UPTAKE OF SECOND DOSE OF MEASLES VACCINE AMONG CHILDREN IN KAKAMEGA COUNTY, KENYA

FREDRICK MIKE MAKOKHA

MASTER OF SCIENCE

(Applied Epidemiology)

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

2016

Uptake of Second Dose of Measles Vaccine Among Children in Kakamega County, Kenya

Fredrick Mike Makokha

A Thesis Submitted in Fulfillment for the Degree of Master of Science in Applied Epidemiology in the Jomo Kenyatta University of Agriculture and Technology

2016

DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

Signature: _____Date: _____

Fredrick Mike Makokha

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

1. Signature: _____ Date: _____

Prof. Helen Lydiah Kutima
JKUAT, Kenya

2. Signature: _____Date: _____

Dr. Paul Mutebi Wanjala
University of Eldoret, Kenya

DEDICATION

This thesis is dedicated to my mother; Penina Aswani, my wife; Lilian Ayuma, my two sons; Teddy and Wayne. You are the reason I work hard.

ACKNOWLEDGEMENT

I would like to thank God, The Almighty for providing me with strength and knowledge that has helped me to make this thesis a reality. I thank my family for their moral support, encouragement and understanding when I was not there for them during the period I worked to come up with this thesis.

I thank Prof. Helen L. Kutima and Dr.Paul Mutebi Wanjala for their guidance and mentorship during the development of the thesis and without whose constructive criticism and recommendations, it would not have been the same. I further value the support received from Dr. Jane Githuku during the entire period of proposal and thesis development.

I also appreciate the financial and technical support received from the Field Epidemiology and Laboratory Training Program (FELTP-Kenya), and Ministry of Health (MOH) for the development and finalization of this thesis.

I wish I could remember and acknowledge all those who offered their support by their names especially the community field guides. Even though their names are not mentioned here they should rest assured that their support is very much acknowledged.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

AFR	African
AIDS	Acquired Immunodeficiency Syndrome
BCG	Bacillus Calmette–Guérin
CBS	Central Bureau of Statistics
CDC	Centre for Disease Control and Prevention
CI	Confidence Interval
CID	Committee on Infectious Diseases
DALYS	Disability-Adjusted Life Years
EMR	Eastern Mediterranean
EMRO	Regional Office for the Eastern Mediterranean
FELTP	Field Epidemiology and Laboratory Training Program
HIV	Human Immunodeficiency Virus
ICF	International Classification of Functioning
IPV	Inactivated Polio Vaccine
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KEMRI	Kenya Medical Research Institute
KNH-UoN ERC	Kenyatta National Hospital/University of Nairobi-Ethics and Research Committee
MCV1	First Dose of Measles Containing Vaccine
MCV2	Second Dose of Measles Containing Vaccine
MOH	Ministry of Health
OPV	Oral Polio Vaccine
OPV3	Third Dose of Oral Polio Vaccine
ORC	Opinion Research Corporation
ORI	Outbreak Response Immunization
RI	Routine Immunization
SIAs	Supplementary Immunization Activities
UNICEF	United Nations Children's Fund
WHA	World Health Assembly
WHO	World Health Organization

DEFINITION OF TERMS

Coverage The proportion of children aged 24-35 months who received a particular vaccine antigen.

Cluster Sampling A sampling technique used when "natural" but relatively homogeneous groupings are evident in a statistical population.

Design Effect A measure of variability due to selection of survey subjects by any method other than simple random sampling and expressed as the ratio of the variance with other types of sampling to the variance with simple random sampling.

Efficacy It's the maximum response achievable from a vaccine.

Immunity It's the state of having sufficient biological defenses to avoid infection, disease, or other unwanted biological invasion.

Immunization It's the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine.

Incidence It's a measure of the risk of developing some new condition within a specified period of time.

Prevalence Odds Ratio It's the measure of association in cross sectional studies.

Sampling Frame It's the set of sampling units from which a sample is to be selected; for example, a list of names, or places, or other items to be used as a sampling unit.

Sampling Interval It's a number that is used to systematically to select clusters (villages) from the sampling frame

Uptake	It’s utilization of vaccination services for a particular vaccine antigen.
Vaccine	It’s a biological preparation that improves immunity to a particular disease.

ABSTRACT

Measles is a major cause of death and complications among young children worldwide despite the availability of a safe and effective vaccine. Annually over 158,000 cases of mortality due to measles are reported globally, especially in Africa and Asia. In Kenya, 59 measles cases per a million populations were reported in 2011. Approximately 80 % of the children aged less than 5 years received a first dose of measles-containing vaccine in Kakamega County in 2014. Second dose of measles-containing vaccine was introduced in the routine immunization schedule in Kenya in the year 2013. A cross-sectional survey was conducted to determine the coverage, the factors associated with uptake of second dose of measles-containing vaccine and reasons for not being vaccinated with second dose of measles-containing vaccine among children aged 24-35 months of age in Kakamega County. Multi-stage cluster sampling technique was used. First, 30 clusters were selected using probability proportional to size with replacement. Out of which 19 households were surveyed per cluster and data of the youngest child aged between 24-35 months in a household collected. Univariate and bivariate analysis was conducted on all variables. Prevalence odds ratios was carried out at 95% confidence interval (CI), and two-tailed statistical significance was set at $p \leq 0.05$. Variables with a p-value ≤ 0.10 were subjected to multiple logistic regression model using backward elimination, dropping the least significant independent variable until all the remaining predictor variables were significant (p-value ≤ 0.05). A total of 571 children were surveyed. The coverage of second dose of measles-containing vaccine was 102 (17.9%) (95%CI = 14.9% to 21.3%). The mother's or caretaker's awareness of the second dose of measles-containing vaccine, less than 30minutes taken to immunizing health facility, uptake of Pentavalent 3 and at least two doses of Vitamin A were significantly associated with the uptake of the second dose of measles-containing vaccine with the following prevalence odds ratios 14.46(6.94-30.15), 3.45(1.14-10.41), 2.73 (1.50-4.96) and 4.52 (2.69-7.58) respectively. The main reasons cited for the children not receiving the second dose of measles-containing vaccine were; lack of awareness of need to return for second dose of measles-containing vaccine 210(44.8%) and lack of awareness of need for immunization 67(14.3%). The second dose of measles-containing vaccine coverage and awareness

of the need to return for immunization was very low in Kakamega County. Department of Health in Kakamega Couny need to put in place strategies aimed at increasing awareness on importance for second dose of measles-containing vaccine, conducting outreach services in hard-to-reach areas and ensuring that there are no missed opportunities for children who present themselves for other health services. A wider study could be conducted to cover the whole Country.

CHAPTER ONE

INTRODUCTION

1.1 Background

Over the last few decades, effective vaccines and immunization programs have dramatically reduced the burden of several vaccine-preventable diseases on population and individual health (WHO, 2010). In countries where vaccination is high the incidence of measles infection has substantially reduced. However, the failure to maintain high coverage of childhood immunization in all districts has resulted in a resurgence of the disease (WHO, 2009a).

In 2007, the coverage of first dose of measles-containing vaccine (MCV1) reached 82% worldwide, and the estimated number of deaths from measles dropped from 750 000 in the year 2000 to 197 000 and further decreased to approximately 158,000 people or 433 deaths per day in 2011 (WHO, 2009a). Though that figure was relatively smaller compared to 2.6 million global measles deaths in 1980 (WHO, 2012b), it was still very high considering that measles could easily be controlled through immunization.

The period between the years 2000 and 2012, the global measles incidence decreased by 77%, from 146 to 33 cases per million population per year (Perry *et al.,* 2014a). A Report by WHO (2010) Secretariat on the global eradication of measles showed that the African Region had attained the goal of 90% measles mortality reduction in comparison with the year 2000 estimates by the end of 2006, three years earlier than its regional target year of 2009.

In the year 1974, World Health Organization (WHO) established the Expanded Programme on Immunization to ensure all children had access to routinely recommended vaccines that included measles-containing vaccine (MCV) (Sodha, 2012). This informed the vision of WHO/United Nations Children's Fund (UNICEF) and other partners of "a

world without measles" in their Global Measles and Rubella Strategic Plan 2012–2020 (WHO, 2012a). The plan stressed on the importance of strong routine immunization (RI) systems providing two doses of MCV to each child, supplemented by campaigns, laboratory backed surveillance, outbreak preparedness and case management, as well as research and development (WHO, 2013).

During the year 2012, large measles outbreaks were reported in Democratic Republic of Congo (72 029 cases), India (18 668 case), Indonesia (15 489 cases), Ukraine (12 746 cases), Somalia (9983 cases), Sudan (8523 cases), Pakistan (8046 cases), and Romania (7450 cases) (WHO, 2014b). Kebede *et al.* (2012) reported a total of 9,756 cases of measles in Ethiopia, 2,566 in Kenya and 16,135 in Somalia with 78% occurring among children aged less than 5 years and primarily in unvaccinated persons. It was established that for African (AFR) and Eastern Mediterranean (EMR) regions to reach measles elimination targets, uniform high coverage with two doses of MCV must be achieved and maintained in Horn of Africa countries, including in refugee camps.

Effective vaccine for measles has been available since the 1960s, and all countries in the world offer MCV in their RI programmes (WHO,2009a). Before the widespread use of measles vaccine, more than 90% of children contracted measles by their tenth birthday (EMRO, 2014). The period between the years 2000 to 2013, measles vaccination resulted in a 75% drop in measles deaths worldwide. Approximately 15.6 million measles deaths were averted (Perry *et al.,* 2014b). However, outbreaks of measles were still common in many developing countries, particularly in parts of Africa and Asia as a result of sub-optimal implementation of immunization strategies (WHO, 2009a).

According to Kenya demographic Health Survey [KDHS] (2009), only 77% of Kenyan children aged 12–23 months had received all the recommended vaccines. This was comparable to the estimated coverage of first dose of measles-containing vaccine (MCV1) in 2010 and 2011 which was 86% and 87% respectively in Kenya (Kebede *et al.,* 2012).

This was relatively great improvement given that in the year 2003 the coverage of fully vaccinated children in Kenya was only 57% (KDHS, 2004). However, in the year 2014, only 67.5% and 62.2% were fully immunized in Kenya and Kakamega County respectively (KDHS, 2014). This implied that the gains achieved over the years were dwindling. This posed a very grim situation which had a potential of leading to explosion of countrywide outbreaks of measles. Thus shuttering the WHO vision of elimination measles by the year 2020 (Jean, Malano, Diallo and Sirimah,2012; WHO, 2014a). For instance, Kenya reported increased incidence of measles from a low of three cases of measles per a million population in the year 2010 to 59 cases of measles per a million population in the year 2011 (Kebede *et al.*, 2012).

In the year 2009, the WHO recommended that every child under the age of five years in all countries that had achieved MCV1 coverage of more than 80% for three successive years were to receive a second dose of measles-containing vaccine (MCV2) in the RI schedule (WHO, 2012b). The provision of MCV2 in the RI schedule offers numerous advantages including; maintaining high immunization coverage and reaching children who had been lost to follow up during infancy (Ministry of health [MOH], 2013). The immunological rationale is to immunize the primary vaccine failures among children who had not responded to MCV1 and the programmatic rationale is to vaccinate those children who had missed out routine immunization services, since most children who do not respond to MCV1 respond well to MCV2 (Gupta, Sosler, Haldar, Hombergh and Bose, 2011; WHO, 2001). In line with WHO recommendation of offering children second opportunity for measles immunization (WHO, 2001), Kenya introduced MCV2 during RI in 2013 given at 18 months of age (MOH, 2013).

Therefore, a study was carried out to establish the coverage, the factors associated with uptake of MCV2 and reasons for not being vaccinated with MCV2 among children aged 24-35 months in Kakamega County. This is because MCV2 is given at 18 months, therefore children aged 24-35 months are in the same birth cohort.

1.2 Statement of the Problem

Measles remains a major cause of mortalities and complications among young children worldwide notwithstanding the availability of a safe and effective vaccine (Belmaker, Bazarsky, Dukhan, Chamny, and Rager-Zisman,2008; WHO, 2009a; Regional Office for the Eastern Mediterranean) [EMRO], 2014; Nakia, Paul, Amy, Susan and Gregory,2015). Measles kills more children than any other vaccine preventable disease worldwide (EMRO, 2014). Approximately 145 700 people died from measles in the year 2013, majority being children under the age of five years globally (Perry *et al.,* 2014b). In 1980s, before extensive vaccination coverage, measles caused approximately 2.6 million deaths yearly worldwide (Perry *et al.,* 2014b).

Measles infection has its greatest incidence in children below 2 years of age in developing countries (EMRO, 2014). Measles remains a major public health concern in Kenya. It contributes significantly to the burden of disease among children aged less than 5 years (MOH, 2013). Kenya is among the 47 high-burden countries for measles priority action that were identified by WHO and United Nations Children's Fund [UNICEF] (WHO/UNICEF, 2006). All these countries had low coverage of the MCV1 with an average coverage of 58% and only offered only one dose of measles vaccine to their children in 2000 (Maya, Gupta and Hoekstra ,2009). Kebede *et al.* (2012) reported a total of 2,566 measles cases were reported in Kenya in 2012 with 78% occurring among children aged less than 5 years and primarily in unvaccinated persons.

In the year 2010, 105 cases of measles were reported, primarily in the former North Eastern province during the first half of the year. Starting in January 2011, measles cases increased throughout the country, first occurring in the North Eastern Province and among the Somali community in Nairobi. National reported measles incidence increased from 3 per 1 million population in 2010 to 59 per 1 million population in 2011 (Kebede *et al.*, 2012). This could be explained by the efficacy of MCV1 being 85% and the accumulation of a large pool of children who did not receive MCV1 or supplementary MCV which was last given in 2009. Kenya has continued to report resurgence of measles every 3 years.

This could be explained by the persistent sub-optimal MCV1 coverage leading to an accumulation of susceptible children (MOH, 2013). This was not an isolated Kenyan problem. It was a global issue because in the years 2010 and 2011, a number of outbreaks of measles were also reported even in the developed world (Sartorius *et al.*, 2013).

1.3 Justification of the Study

The MCV2 was introduced into routine immunization program in Kenya in the year 2013. Apart from the MCV2 administrative coverage that is routinely reported by all the immunizing health facilities in the county, little was known on the actual population coverage for MCV2 and factors that were associated with its uptake or lack of. After the introduction of MCV2 into RI program, it was vital to assess its uptake because with an efficacy of 99% herd immunity would be assured and consequently reducing measles outbreaks (WHO, 2009a).

In Kakamega County, MCV1 coverage among children aged 12–23 months was 77.7 % in the year 2009 and 80.1% in the year 2014 (KDHS, 2009, 2014). With the efficacy of 85% for MCV1 (WHO, 2001,2009), a crude calculation of multiplying the efficacy with the coverage, implied less than 70% of children in every birth cohort had immunity against measles. This meant that 2 to 3 birth cohorts could result into accumulation of large pool of unimmunized children, which translates to approximately 70,000 children, who were vulnerable to measles thus increased likelihood of continued outbreaks of measles.

The findings of this study will be used by immunization program managers of County Government of Kakamega and the National government to increase utilization of MCV2 and consequently reducing the burden of measles in the region. Also the findings would provide information for planning and policy formulation for the purpose of measles elimination in Kakamega Country. The study would also provide literature on the coverage, the factors associated with uptake of MCV2 and reasons for not being vaccinated with MCV2 among children in County.

1.4 Research Questions

1. What is the coverage of MCV2 among children aged 24- 35 months, in Kakamega County?
2. What factors are associated with uptake of MCV2 among children aged 24- 35 months, in Kakamega County?
3. What are the reasons for not being vaccinated with MCV2 among children aged 24- 35 months, in Kakamega County?

1.5 General Objective

The general objective of this study is to establish the coverage, the factors associated with uptake of MCV2 and reasons for not being vaccinated with MCV2 among children in Kakamega County.

1.6 Specific Objectives

The specific objectives of this study were

1. To determine the coverage of MCV2 among children aged 24- 35 months, in Kakamega County.
2. To determine factors associated with uptake of MCV2 among children aged 24- 35 months, in Kakamega County.
3. To determine the reasons for not being vaccinated with MCV2 among children aged 24- 35 months, in Kakamega County.

1.7 Theoretical Review and Conceptual Framework

Figure 1.1 shows the schematic presentation of the Conceptual Framework of this study. Children living in the rural areas are less likely to be vaccinated than those living in urban areas (Ibnouf, Van den Borne and Maarse ,2007). Age, education level, social economic status, marital status, religion, parity, myths, misconceptions and knowledge level of the mother influences the uptake of vaccination services (Ibnouf *et al.,* 2007). Sex and birth order of the child, distance and time taken to reach the nearest vaccination centres affect

utilization of MCV2 (Ibnouf *et al.*, 2007; Abdulraheem, Onajole, Jimoh, & Oladipo,2011). The utilization of other vaccine's antigens such as MCV, Pentavalent, oral polio vaccine (OPV), Rota Virus and Pneumococcal vaccine also have an effect on compliance to MCV2.

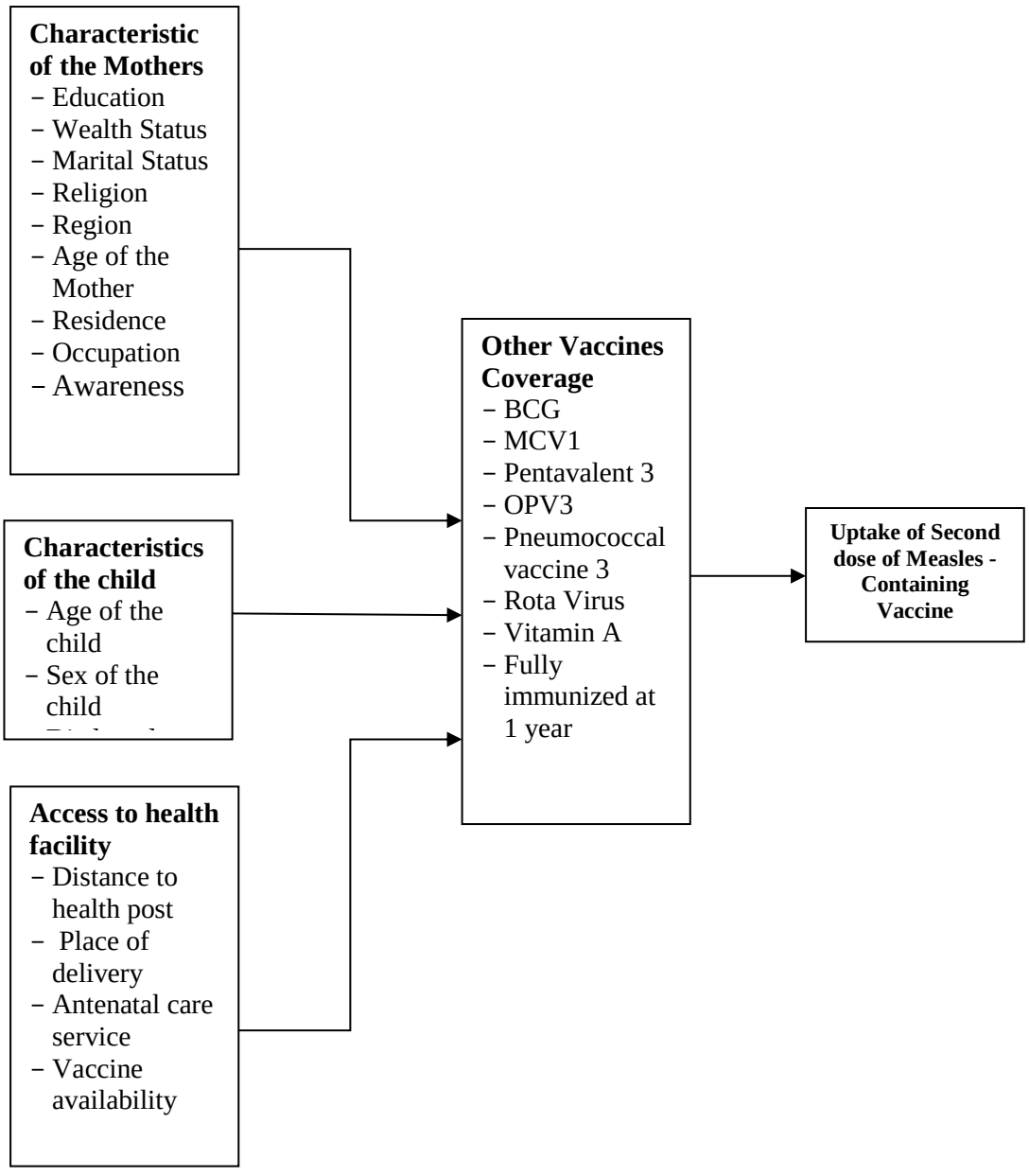


Figure 1.1 Schematic presentation of Conceptual Framework

1.8 Scope

The study focused on factors related to mothers or care-givers and children characteristics, previous vaccination history and accessibility to immunization centres and their contributions to the uptake of MCV2 for children aged 24 to 35 months in Kakamega County. It further determined the main reasons why children were failing to receive MCV2.

CHAPTER TWO

LITERATURE REVIEW

2.1. Global Coverage of MCV

Controlling and elimination of measles is very difficult, because adequate population coverage is a requisite of achieving high individual protection as well as for induction and maintenance of herd immunity (Okonkwo *et. al.,* 2009; Bielicki, Achermann, and Berger, 2012). At least 95% of the population must be immunized to interrupt transmission and prevent outbreaks of measles (Bielicki *et al.,* 2012). Serologic and epidemiologic studies indicate that efficacy of MCV1 is approximately 85% when given at nine months of age, and that of MCV2 is 99% when the second dose is given at more than 12 months of age (WHO, 2009a; Uzicanin and Zimmerman, 2011). MCV2 is highly effective in inducing immunity in children who did not have a response to MCV1 (WHO, 2009a). In a study of measles revaccination among school entry-age children 36 out of 37 seronegative children seroconverted after revaccination (Committee on Infectious Disease [CID], 1998).

One of the three milestones that were set by the World Health Assembly (WHA) in 2010 towards global measles control and eradication by 2015 was to increase routine immunization coverage with MCV1 for children aged one year to more than 90% nationally and more than 80% in every district (Perry *et al.,* 2014a). As a target the WHO (2010) was to achieve vaccination coverage of more than 95% with 2 doses of MCV administered through RI and maintenance of this coverage uniformly across all districts.

Three of the six WHO regions had more than 90% estimated coverage for MCV1 by the year 2010 (WHO, 2012b). In the year 2010, 20,651 (61%) of 33,966 districts worldwide achieved more than 80% MCV1 coverage. Of the estimated 19.1 million children who never received MCV1 in the year 2010, 10.4 million (55%) were in just 5 member states: 6.7 million in India, 1.7 million in Nigeria, 0.8 million in Democratic Republic of Congo, 0.6 million in Uganda and 0.6 million in Pakistan (WHO, 2012b).

In the year 2013, about 84% of the world's children received one dose of measles vaccine by their first birthday through routine health service up from 73% in the year 2000 (Perry *et al.*, 2014b, WHO, 2014b). Member States with more than 90% MCV1 coverage increased from 83 (43%) in the year 2000 to 128 (66%) in year 2012. The number of Member States with more than 90% coverage nationally that also had more than 80% MCV1 coverage in all districts increased from 40 (38%) of 104 in the year 2003 to 58 (45%) of 128 in the year 2012 (WHO, 2014b). During the same period, the number of member states providing MCV2 through RI services increased from 96 (50%) to 145 (75%) (Perry *et al.*, 2014a).

2.2. Regional MCV Coverage

In the African Region, routine measles vaccination coverage improved from 53% in the year 2000 to 82% in the year 2007(African Region World Health Organization [AFRO.WHO], 2009). At the end of 2007, 23 countries had coverage levels of more than 80% while only 2 countries had administrative coverage below 60% (AFRO.WHO, 2009). Despite the improvement at regional and national levels, there were still major gaps in immunization coverage at sub national levels even in the countries that had high national level coverage figures. These gaps continued to create pools of susceptible individuals and resulted in periodic outbreaks of measles that needed to be addressed (AFRO.WHO, 2009).

In the year 2008, 46 member states of the WHO-AFR adopted a measles pre-elimination target of more than 90% MCV1 national coverage, more than 80% MCV1 coverage in all districts, and more than 95% MCV coverage in all districts by Supplementary Immunization Activities (SIAs) that was to be reached by the end of 2012 (Masresha *et al.*,2014). By the year 2010, only 15% of African countries had introduced MCV2 into their routine immunization schedule (Goodman, 2011) and in the year 2011, the MCV1 coverage was still very low in some countries for instance Central African Republic had the lowest coverage of 49% (Masresha *et al.*, 2014). In the year 2012, only 13 (28%) member states had more than 90% MCV1 coverage, and only three (7%) reported more

than 90% MCV1 coverage nationally and more than 80% coverage in all districts (Masresha *et al.,* 2014).

The Coverage with MCV1 also improved from 56% in the year 2000 to 73% by the year 2008 (Perry *et al.,* 2014a). However, in 2008, a total of 7.7 million infants (27% of the birth cohort) did not receive MCV1 (Perry *et al.,* 2014a). It was estimated that 17 countries were at risk of not attaining 90% national coverage levels with MCV1 unless major changes were made to strengthen RI systems (Perry *et al.,* 2014a). There was no much change in the year 2012, where the coverage of MCV1 remained at 73%, with only 33% of the member states reporting MCV1 coverage of more than 90%, and more than 106,052 cases of measles were reported which was approximately 125 cases per million population which was well beyond the WHO target of less than 5 cases per a million population (Perry *et al.,* 2014a).

In the year 2011, countries in the African region took on the goal to eliminate measles by the year 2020 (Jean *et al.,* 2012). According to the Global Routine Vaccination Coverage, 2013 report, the African region had the lowest MCV2 coverage of 7% despite the global coverage being 53% (Harris, Marta, Rudolf, David and Samir, 2014, WHO, 2014b). The proportion of districts reporting more than 80% MCV1 coverage was 45% in the year 2010 and 43% in the following year. However, the estimated MCV1 coverage was 46% in both in the year 2010 and 2011 in Somalia, and coverage of 56% and 57% in Ethiopia in the years 2010 and 2011 respectively (Kebede *et al.*,2012). The proportion of districts in Somalia reporting more than 80% MCV1 coverage was 20% in the year 2010 and 35% in the year 2011. During the same period, the reported measles incidence increased from 145 to 1,542 cases per a million persons per year in Somalia (Kebede *et al.*,2012).

2.3. National and County MCV Coverage

In Kenya, routine vaccination coverage in the year 2007 reached 65% for the children of the poorest quintile, whereas 89% for the richest children (Maya *et al.,* 2009). During campaigns the coverage was 95% and evenly distributed among all wealth quintiles. This

indicated that campaigns reached the unvaccinated children, including those from poorest families (Maya *et al.,* 2009). According to the Kenya Demographic Health Survey (KDHS) (2009), 77% of Kenyan children aged 12–23 months had received all recommended vaccines; one dose each of BCG and measles, and three doses each of pentavalent and oral polio. Only 3% of children had not received any of the recommended vaccines and 85.9% had been vaccinated with MCV1. This was similar to the estimated MCV1 coverage of the year 2010 and 2011 which was 86% and 87% respectively (Kebede *et al.,* 2012; UNICEF/WHO, 2013) which was great improvement as compared to the year 2003 when the coverage of children fully vaccinated in Kenya was only 57% (KDHS, 2004).

The percentage of districts reporting more than 80% MCV1 coverage was 66% in the year 2010 and 65% in the year 2011 (Kebede *et al.,* 2012). A nationwide measles SIAs in 2009 reached approximately 82% of an estimated 5.5 million children aged 9-59 months (Kebede *et al.,* 2012). In a study on Immunization coverage and its determinants among children aged 12 - 23 months in a peri-urban area of Kenya, 291 (76.6%) of the children were fully immunized by card and history, and 77.4% had received MCV1 (Maina, Karanja and Kombich, 2013). The MCV1 coverage in the former Western province, where Kakamega County is located was 77.7% in the year 2009. This was a poorer performance as compared to the perennial low performing North Eastern Province which had 78.9% of its children covered with MCV1 (KDHS, 2009).

2.4. Factors Influencing Uptake of Vaccination

In a study on factors influencing immunization coverage among children under five years of age in Khartoum State, Sudan by Ibnouf *et al.* (2007), it was found that children from urban areas were 7.4 times more likely to have had the correct vaccinations for their age than were children from rural areas. This was contrary to KDHS (2009), results which showed that Vaccination coverage was higher in rural areas than urban areas in Kenya at

81% versus 76% respectively. However, children who resided in urban areas had a 90.4% chance of being given MCV1 as compared to 83.4% for their rural counterparts.

According to Ibnouf *et al.* (2007), children born of mothers older than 30 years of age were 2.17 times more likely to be correctly vaccinated than were those born of mothers younger than 30 years old. In addition, children of highly educated mothers were more likely to be correctly vaccinated than children born of illiterate mothers by 82.4% and 60.4% respectively. This was corroborated by KDHS (2009), which showed that coverage increased with mother's education, 87% of children whose mothers had at least secondary education were fully vaccinated compared with 67% of children whose mothers had no formal education at all. KDHS (2009) also revealed that the MCV1 coverage in mothers with at least secondary education was at 91.6% as compared to mothers with no education who had coverage of 80.6%.

The results were the same in a study by Lyimo (2012) which also found that children whose mothers had no at least secondary education were three times more likely to have a low uptake of MCV1 than a child whose mothers had completed secondary school. It was further found that the younger children were more likely to have low uptake of routine and supplementary MCV (Lyimo, 2012). The knowledge on the importance of vaccination was also found to play a role in the uptake MCV.

According to KDHS (2009), other factors associated with the uptake of MCV1 were; birth order, place of residence, mother's education level and wealth quintile. The uptake of MCV was more than 90% among first to third born children and it reduced 71.6% among children sixth born and above. The MCV1 coverage in children in the lowest wealth quintile was 75.6% as compared to 93.9% in the highest quintile. Ibnouf *et al.* (2007), concluded that the following background variables were also related to correct vaccination coverage: age of the child, socio-economic status of the family, and the mother's awareness of the purpose of vaccination, walking time to vaccination facility, and perceived vaccination quality. Social demographic factors play a big role in uptake of

immunization services. A study by Abdulraheem *et al.* (2011) discovered that parents' objection, disagreement or concern about immunization safety (38.8%), long walking distance (17.5%) and long waiting time at the health facility (15.2%) were the most common reasons for partial immunization.

Many studies have been conducted on the general immunization coverage (Lyimo, 2012, Maina *et al*.,2013) However little is known about the factors that influence uptake of MCV2 especially in the developing world. Lack of information could have been attributed to the fact that MCV2 was introduced into RI program just few years ago in many countries especially in the developing countries. In Kenya MCV2 was only introduced in 2013. Therefore, there was limited information on its uptake.

Kenya qualified to provide MCV2 in RI program after it attained and maintained MCV1 coverage of over 80% since 2009 (MOH, 2013). Following this background there was limited information on the uptake of MCV2. This study sought to address gaps on information on the coverage and factors that influenced uptake of MCV2. This information would be of great importance to health sector decision makers in Kakamega County and Kenya at large.

2.5. Reason for not being vaccinated

A recent report on the outbreaks of measles in the first quarter of 2015 in the United States showed that 68 reported cases of measles were unvaccinated. The main reasons of not being vaccinated were 29 (43%) philosophical or religious objections to vaccination, 27 (40%) were ineligible because they were too young to receive vaccination. Other reasons included; medical contraindication or represented missed opportunities for vaccination (Clemmons, Gastanaduy, Fiebelkorn, Redd1 and Wallace, 2015). In a study by Telma *et al.* 2013 on the factors limiting immunization coverage in urban Dili,Timor-Leste found out that inadequate immunization services, poor parental knowledge and attitudes, limited access to services, poor health staff attitudes and practices, unreliability of services, false

contraindications, fears of side effects, conflicting priorities, and parental beliefs were some of the factors that hindered utilization of immunization services.

In a study on the reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children by Abdulraheem *et al., (*2011) found out that; long waiting time, lack of vaccine on the appointment day, child ill-health at the time of immunization, lack of information about the days for vaccination, long walking distance, parents' objection, disagreement or concern about immunization safety were the major reasons for incomplete vaccination. During an evaluation of the use of combined inactivated poliovirus (IPV) and oral poliovirus vaccines in refugee camps and surrounding communities in Kenya in December 2013 it was found that children who did not receive inactivated poliovirus vaccines; caretakers reported either not knowing where to go for vaccination or ill child or fear of pain and adverse effects (Sheikh *et al.,* 2014). Oluwadare (2009) in a study on the Social Determinants of Routine Immunization in Ekiti State of Nigeria common factors affecting uptake of immunization also found out that where the families live, bad road networks and traveling distances to health facilities to access routine immunization influence the uptake of immunization. Spending longer than 60 minutes to reach the nearest health facility was demonstrated to have a strong negative influence in immunization uptake and the mother's awareness of the importance of immunization also play an important role (Jani, Schacht, Jani, and Bjune, 2008).

CHAPTER THREE

MATERIALS AND METHODS

3.1. Study site

Kakamega County is located about 30km north of the Equator, at Latitude and Longitude of 0’275” N and 34’757” E respectively. The altitude of the County ranges from 1,240 to 2,000 metres above sea level. The southern part of the county is hilly and is made up of rugged granites rising in places to 1,950 metres above sea level. The Nandi Escarpment forms a prominent feature on the County’s eastern border, with its main scarp rising from a general elevation of 1,700 metres to 2,000 metres (County Government of Kakamega [CGOK], 2013).

The county covers an area of approximately 3050.3 Km^2 (CGOK, 2013). Administratively the County consists of sixty wards and twelve sub- Counties namely: Butere, Khwisero, Mumias West, Mumias East, Lurambi, Shinyalu, Ikolomani, Navakholo, Malava, Matungu, Lugari, and Likuyani. It is the second most highly populous County among the 47 in Kenya. According to the 2009 Population and Housing Census, the County had a projected population of 1,929,401 in 2015 with about 4 % being children aged 24-35 months old (CGOK, 2013).

In terms of distance to the nearest health facility, 51.1 per cent of the population live within 5km to the nearest health facility while 32.2 per cent live between 1.1 and 4.9 km to the nearest health facility (CGOK, 2013). According to the Kakamega First County Integrated Development Plan 2013 about 84.5 per cent of the children in the county get immunized. Figure 3.1 is the map of Kakamega County.

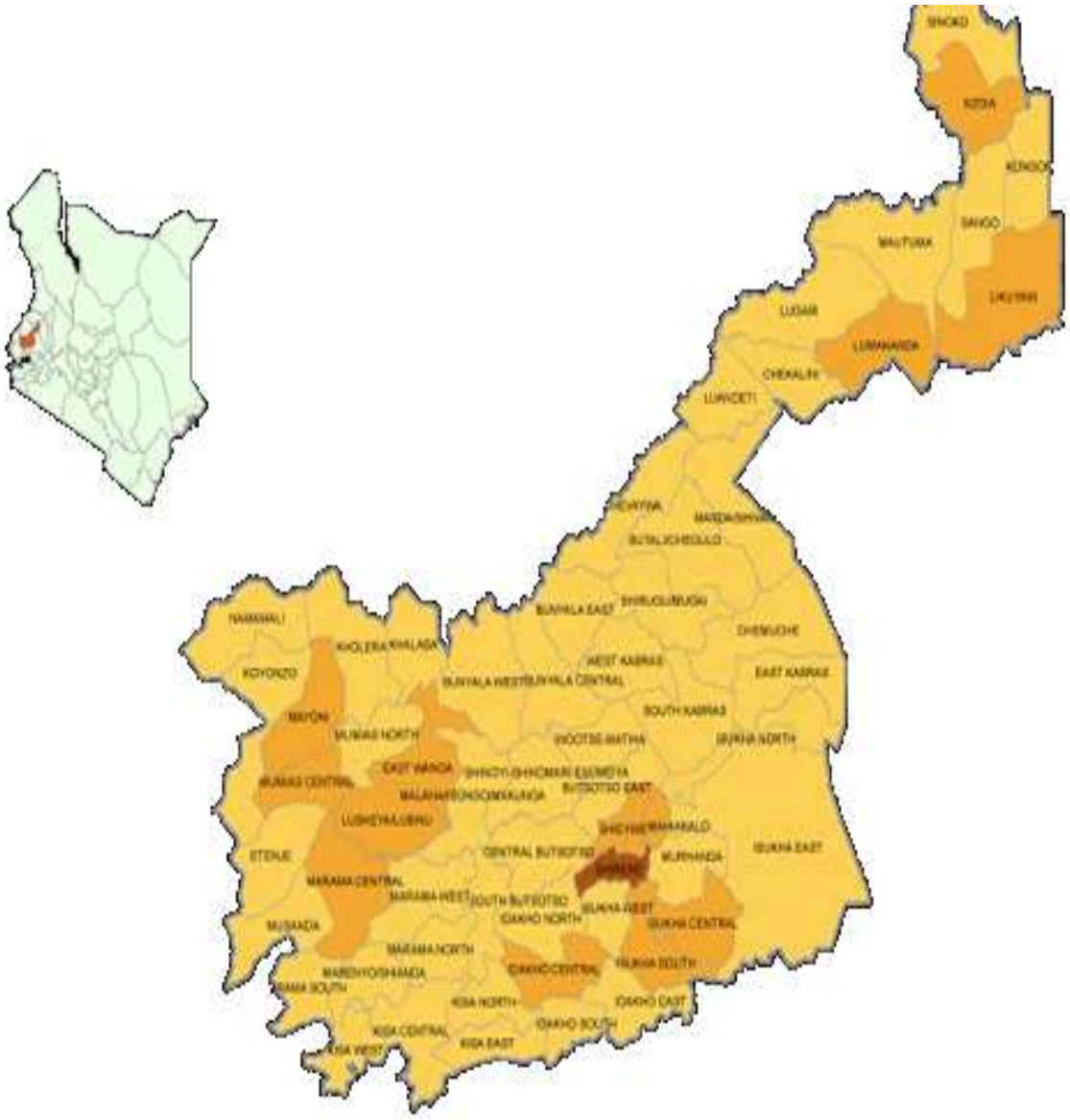


Figure 3.1 A map of Kakamega County
http://4.bp.blogspot.

3.2. Study Design

This study was a cross-sectional survey conducted among children aged 24-35 months in Kakamega County. According to Kate (2006), Cross-sectional studies are carried out at one time point to estimate the prevalence of the outcome of interest for a given population and sometimes carried out to investigate associations between risk factors and the outcome of interest, commonly for the purposes of public health planning.

The cross-sectional study design has been used to establish the prevalence of various conditions, treatments, services or other outcomes and the factors associated with such outcomes (Melissa, Carlson and Sean,2009**).** Since the purpose of this study was to determine the prevalence and the factors associated with uptake of MCV2 and the reasons for not being vaccinated with MCV2 among children in Kakamega County, cross-sectional study design was the most appropriate design for the survey.

3.2.1. Dependent Variable

The dependent variable studied was uptake of MCV2.

3.2.2. Independent Variables

The independent variables studied included; socio-demographic, socio-economic, family size, knowledge on immunization, time taken to reach nearest facility, coverage of other vaccines antigens that included; MCV1, pentavalent 3, OPV3, pneumococcal vaccine and vitamin A uptakes.

3.3. Study Population

3.3.1. Inclusion Criteria

The target population comprised 69,660 who were children aged 24-35 months in Kakamega County (CGOK, 2013). The study included children aged exactly 24 months on the day of interview and any age before they celebrated their third birth day. The mothers or caretakers of children who provided verbal or written informed consent were included in the study.

3.3.2. Exclusion Criteria

All children whose mothers or caretakers had mental impairment or refused to give consent to participate in the study or had not resided in Kakamega County for a period exceeding three months were excluded from the study.

3.4. Sample Size Determination

Little was known on MCV2 coverage in Kenya. However, from the WHO database, Sudan had coverage of 24%, in 2012 (WHO, 2014b). Sudan being a neighboring Country to Kenya their MCV2 prevalence of 24% with 95% confidence interval (CI) was used to determine the sample size of 561 children as shown below.

To estimate the sample size with 95% confidence, Prevalence (p)= 24%, 1-p = 76%, Z=1.96, design effect(DE) = 2, desired precision (d)= ± 0.05, the minimum number of children was

$$n_{min} = \frac{DE \times Z^2 \times p \times (1-p)}{d^2}$$

$$n_{min} = \frac{2 \times 1{,}96^2 \times 0.24 \times 0.76}{0.05^2} = \frac{1.4014}{0.0025} = 561$$

According to WHO guidelines of conducting immunization coverage cluster survey (WHO, 2005), cluster sampling is recommended with a minimum of 30 clusters (Villages). The total sample size was the product of the number of children per cluster and the total number of clusters. With a sample size of 561children each cluster will have;

Number of children per cluster = sample size ÷ number of clusters

= 561÷30 = 18.7 = 19 children per cluster, therefore a sample size of 570 children

3.5. Sampling Technique

Multi-stage cluster sampling technique was used. First; administrative wards in the County with their respective population of children aged 24-35 were listed to provide a sampling frame (Appendix 1). A sampling interval was determined by dividing the target population that was surveyed (69660) by the number of clusters (30). The sampling interval (2322) was then used in systematically selecting wards from the sampling frame. The first ward was chosen at random using computer generated random numbers (861) which was less than the sampling interval. Then subsequent wards were identified by adding the sampling interval to the running total of adding the sampling interval to the random number. Figure 3.2 illustrates the sampling procedure.

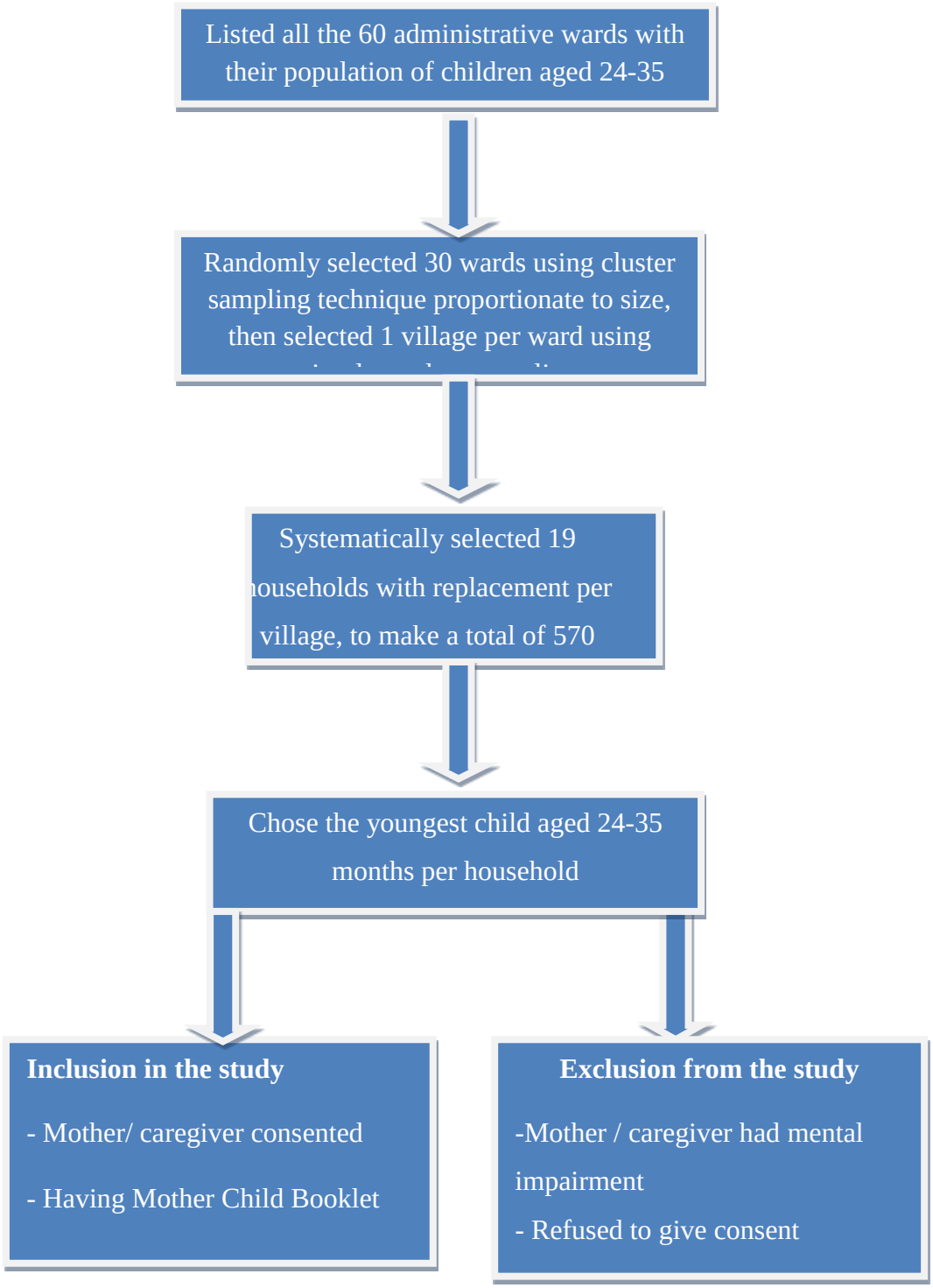


Figure 3.2 Schematic presentation of Sampling Technique

3.6. Data Collection tools

3.6.1. Socio Demographic Characteristics

Data was collected using a structured questionnaire. Five hundred and seventy-one questionnaires were administered to the child's mother or caretaker (Appendix 2: Section A). The questions included demographic and socio- economic information.

3.6.2. Immunization Coverage

Immunization coverage was measured through a checklist (Appendix 2: Section B) both by recording immunization uptake from mother child booklet and mother's history. The immunization history that was captured included: BCG, OPV3, Pentavalent 3, Pneumococcal vaccine 3, Vitamin A, MCV1 and MCV2 uptakes.

3.6.3. Factors Associated with Uptake of MCV2

The factors associated with uptake of MCV2 were captured through a structured questionnaire that was administered to the mother or caretaker of the child (Appendix 2: Section A). The variables included; socio- demographic data, socio-economic status and awareness of the mother about immunization, time taken to reach the nearest health facility among others.

3.6.4. Reasons for Not Being Vaccinated with MCV2

The reasons for failure of being vaccinated with MCV2 were determined by a questionnaire that was administered to mothers or caretakers of children who had not received MCV2. The variables were summarized into three thematic areas; Lack of information, Lack of Motivation and obstacles (Appendix 2: Section C).

3.7. Pretesting of the Data

3.7.1. Validity

The data collection tools were pretested in Buchira village which was not one of sampled villages for study. The questionnaire was given to two experts (Kakamega County

Expanded Program of Immunization Coordinator and Lurambi Sub County Public Health Nurse) who assessed content validity. Kenyatta National Hospital/University of Nairobi-Ethics and Research Committee (KNH-UoN ERC) gave their expert inputs (Appendix 4). The questionnaire was corrected appropriately in line with the objectives of the study as per the pretest results.

3.7.2. Reliability

Test-retest method was used to ascertain reliability. The questionnaires were pretested twice to the same respondents two weeks apart. Comparison in responses was done using t-test at 95% confidence level. Correlation coefficient of 0.91 was obtained which was above 0.7 which was acceptable cut off. To mitigate against inter-rater differences all questionnaires were administered by one person who was well versed with its design giving consistent results.

3.8. Data Collection

In the selected administrative wards in the County all the villages and estates were listed. Using simple random sampling 30 villages or estates were selected. A sketch map of each village was drawn and divided into four quadrants. A table of random numbers was used to determine the quadrant that was surveyed in each village.

A pen was spun on the ground from the midpoint of the selected quadrant to determine the direction of the movement before the table of random numbers was used to select the first household with an eligible child. Subsequent households were selected by moving to the left of each household without skipping until the desired number of children was reached with replacement. The youngest eligible child in the household was selected for the study. Mothers or caretakers of eligible children were interviewed (Figure 3.2).

3.9. Data Management and Analysis

Data was entered and cleaned using Ms Excel 2007 (Microsoft, Seattle, WA, USA) and analysed using EPI Info 7 (CDC, Atlanta, GA, USA) computer software. Univariate

analysis was performed where proportions were calculated for categorical variables, and means and medians for continuous variables. Bivariate analysis (i.e. Chi-square x^2) was used to determine the associations between outcome variable (MCV2 uptake) and the different exposure variables (Socio-demographic, Socio-Economic, Family size, knowledge on immunization, Time taken to reach nearest facility, coverage of other vaccines antigens that included; MCV1, Pentavalent 3, OPV3, Pneumococcal vaccine and Vitamin A).

Prevalence odds ratios were calculated at 95% confidence interval (CI), and two-tailed statistical significance was set at $p \leq 0.05$. Variables with a p-value ≤ 0.10 were subjected to multiple logistic regression model using backward elimination, dropping the least significant independent variable until all the remaining predictor variables were significant (p-value ≤ 0.05). All biologically plausible two-way interactions between variables remaining in the model were tested and retained if significant. The data was displayed using graphs, contingency tables and charts.

3.10. Ethical Consideration

The protocol was approved by the board of post graduate studies of Jomo Kenyatta University of Agriculture and Technology (JKUAT). Ethical clearance was obtained from Kenyatta National Hospital/University of Nairobi-Ethics and Research Committee (KNH-UoN ERC) (Appendix 4). The aim and procedures of the study were explained to participants who gave verbal or written consent prior to their voluntary participation in the study (Appendix 3).

Permission was sought from the Kakamega County Director of Health (Appendix 7). All the information gathered in the study was kept in confidence for the sole purpose of the research only. No names of individuals were written down at any time. Data was kept in folders, which were securely locked in cabinets for storage throughout the study period. Computer documents were password protected and only accessible to the research team. The strict data management procedures ensured confidentiality of the study subjects.

Participation in the study was voluntary and respondents had the right to withdraw from the research anytime without any victimization. The study did not exhibit the potential for harm, damage or injury both psychologically and physically whatsoever. This study provided information on immunization coverage and factors that determined the uptake of MCV2. This would be used in planning for immunization activities in Kakamega County and beyond.

3.11. Limitation

The study was a cross sectional in nature. In essence temporal sequences could not be ascertained and therefore causality was not determined.

There was also a likelihood of recall bias given the long immunization schedule. Therefore, early immunization history may not have been accurate. This limitation was addressed by sampling only children who should have been vaccinated less one year preceding the study.

CHAPTER FOUR

RESULTS

4.1. Coverage of MCV2 among Children

Of the 571 children surveyed, 293(51.3%) were female and 293(51.3%) were aged less than 30 months with median age of 29.0 months and inter-quartile range of 26.5 to 33.0 months. Among the mothers or caregivers, 533(93.3%) were aged less than 40 years with median age of 27.0 years and inter-quartile range of 24.5 to 32.5 years. In addition, 157 (27.4%), had at least secondary education, 476(83.4%) were married and 544(95.3%) of the families were Christian (Table 4.1).

Table 4.1 Proportion of Socio demographic characteristics among children in Kakamega County

Variable	Categories	N= 571 n (%)
Child sex	Male	278(48.7)
	Female	293(51.3)
Child Age	< 30 months	293(51.3)
	≥ 30 months	278(48.7)
Mother's number of Deliveries	= 1	98 (17.2)
	> 1	473 (82.8)
Birth Order	=1	141(24.7)
	≥1	430(75.3)
Age of mother	≥ 40	38(6.7)
	< 40	533(93.3)
Level of education of the mother	Secondary and above	157 (27.4)
	Primary and below	414(73.6)
Occupation of the mother	Permanent Employees	38(6.7)
	Business/ Farmers/Casual	533(93.3)
Marital status of the mother	Married	476(83.4)
	Not married	95(16.6)
Caretaker's awareness on MCV2	Yes	279(48.9)
	No	292(51.1)
Time taken to reach nearest health facility	< 30 minutes	99(17.3)
	≥ 30 minutes	472(82.7)

The corresponding vaccination coverages were: MCV2; 102 (17.9%) (95%CI = 14.9% to 21.3%), MCV1; 480(84.1%) (95%CI = 80.7% to 86.9%), OPV3; 510(89.3%) (95%CI = 86.4% to 91.7 %), Pentavalent3; 489(85.6%) (95%CI = 82.4 % to 88.4%), Pneumococcal3; 438(76.7%) (95%CI = 73.0% to 80.1%), and at least two doses of Vitamin A; 164(28.7%) (95%CI = 25.1-% to 32.7%) (Table: 4.2, Figure: 4.1). In total 16(2.8%) (95%CI= 1.7 % to 4.6%) of the children had not been vaccinated against any antigen.

Table 4.2 Immunization Coverage among Children in Kakamega County

Variable	Categories	N= 571 n (%)
Received MCV2	Yes	102(17.9)
	No	469(82.1)
Received MCV1	Yes	480(84.1)
	No	91(15.9)
Fully immunized at 1 year	Yes	370(64.8)
	No	201(35.2)
Received Pneumococcal vaccine 3	Yes	438(76.7)
	No	133(23.3)
Received Pentavalent 3	Yes	489(85.6)
	No	82(14.4)
Received OPV 3	Yes	510(89.3)
	No	61(10.7)
Received ≥ 2 doses of Vitamin A	Yes	164(28.7)
	No	407(71.3)

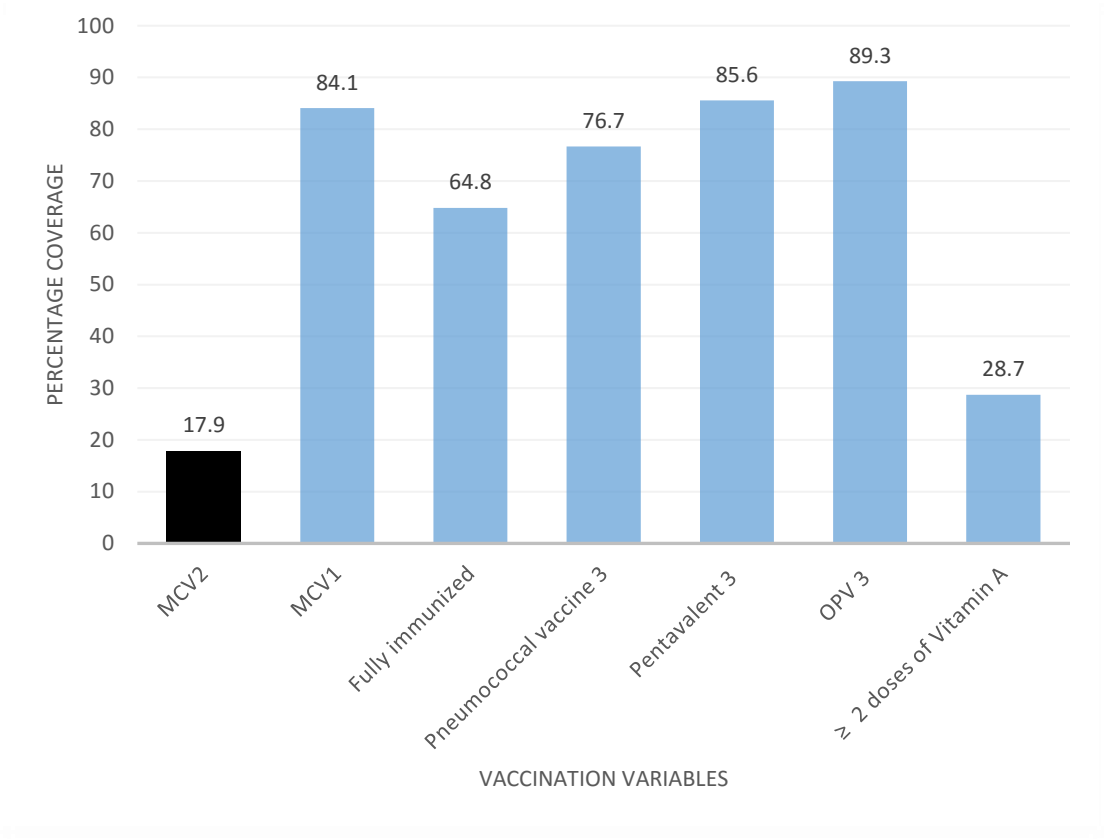


Figure 4.1 Vaccination Coverage among children aged 24-35 months in Kakamega County

4.2. Factors Associated with Uptake of MCV2

When the results of questionnaire responses were subjected to bivariate and multivariate analysis, the following factors were found to be statistically significantly associated with uptake of MCV2 with the corresponding prevalence odds ratios; mothers' or caretakers' awareness of MCV2; 14.46 (95% CI = 6.94-30.15), children who had received pentavalent3; 3.45(95% CI = 1.14-10.41), taking less 30 minutes to nearest immunizing health facility; 2.73 (95% CI = 1.50-4.96) and receiving at least two doses of Vitamin A; 4.52 (95% CI = 2.69-7.58), (Tables 4.2 and 4.3). However mothers born of one child; 2.45 (95% CI = 1.47-4.02), child being first born; 1.79(95% CI = 1.12-2.83), mothers aged over 40 years of age; 2.27 (95% CI = 1.07-4.62), mothers had at least secondary education;

1.79(95% CI = 1.13-2.82), mothers had employment; 2.59(95% CI = 1.24-5.22), children had received OPV3; 7.18(95% CI = 2.04-44.41), children had received MCV1; 4.35(95% CI = 1.83-12.43), children had received Pneumococcal3; 1.78(95% CI = 1.02-3.25) and children fully immunized at 1 year; 4.35(95% CI = 1.83-12.43) were only statistical significant on bivariate analysis with the corresponding prevalence odds ratios (Table 4.3).

Children of mothers or caretakers who were aware of MCV2 had 15 times more chances of receiving MCV2 than those whose mothers or caretakers had no knowledge of MCV2. This was because one could only utilize a service when they are aware that the service exists. The time taken to the nearest immunization post influenced the uptake of MCV2. For instance, children staying less than 30 minutes walking distance to immunization health facilities had 3.3 higher chances of receiving MCV2 than those who walked for longer time.

The probability of children receiving MCV2 was approximately 5 and 6.5 times higher in children who had received pentavalent3 and least two doses of Vitamin A respectively than in those who had not received the antigens. Previous immunization history also contributed a lot on the uptake of MCV2. From bivariate analysis uptake of OPV3, MCV1, Pneumococcal 3 and fully immunized children at one year of age were associated with uptake of MCV2 (Table: 4.3). With good previous immunization history, there were higher chances of the mothers or caretakers adhering to newly introduced intervention than when there were dropouts of immunization schedule along the way.

Table 4.3 Prevalence odds ratio for MCV2 uptake among children aged 24-35 months by risk factors in Kakamega County

Variable	Categories	MCV2		Prevalence OR (95% CI)	P- value
		YES	NO		
Child sex	Female	59	234	1.37(0.89-2.12)	0.1454
	Male	43	235		
Child Age	< 30 months	54	239	1.08(0.70-1.67)	0.7169
	≥ 30 months	48	230		
Mother's number of Deliveries	= 1	30	68	2.45(1.47-4.02)	0.0003
	> 1	72	401		
Birth Order	=1	35	106	1.79(1.12-2.83)	0.0130
	≥1	67	363		
Age of mother	≥ 40	12	26	2.27(1.07-4.62)	0.0225
	< 40	90	443		
Education level of the mother	Secondary and above	39	118	1.79(1.13-2.82)	0.0109
	Primary and below	63	351		
Occupation of the mother	Permanent Employees	13	25	2.59(1.24-5.22)	0.0065
	Business/Casual	89	444		
Marital status of the mother	Married	81	395	0.72(0.42-1.26)	0.2375
	Not married	21	74		
Caretaker's awareness on MCV2	Yes	93	186	15.65(7.99- 33.74)	0.0000
	No	9	283		
Time taken to nearest health facility	< 30 minutes	35	64	3.30(2.02-5.36)	0.0000
	≥ 30 minutes	67	405		
Received OPV 3	Yes	100	410	7.18(2.04-44.41)	0.0017
	No	2	59		
Received Pentavalent 3	Yes	98	391	4.88(1.89-16.03)	0.0009
	No	4	78		
Received Pneumococcal 3	Yes	86	352	1.78(1.02-3.25)	0.0451
	No	16	117		
Received MCV1	Yes	97	383	4.35(1.83-12.43)	0.0007
	No	5	86		
Fully immunized at 1 year	Yes	79	291	2.10(1.28-3.52)	0.0032
	No	23	178		
Received ≥ 2 doses of Vitamin A	Yes	65	99	6.54(4.14-10.44)	0.0000
	No	37	370		

Table 4.4 Multivariate analysis for most significant risk factors MCV2 uptake among children aged 24-35 months in Kakamega County

Variables	Adjusted Prevalence Odds Ratio	95% C.I.	P-Value
Mothers' /Caretakers' awareness on MCV2	14.46	6.94 -30.15	0.0000
Received Pentavalent 3	3.45	1.14-10.41	0.0281
Time taken to nearest health facility	2.73	1.50-4.96	0.0010
Received ≥ 2 doses of Vitamin A	4.52	2.69-7.58	0.0000

4.3. Reasons for Not Being Vaccinated with MCV2

Among the 469(82.1%) children who had missed to receive MCV2, 235(50.1%) were male, 239(51.0%) were aged less than 30 months and 291(62.1%) were fully immunized by the age of one year, while 186(39.7%) of their mothers or caretakers were aware of MCV2. Of the mothers 395(84.2%) were married, 282(60.1%) were aged less than 30 years, 118 (25.2%) had at least secondary education, 405(86.4%) walked for more than 30 minutes to reach the nearest immunization health facility and only 99 (21.1%) had received at least two doses of Vitamin A.

The most common reasons cited by the Mothers and caretakers for the child not receiving MCV2 were lack of awareness of the need to return for the second dose of MCV 210(44.8%) (95% CI=40.2-49.4) followed by lack of awareness of the need for immunization 67(14.3%) (95% CI=11.3-17.9). The other reasons included; fear of side reactions 25(5.3%) (95% CI=3.6-7.9), vaccine was not available 27(5.8%) (95% CI=3.9-8.4) and the mothers were too busy 25(5.3%) (95% CI=3.6-7.9) The results of these responses are shown in table 4.5.

Table 4.5 Reasons for not being vaccinated with MCV2 among Children in Kakamega

Category	Reason	N=469	
		n (%)	95% CI
Lack of information	Unaware of need to return for MCV2	210(44.8)	40.2-49.4
	Unaware of need for immunization	67(14.3)	11.3-17.9
	Fear of side reactions	25(5.3)	3.6-7.9
	Place and/or time of immunization unknown	12(2.6)	1.4-4.6
	Wrong ideas about contraindications	8(1.7)	0.8-3.5
Lack of motivation	Postponed until another time	17(3.6)	2.2-5.9
	Cultural/ religious reasons	9(1.9)	0.9-3.7
	Rumours	8(1.7)	0.8-3.5
	No faith in immunization	4(0.9)	0.3-2.3
Obstacles	Vaccine not available	27(5.8)	3.9-8.4
	Mother too busy	25(5.3)	3.6-7.9
	Family problem, including illness of Mother	17(3.6)	2.2-5.9
	Long waiting time,	9(1.9)	0.9-3.7
	Place of immunization too far	9(1.9)	0.9-3.7
	Child ill	8(1.7)	0.8-3.5
	Vaccinator absent	7(1.5)	0.7-3.2
	Time of immunization inconvenient	5(1.07	0.4-2.6
	Mistrust (specify)	2(0.4)	0.1-1.7
Total		469(100.00)	

Approximately 70% of the children who did not receive MCV2 were due to lack of the necessary information about immunization (Figure 4.2). About half of the mothers or caretakers were not aware of MCV2. This was because MCV2 was only introduced in

Kenya in the year 2013. Dissemination and social mobilization of MCV2 was not done well. This was evidenced by some of the health workers not being aware of MCV2.

More than 20% of the children who did not receive MCV2 were due obstacles such as; vaccines were not available, mothers were too busy, illness of the mothers, long waiting time at the immunizing Centre, place of immunization too far, child illness, vaccinator absence and inconvenient time of immunization.

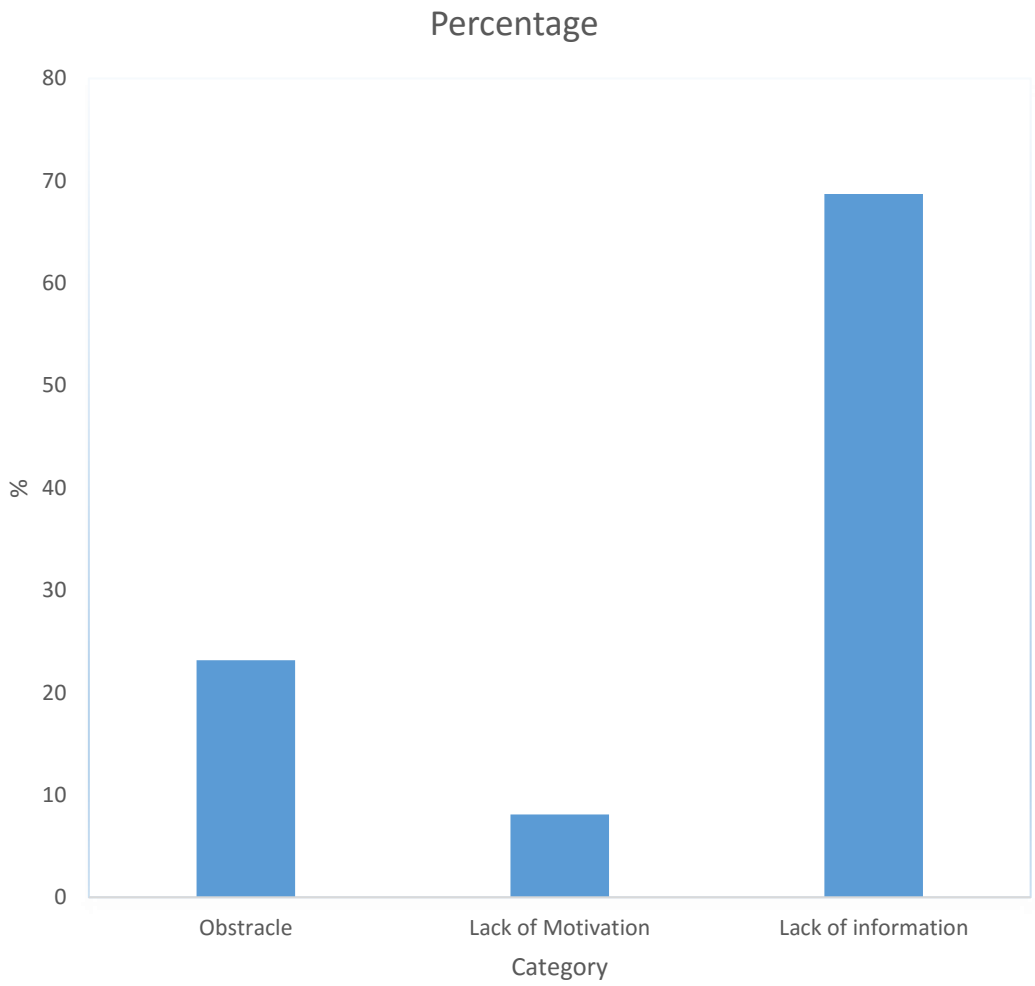


Figure 4.2 Reasons for missing MCV2 in Kakamega County

CHAPTER FIVE

DISCUSSION

5.1. Discussion

From the study MCV2 coverage in Kakamega County was 17.9%, which was very low for the effective control of measles outbreaks in the region. This low coverage could be attributed to MCV2 being new intervention in Kenya and Kakamega County RI schedule, MCV2 was only introduced into RI in Kenya in the year 2013 (MOH, 2013). Many health workers and Care takers of the children were not aware of the need of MCV2. Global coverage estimates for the MCV2 were reported for the first time in the year 2013 (WHO, 2014b). The global coverage was 35% by the end of the second year of life and 53% when including older age groups (WHO, 2014b). In Africa it was estimated at 7% (Harris *et al.,* 2014; WHO.,2014b).

In comparison with the WHO database of the year 2012, both Sudan and the Eastern Mediterranean region had reached a coverage of 24%, in the year 2012 and 2013 respectively (WHO,2014b). However, in the year 2013, MCV2 coverage was 81% in the European and 92% in the Western regions. This was partly explained by the fact that only 23% of the African region countries had included MCV2 in their RI schedule by 2013 as compared to 71% and 48% in the European and Western regions respectively (WHO, 2014b).

The low uptake of MCV2 in Kakamega County could be attributed to poor immunization trends that were happening across Kenya. According to the KDHS (2009), 77% of Kenyan children aged 12–23 months had received all recommended vaccines. However, the Kenya Demographic Health Survey 2014, showed that the proportion of children aged 12-23 months who were fully vaccinated stood at 68% nationally and 62.2% in Kakamega County (KDHS, 2014). Notwithstanding MCV1 coverage in Kenya remained at 87% in 2014(KDHS, 2014). This compared well with estimates of 86% and 87% in the year 2010 and 2011 respectively (Kebede *et al.*, 2012; UNICEF/WHO., 2013). There was stagnation

that could be attributed to devolution of health services where there was confusion between the County and National governments on who was responsible for immunization activities. The low coverage of MCV2 coupled with unchanged MCV1 coverage created a pool of unimmunized children against measles all year around. This created conducive environment for sustained measles outbreaks in the region, which further dimmed the prospect of eliminating measles within the region by 2020 (Jean *et al.,* 2012; MOH,2013).

Previous immunization history contributed a lot in the uptake of MCV2. From bivariate analysis, uptake of OPV3, Pentavalent 3, MCV1, Pneumococcal 3 and Vitamin A were associated with uptake of MCV2. However, when subjected to multivariate analysis only four factors were significant in determining the uptake of MCV2 namely; caretaker's awareness of MCV2, time taken to the nearest health facility, uptake of Pentavalent 3 and uptake of at least two doses of Vitamin A. This agreed with many studies that have shown that time or distance taken to vaccination facility and the mother's awareness of the purpose of vaccination played a big role in the utilization of immunization services (Ibnouf, *et al.,* 2007; Abdulraheem *et al.*,2011).

The children of the mothers or caretakers who were aware of MCV2 were 15 times more likely of receiving MCV2 than those whose caretakers had no knowledge of MCV2. Ibnouf *et al. (*2007) and KDHS (2009), also found that knowledge on the importance of vaccination played critical role in the uptake of MCV. These results agreed with a study conducted by Sheikh *et al.* (2014) that showed that the caretakers knowledge of the immunization increased the coverage of OPV and IPV during immunization campaigns.

The time taken to the nearest immunization post had a bearing on the uptake of MCV2. For instance, children staying within 30 minutes' walk to the immunization centre had 3.3 higher chance of receiving MCV2 than those who walk longer. This was also similar to the finding from the peer-reviewed published literature, 1999 to 2009 by WHO on epidemiology of the unimmunized child that found out that distance to services was most frequently identified as a reason for low vaccine uptake by caregivers living in rural and/or

remote communities, often in locations without a health facility or where outreach services were not conducted on a regular basis. Equally, in a few articles, duration of travel time in an urban setting was noted as a reason for low vaccine uptake (WHO, 2009b). Ibnouf, *et al.,* (2007) also noted that accessibility to services in terms of walking time and distance were key factors that influenced the utilization of healthcare services since most people would not travel further than five kilometres to basic preventive and curative care.

The results also revealed that children born of mothers with at least secondary level of education had better chances of taking their children for MCV2. These findings correlated with a number of studies that showed that children of highly educated mothers were more likely to be correctly vaccinated than children born of less educated mothers (Ibnouf *et al.,* 2007; KDHS.,2009; Lyimo,2012). However, in a study on the factors influencing childhood immunization in an urban area of Brazil, marital status, age and literacy of the mothers were not associated with use of immunization services (Barreto and Laura, 1992). In addition, a survey by Lyimo, (2012), on the uptake of measles vaccination services and associated factors among under-fives of age in Temeke District, Dar Es Salaam region, Tanzania, confirmed that the younger children were more likely to have low uptake of routine and supplementary MCV.

The sex and age of the child and marital status of the mother did not influence the uptake of MCV2 in Kakamega County. These results were consistence with a study conducted in Brazil that showed that there was no difference in coverage by sex and age of the child (Barreto *et al.,* 1992). Mothers who were aged over 40 years were more likely to take their children for MCV2 than their younger counterparts. This was comparable to a study by Ibnouf *et al.* (2007), which showed that children born of mothers older than 30 years of age were 2.17 times more likely to correctly vaccinate their children than mothers younger than 30 years old.

A first born and children without siblings had 1.79 and 2.45 more chances of receiving MCV2 respectively. This compared to KDHS (2009) finding which confirmed that birth

order was associated with the uptake of MCV1. The uptake of MCV was more than 90% among first to third born children and reduced to 71.6% among children of the birth order that was sixth and above.

The commonest cited reason for not receiving MCV2 by the Mothers or caretakers was lack of awareness of the need of MCV2. The MCV2 was only introduced into RI program about two years earlier and many people were not aware (MOH, 2013). The popular notion that vaccination ends at nine months had greatly affected uptake of MCV2. Majority of mothers stop taking their children for child welfare clinic after completion of MCV1 at the ninth month. Since MCV2 is given at the eighteenth month, mothers or caretakers were not aware of MCV2 because they presumed vaccination ended after MCV1. They could hardly get information of MCV2 because most of health messages were mostly conveyed from health facilities.

Since the devolution of health services to counties there were many of stock outs of vaccines. In addition, there was confusion between the national and county governments as to who was responsible for immunization services. This may have led to MCV being out of stock by the time when the mothers or caretakers sought for immunization services. Less than 10% of the children missed MCV2 because of lack of motivation such as mothers or caretakers postponing until some other time, cultural or religious reasons, having no faith in immunization and myths or rumours on immunization as depicted in Figure 4.2.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusion

The MCV2 coverage in Kakamega County was very low and given that the majority of those who missed MCV1 also missed MCV2 there was a likelihood of frequent measles outbreaks in the County thereby lowering the prospects for the vision of measles elimination in the region by 2020 unless a lot of emphasis is put on routine immunization.

The distance to the nearest vaccinating facility, caretaker's awareness, uptake of at least two doses of vitamin A and uptake pentavalent 3 were strongly associated with uptake of MCV2. However, the sex and age of the child and mother's marital status did not affect the uptake of MCV2. Measures need to be put in place to utilize opportunities presented during the uptake of other vaccines in creating awareness on MCV2.

The lack of information on immunization services and obstacles to immunization were the major causes of not receiving MCV2. Lack of motivation was the least determinant of missing MCV2 and most of the mothers of children aged 24 and 35 months were not aware of the need for MCV2. There is need to create awareness of MCV2 in Kakamega County.

6.2. Recommendations

1. The department of health of Kakamega County should create awareness on the importance of receiving MCV2 at 18 months since most respondents were not aware.
2. There is need to strengthen immunization outreach services in far-to-reach areas. Since distance was one of determinant of MCV2 uptake.
3. Health workers need to be encouraged to use the missed opportunities in capturing children could who have missed MCV2 and other vaccines.

6.3. Recommendations for Further Research

1. A wider study should be conducted in all the other counties and sub counties in Kenya.
2. Studies on sero-prevalence of measles immunization on children who received MCV2 should be conducted to establish the efficacy of vaccination in the region.

REFERENCES

Abdulraheem I. S., Onajole A. T., Jimoh A. A. G., and Oladipo A. R. (2011). Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *Journal of Public Health and Epidemiology,* 3(4)/194-203.

AFRO.WHO (2009). First opportunity measles vaccination routine measles immunization. Retrieved from http: //www.afro.who.int/en/clusters-a-programmes / ard/ immunization-and-vaccines-development (AFRO.WHO 2009).

Barreto T. V., and Laura C. R.(1992). Factors influencing childhood immunization in an urban area of Brazil. *Journal of Epidemiology and Community Health.* 46: 357-361.

Belmaker I., Bazarsky E., Dukhan L., Chamny S., and Rager-Zisman B. (2008). Two -dose measles immunization as a strategy to eliminate measles in the Middle East and Israel. *IMAJ*. 10:640–645.

Bielicki A. J., Achermann R., and Berger C. (2012). Timing of measles immunization and effective population vaccine coverage. *Pediatrics.* 130; 600-609.

Clemmons N.S., Gastanaduy P.A., Fiebelkorn A.P., Redd1 S.B., and Wallace G.S., (2015). Measles-United States.January *MMWR***.** 64(14),373-376

Committee on Infectious Diseases (1998). Age for routine administration of the second dose of measles-mumps-rubella vaccine. *Pediatrics.* 51; 101-129.

County Government of Kakamega (2013). *First County integrated development plan 2013-2017.*

Goodman T. (2011). Second dose of measles-containing vaccine-introduction, 10th Annual measles initiative meeting September 13-14. Retrieved from www.unicef.org/immunization/files/Note_to_media_FINAL_17-01-13

Gupta S. K., Sosler S., Haldar P., Hombergh H. V. D., and Bose A. S. (2011). Introduction strategy of a second dose measles containing vaccine in India. *Indian Pediatrics.* 48, 742-743.

Harris B. J., Marta G., Rudolf E., David W. B., and Samir V. S. (2014). Global routine vaccination coverage. *MMWR.* 63(46),1055-1058.

Ibnouf A.H., Van den Borne H.W., and Maarse J. (2007). Factors influencing immunization coverage among children under five years of age in Khartoum State, Sudan. *SA Fam Pract.*49(8),14.

Jani V. J., Schacht D. C., Jani V. I., and Bjune G. (2008). Risk factors for incomplete vaccination and missed opportunity for immunization in rural Mozambique *BMC Public Health*. 8,161.

Jean G. T. D., Malano E. R., Diallo I. T., and Sirimah C. (2012). An evaluation of the 2012 measles mass vaccination campaign in Guinea. *Pan African Medical Journal.*17,4.

Kate A. L. (2006). Study design III: Cross-sectional studies, *evidence-based dentistry.* Dental Health Services Research Unit, University of Dundee, Dundee, Scotland, UK.*7*, 24–25.

Kebede A., Ahmed H., Masresha B., Perry T. R., Burton A., Spiegel P., Blanton C., Husain F. and Goodson L. J. (2012). Measles in horn of Africa, 2010- 2011, *MMWR. 61*(34), 678-684.

Kenya Demographic Health Survey (2004). *Kenya Demographic and Health Survey 2003*. Calverton, Maryland: CBS, MOH, and ORC Macro:139

Kenya Demographic Health Survey (2009). *Kenya Demographic and Health Survey 2008-09.* Calverton, Maryland: KNBS and ICF Macro:131

Kenya Demographic Health Survey (2014). *Kenya Demographic and Health Survey, Key Indicators 2014,* Calverton, Maryland: KNBS and ICF Macro:144

Lyimo J. (2012). Uptake of measles vaccination services and associated factors among under-fives in Temeke District, Dar Es Salaam Region, Tanzania, *Muhimbili University of Health and Allied Sciences*. Thesis

Maina C. L., Karanja S., and Kombich J. (2013). Immunization coverage and its determinants among children aged 12 - 23 months in a peri-urban area of Kenya. *Pan African Medical Journal.14*(3).

Map of Kakamega County. retrieved from http://4.bp.blogspot.com/-a0IZkd5Pa0/Vd7klNzpffI/AAAAAAAAAR8/LHCsTLjeYw8 /s1600/kk.png

Masresha G. B., Kaiser R., Eshetu M., Katsande R., Luce R., Fall A. and Nshimirimana D. (2012). Progress toward measles pre-elimination - African Region, 2011–2012, 63(13);285-291.

V. D. E., Gupta S. K., and Hoekstra E. (2009). Two doses of measles vaccine reduce measles deaths. *Indian Pediatrics.46*, 933-938.

Melissa D.A., Carlson R., and Sean M. (2009). Study design, precision, and validity in observational studies. A User's Guide to Research in Palliative Care, *Journal of Palliative Medicine.* 12(1), 77–82.

Ministry of Health (2013). Measles vaccine second dose introduction in routine immunization. *A Guide for Health Workers.* 5-9

Nakia S. C., Paul A. G., Amy P. F., Susan B. R., and Gregory S. W. (2015). Measles-United States, January 4-April 2, 2015. MMWR. 64(14).373-376.

Okonko I. O., Onoja B. A., Adedeji A. O., Ogun A. A., Udeze A. O., Ejembi J., and Fowotade A. (2009). The role of vaccines in elimination and global eradication of measles: A review of literature. *African Journal of Pharmacy and Pharmacology* 3(9),413-425.

Oluwadare Christopher (2009). The social determinants of routine immunization in Ekiti state of Nigeria. *Ethno-Med*, 3(1), 49-56.

Perry T. R., Dobo G. M. , Dabbagh A., Mulders N. M., Strebel M. P., Okwo-Bele J., Rota A. P. and Goodson L. J. (2014a). Global control and regional elimination of measles, 2000–2012. MMWR. 63(05);103-107

Perry T. R., Dobo G. M. , Dabbagh A., Mulders N. M., Strebel M. P., Okwo-Bele J., Rota A. P. and Goodson L. J. (2014b). Progress toward regional measles elimination worldwide, 2000–2013. *MMWR.*64(44),1246-1251.

Regional Office for the Eastern Mediterranean (2014). Measles. Retrieved from http://www.emro.who.int/pdf/health-topics/measlesdiseaseand epidemiology

Sartorius B., Cohen C., Chirwa T., Ntshoe G., Puren A., and Hofman K. (2013). Identifying high-risk areas for sporadic measles outbreaks: lessons from South *Africa. Bull World Health Organ.* 91, 174–183.

Sheikh M. A., Makokha F.M., Abdullahi H., Gedi M., Ondrej M., Humayun K., … and Estivariz C. F.(2014). Combined use of inactivated and oral poliovirus

vaccines in refugee camps and surrounding communities- Kenya, December 2013. *MMWR.* 63(11), 237-241**.**

Sodha V. S. (2012). Global routine vaccination coverage, 2011. *MMWR***.** *61*(43), 883-885.

Telma R. A., Joana C. R., Mateus D., Tanya W. B., Michael F., and Kelli C. (2013). Factors limiting immunization coverage in urban Dili,Timor-Leste, Global Health: *Science and Practice. 1*(3), 417–427

Uzicanin A., and Zimmerman L. (2011). Field effectiveness of live attenuated measles-containing vaccines: a review of published literature. *The Journal of Infectious Diseases.* 204, 133-149.

World Health Organization (2001). Measles mortality reduction and regional elimination strategic plan 2001-2005. Retrieved from http://www.who.int/immunization/diseases/WHO_UNICEF_Measles_Emergencies

World Health Organization (2005). Immunization coverage cluster survey - Reference manual. Geneva: World Health Organization; *WHO/IVB.*04.23

World Health Organization (2009a). Measles vaccines: WHO position paper? *Weekly epidemiological record.* 84,349–60

World Health Organization (2009b). Epidemiology of the unimmunized child, findings from the *Peer-Reviewed Published Literature,* 1999 – 2009. Retrieved from www.who.int/immunization/.../CDC_UNVACC_REPORT

World Health Organization (2010). Global eradication of measles, *Report by the Secretariat,* 2010. *Weekly epidemiological record*. 87, 45–52

World Health Organization (2012a). Global Measles and Rubella Strategic *Plan 2012–2020*. Retrieved from whqlibdoc.who.int/.../2012/9789241503396

World Health Organization (2012b). Progress in global measles control, 2000–2010, *Weekly epidemiological record.* 87(5) 45–52.

World Health Organization (2013). A guide to introducing a second dose of measles vaccine into routine immunization schedules. *WHO/IVB.* 13.03

World Health Organization (2014a). Global control and regional elimination of measles, 2000–2012, *Weekly epidemiological record.*89,45–52

World Health Organization (2014b). Global routine vaccination coverage, 2013, *Weekly epidemiological record.* 89, 517–528

World Health Organization/ United Nations Children's Fund (2006). Joint statement, global plan for reducing measles mortality 2006-2010. Retrieved from http://www.unicef.org/media/files/globalplan.pdf

APPENDICES

Appendix 1 List of Sub-Counties, wards and Villages selected for the study

Sub -County	Ward	Projected Children Aged 24-35 Months	Accumulative Projected Children Aged 24-35 Months in 2015	Villages Selected Number	Villages Selected
Lugari	Mautuma	1052	1052	1	Mlimani North
	Lugari	1317	2369		
	Lumakanda	1257	3626	2	Bondeni
	Chekalini	827	4453		
	Chevaywa(Matete)	1390	5843	3	Kukusi
	Lwandeti	1164	7007		
Likuyani	Likuyani	1142	8149	4	Ivungwi
	Sango	959	9108		
	Kongoni	994	10102		
	Nzoia	1271	11373	5	Bondeni 'B'
	Sinoko	881	12254		
Malava	West Kabras (Burundi)	1095	13349	6	Shisini
	Chemuche	1248	14597		
	East Kabras	950	15547	7	Kimang'eti B
	Chegulo	1337	16884		
	Manda-Shivanga	1351	18235	8	Mahusi
	Shirugu-Mugai	1051	19286		
	South Kabras	1574	20860	9	Shilongo
Lurambi	Butsotso East	974	21834	10	Shitoto

	Butsotso South	729	22563		
	Butsotso Central	1079	23642		
	Shieywe	2026	25668	11	Lwatingu B
	Mahiakalo	506	26174		
	Shirere	1406	27580	12	Mudiri/AP Camp
Navakholo	Ingotse-Matiha	927	28507		
	Shinoyi-Shikomari-Esumeiya	1063	29570	13	Naluchira
	Bunyala West	1611	31181	14	Kaunda A
	Bunyala East	928	32109		
	Bunyala Central	1225	33334		
Shinyalu	Kambiri	986	34320	15	Mukango
	Murhanda	1187	35507		
	Isukha Central (Shibuye)	1449	36956	16	Lugala
	Isukha South (Khayega)	1502	38458	17	Liabarende
	Isukha East	752	39210		
	Isukha West	814	40024		
Ikolomani	Idakho South (Eregi)	877	40901	18	Shivakala
	Idakho East	1123	42024		
	Idakho North(Shimanyiro)	1085	43109	19	Imulama

	Idakho Central	1305	44414		
Mumias West	Mumias Central	1561	45975	20	Mululi
	Mumias North	662	46637		
	Etenje	1182	47819	21	Ebuyenjere
	Musanda	1289	49108		
Mumias East	Lusheya-Lubinu	1578	50686	22	Mwikunda
	Malaha-Isongo-Makunga	1300	51986	23	Ematietie
	East Wanga	1357	53343		
Matungu	Koyonzo	1503	54846	24	Koyonzo A
	Kholera	1208	56054		
	Khalaba	830	56884	25	Lutasio B
	Mayoni	1283	58167		
	Namamali	1324	59491	26	Mukunyuku A
Butere	Marama West	1311	60802		
	Marama Central	1876	62678	27	Shamache
	Marenyo-Shianda	968	63646	28	Mulukhuna
	Marama North	872	64518		
	Marama South	837	65355		
Khwisero	Kisa North	809	66164	29	Emuruba
	Kisa East	835	66999		
	Kisa West	891	67890		
	Kisa Central	1770	69660	30	Mushiangubu
	Total	**69660**			

Appendix 2 Household Questionnaire

MCV2 February 2015

Sub County: ……. Village..... Cluster No…… HH No.....

Date: _ _ /_ _ / 2015 Interviewer: .....

Once the parents have accepted participating in the survey, fill out the following information for a child aged 24-35 months. For questions with several options, CIRCLE the correct answer.

Section A: Family Background

A1. Interviewee relationship: Mother / Father / Grandmother /Grandfather /Aunt/ Uncle/ Sibling > 18years

A2: Mother's Age: _____

A3: The mother's highest level of formal education reached? No education / Primary / Secondary / Tertiary and above

A4: What is the mother's occupation? / Farmer /Business / Professional/ Casual labourer / None

A5: What is the mother's average monthly income in Kenya shillings? < 5000 / 5000-10000 / 10001-20000/ 20001-50000/ >50000

A6: Marital status of the mother? Married/Single/ Separated/ Divorced/ Widowed

A7: Number of children born by the mother? …….. How many are alive…….?

A8: Have you heard about Vaccination of children? Yes / No

A9: are you aware that children are being given the second dose of measles vaccine from 18 month of age? Yes / No

A9a: If Yes' how did you learn about the dose? Health workers / Religious leader/Local Leader / Neighbour / Megaphone /Radio /Television/ Not Applicable

A10: On foot how long do you take to reach the nearest immunization post? _____minutes

A11: Who manages the immunization post? Government / Faith Based Organization/ Private/ Don't Know

A12: Where was the child delivered? Home / Hospital

A13: What is the child's age in months: _____

A14: What is the child's birth order: _____

A15: Child's Sex: Male / Female

A16: Did the mother attend antenatal clinic visit during the child's pregnancy? Yes / No / Don't Know / Not Applicable

A17: Did the mother get Tetanus Toxoid vaccine during the child's pregnancy? Yes / No / Don't Know / Not Applicable

A18: Mother's religion? Christian / Muslim / Cult / None / Others Specify ……

Section B: Ask the interviewee to bring the mother Child Booklet for the youngest child aged 24-35 months and ask the following questions.

B1: Mother Child Booklet Available? Yes / No

B2: Child immunization: Card / History / Both

Child Immunization Form

Antigen	**Status**	**Date given**
BCG	Yes / No	
MCV2	Yes / No	
MCV1	Yes / No	
Pentavalent 3	Yes / No	
Pneumococcal 3	Yes / No	
OPV 3	Yes / No	
Vitamin A at 6 Momths	Yes / No	
Vitamin A at 12 Momths	Yes / No	
Vitamin A at 18 Momths	Yes / No	
Vitamin A at 24 Momths	Yes / No	

B 3: Has your child ever suffered from measles? Yes/No/Don't knowledge, if yes at what age? ….

Section C: Reasons for Measles Second Dose Immunization Failure

Note: Ask only one question 'why the child was not given second dose of measles vaccine and circle appropriately.

Category	Reason
Lack of information	Unaware of need for immunization
	Unaware of need to return for second dose
	Place and/or time of immunization unknown
	Fear of side reactions
	Wrong ideas about contraindications
Lack of motivation	Postponed until another time
	No faith in immunization
	Rumours
	Cultural/ religious reasons
Obstacles	Place of immunization too far
	Time of immunization inconvenient
	Vaccinator absent
	Vaccine not available
	Mother too busy
	Family problem, including illness of Mother
	Child ill
	Long waiting time,
	Mistrust (specify)

Appendix 3 Consent Form

STUDY PARTICIPATION CONSENT FORM
UPTAKE OF THE SECOND DOSE OF MEASLES-CONTAINING VACCINE AMONG CHILDREN IN KAKAMEGA COUNTY, KENYA

Name and contacts of Principal Investigator
Mr. Fredrick Mike Makokha
Kenya Field Epidemiology and Laboratory Training Program
P.O.Box 2309-50100
Kakamega
Tel; 0719-551-047
E-mail ; makokhamf@gmail.com

Investigators' Statement: We are requesting you to be in a research study. The purpose of this consent form is to give you the information you will need to help you decide whether to be in the study or not.

Please read this form carefully or listen as it is read to you. You may ask questions about what we will ask you to do, the risks, the benefits and your rights as a volunteer, or anything about the research or in this form that is not clear.

If you wish we will give you a copy of this form for your records. You are free to refuse to participate and to withdraw from the study at any time without penalty or loss of benefits.

Purpose and Benefits: The aim of this study is to determine the coverage, the factors associated with uptake of second dose of measles – containing vaccine and the reasons for not being vaccinated among children in Kakamega County. This study will benefit both

the National and Kakamega County government by identifying factors that determine utilization or lack of utilization of second dose of measles vaccination so that the information would be used planning and management of immunization services. You can take part in this study if your child is aged 24-35 months and you have been residing in the county for more than three months.

Procedures: This is what will happen if you decide to participate in this study. I will ask several questions regarding you and your child. I will also check your child's Mother Child Booklet to confirm dates when your child was vaccinated.

Risks, Stress, or Discomfort: You may become embarrassed, worried, or anxious because of some of the questions you will be asked. Participation in the study will require you to commit your time. Completing the questions will take 15-20 minutes. However, I will try to serve you as quickly as possible.

Compensation: There will be no compensation for participation in the study.

Confidentiality: Your confidentiality will be maintained at all times. The questionnaires will not have any names but will be assigned unique Identifiers. The filled questionnaires will be stored in a lockable filing cabinet only accessible to the principal investigator and research assistants.

Electronic data will be stored in a password protected database accessible only through the principal investigator. The analysis and report of the study will only use the study numbers and no detail will be provided at any point that might identify an individual.

There shall be no mention of names or identifiers in the report or publications which may arise from the study. The information obtained will be used only for the purpose of the study

Your participation in the study will be highly appreciated.

Signature of investigator _____Date_____

Name of Investigator_____

Subject's statement:

This study has been explained to me. I volunteer to take part in this research. I have had a chance to ask questions. If I have questions about my rights as a research subject, I can call the University of Nairobi Ethics and research Committee at (254-020)2726300 Ext 44355. I will receive a copy of this consent form.

Signature of subject _____Date _____
or
Left thumbprint of subject _____Date_____

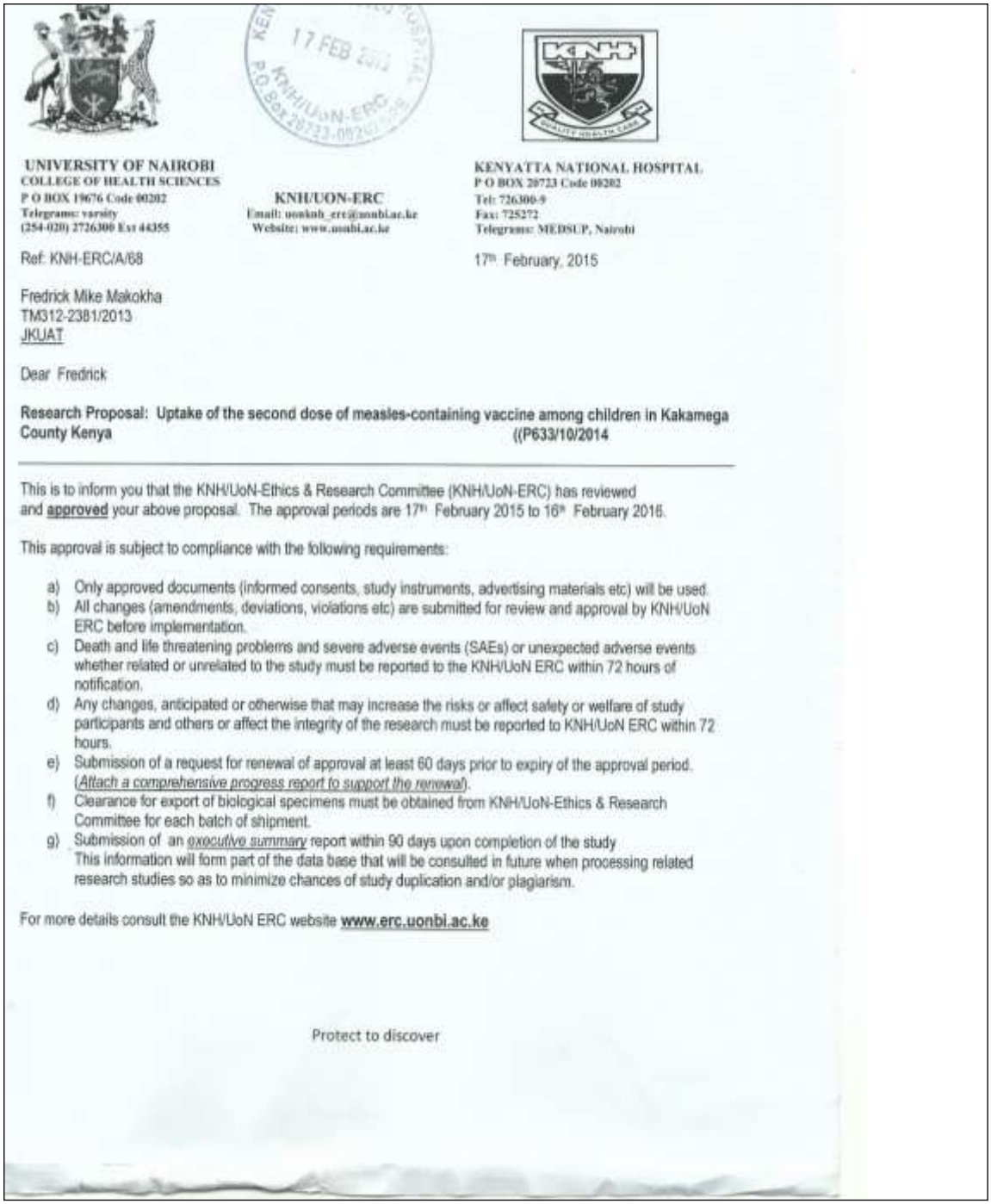
Name of Subject_____

Signature of witness (If thumbprint used)_____

Name of Witness_____

In case of any ethical concerns please contact
KNH/ UON-ERC
PO BOX 19676 Nairobi (code 00202)
Telephone number (254-020)2726300 Ext 44355

Appendix 4 Ethics Review Committee Approval



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

KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke

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

Ref: KNH-ERC/A/68

17th February, 2015

Fredrick Mike Makokha
TM312-2381/2013
JKUAT

Dear Fredrick

Research Proposal: Uptake of the second dose of measles-containing vaccine among children in Kakamega County Kenya ((P633/10/2014

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 17th February 2015 to 16th February 2016.

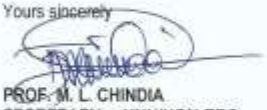
This approval is subject to compliance with the following requirements:

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

For more details consult the KNH/UoN ERC website **www.erc.uonbi.ac.ke**

Protect to discover

Yours sincerely



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

c.c. The Principal, College of Health Sciences, UoN
The Deputy Director CS, KNH
The Assistant Director, Health Information, KNH
The Chairperson, KNH/UON-ERC
Supervisors: Prof. Helen Lydiah Kutima, Dr. Paul Mutebi Wanjala

Appendix 5 Certificate of Publication

International Journal of Scientific and Research Publications
ISSN 2250-3153

www.ijsrp.org

Certificate of Publication

This is to certify paper titled **"Uptake of Second Dose of Measles-Containing Vaccine among Children in Kakamega County, Kenya"** submitted by Author(s) **F. M. Makokha, P. M. Wanjala, J. Githuku, and H. L. Kutima** has been published for July 2015, Volume 5, Issue 7 online publication under ISSN 2250-3153.

Signed by:

[J. Prakash]
Publication Head,
IJSRP Inc. Email:
editor@ijsrp.org
www.ijsrp.org

Appendix 6 Publication

International Journal of Scientific and Research Publications, Volume 5, Issue 7, July 2015 1
ISSN 2250-3153

Uptake of Second Dose of Measles- Containing Vaccine among Children in Kakamega County, Kenya

F. M. Makokha[1, 2, 3], P. M. Wanjala [4], J. Githuku[2, 3], and H. L. Kutima[1]

[1] Jomo Kenyatta University of Agriculture and Technology (JKUAT)
[2] Field Epidemiology and Laboratory Training Program (FELTP)
[3] Ministry of Health Kenya (MOH)
[4] University of Eldoret

Abstract- Measles is a major cause of death and complications among young children worldwide despite the availability of a safe and effective vaccine. Per annum over 158,000 cases of measles mortality are reported globally, especially in Africa and Asia. In Kenya, 59 per a million measles incidence were reported in 2011. Approximately 80.1 % of the children aged less than 5 years receive a first dose of measles-containing vaccine in Kakamega County. In 2013 a second dose of measles-containing vaccine was introduced in the routine immunization system. A cross-sectional survey was conducted to determine the coverage of second dose of measles-containing vaccine among children in Kakamega County. Thirty clusters were selected using probability proportional to size with replacement, 19 households were surveyed per cluster and data of the youngest child aged between 24-35 months collected. Among the 571 children surveyed, the coverage of second dose of measles-containing vaccine was 102 (17.9%) (95%CI = 14.9% to 21.3%).The caretaker's awareness of the second dose of measles-containing vaccine, time taken to the nearest health facility, uptake of Pentavalent 3 and uptake of at least two doses of Vitamin A was significantly associated with the uptake of the second dose of measles-containing vaccine, p-value of 0.0000, 0.0010, 0.0281 and 0.0000respectively. The second dose of measles-containing vaccine coverage in Kakamega is very low, strategies focusing on demand creation, conducting outreach services in hard-to-reach areas and ensuring that there are no missed opportunities should be put in place to increase utilization of the second dose of measles-containing vaccine across the County.

Index Terms- Children in Kakamega County, Kenya, Measles-containing vaccine, uptake

I. Introduction

Measles is a highly contagious, acute viral illness that can lead to complications such as pneumonia, encephalitis, and death (1,2). Almost all non-immune children contract measles if exposed to infection. Measles kills more children than any other vaccine-preventable disease. Measles is a worldwide major cause of death and complications among young children despite the availability of a safe and effective vaccine. Per annum over 158,000 measles mortalities are reported globally, especially in Africa and Asia (2).

An effective measles vaccine has been available since the 1960s, and all countries offer measles-containing vaccine (MCV) in tandem with immunization program (3). Since 2000, deaths due to measles have decreased by 78 percent globally. However measles outbreaks are still common in many developing countries, particularly in parts of Africa and Asia as a result of sub-optimal implementation of immunization strategies (3). Measles remains a public health concern in Kenya. It contributes significantly to the burden of disease among children aged less than 5 years (4).

According to Kenya Demographic Health Survey (KDHS) (7, 14), 85.0% in 2009 and 87.9% in 2014 of Kenyan children aged 12–23 months had received first dose of measles-containing vaccine (MCV1). Similarly administrative coverage of MCV1 was 86% in 2010 and 87% in 2011 in Kenya (5). This was a steady increment as compared to 2003 when the coverage of MCV1 in Kenya was 46.4% (6). The MCV1 coverage in the former Western province, where Kakamega County is located was estimated at 77.7% in 2009 (7) and 80.1% in 2014 (14).

In 2009, the World Health Organization (WHO) recommended that all children under 5 years of age in countries where MCV1 coverage was more than 80% for three consecutive years should receive a second dose of measles-containing vaccine (MCV2) in their routine immunization (RI) schedule (8). The rationale for providing a second opportunity for measles vaccination is two-fold: First to immunize the primary vaccine failures among children who did not respond to MCV1 and second is to vaccinate those children who were missed out by routine services (9). In line with the WHO recommendation Kenya introduced MCV2 in RI in 2013 (4). Apart from administrative coverage that is reported routinely by all the immunization points in the county, little was known on the population coverage. Therefore, this study set out to determine the uptake and factors associated with its uptake of MCV2 in Kakamega County, Kenya.

II. Materials and Methods

Study site

Kakamega County is the second most highly populous county among the 47 counties in Kenya, with projected 2015 population was 1,929,401 of which about 4 % being children aged 24-35 months old. It is located in Western Kenya about 30km north of the Equator, at Latitude and Longitude of 0°275° N, 34°757°E respectively. The County boarders Vihiga County to the South, Busia and Siaya Counties to the West, Bungoma and Trans Nzoia Counties to the North, Uasin Gishu to the North East and Nandi County to the East. The county covers an area of approximately 3050.3 km^2. Administratively the County consists of sixty wards and twelve sub- Counties (10).

Sample and Sampling Technique

A sample of 571 children was surveyed as per the WHO guidelines of conducting immunization coverage survey. Multi-stage cluster sampling technique was used by selecting 30 clusters (Villages) and then 19 children aged 24-35 selected from each village (11).

Data Processing and Analysis

Data was entered and cleaned using MS Excel 2007 (Microsoft, Seattle, WA, USA) and analysed using EPI Info 7 (CDC, Atlanta, GA, USA) computer software. Univariate and bivariate analysis were calculated. Prevalence Odds Ratios at 95% confidence interval (CI) were used to assess measure of association between variables. P-value of = 0.05 was considered significant. Factors with a p-value = 0.10 were subjected to multiple logistic regression model using backward elimination, dropping the least significant independent variable until all the remaining predictor variables were significant (p-value = 0.05). All biologically plausible two-way interactions between variables remaining in the model were tested and retained if significant.

III. Results

Coverage of MCV2 among Children

Of the 571 children surveyed, 293(51.3%) were female and 293(51.3%) were aged less than 30 months with median age of 29.0 months with inter-quartile range of 26.5 to 33.0 months, 533(93.3%) of the mothers were aged less than 40 years with median age of 27.0 years with inter-quartile range of 24.5 to 32.5 years, 157(27.4%) of the mother had at least secondary education. The corresponding vaccination coverage was 102 (17.9%) (95%CI = 14.9% to 21.3%), 480(84.1%) (95%CI = 80.7% to 86.9%), 510(89.3%) (95%CI = 86.4% to 91.7 %), 489(85.6%) (95%CI = 82.4 % to 88.4%), 438(76.7%) (95%CI = 73.0% to 80.1%), and 164(28.7%) (95%CI = 25.1-% to 32.7%) for MCV2, MCV1, OPV3, Pentavalent3, Pneumococcal3 and at least two doses of Vitamin A respectively (Table 1). 16(2.8%) (95%CI= 1.7 % to 4.6%) had not been vaccinated against any antigen.

Table 1: Coverage for MCV2 among children aged 24-35 months by risk factors

Variable	Categories	N= 571 n (%)	95% CI
Child sex	Male	278(48.7)	44.5-52 9
Child Age	< 30 months	293(51.3)	47.1-55 5
Number of Deliveries	> 1	473 (82.8)	79.3-85 8
Birth Order	=1	430(75.3)	71.5-78 8
Age of mother	< 40	533(93.3)	90.9-95 2
Level of education of the mother	Secondary and above	157 (27.4)	23.8-31 3
Occupation of the mother	Business/ Farmers/Casual	533(93.3)	90.9-94 2
Marital status of the mother	Married	476(83.4)	80.0-86 3
Caretaker's awareness on MCV2	Yes	279(48.9)	44.7-53 0
Time taken to nearest health facility	< 30 minutes	99(17.3)	14.4-20 8
Received OPV 3	Yes	510(89.3)	86.4-91 7
Received Pentavalent 3	Yes	489(85.6)	82.4-88 4
Received Pneumococcal vaccine 3	Yes	438(76.7)	73.0-80 1
Received MCV1	Yes	480(84.1)	80.7-86 9
Fully immunized at 1 year	Yes	370(64.8)	60.7-68 7
Received MCV2	Yes	102(17.9)	14.9-21 3
Received = 2 doses of Vitamin A	Yes	164(28.7)	25.1-32 7

Factors Associated With Uptake of MCV2

Multivariate analysis showed that only caretaker's awareness of MCV2, time taken to the nearest health facility, uptake of Pentavalent3 and two or more doses of Vitamin

A were significantly associated with uptake of MCV2 (Table 2). However factors such as uptake of MCV1, and oral polio vaccine 3 were also significant in bivariate analysis.

Table 2: Multivariate Analysis for most significant risk factors MCV2 uptake among children aged 24-35 months

Term	Odds Ratio	95% C.I.	P-Value
Caretaker aware of MCV2	14.5	6.9 -30.2	0.0000
Received Pentavalent 3	3.5	1.1-10.4	0.0281
Time taken to nearest health facility < 30min	2.7	1.5-5.0	0.0010
Received = 2 doses of Vitamin A	4.5	2.7-7.6	0.0000

IV. Discussion

Global coverage estimates for the MCV2 were reported for the first time in 2013.The global coverage was 35% by the end of the second year of life and 53% when including older age groups, and in Africa it was estimated at 7% (12, 13). Therefore the MCV2 coverage of 17.9% in Kakamega County is comparable to coverage in developing world given that the MCV2 was only introduced into RI in Kenya in 2013 (4). For instance both Sudan in 2012 and Eastern Mediterranean region in 2013 had coverage of 24% (13). However in 2013, MCV2 coverage was 81% in European and 92% in Western regions. This could be partly explained by the fact that only 23% of the countries in the African region had included MCV2 in their RI system by 2013 as compared to 71% and 48% in European and Western regions respectively (13).

The low uptake of MCV2 in Kakamega County could also be attributed to poor immunization trends witnessed across the Country. According to the KDHS (7), 77% of Kenyan children aged 12–23 months had received all recommended vaccines. However, KDHS(14) shows that only 68% and 62.2% of children age 12-23 months were fully vaccinated nationally and in Kakamega County respectively (14). However, MCV1 coverage in the country remained at a high of 87% in 2014(14). This was similar with estimates of 85% in 2010 and 87% in 2011 (5, 15). This stagnation could be attributed to devolution of health services in 2013, where some health indicators declined. This low uptake of MCV2 coupled with unchanged coverage of MCV1 creates a pool of children without immunity against measles infection. This is a precondition for major measles outbreaks in the region. This also dims the prospect of eliminating measles in the region by 2020.

From bivariate analysis sex and age of the child and marital status of the mother did not influence the uptake of MCV2 in Kakamega County. This is similar to a study conducted in Brazil that showed that there was no difference in coverage by sex and age of the child (16). Children of the caretakers who were aware of MCV2 had 15 times more chances of receiving MCV2 than those whose caretakers had no knowledge of MCV2; this is collaborated with Ibncuf, Borne *et al.* (17) and KNBS (7) that showed that knowledge on the importance of vaccination played a role in the uptake MCV.

Time taken to the nearest immunization post was associated with the uptake of MCV2. For instance children stay within 30 minutes walk to the immunization centre had 3.3 better chances of receiving MCV2 than those who walk for longer. Previous immunization history also contributed a lot in the uptake of MCV2. From multivariate analysis only four factors were significant in determining the uptake of MCV2 namely; caretaker's awareness of MCV2, time taken to the nearest health facility, uptake of Pentavalent 3 and uptake of at least two doses of Vitamin. This agrees with many studies that have shown that time or distance taken to vaccination facility and the mother's awareness of the purpose of vaccination play a big role in the utilization of immunization services (17, 19).

V. Conclusion

The MCV2 coverage in Kakamega is very low and given that the majority of those who missed MCV1 also missed MCV2 there is likelihood of recurrent measles outbreaks in the County. Which means the vision of measles elimination by 2020 will remain a mirage. The distance from immunizing facilities, caretakers awareness, uptake of at least two doses of vitamin A and pentavalent 3 were the main determinants of receiving MCV2.

VI. Recommendations

Kakamega County needs to put in place strategies that focus on demand creation for MCV2, outreach services in hard-to-reach areas and utilizing the missed opportunities in order to maximize uptake of MCV2 in the County.

Acknowledgments

The authors are grateful to the FELTP-Kenya and MOH-Kenya for their financial and technical support in the development and finalization of this article. We also acknowledge the field guides who spent their precious time by walking with us from house to house, introducing research us to caregivers in all the villages.

Competing interest: The authors declare that there are no conflicts of interests regarding the publication of this article.

References

[1] Nakia S. C., Paul A. G., Amy P. F., Susan B. R. and Gregory S. W. (2015) Measles-United States, January 4-April 2, 2015. MMWR, April 17, 2015 Weekly / Vol. 64 / No. 14

[2] EMRO (2014). Retrieved from http://www.emro.who.int/pdf/health-topics/measles/disease-and- epidemiology. pdf?ua=1, Wednesday 21st of May 2014 08:07:13 PM

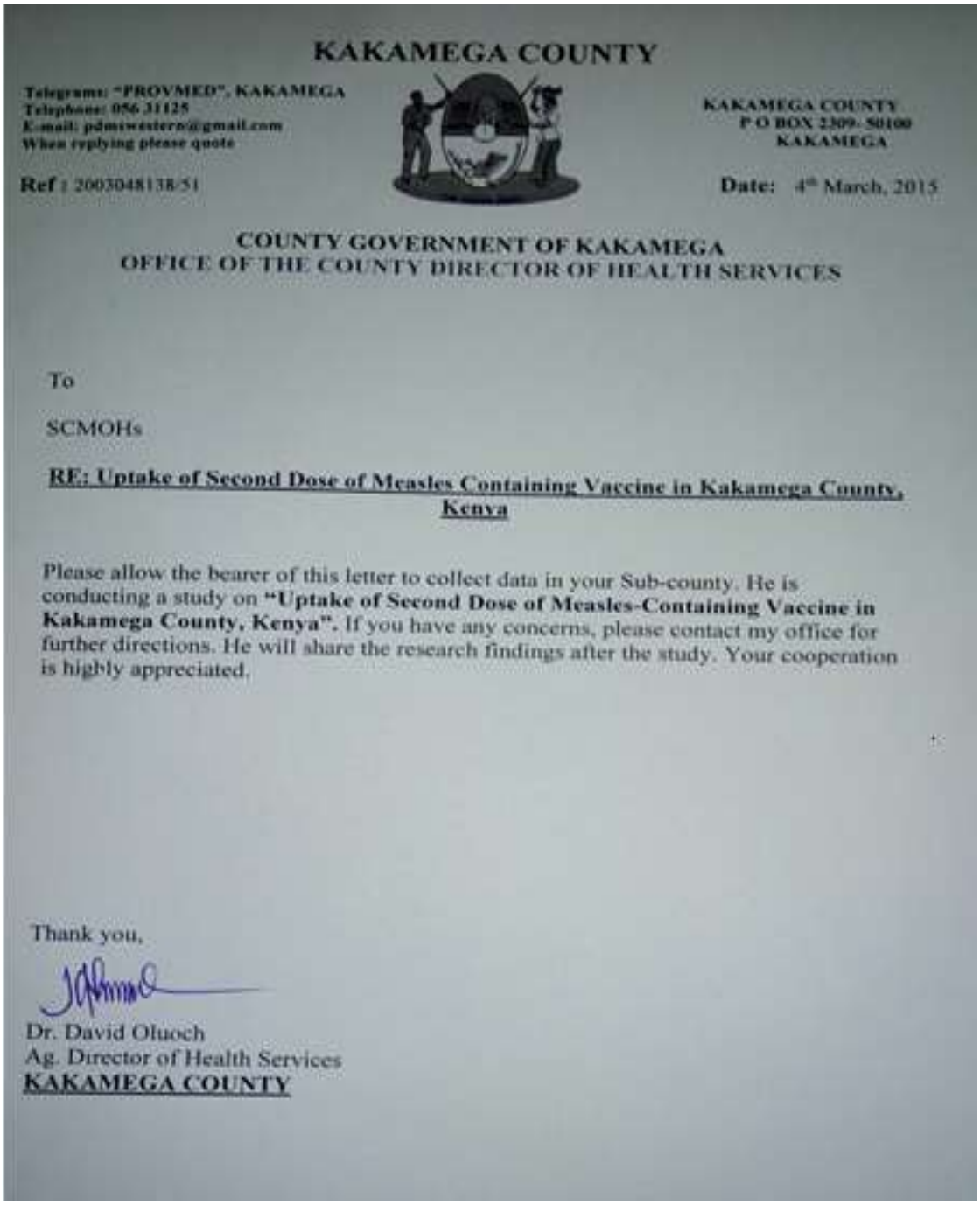
[3] WHO (2009). Measles vaccines: WHO position paper? Weekly epidemiological record 84:349–60, no. 35, 28 august 2009
[4] MOH (Kenya) (2013). Measles vaccine second dose introduction in routine immunization. A Guide for Health Workers. MOH, Division of Vaccines and Immunization, July 2013.
[5] Kebede A., Ahmed H., Masresha B., Perry T R., Burton A., Spiegel P., Blanton C., Husain F. and Goodson L. J. (2012). Measles - Horn of Africa, 2010- 2011, MMWR / August 31, 2012 / Vol. 61 / No. 34
[6] Central Bureau of Statistics (CBS), Ministry of Health (MOH), and ORC Macro. 2004. Kenya Demographic and Health Survey 2003. Calverton, Maryland: CBS, MOH, and ORC Macro.
[7] Kenya National Bureau of Statistics (KNBS) and ICF Macro. 2010. Kenya Demographic and Health Survey 2008-09. Calverton, Maryland: KNBS and ICF Macro.
[8] WHO (2012). Progress in global measles control, 2000–2010, Weekly epidemiological record, No. 5, 3 February 2012
[9] Gupta S. K., Sosler S., Haldar P., Hombergh H. V. D. and Bose A. S. (2011). Introduction strategy of a second dose measles containing vaccine in India. Indian Pediatrics Volume 48__May 17, 2011
[10] County Government of Kakamega (CGOK) (2013). First County integrated development plan 2013-2017.
[11] WHO (2005). Immunization coverage cluster survey - Reference manual. Geneva: World Health Organization; WHO/IVB/04.23 Printed: June 2005
[12] Harris B. J., Marta G., Rudolf E., David W. B., Samir V. S.(2014). Global routine vaccination coverage, 2013, MMWR November 21, 2014 / 63(46);1055-1058
[13] WHO (2014). Global routine vaccination coverage, 2013, Weekly epidemiological record. No. 47, 2014, 89, 517–528 21 NOVEMBER 2014
[14] Kenya National Bureau of Statistics (KNBS) and ICF Macro (2015). Kenya Demographic and Health Survey, Key Indicators 2014, Calverton, Maryland: KNBS and ICF Macro.
[15] UNICEF/WHO (2013). Immunization summary a statistical reference containing data through 2011. UNICEF, New York, NY 10017, USA November 2012
[16] Barreto T. V., Laura C. R.(1992). Factors influencing childhood immunization in an urban area of Brazil. Journal of Epidemiology and Community Health 1992; 46: 357-36
[17] Ibnouf A.H., Van den Borne H.W., and Maarse J. (2007). Factors influencing immunization coverage among children under five years of age in Khartoum State, Sudan. SA Fam Pract 2007;49(8):14
[18] Lyimo J. (2012). Uptake of measles vaccination services and associated factors among under fives in Temeke District, Dar Es Salaam Region, Tanzania. Unpublished MSc. thesis, Muhimbili University of Health and Allied Sciences
[19] Abdulraheem I. S., Onajole A. T., Jimoh A. A. G., and Oladipo A. R. (2011). Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. Journal of Public Health and Epidemiology Vol. 3(4), pp. 194-203, April 2011

AUTHORS

First Author – Fredrick Mike Makokha, BScN, JKUAT, FELTP, MOH, makokhamf@gmail.com
Second Author – Dr. Paul Mutebi Wanjala, Ph.D , Eldoret University, p_mutebi@yahoo.com
Third Author – Dr. **Jane Githuku**, MD, FELTP, MOH, jgithugu@feltp.or.ke
Fourth Author– Prof. Helen Lydia Kutima, Ph.D, JKUAT, hkutima@yahoo.com

Correspondence Author – Fredrick Mike Makokha, makokhamf@gmail.com, makokhamf@yahoo.com +254719551047

Appendix 7 Introduction letter from County Health Department



KAKAMEGA COUNTY

Telegrams: "PROVMED", KAKAMEGA
Telephone: 056 31125
E-mail: pdmswestern@gmail.com
When replying please quote

KAKAMEGA COUNTY
P O BOX 2309- 50100
KAKAMEGA

Ref : 2003048138/51

Date: 4th March, 2015

COUNTY GOVERNMENT OF KAKAMEGA
OFFICE OF THE COUNTY DIRECTOR OF HEALTH SERVICES

To

SCMOHs

RE: Uptake of Second Dose of Measles Containing Vaccine in Kakamega County, Kenya

Please allow the bearer of this letter to collect data in your Sub-county. He is conducting a study on **"Uptake of Second Dose of Measles-Containing Vaccine in Kakamega County, Kenya"**. If you have any concerns, please contact my office for further directions. He will share the research findings after the study. Your cooperation is highly appreciated.

Thank you,

Dr. David Oluoch
Ag. Director of Health Services
KAKAMEGA COUNTY