in interviewing participants. Pilot

testing of data collection tool was done in Langata health center by interviewing 20 caregivers who brought their children for routine vaccination before study participant recruitment commenced and adjustment done to the questionnaire.

### **3.8 Data collection**

Recruitment of participants was done by the nurse/principal investigator during routine working hours at the MCH clinic on daily basis excluding weekends.as the clients come for their routine immunization services. Eligible participants coming for the first pentavalent vaccination were identified and provided with detailed explanation of the evaluation study and those who were willing to participate were taken through the informed consent process. Those who consented were allowed first to receive the vaccination due for that day and there after the nurse conducted the interview using the standard questionnaire and determined when participants are due for their next dose of pentavalent vaccine. On the second visit (4 weeks after 1<sup>st</sup> visit) the nurse recorded in the questionnaire if the children came back for their second dose of pentavalent vaccine, a series of follow-up questions regarding the reminder strategy, as well some brief questions specific to this vaccination visit were asked and were given information on when they are due for their third dose. During the final visit (4 weeks after visit 2) each of the children enrolled coming back for their third dose of pentavalent vaccine were asked a series of follow up questions regarding the reminder strategy.

### **3.8.1 Reminder and follow up of Participants**

Depending on the strategy caregivers of enrolled children were reminded to bring their child back for vaccination via SMS, sticker reminders, or routine facility practices. Those receiving the SMS text message were sent a text message reminding them of the due date for the next vaccination two days prior to the appointment date and a second one on the actual date of appointment. SMS messages were sent through a web based SMS system. The sticker reminder arm had a sticker put on the cover page of the mother child booklet indicating the next return date and went home with another sticker to be fixed on the inside of the house door. The control group had the next return date indicated on the mother child booklet and had no reminders.

### **3.8.2 Tracing of Defaulters.**

Those children in either of the strategies who failed to turn up for the next appointment for penta 2 and penta 3 tracing were done at least 2 weeks after expected time of completion of penta 3 vaccine to establish reason for missing vaccination and offered an opportunity to get the missed vaccines. The tracing was done by the principal investigator in each of the facilities with the help of facility nurse. Telephone calls were made to the parents/guardian's to find out reason for missing scheduled vaccinations. Those who could not be traced through telephone calls, tracing was done with help of the community health extension worker (CHEW) who keeps a register of all households in that locality to locate the house and thereafter the principal investigator interviewed

the mother or responsible care taker to establish the reason for missed vaccination and another opportunity to get the child vaccinated (tracing tool appendix 3.4).

### **3.9 Data Analysis**

Data was collected on paper questionnaires, An Epi-info version 7 was used to create a make view for data entry. The data was saved as a file in access database and data security ensured using a password protected computer. Data validity was ensured through cleaning and editing of the data before analysis was performed. Data was saved in DVD, CD and USB flash to provide back-up storage to prevent data loss.

Data was analyzed using EPI Info 7 (CDC, Atlanta, GA, USA) and Ms Excel 2007 (Microsoft, Seattle, WA, USA). Univariate analysis was performed where proportions were calculated for categorical variables and means and medians for continuous variables. Bivariate analysis of the data was performed using the vaccination status of children (completed vaccinations and didn't complete vaccination) as the dependent variable and the determinants of Vaccinations (caregivers age, Education status, Distance to facility, marital status, waiting time, place of delivery, employment and vaccination reminders) as the independent variables. Odds ratios, 95% confidence intervals and P-value of  $\leq 0.05$  were used to determine level of significance with factors with P-value of  $\leq 0.05$  considered as significant. Multivariate analysis was carried out for significant factors to determine independently significant factors.

In this evaluation, the following Drop-Out Rates was calculated within each of the three strategies based on the calculations below:

TIME 2

$$\text{Penta 2 dropout rate} = (\text{Penta1} - \text{Penta 2}) / \text{Penta1}$$

TIME 3

$$\text{Penta 3 dropout rate} = (\text{Penta1} - \text{Penta 3}) / \text{Penta1}.$$

### **3.10 Ethical Considerations**

For the purpose of conforming to the ethical regulations binding studies on human subjects, the study approval was obtained from the Kenyatta National Hospital/University of Nairobi Ethics Research Committee (ERC) prior to commencement of the study (appendix 11)

Confidentiality of records was maintained constantly under key and locks system and will be finally destroyed five years after the study period.

All parents/guardians to the children taking part in the study were requested to sign a consent form after study description given to them and the consequences of participating in the study explained to them prior to enrollment into the study.



### **3.11 Plans for Dissemination of the study results**

As part of the informed consent, all parents/guardians were made to understand that the findings of this study will be presented to the University during my thesis defense and to the Kenya Ministry of Health and other policy decision makers through presentations at District, County and national level. They will also be shared in international conferences and published in international journals for peer review, without revealing the identity of the study participants.

## CHAPTER FOUR

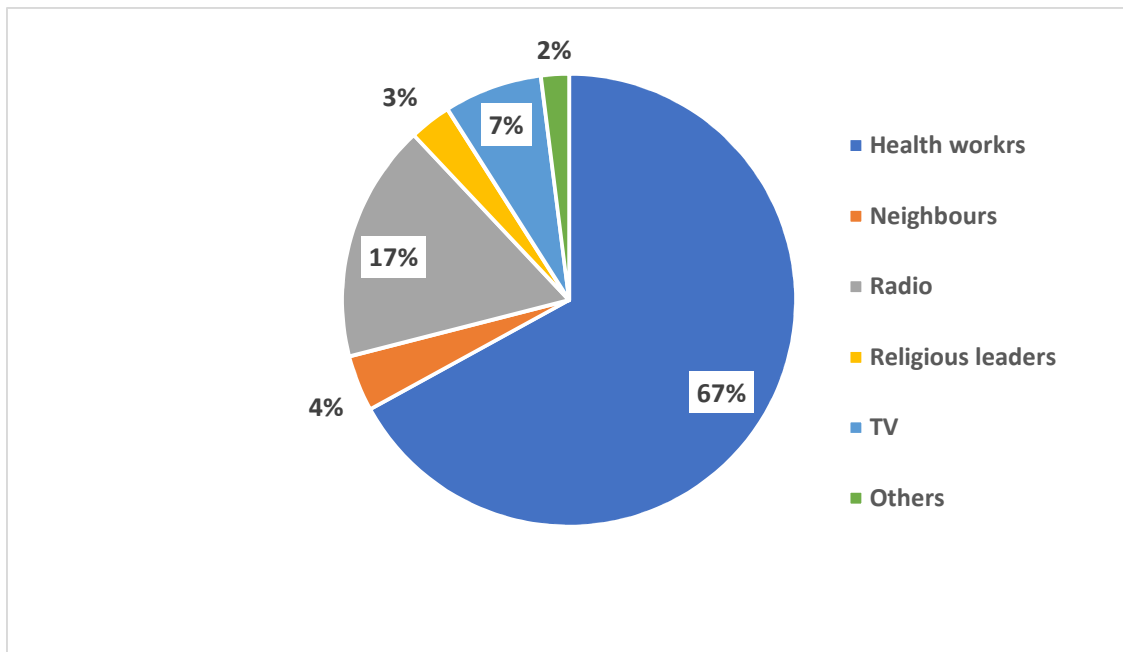
### RESULTS

#### 4.1 Socio-demographic characteristics

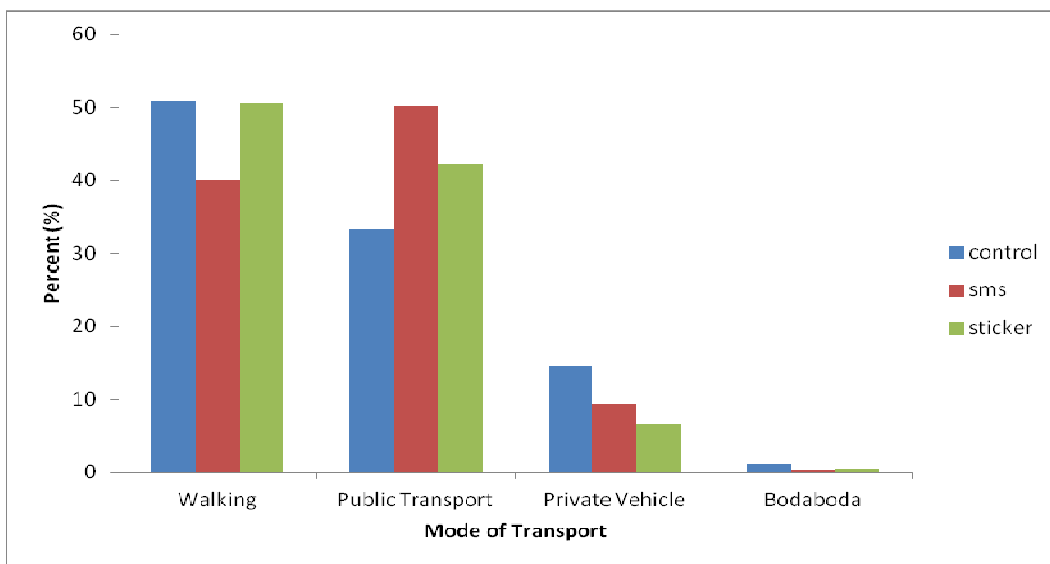
A total of 1,116 children were enrolled; 372 in each intervention group and 372 controls between February and October 2014. The median age of children was 45 days old (range: 31-99 days), and 574 (51%) were males. The mean age of caregivers was 26 years (14-45), 856 (77 %) were unemployed, and 549 (49%) had attained up to primary level education. There were no statistical differences in demographic characteristics between the three groups (Table 4.1). Majority of the caregivers 522 (47%) walked to health facility and <1% used bodaboda to reach facility for vaccination services (Figure 4.1). The caregivers main source of information was provided by health care workers 748 (67%), followed by radio 189 (17%) and Television 80 (7%) (Figure 4.3). There was no significant statistical difference among the groups

**Table 4.1: Univariate Analysis of Socio-demographic characteristics of caregivers/children attending vaccination services in selected districts in Kenya, 2014**

Variable	SMS n (%)	Sticker n (%)	No intervention n (%)	p-value
<b>Sex</b>				
Female	181(49)	170(46)	191(51)	0.3
Male	191(51)	202(54)	181(49)	
<b>Child's age</b>				
≤42days	53(14)	53(14)	51(14)	0.95
43-49 days	265(71)	260(70)	269(72)	
50-56days	32(9)	40(11)	32(9)	
57-63days	9(2)	10(3)	11(3)	
≥64days	13(3)	9(2)	9(2)	
<b>Maternal age</b>				
≤20	66(18)	69(19)	47(13)	0.1
21-25 yrs	134(36)	151(41)	136(37)	
26-30	102(27)	85(23)	113(30)	
31-35	50(13)	42(11)	41(11)	
>35 yrs	20(5)	25(7)	35(9)	
<b>Maternal employment</b>				
Employed	90(24)	80(22)	101(27)	0.2
Unemployed	282(76)	292(78)	271(73)	
<b>Maternal education</b>				
No formal education	1(0)	2(1)	6(2)	0.09
Primary	151(41)	170(46)	175(47)	
Secondary	140(38)	118(32)	108(29)	
Tertiary	80(21)	82(11)	83(22)	
<b>Marital status</b>				
Married	303(81)	320(86)	322(87)	0.1
Single	69(19)	52(14)	50(13)	



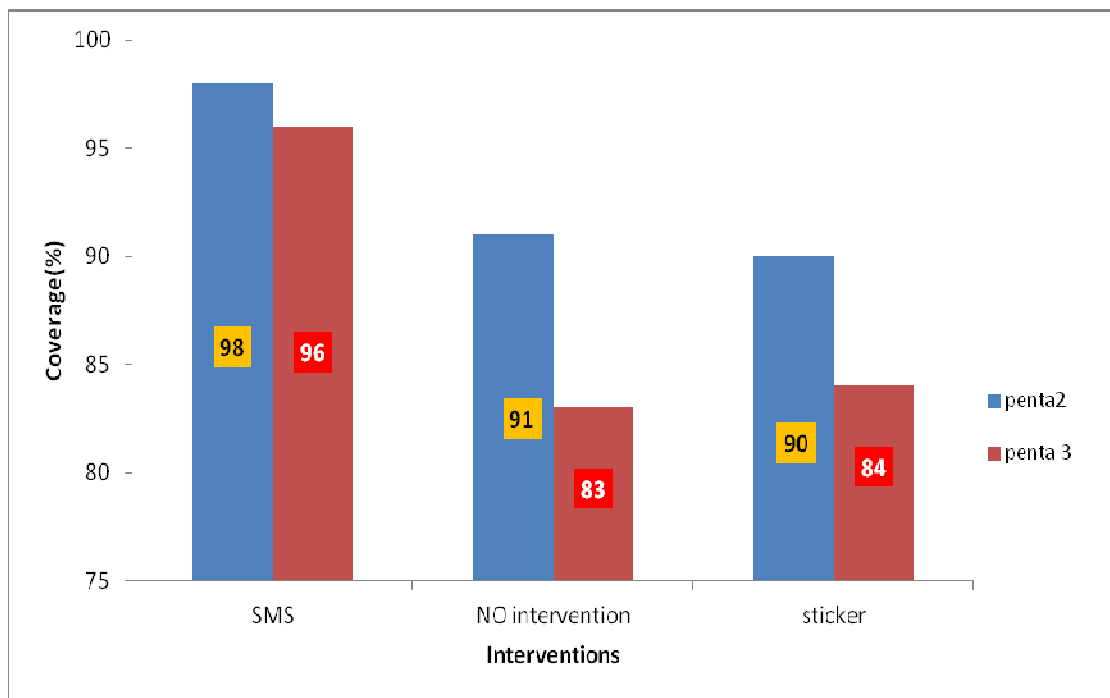
**Figure 4.1: source of information on routine vaccination among caregivers bringing children for vaccination services in selected districts in Kenya, 2014**



**Figure 4.2: Mode of transport to health facilities among caregivers bringing children for vaccination services in selected districts in Kenya, 2014**

## 4.2 Vaccination Coverage

At 10 weeks of age 365 (98%) children in the SMS intervention group had received second pentavalent vaccine. At 14 weeks of age 359 (96%) had received their third Dose of pentavalent vaccine (P=0.4). At 10 weeks of age 334 (90%) children in the sticker intervention group had received second pentavalent vaccine. At 14 weeks of age 312 (84%) received their third Dose of pentavalent vaccine (P=0.02). At 10 weeks of age 340 (91%) children in the control group had received second pentavalent vaccine. At 14 weeks of age 309 (83%) received their third dose of pentavalent vaccine (P=<0.001) (Fig 4.3).



**Figure 4.3: vaccination coverage at 10 and 14 weeks among children attending vaccination services in selected districts in Kenya, 2014**

### **4.3 Effectiveness of SMS and Sticker Reminders on Vaccination Dropouts**

Overall, among those children enrolled who received the first dose of pentavalent vaccine, 136 (12%) did not return for their third dose of pentavalent vaccine. Of these, 63 (17%) were from the control group compared to 13 (4%) from the SMS intervention group (OR 0.2, CI: 0.04-0.8), and 60 (16%) were from the sticker intervention group (OR: 0.94, CI: 0.53-1.6).

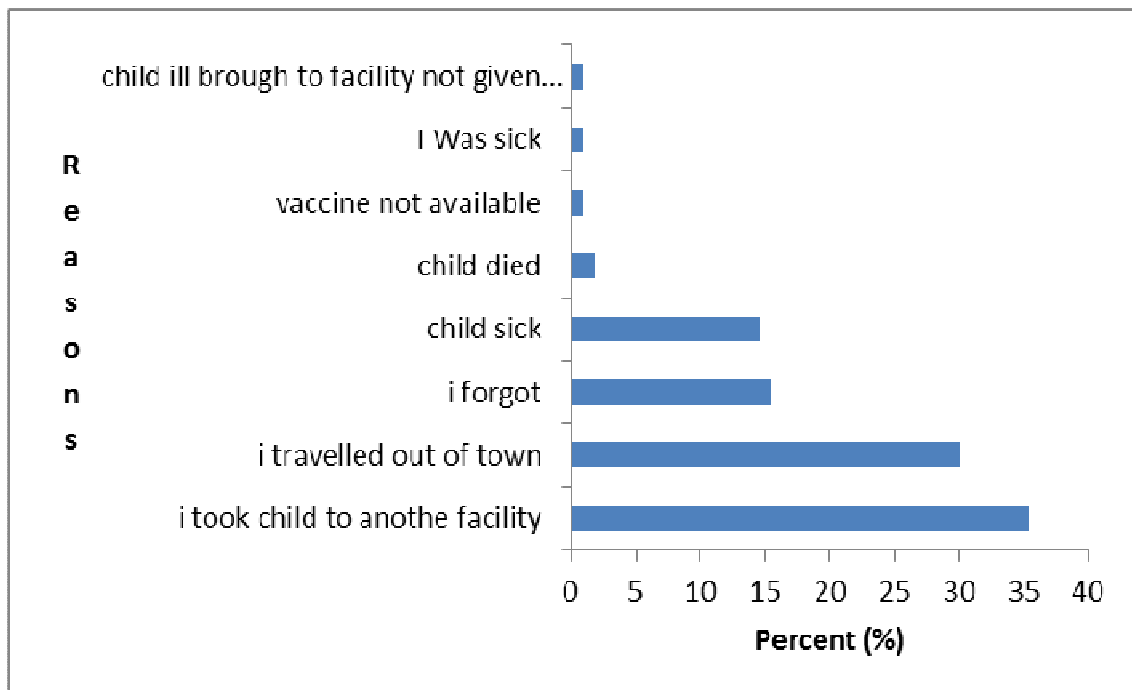
At 10 weeks, the risk difference for those who received SMS reminders and the control group was seven percent (95% CI: 0.3-14). At 14 weeks, the risk difference for those who received SMS reminders and the control group was 13% (95% CI: 5.6-21.26). The mean delay in receiving second dose of pentavalent vaccine on the scheduled date in the SMS intervention group was 0 days (standard deviation (SD): 1.2), in the control group the mean delay was one day (SD: 4.3), while in the sticker group, the mean delay was one day (SD: 6.3). There was a significant difference in the mean delay in days between the SMS and Control group ( $p < 0.001$ ), but no significant difference in delay between the control and sticker group ( $p = 0.5$ ). The mean delay in receiving the third pentavalent dose on the scheduled date in the SMS intervention group was 0 days (SD: 2), in the control group, two days (SD: 7) and in the sticker group, two days (SD 6). There was a significant difference in the mean delay in days between the SMS and Control group ( $P < 0.001$ ), but no significant difference in mean delays in days between the control and sticker group ( $P = 1$ ).

#### 4.4 Cost of SMS reminders

A total of 1,488 messages were sent to the participants in the SMS group, cost \$33.1 USD, and the premium cost of scheduling messages from web for six months' cost \$66.7 USD giving a cost of \$0.27 USD per child for the project.

#### 4.5 Reasons for missed vaccinations

A total of 110 (81%) mothers who didn't return their children for vaccination were traced to identify reasons for missed vaccination that included: child taken to another facility 39 (35%); travelled out of town 33 (30%); forgot 17 (15%); child was sick 16 (15%); or child died 2 (2%) (Figure 4.4).



**Figure 4.4: Reasons for missed vaccination among children attending vaccination services in selected districts in Kenya, 2014**

#### **4.6 Associated factors with missed vaccinations**

On bivariate analysis, education level primary and below (Odd Ratio (OR) :1.9, 95% Confidence Interval (CI): 1.1-3.29), age of child at first pentavalent dose >56 days (OR:2.2, CI: 1.3-3.1), distance > 5km from facility (OR:1.57, CI :1.095-2.26), waiting time > 30 minutes (OR:1.4, CI :1.03-2.12) were associated with higher odds of missed vaccinations. In contrast those who received SMS reminders (OR: 0.2, CI: 0.1-0.3) were 80% less likely to miss vaccinations. There was no significant difference between sticker intervention group and the control group (OR: 0.94, CI: 0.6-1.4) (Table 4.2).



**Table 4.2: Factors associated with missed vaccinations among children attending vaccination services in selected districts in Kenya, 2014**

<b>Variable</b>	<b>Dropout</b>	<b>No dropout</b>	<b>OR(CI)</b>	<b>P-Value</b>
	n(%)	n(%)		
<b>Mother Age</b>				
<25yrs	74 (12)	528 (88)	1.0 (0.7-1.4)	0.9
>25yrs	62 (12)	451 (88)		
<b>Education</b>				
primary and below	82 (15)	476 (85)	1.9 (1.1-3.29)	0.02
Secondary and above	17 (8)	188 (92)		
<b>Marital status</b>				
Not Married	21 (13)	138 (87)	1.1 (0.67-1.82)	0.7
Married	113 (12)	822 (88)		
<b>Place of Delivery</b>				
Home	25 (14)	153 (86)	1.2 (0.75-1.89)	0.46
Hospital	111 (12)	824 (88)		
<b>Employment</b>				
Unemployed	29 (11)	231 (89)	0.9 (0.57-1.36)	0.56
Employed	107 (13)	749 (87)		
<b>Age of child at penta 1</b>				
>56days	20 (22)	70 (78)	2.2 (1.3-3.8)	0.002
<56days	116 (11)	910 (89)		
<b>Distance from facility</b>				
>5km	64 (15)	354 (85)	1.6 (1.095-2.26)	0.01
<5km	72 (10)	626 (90)		
<b>Birth order</b>				
first born	52 (12)	377 (88)	0.9 (0.69-1.43)	0.96
not a first born	84 (12)	603 (88)		
<b>Waiting time</b>				
>30Mins	65 (15)	378 (85)	1.4 (1.03-2.12)	0.03
<30Min	70 (10)	601 (90)		
<b>Interventions</b>				
SMS reminder	13 (3.5)	359 (96.5)	0.2 (0.01-0.33)	<0.001
No reminder(control)	63 (17)	309 (83)		
Control	63 (17)	309 (83)	1.1 (0.72-1.56)	0.77
sticker reminder	60(16)	312(84)		

In multivariate analysis care givers with education level of primary and below (OR: 1.85, CI: 1.0-2.7) in comparison to secondary level and above, and residing > 5km from a health facility in comparison to residing within 5 km range (OR: 1.64, CI: 1.1-3.1) were more likely to drop-out. In contrast, those who received SMS reminders were 10-40 % less likely to miss vaccinations in comparison to the control group (OR: 0.196, CI: 0.1-0.4). There was no statistical difference between those who received sticker reminders and the control group (OR: 0.67 CI: 0.4-1.2) (Table 4.3).

**Table 4.3: Independent factors associated with missed vaccinations among children attending vaccination services in selected districts in Kenya, 2014**

Variable	AOR	95%CI	P-Value
Child's age >56days	1.81	0.83-3.90	0.14
Education level below primary	1.85	1.0-2.70	<b>0.05</b>
Distance >5km from facility	1.64	1.09-3.10	<b>0.025</b>
Waiting time >30 minutes	0.86	0.51-1.45	0.57
SMS reminder	0.196	0.09-0.43	<b>&lt;0.001</b>
Sticker Reminder	0.69	0.40-1.20	0.181

\*\*: Adjusted Odds Ratio

## CHAPTER FIVE

### DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Discussion

##### 5.1.1 Effectiveness of SMS reminders

This evaluation with large number of participants found that SMS reminders were effective in reducing dropouts in vaccinations in the selected districts in Kenya. The vaccination coverage was significantly higher among those receiving SMS reminder than those receiving routine reminders. About 13% of the children vaccinated in the SMS intervention group is attributed to SMS reminders and could not have been vaccinated if SMS reminders were not used at 14 weeks.

The finding of this study is similar to other studies conducted earlier. In western Kenya, a feasibility study on the use of mobile based SMS showed 95% penta 2 coverage among those who received SMS compared to 60% among those who did not receive SMS reminders however this study had a cash transfer component. A randomized controlled trial conducted in Kadoma city in Zimbabwe (2015) also reported significant high vaccination coverage of 97%, 96%, and 95% among those who received SMS reminders compared to 82%,80% and 75% coverage among the control group for pentavalent vaccine at 6, 10 and 14 weeks (Bangure *et al.*, 2015). Most recently a study in Nigeria also reported 98.6% vaccination coverage for phone based reminders

compared to 57.3% coverage for the non-intervention group confirming further the effectiveness of SMS based reminders in reducing vaccination dropouts in childhood immunization programs (Brown *et al* 2016). A systematic review of effects of all types of reminders including SMS found that patient reminder systems were effective in improving vaccination rates (Szilagyi *et al.*, 2000). Also studies conducted in low-income, minority, populations in New York City found that SMS reminders improved coverage from 4% to 17%, depending on the vaccine (Stockwell *et al.*, 2012). Short message services (SMSs) have been successfully employed for various health applications with similar promising results, such as promoting adherence to drug treatments for chronic diseases (Lester *et al.*, 2010; Strandbygaard *et al.*, 2010; Vervloet *et al.*, 2011), uptake of screening tests (de Tolly *et al.*, 2012; Dokkum *et al.*, 2012; Khokhar, 2009; Lakkis *et al.*, 2011), immunization coverage (Kharbanda *et al.*, 2011; Stockwell *et al.*, 2012), clinical appointment attendance (Guy *et al.*, 2012; Hasvold & Wootton, 2011), and training health workers in malaria treatment (Zurovac *et al.*, 2011).

Although the mean delay of one day in receiving the second dose of pentavalent vaccine and two days in receiving the third dose of pentavalent vaccine for the control group compared to the SMS text reminder group which had no delays for the provision of these doses of pentavalent vaccine was highly statistically significant, A delay of one or two days may not be clinically significant in terms of susceptibility to disease. Thus, the study findings support the hypothesis that SMS is effective reminder system in vaccination.

### **5.1.2: Effectiveness of Sticker reminders**

This study also evaluated the effectiveness of sticker reminders and found no significant statistical difference between sticker reminders and the control group. The difference in vaccination coverage at 10 and 14 weeks was not statistically significant between the sticker reminder and the control group. Clinically 1% difference in vaccination coverage is important towards meeting the set target and any intervention that can increase vaccination coverage even by 1% is good enough to contribute towards increasing vaccination coverage. There are limited information on the use of sticker reminders however in one study done in Ethiopia in 1993 found stickers reminders effective in reducing vaccination dropouts (Berhane & Pickering, 1993), but unlike our study the control group in the Ethiopia study used a population that was vaccinated in the previous year. The difference in findings might be time related as 20 years ago there was more use of paper based strategies compared to the use of technologies currently.

### **5.1.3: Factors Associated with Missed Vaccinations**

Education is key in determining vaccination service utilization, this study found children whose mothers had below secondary level education were 2 times more likely to miss vaccinations in contrast to those with above secondary level of educations and children residing >5 km from the health facility was associated with being a drop-outs. Similar finding were found in previously conducted studies in Kenya ( Elizabeth *et al* 2015, Kariuki, 2012; Maina *et al.*, 2013; Mutua *et al.*, 2011; Ndiritu *et al.*, 2006;

Omutanyi & Mwanthi, 2005). This suggest that while efforts needed to address demand creation, the access factors (distance) remain a challenge and have to be addressed for a successful immunization program in the country.

## **5.2 Limitations**

This study is subject to several limitations. If a mother took her child to another facility for second or third pentavalent dose the system considered the child unvaccinated leading to misclassification, however further sensitivity analysis assuming that these children were actually vaccinated did not affect the general observed difference between the interventions.

## **5.3 Conclusions**

1. Vaccination coverage was higher in the SMS intervention group than in the control group and is both statistically and clinically significant. The overall increase may be attributed to the use of SMS reminders in this study.
2. The difference in coverage between the sticker intervention group and the control group is not statistically significant. This may be an indication of ineffectiveness of sticker reminders.
3. Below secondary level education and distance from facility >5km were independently associated with missed vaccination schedules.

### **5.3 Recommendations**

1. It is recommended that SMS reminders be adopted in routine childhood vaccination services in Kenya
2. Facility based outreach services be strengthened to cover hard to reach areas
3. Advocate and invest in the girl child education to bring educated mothers for future prosperity

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## APPENDICES

### **Appendix 1: Informed Consent Document (English version)**

**Study Title:** Evaluating SMS and Sticker Reminders in Reducing Dropout Rates in Routine Immunization in selected Districts in Kenya

**Principal investigator:** Adam Hassan Haji: Field Epidemiology and Laboratory Training Program (FELTP), Institute of Tropical Medicine (ITROMID), Jomo Kenyatta University of Agriculture and Technology (JKUAT)

**Introduction:** I am Dr Adam Haji a postgraduate student at Jomo Kenyatta University of Agriculture and Technology, working for the ministry of Health Kenya. We are doing research on **evaluating SMS and Sticker Reminders for Reducing Dropout Rate in Routine Immunization in Selected Districts in Kenya**, I am going to give you information and invite you to be part of this research. You do not have to decide immediately whether or not you will participate in the research .Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me, the study doctor or the staff

**Study location:** machakos, Langata and Njoro Districts

**Purpose of the research:** To provide evidence based effective strategies to reduce vaccine dropout rates and increase vaccination coverage.

**Description of the research:** This study involves answering few questions that will take about 10-15 minutes of your time and follow up question in the next 2 vaccination scheduled.

**Study procedure:** children coming for their first pentavalent vaccine will be recruited and followed up through to penta 3 vaccines. They will either receive SMS reminders, Sticker reminder or only reminded verbally when to come back for the next dose.

**Randomization:** The study involves evaluating 2 interventions that we hope can help in reducing vaccination dropout in our country. For this purpose the participating health facilities have been divided between this 2 intervention and a control group randomly and you will automatically allocated the available intervention in your facility.

**Intervention:** the study involves three interventions namely SMS reminder, Sticker reminder and a control group who will receive no SMS or Sticker but will have the verbal information on the next date for vaccination and the same indicated on the child/mother booklet

**Defaulter tracing:** incase for one reason or the other you fail to come back for the next appointment date we shall be contacting you through a phone call or home visit to establish the reason for missed vaccination and offer you another opportunity to vaccinate your child.

**Risks and discomfort:** There are no risks or harm whatsoever involved in this study as it involves administering a questionnaire only.

**Potential benefits:** The findings of this study will help the government to adapt the best method to remind parents on scheduled immunization and increase immunization coverage thereby protecting children against vaccine preventable diseases.

**Cost compensation:** there will be no payment for your participation in this study.

**Confidentiality:** Without your consent, no information that reveals the identity of your child will be released or published to any unauthorized person. Records containing information about your child will be constantly kept under key and lock system and will be finally destroyed five years after the study period. There is a minimal risk of breach of confidentiality but the likelihood of this occurring will be significantly reduced by steps explained above.

**Voluntary participation:** Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw your child from this study.

### **Contact**

- a) For any questions or concerns about the study or if any problems arise, please contact:

**Principal investigator, Adam Hassan Haji P.O Box 13101-00400 Nairobi, Cell phone No. 0722641655; e-mail:[hajiadam661@gmail.com](mailto:hajiadam661@gmail.com).**



b) If you have any questions or concerns about your rights as a research participant, please contact the KNH/UON-Ethical Review committee at 2726300 ext.44102 or by post at p.o box 19676-00202.email address: *uonknh\_erc@uonbi.ac.ke*

**Consent**

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily for my child to participate as a participant in this study

**Name of Participant** \_\_\_\_\_

**Print Name of Parent or Guardian** \_\_\_\_\_

**Signature of Parent or Guardian** \_\_\_\_\_ **Date**

\_\_\_\_\_

**Name of person getting consent** \_\_\_\_\_

**Signature** \_\_\_\_\_ **Date:**

\_\_\_\_\_

## **Appendix 2: Hati ya kudhibitisha uridhaa (Toleo la Kiswahili)**

**Mada ya Utafiti:** Kutathmini Ujumbe mfupi(SMS) na vibandiko vya kukumbusha kwa kupunguza kuachwa kwa chanjo kwenye wilaya chache zilizochaguliwa hapa Kenya.

**Mkuu wa uchunguzi:** Adam Hassan Haji: Field Epidemiology and Laboratory training program (FELTP), Chuo Kikuu cha Jomo Kenyatta cha Kilimo na Teknolojia (JKUAT)

**Utangulizi:** Mimi ni Dk Adam Haji mwanafunzi wa uzamili katika Chuo Kikuu cha Jomo Kenyatta cha Kilimo na Teknolojia, na fanya kazi kwa wizara afya Kenya. tunafanya utafiti juu ya Kutathmini Ujumbe mfupi(SMS) na vibandiko vya kukumbusha kwa kupunguza kuachwa kwa chanjo kwenye wilaya chache zilizochaguliwa hapa Kenya nita kukupa maelezo na kuwakaribisha kuwa sehemu ya utafiti huu. Si lazima kuamua mara moja kama uta shiriki katika utafiti au la. Kabla ya kuamua, unaweza kuzungumza na mtu yeyote una amini vizuri kuhusu utafiti.

Kama kuta kwa na chochote huelewi katika maelezo tafadhali ni simamishe na mimi itachukua muda kueleza tena. Kama una maswali baadaye, unaweza kuniuliza mimi, daktari wa utafiti au wafanyakazi wengine wa utafiti.

**Mahali pa utafiti:** Wilaya za Machakos, Langata na Njoro.

**Lengo la utafiti:** Kupata ushahidi kutokana na mikakati iletayo ufanisi katika kupunguza kuachwa kwa chacho za watoto na kuongeza wanaopata chanjo hizo.

**Maelezo ya utafiti:** Utafiti huu unahusisha kujibu kwa maswali machache yatakayochukua takriban dakika kumi hadi kumi na tano na pia tutauliza maswali wakati wa chacho ya pili baada ya hii ya leo.

**Utaratibu wa utafiti:** watotowanao kuja kwa ajili ya chanjo yao ya kwanza ya pentavalent wata sajiliwa na kifuataliwa hadi chanjo ya penta ya 3. Wata kupokea kukumbushwa kupitia ujumbe ufupi(SMS), vibandiko au kuambiwa kwa maneno wakati wa kurudi kwa chanjo ijayo.

**Ubahatishaji wa wataokaoshiriki:** Utafiti huu utahusisha kutathmini mipango miwili ambayo tunatumai inaweza saidia kupunguza kuachwa kwa chanjo za watoto hapa nchini. Kufikia lengo hili, vituo vya afya vitakavyoshiriki vimegawanywa mara mbili baina ya kundi lenye mipango hii miwili na kundi lingine lisilo na mpango wowote. Wewe utashirikishwa kwenye kituo cha afya na utakuwa kwenye mpango ulochaguliwa kwa kituo hicho.

**Mipango:** utafiti huu utahusisha mipango mitatu yaani Ujumbe mfupi (SMS), vibandiko vya ukumbusho na kundi ambalo halitakuwa na mpango wowote lakini watataambiwa kwa mdomo tu kuhusu tarehe ya chanjo ya pili baadaya ya mwanzo wa utafiti na pia tarehe hii itaandikwa kwa kijitabu cha kliniki(MCH Booklet)

**Kuwatafuta watakaocha chanjo:** Kwa sababu moja ama nyingine usipofika kwa chanjo ya pili baada ya hii ya leo tutakupigia simu amd tukutembelee nyumbani ili tafahamu sababu yako ya kutofika hapa kwa chanjo. Tutakupa nafasi nyingine ya kumpa chanjo motto wako.

**Hatari na Usumbufu wa kujihusisha kwa utafiti:**Hakuna hatari ama usumbufu wowote kwenye utafiti huu kwani tunauliza maswali tu.

**Faida ya kushiriki:** Matokeo ya utafiti huu yatasaidia serikali kuchagua ule mpango bora wa kuwakumbusha wazazi kuhusu chanjo ya watoto wao na kuongeza wanaopata chanjo ili kuwakinga watoto dhidi ya magonjwa yanayozuiwa na chanjo.

**Malipo:** hakutakuwa na malipo yeyote kwa kushiriki katika utafiti huu

**Usiri:** Bila idhini yako, hakuna habari itakayodhihirisha majina ya motto wako yatachapishwa. Kumbukumbu zitakazokuwa na habari kuhusu motto wako zitahifadhiwa vyema kwa kufungiwa na kufuli na mwishowe zitachomwa miaka mitano baada ya utafiti kufanyika.

**Kushiriki kwa hiari:** kushiriki kwako kwenye utafiti huu ni kwa hiari. Unaweza kuamua kutoshiriki na pia unaweza kujitoka kutoka kwa utafiti wakati wowote. Hutaadhibiwa kwa njia yoyote ukikataa kushiriki ama ukijitoka kwa utafiti)

#### **kuwasiliana**

- a) Kama una swali ama wasiwasi wowote kuhusu utafiti huu, tafadhali wasiliana nasi

**Mtafiti mkuu: Adam Hassan Haji SLP 13101-00400 Nairobi, Nambari ya Simu. 0722641655; parua pepe:hajiadam661@gmail.com.**

- b) Kama una maswali yoyote au wasiwasi juu ya haki zako kama mshiriki wa utafiti, tafadhali wasiliana **KNH / UON-kamati ya kuthmini maadili.Simu 2726300 ext.44102 au kwa njia ya posta katika S.L.P 19676-00202.parua pepe: [uonknh\\_erc@uonbi.ac.k](mailto:uonknh_erc@uonbi.ac.k)**

**Ridhaa**

Nimesoma ama nimesomewa habari hii. Nimepewa nafasi ya kuuliza maswali kuhusu utafiti na maswali niliyouliza yamejibiwa na nimeridhika. Nakubali(Natoa idhini) kwa hiari kuwa motto wangu ashiriki kwenye utafiti huu)

**Jina la mshirika**\_\_\_\_\_

**Jina la mzazi ama mlezi)**\_\_\_\_\_

**Sahihi ya mzazi ama mlezi)** \_\_\_\_\_ **Tarehe**\_\_\_\_\_

**Jina ya mwenye kupata ridhaa**\_\_\_\_\_

**Sahihi**\_\_\_\_\_ **Tarehe**\_\_\_\_\_

### Appendix 3: Questionnaire

**Study Title:** Evaluating SMS and Sticker Reminders for Reducing Dropout Rates in Routine Immunization in Selected Districts in Kenya 2013

#### 3.1: SMS Strategy Questionnaire

##### SECTION A: PERSONAL IDENTIFIYERS

Questionnaire no:

Child's unique no:

Today's Date (dd/mm/yy) \_\_\_\_\_

1. District code \_\_\_\_\_
2. Immunizing Facility code no \_\_\_\_\_
3. Interviewer's name \_\_\_\_\_
4. Relation to child:  Mother  father  aunt  Nanny   
Friend/Neighbor  others  
specify \_\_\_\_\_
5. Whose mobile number is this?  Mine  Family member   
Neighbor/friend

##### SECTION B: HOUSEHOLD

*Now I would like to ask you a few questions about your background*

6. Number of children < 5 years old living in the household
7. caretaker's Employment  unemployed  Employed works outside home
8. caretaker's Age in year

9. caretaker's level of education: None  Primary  Secondary   
Tertiary  I don't know
10. Care taker's marital status:  Single  Married Separated   
Divorced  Widowed
11. Mother's religion:  Catholic  Protestant  Muslim   
Hindu   
other(specify)\_\_\_\_\_

**SECTION C: CHILD**

Date of birth of child(dd/mm/yy)

12. Age of child:  weeks

13. Sex : Male  Female

14. Birth order of the Child

15. Did the mother attend ANC during pregnancy? Yes No

16. Where was the child born  
Home GOK facility private Health Facility  others  
specify\_\_\_\_\_

**SECTION D: Vaccination**

17. How far did you travel today to reach this health facility?

<5km  6-10km  >10km

18. How long did it take you from the time you left the house to when you arrived at the health facility?  <10 min  11-30 min  31-60 min  >60min
19. What means did you use to reach the facility  
 Walking  private vehicle  public transport   
others (specify) \_\_\_\_\_
20. Did you pay for transport?  Yes  No
21. If yes how much did you pay?
22. What is your main source of information on routine immunization  
 Neighbours  Health workers  Radio  TV  Religious leaders  
 others (specify) \_\_\_\_\_
23. Have you heard any announcement about routine immunization on television?  
 Yes  No
24. Have you heard any announcement on routine immunization on a radio?  
 Yes  No
25. Do you believe vaccinations are beneficial to your children?  Yes  
 No
26. Do you believe vaccinations can cause harm to your children?  Yes  
 No



**SECTION E: Vaccination visits**

**Visit 1:**

27. Date of visit.(dd/mm/yy)

28. How long did it take from the time you arrived at the health facility to when the child received the vaccine?  <10mi  10-30min  31-60min  
 >60min

29. Vaccines received today?  BCG  Penta 1  OPV1  PCV1

30. Date of next vaccine (dd/mm/yy)

**Visit 2:**

31. Date of visit (dd/mm/yy)

32. How long did it take from the time you arrived at the health facility to when the child received the vaccine?  <10min  10-30min  31-60m  
 >60min

33. Vaccines received today?  BCG  Penta 2  OPV2  PCV2

34. Date of next vaccine (dd/mm/yy)

35. Did you receive a text message alerting you to bring your child for vaccinations?  Yes  No

36. If No why did you return\_\_\_\_\_

37. Is your mobile phone number current?  Yes  No

If no what is your current phone number

***If the child comes 2 weeks after scheduled date for penta 2 answer Q41***

38. What is/are the reason(s) for your child missing the immunization date as scheduled(*tick as appropriate*)

- Child sick
- Child ill-brought but not given vaccination
- Vaccine not available
- I forgot
- I didn't have money for transport
- I took child to another facility
- I travelled out of town
- Child was vaccinated but not documented
- Child died
- Others specify

**Visit 3**

39. Date of visit            (*dd/mm/yy*)   

40. How long did it take from the time you arrived at the health facility to when the child received the vaccine?     <10min     10-30min     31-60m  
 >60min

41. Vaccines received today?     BCG     penta 3     OPV3     PCV3

42. Did you receive a text message alerting you to bring your child for vaccinations?

Yes

No

43. If No why did they return\_\_\_\_\_

44. Is your mobile phone number current?  Yes

No

If no what is your current number

***If the child comes 2 weeks after scheduled date for penta 3 answer Q48***

45. What is/are the reason(s) for your child missing the immunization date as scheduled(*tick as appropriate*)

Child sick

Child ill-brought but not given vaccination

Vaccine not available

I forgot

I didn't have money for transport

I took child to another facility

I travelled out of town

Child was vaccinated but not documented

Child died

Others spec

***End of interview thank the respondent***

### 3.2: Sticker Strategy Questionnaire

#### SECTION A: PERSONAL IDENTIFIYERS

Questionnaire no:  Child's unique no:

Today's Date (dd/mm/yy) \_\_\_\_\_

1. District code \_\_\_\_\_
2. Immunizing Facility code no \_\_\_\_\_
3. Interviewer's name \_\_\_\_\_
4. Relation to child:  Mother  Father  Aunt  Nanny   
Friend/Neighbor  others  
specify \_\_\_\_\_
5. Whose mobile number is this?  Mine  Family member   
Neighbor/friend

#### SECTION B: Household

6. Number of children < 5 years old living in the household
7. caretaker's Employment?  unemployed  employed works outside home
8. caretaker's Age in year
9. caretaker's level of education :  None  Primary  Secondary   
Tertiary  I don't know
10. caretker's marital status:  Single  Married  Separated   
Divorced  widowed

11. Caretaker's religion : catholic  protestant  Muslim  Hindu   
other(specify)\_\_\_\_\_

### SECTION C: CHILD

Date of birth of child (dd/mm/yy)

12. Age of child:  weeks

13. Sex :  Male  Female

14. Birth order of the Child

15. Did the mother attend ANC during pregnancy?  Yes  No

16. Where was the child born?

Home  GOK facility  private Health Facility  others

specify\_\_\_\_\_

### SECTION D: Vaccination

17. How far did you travel today to reach this health facility?

<5km  6-10km  >10km

18. How long did it take you from the time you left the house to when you arrived

at the health facility?  <10 min  11-30 min  31-60 min

>60min

19. What means did you use to reach the facility

Walked to facility  private vehicle  public transport  others(specify)

\_\_\_\_\_

20. Did you pay for transport?  Yes  No

21. If yes how much did you pay?

22. What is your main source of information on routine immunization

Neighbours  Health workers  Radio  TV  Religious  
leaders  Others (specify) \_\_\_\_\_

23. Have you heard any announcement about routine immunization on television?

Yes  No

24. Have you heard any announcement on routine immunization on a radio?

Yes  No

25. Do you believe vaccinations are beneficial to your children?  Yes

No

26. Do you believe vaccinations can cause harm to your children?  Yes

No

### **SECTION E: Vaccination visits**

#### **Visit 1:**

27. Date of visit.(dd/mm/yy)

28. How long did it take from the time you arrived at the health facility to when the child received the vaccine?  <10min  10-30min  31-60min  >60min

29. Vaccines received today?  BCG  Penta 1  OPV1  PCV1

30. Date of next vaccine (*dd/mm/yy*)

**Visit 2:**

31. Date of visit (*dd/mm/yy*)

32. How long did it take from the time you arrived at the health facility to when the child received the vaccine?  <10min  10-30min  31-60min  >60min

33. Vaccines received today?  BCG  Penta 2  OPV2  PCV2

34. Date of next vaccine (*dd/mm/yy*)

35. Where did you place the sticker?  inside the house door  outside the house door  others specify\_\_\_\_\_

36. Did the sticker help you to remember when to come back for immunization  Yes  No

37. If no why did you return\_\_\_\_\_

***If the child comes 2 weeks after scheduled date for penta 2 answer Q38***

38. What is/are the reason(s) for your child missing the immunization date as scheduled(*tick as appropriate*)

- Child sick
- Child ill-brought but not given vaccination
- Vaccine not available
- I forgot
- I didn't have money for transport
- I took child to another facility
- I travelled out of town
- Child was vaccinated but not documented
- Child died
- Others specify

**Visit 3**

39. Date of visit (*dd/mm/yy*)

40. How long did it take from the time you arrived at the health facility to when the child received the vaccine?  <10min     10-30min     31-60min  
 >60min

41. Vaccines received today?  BCG     penta 3     OPV3     PCV3

42. Did the sticker help you to remember when to come back for immunization  
 Yes                                   No

43. If no why did you return \_\_\_\_\_



***If the child comes 2 weeks after scheduled date for penta 2 answer Q44***

44. What is/are the reason(s) for your child missing the immunization date as scheduled(*tick as appropriate*)

- Child sick
- Child ill-brought but not given vaccination
- Vaccine not available
- I forgot
- I didn't have money for transport
- I took child to another facility
- I travelled out of town
- Child was vaccinated but not documented
- Child died
- Others specify

***End of interview thank the respondent***

**Study Title:** Evaluating SMS and Sticker Reminders for Reducing Dropout Rates in Routine Immunization in Selected Districts in Kenya 2013

3.3: Control Group questionnaire

**SECTION A: PERSONAL IDENTIFIYERS**

Questionnaire no:

Child's unique id:

Today's Date (dd/mm/yy) \_\_\_\_\_

1. District code no \_\_\_\_\_
2. Immunizing Facility code \_\_\_\_\_
3. Interviewer's name \_\_\_\_\_
4. Relation to child:  Mother  Father  Aunt  Nanny   
Friend/Neighbor  others  
specify \_\_\_\_\_
5. Whose mobile number is this?  Mine  Family member   
Neighbor/friend

**SECTION B: Household**

6. Number of children < 5 years old living in the household
7. caretaker's Employment?  unemployed  employed works outside home
8. caretaker's Age in year
9. Caretaker's level of education :  None  Primary  Secondary   
Tertiary  I don't know

10. Caretakers's marital status: Single Married  Separated   
Divorced widowed

11. Mother's religion: catholic  protestant  Muslim  Hind   
other(specify)\_\_\_\_\_

### SECTION C: CHILD

Date of birth of child (dd/mm/yy)

12. Age of child:  weeks

13. Sex: Male Female

14. Birth order of the Child

15. Did the mother attend ANC during pregnancy? Yes  No

16. Where was the child born?

Home GOK facility private Health Facility others

specify\_\_\_\_\_

### SECTION D: Vaccination

17. How far did you travel today to reach this health facility?

<5km  6-10km >10km

18. How long did it take you from the time you left the house to when you arrived

at the health facility? <10 min 11-30 min 31-60 min

>60min

19. What means did you use to reach the facility

Walked to facility  private vehicle  public transport  others (specify)

\_\_\_\_\_

20. Did you pay for transport?  Yes  No

21. If yes how much did you pay?

22. What is your main source of information on routine immunization

Neighbours  Health workers  Radio  TV  Religious

leaders  Others (specify

23. Have you heard any announcement about routine immunization on television?

Yes  No

24. Have you heard any announcement on routine immunization on a radio?

Yes  No

25. Do you believe vaccinations are beneficial to your children?  Yes

No

26. Do you believe vaccinations can cause harm to your children?  Yes

No

### **SECTION E: Vaccination visits**

#### **Visit 1:**

27. Date of visit.(dd/mm/yy)

28. How long did it take from the time you arrived at the health facility to when

the child received the vaccine?  <10min  10-30min  31-60min

>60min

29. Vaccines received today? BCG Penta 1  OPV1 PCV1

30. Date of next vaccine (*dd/mm/yy*)

**Visit 2:**

31. Date of visit (*dd/mm/yy*)

32. How long did it take from the time you arrived at the health facility to when the child received the vaccine?  <10min  10-30min  31-60min  >60min

33. Vaccines received today? BCG Penta 2  OPV2 PCV2

34. Date of next vaccine (*dd/mm/yy*)

***If child comes 2 weeks after scheduled date for penta 2 answer Q37***

35. What is/are the reason(s) for your child missing the immunization date as scheduled(*tick as appropriate*)

- Child sick
- Child ill-brought but not given vaccination
- Vaccine not available
- I forgot
- I didn't have money for transport
- I took child to another facility
- Child was vaccinated but not documented
- Child died
- Others specify

**Visit 3**

36. Date of visit (dd/mm )

37. How long did it take from the time you arrived at the health facility to when the child received the vaccine?  <10min  10-30min  31-60min  >60min

38. Vaccines received today?  BCG  penta 3  OPV3  PCV3

*If the child comes 2 weeks after scheduled date for penta 3 answer Q41*

39. What is/are the reason(s) for your child missing the immunization date as scheduled (*tick as appropriate*)

- Child sick
- Child ill-brought but not given vaccination
- Vaccine not available
- I forgot
- I didn't have money for transport
- I took child to another facility
- I travelled out of town
- Child was vaccinated but not documented
- Child died
- Others specify

*End of interview thank the respondent*

### 3.4: Tracing Tool

**Study Title:** Evaluating SMS and Sticker Reminders for Reducing Dropout Rates in Routine Immunization in Selected Districts in Kenya 2013

District code.....Facility code.....Childs unique no.....

Strategy

- a) SMS
- b) STICKER
- c) CONTROL

Date child was due vaccination\_\_\_\_\_

Date traced\_\_\_\_\_

1. Tracing method

- a) Phone call
- b) Home visit
- c) Others specify

What is the main reason for your child missing vaccination?  Child sick

Child ill-brought but not given vaccination

Vaccine not available

I forgot

I didn't have money for transport

I took child to another facility

I travelled out of town

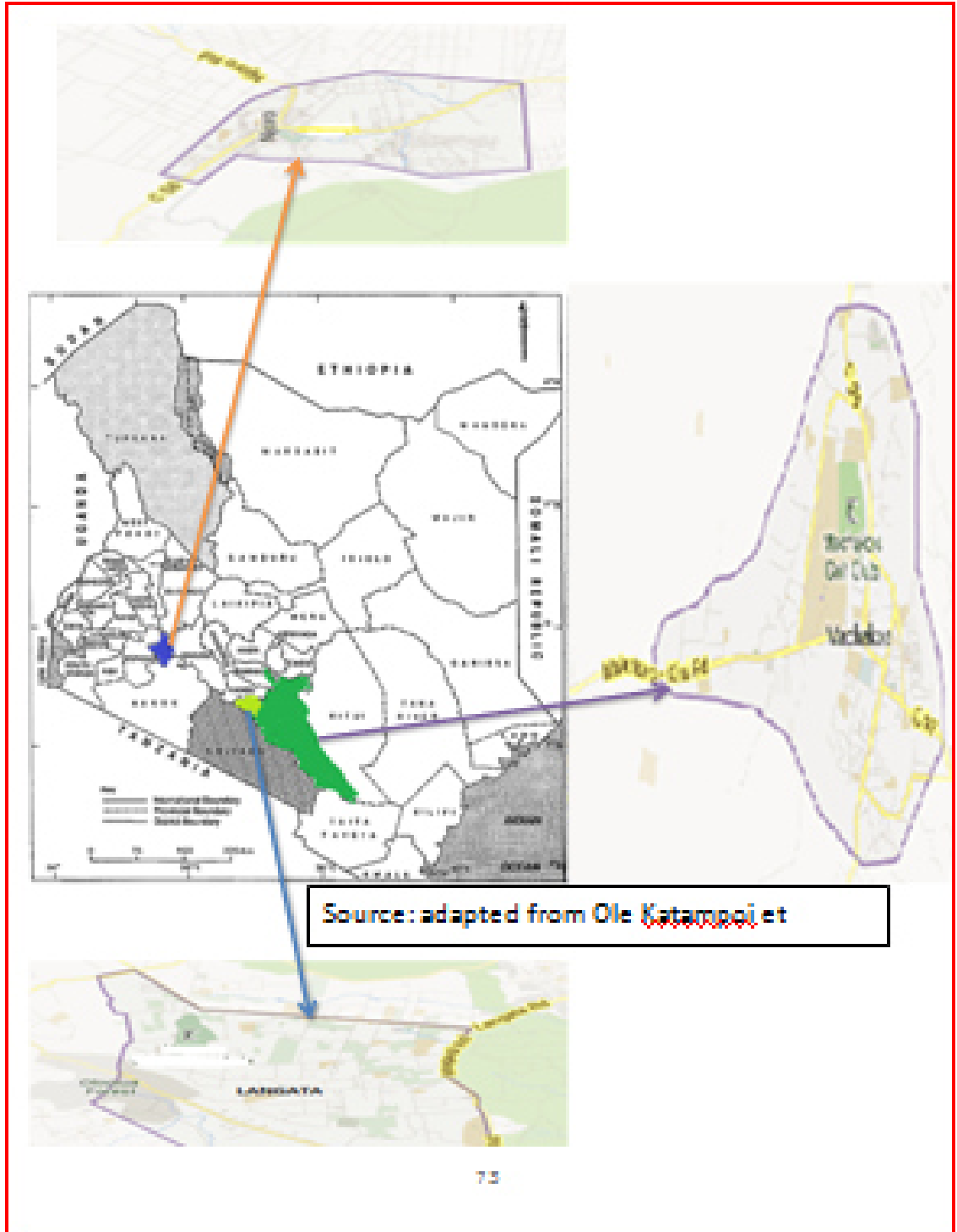
Child was vaccinated but not documented

Child died

Others specify

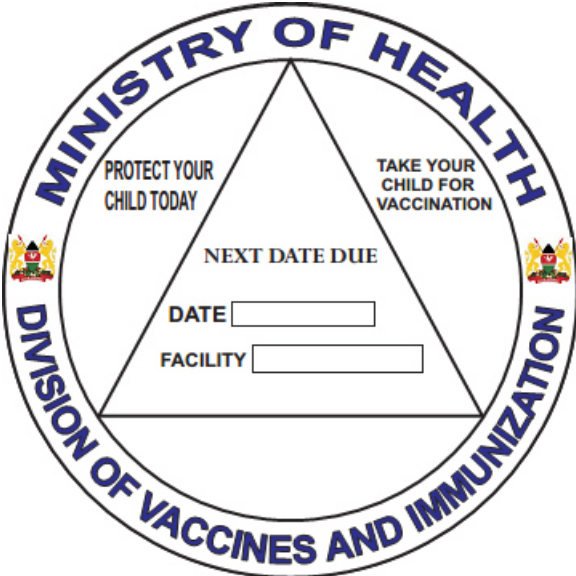
Traced by: \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

**Appendix 4: Map of Kenya showing Study Sites**



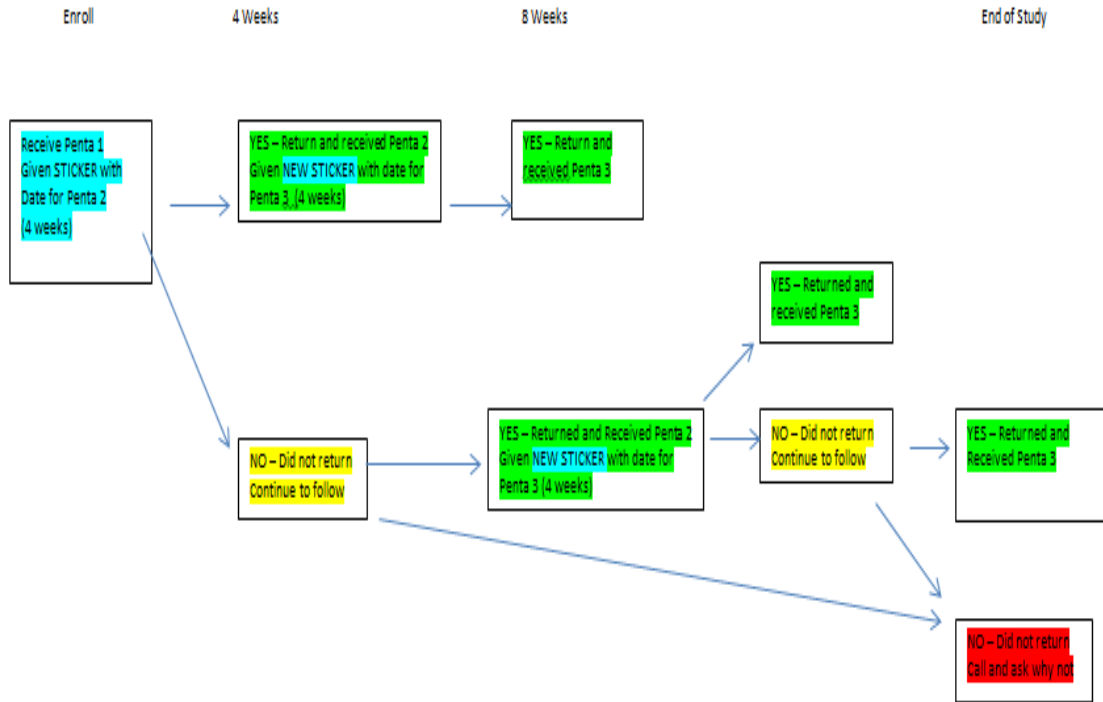


**Appendix 5: Sticker**



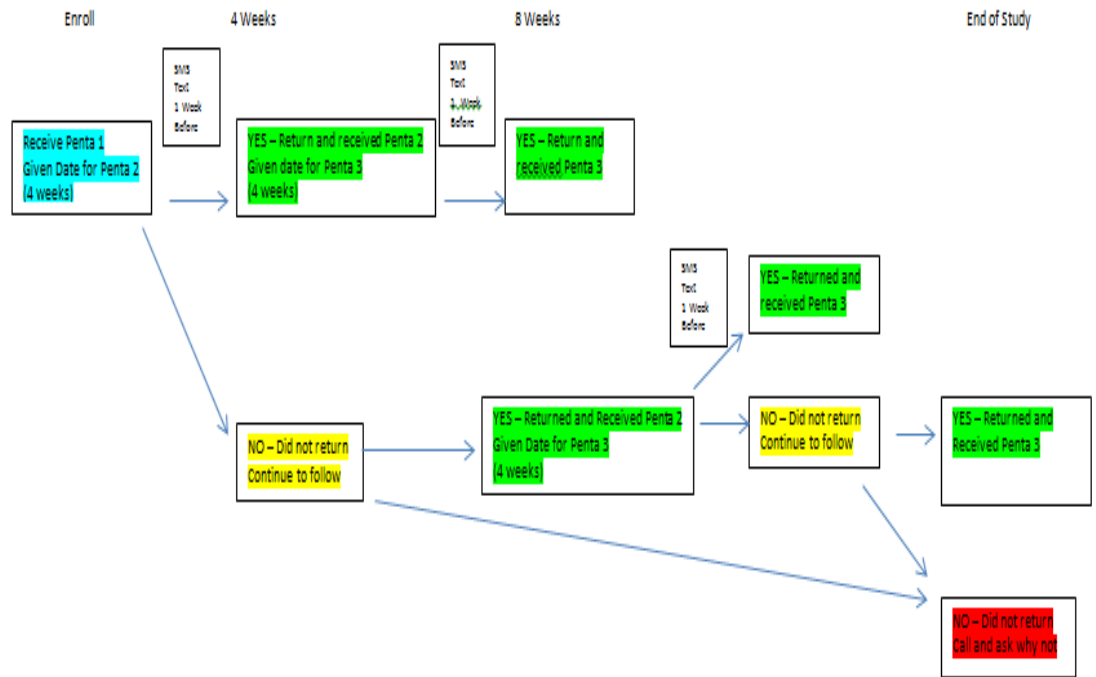
## Appendix 6: Sticker ARM

Figure 3.1: Shows how participants in the sticker strategy were followed up



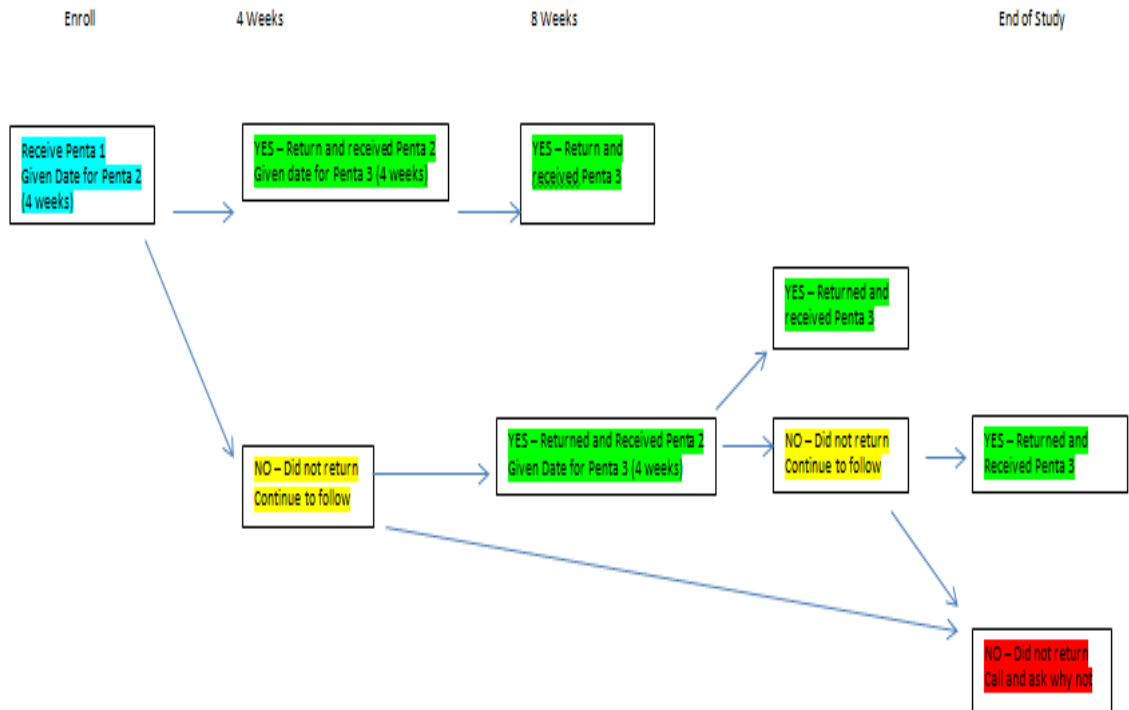
## Appendix 7: SMS ARM

Figure 3.2: Shows how participants in the control strategy were followed up



## Appendix 8: Control Arm

Figure 3.3: Shows how participants in the SMS strategy were followed up



### Appendix 9: Kenya Drop-Out Study -- Sample size

To calculate the sample sizes needed to detect a difference between two binomial probabilities with specified significance level and power

**One sided test:**  $H_0 : P_1 = P_2$  versus  $H_a = P_1 < P_2$

Variables	Descriptions
$\alpha$	Significance level assume 0.05
1- $\beta$	Power of the test assume 0.80
$P_1$	Success proportion in arm 1
$P_2$	Success proportion in arm 2
R	Ratio of arm 2 to arm 1
N	Sample size
Expected Drop-Out Rate Decline	0.15

Expected Drop-out Rate decline = 0.15

Sample size							
P1 initial	0.10	0.13	.15	<b>0.156</b>	.20	.25	.30
.15 decline	.015	.0195	.0225	<b>0.234</b>	.03	.0375	.045
P2 expected	.085	.1105	.1275	<b>0.1326</b>	.17	.2125	.255
n – assume r=1 (same sample size $P_1$ & $P_2$ )	608	456	389	<b>372</b>	280	213	170

\* Assumes 15% loss in sample size between Penta 1 and Penta 3



**Formula:**

Define  $z_p$  be the upper 100(1-p) percentile of the standard normal distribution,  
 $m$  be the required sample size from the first population,  
 $rm$  be the required sample size from the second population,  $0 < r < \infty$

$$\delta = |P_2 - P_1|, \bar{P} = \frac{P_1 + rP_2}{r+1} \text{ and } \bar{Q} = 1 - \bar{P}$$

$$m = \frac{m'}{4} \left[ 1 + \sqrt{1 + \frac{2(r+1)}{rm'\delta}} \right]^2 \quad (*)$$

$$\text{where } m' = \frac{\left[ z_\alpha \sqrt{(r+1)\bar{P}\bar{Q}} + z_\beta \sqrt{(rP_1Q_1 + P_2Q_2)} \right]^2}{r\delta^2}$$

$$N = (r+1)m$$

Note: (\*) is corrected with continuity.

**Notations:**

- $\alpha$ :** The probability of type I error (significance level) is the *probability of rejecting the true null hypothesis*.
- $\beta$ :** The probability of type II error (1 – power of the test) is the *probability of not rejecting the false null hypothesis*.

**Reference:**

1. Casagrande, Pike and Smith (1978) *Biometrics* 34: 483-486
2. Fleiss, Tytun and Ury (1980) *Biometrics* 36: 343-346

**Appendix 10: control form**

# Vaccination dropout evaluation study

## Control form

Intervention Arm \_\_\_\_\_ Facility code: \_\_\_\_\_ Nurse Name \_\_\_\_\_

S/NO	UNIQUE NO.	CHILD'S NAME	Mother/care's name	Telephone No	DATE OF ENROLLMENT(P1)	NEXT REETURN DATE(P2)	DATE GIVEN P2	RETURN DATE P3	DATE P3 GIVEN

## Appendix 11: ERC Clearance



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KENYATTA NATIONAL HOSPITAL  
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Fax: 720 272  
Telegrams: NKH018 P, Nairobi

Ref: KNH-ERC/A/15      Link: [www.uonbi.ac.ke/activities/KNHUoN](http://www.uonbi.ac.ke/activities/KNHUoN)

Adam Hassan Haji  
TK012-2014/2012  
JGUAT

Dear Adam



**RESEARCH PROPOSAL: EVALUATING SMS AND STICKER REMINDERS FOR REDUCING DROPOUT RATES IN ROUTINE IMMUNIZATION IN SELECTED DISTRICTS IN KENYA 2013 (P/2013/2012)**

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 24<sup>th</sup> January 2014 to 23<sup>rd</sup> January 2015.

This approval is subject to compliance with the following requirements:

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

For more details consult the KNH/UoN-ERC website [www.uonbi.ac.ke/activities/KNHUoN](http://www.uonbi.ac.ke/activities/KNHUoN).

Yours sincerely

  
PROF. M. L. CHINDIA  
SECRETARY, KNH/UoN-ERC

c.c. Prof. A.N. Guantai, Chairperson, KNH/UoN-ERC  
The Deputy Director CS, KNH  
The Principal, College of Health Sciences, UoN  
Assistant Director/Health Information, KNH  
Supervisors: Prof. Zipporah Ng'ang'a, Dr. Wences Arvelo



## Appendix 12: List of Districts and facilities

Districts	County
1. Igembe South	Meru
2. Machakos**	Machakos
3. Langata**	Nairobi
4. Njoro**	
5. Kisauni	Mombasa
6. Ndhiwa	Homabay

**\*\*Selected districts for study**

### LIST FACILITIES

	<b>NJORO DISTRICT</b>	<b>Langata District</b>	<b>Machakos District</b>
1.	Kianjoya Disp	7KR H/C	Machakos General hospital **
2.	Kihiyo Disp	KAREN H/C **	HOLA H/C
3.	Lare H/C	KIBERA COMM H/C	MUTUTUI DISP **
4.	Likia Disp	KIBERA D.O DISP	MUUMANDU
5.	Mau Narok H/C **	LANGATA H/C **	MUA HILL H/C
6.	Mette Disp	LANGATA HOSP	MUVUTI DISP
7.	Neisut Disp **	ST MARY MISSION	KALAMA DISP
8.	Njoro H/C **	kibera MSF disp **	Bishop kioko **
9.	Teret Disp		
10.	Tueigotich Disp		
11.	Pwani Gok Disp		
12.	Huruma Disp		
13.	Njoro Pcea Dsip		

**\*\* Selected Health facilities**

## Appendix 13: Published Manuscript

### Reducing routine vaccination dropout rates: evaluating two interventions in three Kenyan districts, 2014

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4. Division for Global Health Protection, US Centers of Disease Control, and Prevention, Atlanta
5. Division of Vaccines and Immunization, Kenya Ministry of Health, Nairobi, Kenya

#### Abstract

**Background:** Globally, vaccine preventable diseases are responsible for nearly 20% of deaths annually among children <5 years old. Worldwide, many children dropout from the vaccination program, are vaccinated late, or incompletely vaccinated. We evaluated the impact of text messaging and sticker reminders to reduce dropouts from the vaccination program.

**Methods:** The evaluation was conducted in three selected districts in Kenya: Machakos, Langata and Njoro. Three health facilities were selected in each district, and randomly allocated to send text messages or provide stickers reminding parents to bring their children for second and third dose of pentavalent vaccine, or to the control group (routine reminder) with next appointment date indicated on the well-child booklet. Children aged <12 months presenting for their first dose of pentavalent vaccine were enrolled. A dropout was defined as not returning for vaccination  $\geq 2$  weeks after

scheduled date for third dose of pentavalent vaccine. We calculated dropout rate as a percentage of the difference between first and third pentavalent dose.

**Results:** We enrolled 1,116 children; 372 in each intervention and 372 controls between February and October 2014. Median age was 45 days old (range: 31-99 days), and 574 (51%) were male. There were 136 (12%) dropouts. Thirteen (4%) children dropped out among those who received text messages, 60 (16%) among who received sticker reminders, and 63 (17%) among the controls. Having a caregiver with below secondary education [Odds Ratio (OR) 1.8, 95% Confidence Interval (CI) 1.1-3.2], and residing >5km from health facility (OR 1.6, CI 1.0-2.7) were associated with higher odds of dropping out. Those who received text messages were less likely to drop out compared to controls (OR 0.2, CI 0.04-0.8). There was no statistical difference between those who received stickers and controls (OR 0.9, CI 0.5-1.6).

**Conclusion:** Text message reminders can reduce vaccination dropout rates in Kenya. We recommend the extended implementation of text message reminders in routine vaccination

## **Introduction**

Globally, vaccine preventable diseases are responsible for nearly 20% of the 8.8 million deaths annually among children under five years of age (1). Despite documented benefits that vaccines are efficient and cost-effective interventions for improving child survival, children in many parts of the world, particularly in Sub-Saharan Africa, are either vaccinated late or unvaccinated all together (2,3). In Kenya, coverage for the third dose of pentavalent, a combined routine childhood vaccine against diphtheria, pertussis, and tetanus, has increased at the national level from 63% in 2000 to 84% in 2013 (4). Despite improvements of national coverage, many districts in Kenya continue to report low vaccination coverage. In 2013, only 45% of the districts attained  $\geq 80\%$  coverage for the third dose of pentavalent vaccine (4). Additionally, vaccination dropout rates still remain high with over 27% of Kenyan districts reporting dropout rates between 10%-

33% for the third dose of pentavalent vaccine in 2011 (5). Low vaccination coverage is associated with outbreaks of vaccine preventable diseases.

Several interventions have been used to reduce dropout rates for vaccinations among children. Sticker reminders with recommended return dates for vaccination placed strategically within the home have been shown to reduce vaccination dropouts in Ethiopia (6). Postcards, automated telephone or mail reminders and outreach services have also been documented to improve vaccination coverage (7). Mobile phones are increasingly being used for health applications (8–12), such as improving vaccination coverage (13,14), promoting adherence to drug treatments for chronic diseases (15,16), increasing uptake of screening tests (17–20), improving clinical appointment attendance (21,22) and providing training health workers in malaria treatment (23). Short message services (SMSs) through mobile phones have been successfully used to reduce dropout for vaccination services in Zimbabwe (24).

There has been limited research in Kenya comparing use of SMS or sticker reminders to improve vaccination coverage and reduce vaccination dropouts. One study conducted in Western Kenya with a small sample size showed significant benefits of SMS for reducing dropouts, but results may have been biased by monetary compensation of participants (25). Evidence is needed to corroborate the effectiveness of SMS or sticker reminders in routine vaccination programs throughout the country. We evaluated the impact of SMS and sticker reminders to reduce dropout rates for routine childhood vaccinations, and determined factors associated with missed vaccination in selected districts in Kenya.

## **Methods**

### **Study Sites**

We conducted an evaluation study in three selected districts in Kenya. District selection was based on pentavalent vaccine coverage for 2012. Districts with more than 10%

dropout rates for the third pentavalent dose, which is considered above acceptable limits in the expanded programme on immunization, were considered for inclusion in the study. In 2012, 34 districts with dropout rates more than 10% were identified. Among these, districts with very high coverage rates (third dose pentavalent coverage  $\geq 90\%$ ) were excluded, as were districts that were geographically hard-to-reach or with security concerns. Six districts with dropout rates ranging from 13-27% with both rural and urban settings were identified, and subjected to simple random sampling to select three districts. These districts included Machakos, Langata and Njoro (Figure 1).

Machakos District is in Machakos County, had a projected population of 211,404 from 2009 census (26) and 13,271 live births in 2012. In 2012 the district achieved coverage of 88% for the first dose of pentavalent, 79% for the third dose, and 76% full vaccination coverage. The dropout rate among children for the third dose of pentavalent vaccine was 13%. Langata district is in Nairobi County, had a projected population of 397,238 from 2009 census (26) and 12,402 live births in 2012. In 2012 the district achieved coverage of 96% for the first dose of pentavalent, 84% for the third dose, and 82% full vaccination coverage. The dropout rate among children for the third dose of pentavalent vaccine was 13%. Njoro district is in Nakuru county, had an estimated population 100,000, and 7,904 (26) live births. In 2012, the district achieved coverage of 86% for the first dose of pentavalent, 75% for the third dose, and 74% full vaccination coverage. The dropout rate among children for the third dose of pentavalent vaccine was 13%.

### **Study population**

Children <12 months of age who were brought to the selected vaccinating health facilities in the three districts for their first dose of pentavalent vaccine were recruited on a first come basis until the strategy-level target sample sizes was reached. Children whose mothers did not have a telephone number were excluded from the study. Dropout was defined as any child who failed to return for the third dose of pentavalent vaccine two weeks or more after the scheduled date.

## **Evaluation**

We selected three health facilities in each district, and randomly allocated each facility to one of the two interventions to provide short text messages or stickers reminding caretakers to return for second and third dose of pentavalent vaccines, or to serve as the control group, receiving no extra reminder messages and continue providing the next appointment date in the well-child booklet. Participants were conveniently enrolled in the selected health facilities until the strategy-level target sample sizes were reached.

Caretakers of participants in the SMS intervention group received two text reminders via SMS. Reminders were dispatched from an automated web based system two days before and on the day of the scheduled vaccination due date for the second and third dose of pentavalent vaccine. The first message reminded the parent of the next due date for the vaccination and which health facility to attend for vaccination. The second message reminded the caretakers that the actual due date was that day. The text messages were sent in Kiswahili and English. The sticker intervention group received two stickers at the time of enrollment which noted the day of the scheduled vaccination due date and the name of the health facility (Figure 2). Caretakers were instructed to place one sticker on the child's health booklet, and the other sticker in a visible area of the main household or within the bedroom. Placement of the sticker within the home was verified during subsequent visits by asking the parent where they placed the sticker. The control group received no reminders, but the scheduled vaccination due date was indicated on the child's health booklet as per routine procedures. All the groups received routine health education and advice on vaccination. Any caretaker who failed to return the child for vaccinations two weeks or more after the expected completion of third pentavalent dose was contacted by the investigator to establish reasons for missed vaccinations.

### **Data collection and analysis**

Data were collected by study nurse and principal investigator during routine working hours at the maternal child health clinic on a daily basis. Caretakers were interviewed face to face using a pretested standard questionnaire. The questionnaire collected information on socio-demographic, knowledge and source of information on vaccination, and recorded details of vaccines received during each visit.

Data were entered and analyzed using Epi info software. The primary outcome measure was receipt of scheduled vaccines at 10 and 14 weeks. The secondary outcome measures were dropout in vaccination and factors associated with missed vaccinations. We conducted data analysis using Epi Info version 7.1.4 and excel analysis software. Proportions and means were calculated for categorical and continuous variables respectively and summarized into tables and figures for univariate analysis. Bivariate and Multivariate analysis using unconditional logistic regression using facility clusters were conducted to identify independent predictors of missed vaccinations. Odds and Adjusted Odds Ratio (OR & AOR) and 95% Confidence Interval (CI) were used to estimate the strength of association between independent variables and the dependent variable. The threshold for statistical significance was set at  $p < 0.05$ . We calculated dropout rate as a percentage of the difference between first and third pentavalent dose.

Sample size calculation was done using Casagrande *et al* 1978 (27) formula for comparing two proportions to detect a 15% decrease in the drop-out vaccination rate for each of the three intervention groups, assuming a dropout rate for the third dose of pentavalent of 15.6% (28), study power of 80%, and confidence level of 95%. The minimum sample size was 372 participants per intervention arm.

## **Ethical considerations**

Written informed consent was obtained from caregivers of eligible children before enrolment. The study protocol was reviewed and approved by Kenyatta National Hospital/University of Nairobi Ethical Review Committee. Confidentiality of records was maintained constantly under lock and key system and will be destroyed five years after data collection is completed. **Results**

We enrolled 1,116 children; 372 in each intervention group and 372 controls between February and October 2014. The median age of children was 45 days (range: 31-99 days), and 574 (51%) were males. The mean age of caretakers was 26 years (14-45), 856 (77 %) were unemployed, and 549 (49%) had attained up to primary level education. There were no statistical differences in demographic characteristics among caretakers and children enrolled in each of the three groups (Table 1).

In the SMS intervention group, at 10 weeks of age 365 (98%) children had received their second dose of pentavalent vaccine. At 14 weeks of age, 359 (96%) had received their third dose of pentavalent vaccine ( $p=0.4$ ). In the sticker intervention group at 10 weeks of age, 334 (90%) children had received their second dose of pentavalent vaccine. At 14 weeks of age 312 (84%) had received their third dose of pentavalent vaccine ( $p=0.02$ ). In the control group at 10 weeks of age, 340 (91%) children had received their second dose of pentavalent vaccine. At 14 weeks of age, 309 (83%) of children had received their third dose of pentavalent vaccine ( $p\leq 0.001$ ) (Figure 3). There was a significant increase in dropouts between second and third dose of pentavalent vaccine in the control and sticker intervention groups, but no significant increase in dropouts in the SMS intervention group. At 10 weeks, the risk difference for those who received SMS reminders and the control group was seven percent (95% CI: 0.3-14). At 14 weeks, the risk difference for those who received SMS reminders and the control group was 13% (95% CI: 5.6-21.26). The mean delay in receiving second dose of pentavalent vaccine on the scheduled date in the SMS intervention group was 0 days (standard deviation



(SD): 1.2), in the control group the mean delay was one day (SD: 4.3), while in the sticker group, the mean delay was one day (SD: 6.3). There was a significant difference in the mean delay in days between the SMS and Control group ( $p < 0.001$ ), but no significant difference in delay between the control and sticker group ( $p = 0.5$ ). The mean delay in receiving the third pentavalent dose on the scheduled date in the SMS intervention group was 0 days (SD: 2), in the control group, two days (SD: 7) and in the sticker group, two days (SD 6). There was a significant difference in the mean delay in days between the SMS and Control group ( $p < 0.001$ ), but no significant difference in mean delays in days between the control and sticker group ( $p = 1$ ).

A total of 1,488 messages were sent to the participants in the SMS group, cost \$33.1 USD, and the premium cost of scheduling messages from web for six months cost \$66.7 USD giving a cost of \$0.27 USD per child for the project. Overall, among those children enrolled who received the first dose of pentavalent vaccine, 136 (12%) did not return for their third dose of pentavalent vaccine. Of these, 63 (17%) were from the control group compared to 13 (4%) from the SMS intervention group (OR 0.2, CI: 0.04-0.8), and 60 (16%) were from the sticker intervention group (OR: 0.94, CI: 0.53-1.6). We traced 110 (81%) caretakers to identify reasons for missed vaccination that included: child taken to another facility 39 (35%); travelled out of town 33 (30%); forgot 17 (15%); child was sick 16 (15%); or child died 2 (2%) (Figure 4).

On bivariate analysis, those who received SMS reminders (OR 0.2, CI 0.04-0.8) were 20% less likely to miss vaccinations. In contrast, an education level of primary and below (OR 1.9, CI 1.1-3.3), age of child at first pentavalent dose  $> 56$  days (OR 2.2, CI 1.3-3.1), residing a distance  $\geq 5$  km from facility (OR 1.6, CI :1.1-2.3), waiting time  $> 30$  minutes (OR 1.4, CI 1.0-2.1) were associated with higher odds of missed vaccinations. (Table 2).

In multivariate analysis, mothers with maternal education level of primary and below (OR 1.9, CI: 1.0-2.7), and residing  $> 5$  km from a health facility (OR 1.6, CI 1.1-3.1)

were more likely to dropout. In contrast, those who received SMS reminders were 10-40 % less likely to miss vaccinations in comparison to the control group (OR 0.2, CI: 0-0.8). (Table 3).

## **Discussion**

This evaluation with a large number of participants found that SMS reminders were effective in reducing dropouts for vaccinations in the selected districts in Kenya. The vaccination coverage was significantly higher among those receiving SMS reminder than those receiving routine reminders. About 13% of the children vaccinated in the SMS intervention group is attributed to SMS reminders who likely would not have been vaccinated if SMS reminders had not been used at 14 weeks. This finding is similar to a study conducted in Kadoma city in Zimbabwe (2013) that demonstrated high vaccination coverage among those who received SMS reminders (24). A systematic review of effects of all types of reminders including SMS found that patient reminder systems were effective in improving vaccination rates (29). Also studies conducted in low-income, minority populations in New York City found that SMS reminders improved coverage from 4% to 17%, depending on the vaccine (13). Thus our findings support the hypothesis that SMS is an effective reminder system for vaccination services.

We also found that there was no difference between the sticker reminders group and the control group. The vaccination coverage at 10 and 14 weeks were not statistically significant between the sticker reminder and the control group. A study done in Ethiopia in 1993 found stickers to be effective in reducing vaccination dropouts (6). However, , unlike our study, the control group in the Ethiopia study used a population that had been vaccinated during the previous year. Additionally, children whose mothers had below secondary level education and children residing >5 km from the health facility was

associated with being a drop-out. Similar findings were detected in previously conducted studies in Kenya (28,30–33). These data suggest that while efforts are needed to find effective methods for vaccination reminders, the access factors (distance from health facility) remain a challenge.

This study is subject to several limitations. If a caregiver took the child to another facility for second or third pentavalent dose, the system considered the child unvaccinated, leading to misclassification, however, a sensitivity analysis that assumed that these children were actually vaccinated had no effect on the general observed difference between the interventions. The results of this study may not be generalizable for the entire population in the country.

## **Conclusions**

Vaccination coverage was higher in the SMS intervention group than in the control group; this result was both statistically and clinically significant. The overall increase may be attributed to the use of SMS reminders in this study. The difference in coverage between the sticker intervention group and the control group was not statistically significant, and may be an indication of the ineffectiveness of sticker reminders.

We recommend the extended implementation of SMS reminders in routine vaccination services in Kenya.

## **Competing interests**

The authors declare that they have no competing interests.

## **Authors' contributions**

Adam H Haji developed the concept, conducted the study, performed the analysis, interpreted the results and drafted the manuscript. Arvello Wences, Ziporrah Ng'anga, Zeinab Gura, Sara Lowther, Hardeep Sandhu and Collins Tabu participated in revising the manuscript and providing important intellectual content. All authors have provided approval of the final manuscript

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Table 1: Univariate analysis of socio-demographic characteristics of mothers/child attending vaccination services in Machakos, Njoro and Langata districts in Kenya, 2014

Variable	SMS n (%)	Sticker n (%)	No intervention n (%)	p-value
<b>Sex</b>				
Female	181(49)	170(46)	191(51)	0.3
Male	191(51)	202(54)	181(49)	
<b>Child's age</b>				
≤42days	53(14)	53(14)	51(14)	0.95
43-49 days	265(71)	260(70)	269(72)	
50-56days	32(9)	40(11)	32(9)	
57-63days	9(2)	10(3)	11(3)	
≥64days	13(3)	9(2)	9(2)	
<b>Maternal age</b>				
≤20	66(18)	69(19)	47(13)	0.1
21-25 yrs	134(36)	151(41)	136(37)	
26-30	102(27)	85(23)	113(30)	
31-35	50(13)	42(11)	41(11)	
>35 yrs	20(5)	25(7)	35(9)	
<b>Maternal employment</b>				
Employed	90(24)	80(22)	101(27)	0.2
Unemployed	282(76)	292(78)	271(73)	
<b>Maternal education</b>				
N o formal education	1(0)	2(1)	6(2)	0.09
Primary	151(41)	170(46)	175(47)	
Secondary	140(38)	118(32)	108(29)	
Tertiary	80(21)	82(11)	83(22)	
<b>Marital status</b>				
Married	303(81)	320(86)	322(87)	0.1
Single	69(19)	52(14)	50(13)	

Table 2: Bivariate analysis of factors associated with missed vaccination among children attending vaccination services in Machakos, Njoro and Langata districts in Kenya, 2014

Variable	Dropout n(%)	No dropout n(%)	OR(CI)
Mother Age			
<25yrs	74 (12)	528 (88)	1.0 (0.7-1.4)
>25yrs	62 (12)	451 (88)	
Education			
primary and below	82 (15)	476 (85)	1.9 (1.1-3.29)
Secondary and above	17 (8)	188 (92)	
Marital status			
not Married	21 (13)	138 (87)	1.1 (0.67-1.82)
Married	113 (12)	822 (88)	
Place of Delivery			
Home	25 (14)	153 (86)	1.2 (0.75-1.89)
Hospital	111 (12)	824 (88)	
Employment			
Unemployed	29 (11)	231 (89)	0.9 (0.57-1.36)
Employed	107 (13)	749 (87)	
Age of child at penta 1			
>56days	20 (22)	70 (78)	2.2 (1.3-3.8)
<56days	116 (11)	910 (89)	
Distance from facility			
>5km	64 (15)	354 (85)	1.6 (1.095-2.26)
<5km	72 (10)	626 (90)	
Birth order			
first born	52 (12)	377 (88)	0.9 (0.69-1.43)
not a first born	84 (12)	603 (88)	
Waiting time			
>30Mins	65 (15)	378 (85)	1.4 (1.03-2.12)
<30Min	70 (10)	601 (90)	
transport paid			
Yes	63 (12)	464 (88)	0.96 (0.67-1.38)
No	73 (12)	516 (88)	
Interventions			
SMS reminder	13 (3.5)	359 (96.5)	0.2 (0.04-0.8)
No reminder(control)	63 (17)	309 (83)	
Control sticker reminder	63 (17) 60(16)	309 (83) 312(84)	0.94 (0.53-1.67)

Table 3: multivariate analysis of factors associated with missed vaccination among children attending vaccination services in Machakos, Njoro and Langata districts in Kenya, 2014

Variable	AOR	95%CI	P-Value
Child's age >56days	1.81	0.83-3.90	0.14
Education level below primary	1.85	0.99-2.70	<b>0.05</b>
Distance >5km from facility	1.64	1.09-3.10	<b>0.025</b>
Waiting time>30 minutes	0.86	0.51-1.45	0.57
SMS reminder	0.196	0.09-0.43	<b>&lt;0.001</b>
Sticker Reminder	0.69	0.40-1.20	0.181

\*\* : Adjusted Odds Ratio

-



Figure 1: Map of Kenya Showing Study Sites

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Figure 2: showing adhesive sticker

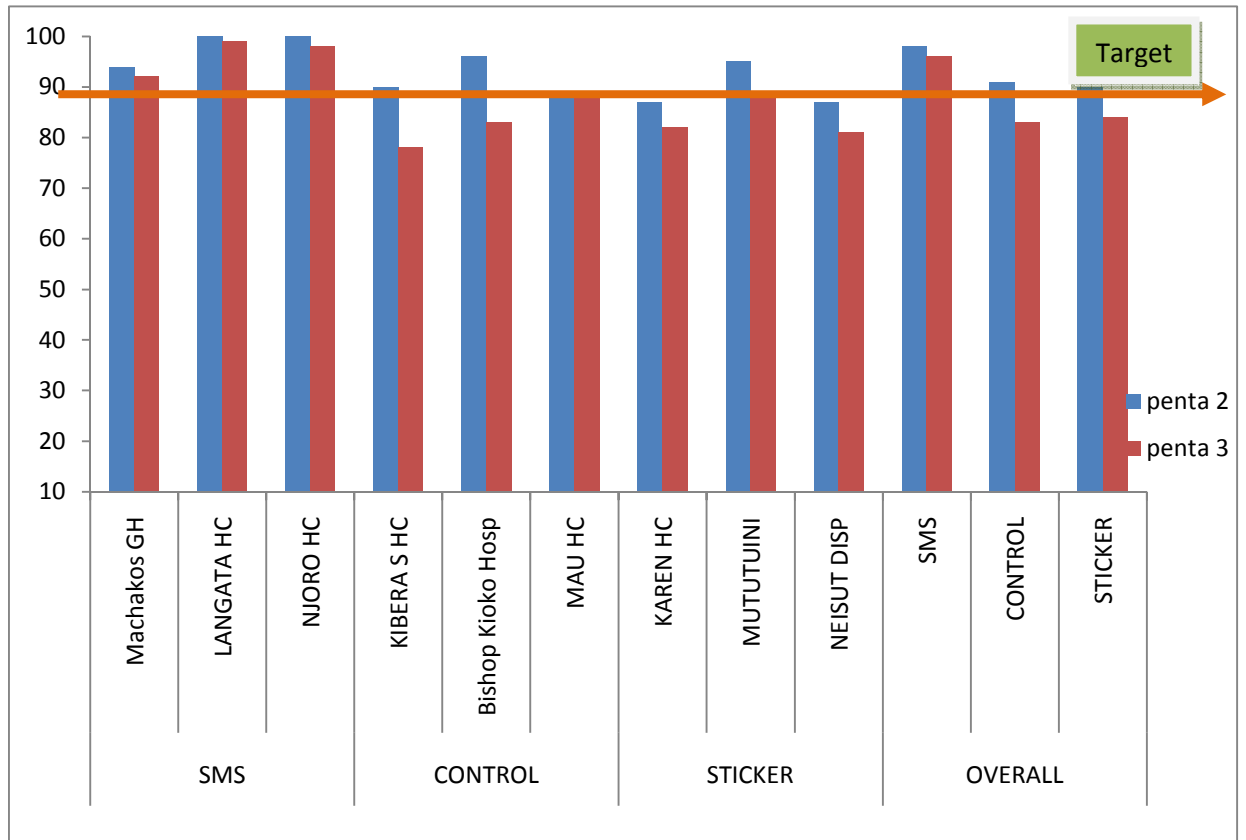


Figure 3: vaccination coverage at 10 and 14 weeks by facility among children attending vaccination services in Machakos, Njoro and Langatadistricts, Kenya 2014

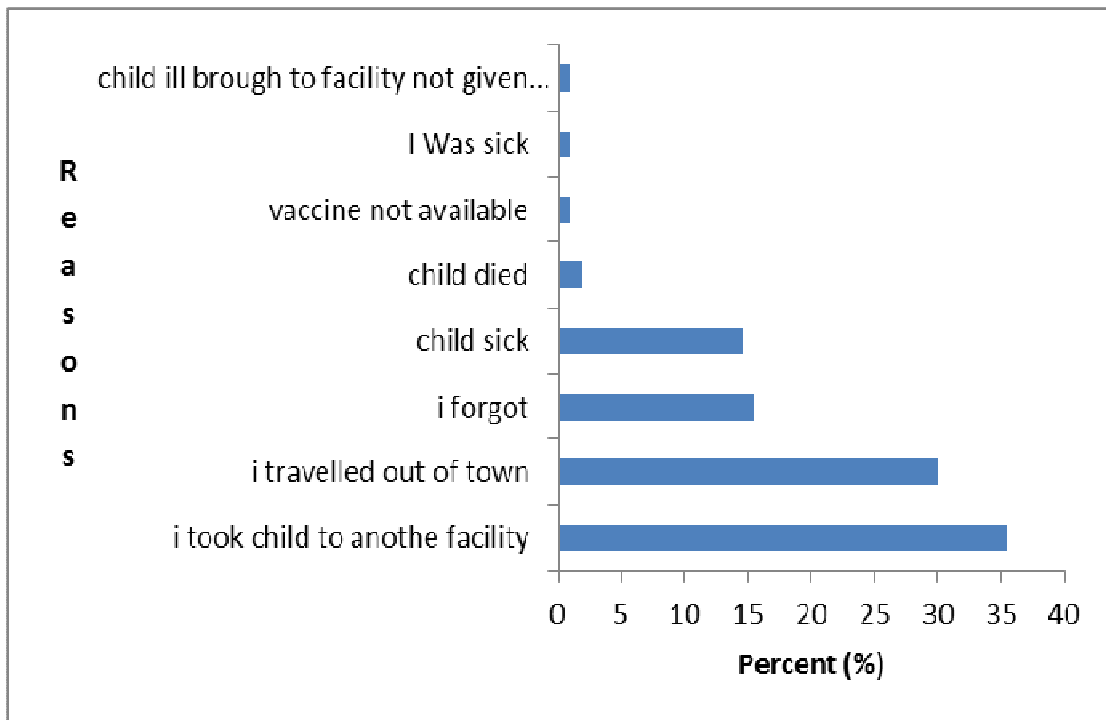


Fig 5: reasons for missed vaccination among children attending vaccination services in

Fig 4: Reasons for missed vaccination among children attending vaccination services in Machakos, Njoro and Langatadistricts, Kenya 2014