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# Community health workers in Kajiado County: an evaluation of the community health strategy in rural Kenya

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BOSTON UNIVERSITY  
SCHOOL OF MEDICINE

Thesis

**COMMUNITY HEALTH WORKERS IN KAJIADO COUNTY:  
AN EVALUATION OF THE COMMUNITY HEALTH STRATEGY  
IN RURAL KENYA**

by

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B.S., University of California, Davis, 2010

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**ABSTRACT**

Between 1980 and 2000, mortality rates of children under the age of five and maternal mortality ratios declined across sub-Saharan Africa. During the same period, Kenya's mortality rates continued to rise until 2005 when the Kenyan Ministry of Health (MOH) introduced the Kenya Essential Package for Health (KEPH) in an effort to reverse its declining health indicators. The KEPH defined six service delivery levels which included the new community level, also known as level one. The Ministry of Health's plan for delivering services at the community level, known as the Community Health Strategy (CHS), called for the creation of Community Health Workers (CHWs) which the MOH hoped would produce the expected outcomes of the CHS. CHWs would be trained volunteers that were both members of the community they would serve, and selected by their community. Their training would allow them to recognize health problems, provide basic first aid, refer patients with serious problems to health facilities, conduct surveys, maintain records, provide education, and distribute supplies.

In 2010, the Division of Community Health Services released an evaluation of the relevance, efficiency, and sustainability of the community health strategy. Their results showed that CHWs could produce many of the CHS's expected outcomes. In 2013,

researchers from the Boston University School of Public Health and Moi University resolved to conduct a cross-sectional study for the Kenyan Ministry of Public Health and Sanitation to assess the effectiveness of the CHWs in Kajiado County. The county faced numerous health challenges and an overburdened health system.

Data collection was completed over a seven-day period in June of 2013 by fourteen teams. Data was collected from 12 communities located in the areas of Rombo, Entonet, and Central Divisions of the Loitokitok sub-county within Kajiado County in rural South Kenya. Six of the selected communities had CHWs mobilized and were the intervention communities. Six communities had no registered CHWs and served as the controls. Eligibility to participate in the study was limited to permanent members of randomly selected households that housed at least one child less than five years of age and no active CHWs. Mothers of children less than five years of age were the preferred respondents. The primary and secondary outcomes were selected to address as many of the CHS's expected outcomes as possible. In an effort to compensate for the study's cross-sectional design, results were analyzed by stratifying them by each community's proximity to a hospital, the time since the CHW's last visit, and the respondent's knowledge of their CHW's name. Data was collected from 316 households, half of which were from intervention communities, and was entered into CSPro 5.0 before being exported to EpiInfo 7.1.1 for analysis.

Analysis of the results suggests that the Community Health Strategy has been largely ineffective at producing its expected outcomes in Kajiado County as communities with active community health workers typically did not fare significantly better than non-

CHW communities. The CHS was not entirely unsuccessful however, as mothers in CHW communities were significantly more likely to give birth at a health facility (PR: 1.41; CI: 1.15-1.72) than in non-CHW communities. Results also indicated that a community's proximity to a hospital could be a confounder in the relationship between a community's CHW status and health outcomes. The success of CHWs may have been masked by their tendency to visit households with worse health indicators more frequently.



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## LIST OF ABBREVIATIONS

AL	Artemether-Lumefantrine
ANC	Antenatal Care
BU	Boston University
CHEW	Community Health Extension Worker
CHS	Community Health Strategy
CHW	Community Health Worker
CORP	Community-Owned Resource Persons
HWT	Home Water Treatment
IEC	Information, Education, Communication
IPT	Intermittent Preventative Treatment
ITN	Insecticide Treated Net
KDHS	Kenya Demographic and Health Survey
KEPH	Kenya Essential Package for Health
MDG	Millennium Development Goal
MMR	Maternal Mortality Ratio
MOH	Ministry of Health
MOMS	Ministry of Medical Services
MOPHS	Ministry of Public Health and Sanitation
NHSSP II	National Health Sector Strategic Plan II
ORS	Oral Rehydration Salts
SFS	School for Field Studies

SP ..... Sulfadoxine-Pyrimethamine  
U5M ..... Under-5 Mortality  
UN..... United Nations  
WHO..... World Health Organization

## INTRODUCTION

Over the past 30 years, major progress has been made globally in reducing the death rates of both mothers and children less than five years of age. Between 1990 and 2005, the global maternal mortality ratio (MMR, the number of maternal deaths per 100,000 live births) fell by 0.37% per year [1]. Between 1990 and 2008, the mortality rate of children under the age of five declined by 28% and the total number of under-5 deaths globally declined from 12.5 million to 8.8 million [2]. During this period, sub-Saharan Africa made great strides in reducing both its under-5 mortality (U5M) rate, which declined by 22%, and its MMR, which declined from 990 in 1990 to 510 in 2013 [2], [3]. Despite significant progress, sub-Saharan Africa continues to suffer an unacceptably high under-5 mortality rate and MMR. Sub-Saharan Africa under-5 mortality rose from 4 million in 1990 to 4.4 million in 2008 and its proportion of the global maternal deaths rose from 23% in 1980 to 52% in 2008 [1], [2].

As a response to these and other disparities between its member states, the United Nations (UN) ratified the United Nations Millennium Declaration in 2000 which created the Millennium Development Goals (MDGs) [4]. Two of them, MDGs 4 and 5, addressed the issues of maternal mortality and child mortality directly. MDG 4's target was to reduce the under-five mortality rate by two-thirds between 1990 and 2015 and MDG 5's targets included reducing the MMR by three quarters over that same period and achieving universal access to reproductive health by 2015. MDGs 1, 6, and 7 also addressed these issues, albeit less directly. MDG 6's targets focused on reversing the spread of HIV and other infectious

diseases by 2015. MDG's 1 and 7 included targets for reducing hunger and improving access to safe drinking water and basic sanitation [4].

In an attempt to meet the millennium development goals for reducing the under-5 mortality rate and MMR, many developing nations have begun to utilize community health workers (CHWs). The umbrella term “community health worker” covers a variety of community health aides who are selected by the community they will serve and provided with basic medical training [5]. The International Standard Classification of Occupations identifies community health aide, community health promoter, and village health worker as alternative titles for CHWs although Bhattacharyya et al. identified at least 21 additional titles used by different countries [6], [7]. The term sometimes includes traditional, faith, and complementary healers as well as traditional birth attendants [8]. Definitions for CHWs vary, but the WHO proposed the following definition:

*Community health workers should be members of the communities where they work, should be selected by the communities, should be answerable to the communities for their activities, should be supported by the health system but not necessarily a part of its organization, and have shorter training than professional workers. [5]*

Integrating CHWs into a healthcare system can provide several advantages. Being members of the community they serve, they have no cultural or linguistic barriers to overcome that might be present at a healthcare facility. When compared with health facilities, CHWs are geographically closer to the people they serve, available when health facilities are closed, and can help ensure that treatment at home is appropriate [9].

The use of CHWs has also been identified as a strategy for dealing with the growing shortage of professional health workers, particularly in in low-income countries in the most



severely affected regions, sub-Saharan Africa and South-East Asia [5]. One of the earliest examples of a health care provider that could be classified as a CHW, the Barefoot Doctors of China, was created in response to a continuing shortage of physicians. Created in 1965 by Chairman Mao, the Barefoot Doctor program provided several months of rudimentary medical training to recruits chosen by their fellow workers, to whom they returned to serve the elementary health care needs of upon completing their training [10].

Interest in CHWs remained low until the 1978 Declaration of Alma-Ata, the product of the International Conference on Primary Health Care (PHC) which met in Alma-Ata (now Almaty in present day Kazakhstan) [5]. In the declaration, the conference defined primary health care as “essential care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination” [11]. The declaration identified community health workers (CHWs) as one of the cornerstones of primary health care, stating that their use would be the most effective way to achieve total healthcare coverage in many developing nations, causing CHW programs to mushroom [5], [11]. Interest in CHWs waned in the 1990s before rising again in the 2000s as response to the HIV/AIDS pandemic and increasing shortages of professional health workers [5]. In 2006, the WHO estimated that 57 countries were experiencing critical shortages health service providers equivalent to a global deficit of 2.4 million doctors, nurses, and midwives [8]. In 2011, the World Health Organization (WHO) estimated that there were 1.37 million CHWs globally, most of which worked in developing countries [12]. Sub-Saharan Africa’s high MMR and under-5 mortality are related to unsafe health practices,

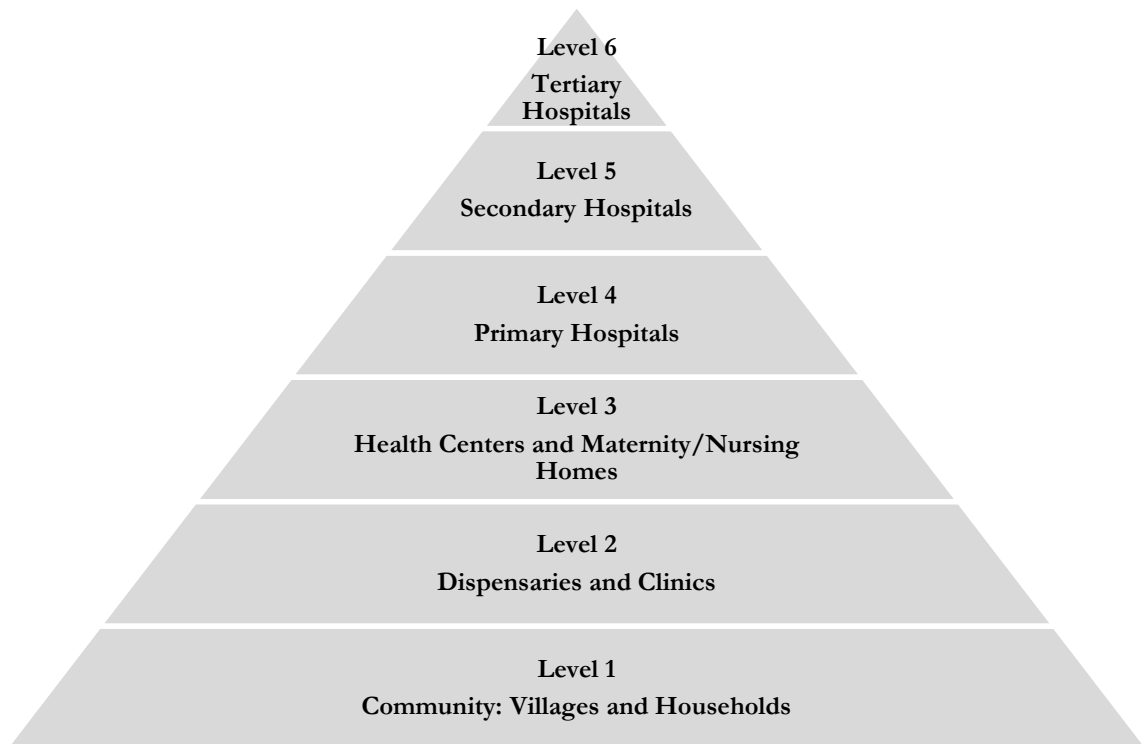
which CHWs can address by providing counsel on behaviors related to health and disease prevention [9], [13].

### **Kenya's Community Health Strategy and CHW Rollout**

In response to the Alma-Ata Declaration, Kenya formally adopted the Primary Health Care strategy in 1982 which the Kenyan Ministry of Health (MOH) had indigenized by incorporating elements of their 1972 community based health care strategy such as a focus on promoting 'the well-being of every child' [14]. Unfortunately, the program failed to reverse the trend of progressively worsening health indicators. Between 1980 and 2000, Kenya's under-five mortality rate rose continuously during a period when sub-Saharan Africa's U5M rate was declining [2], [15]. During the same period Kenya's MMR rose from 494 to an all-time high of 730 [1]. Some of Kenya's health indicators continued their decline into the new millennium. The 2003 Kenyan Demographic and Health Survey (KDHS) found that the proportion of women who had four or more antenatal visits declined from 60 percent in 1998 to 54 percent in 2003 and only 41.6% of women who had given birth were assisted by medically trained personnel [15]. The 2003 KDHS also identified numerous issues contributing to the high under-5 mortality rate. Only 4.6% of children under-five slept under an insecticide treat net (ITN), 56.8% of children in the second year of life had been fully immunized, and 30.3% of all children under-five were stunted, [15].

In 2005, the Kenyan MOH created Kenya's second National Health Sector Strategic Plan (NHSSP II) in effort to reverse Kenya's declining health indicators and meet the nation's Millennium Development Goal targets. Built on the framework of the first NHSSP, the new plan sought to shift the emphasis of the MOH's efforts from managing the burden

of disease to the promotion of individual and community health [16]. To accomplish this, the NHSSP II introduced the Kenya Essential Package for Health (KEPH) which defined six service delivery levels (**Figure 1**) and split the population into six life-cycle cohorts (**Figure 2**) [17]. All existing health programs were bundled into the KEPH with the hope that programs serving the same life-cycle cohorts would complement each other with the synergy allowing for outputs better than they would have achieved individually. With the NHSSP II, the Kenyan MOH hoped to finally realize the goals of the PHC strategy by emphasizing strong community involvement in health care. The KEPH was to be phased in over the life of the NHSSP II beginning with changes to the first two life cycle cohorts (pregnancy/newborn and early childhood) [16].



**Figure 1: Healthcare Service Delivery Levels Under the KEPH**

<b>Pregnancy, Delivery and the Newborn Child (Up to 2 Weeks of Age)</b>	<b>Early Childhood (3 weeks to 5 Years)</b>	<b>Late Childhood (6 to 12 Years)</b>	<b>Adolescence (13 to 24 Years)</b>	<b>Adulthood (25 to 29 Years)</b>	<b>Elderly (60 Years and Over)</b>
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**Figure 2: Live Cycle Cohorts Created by the KEPH**

In 2006, the Community Health Strategy (CHS) was created to deliver KEPH service to level 1, also known as the community level [17]. The goal of the level 1 health services was to promote positive health behavior and create demand for health services provided at other levels. The basic level one care unit, also known as a community unit, would contain 5,000 people, each requiring 50 community-owned resource persons (CORPs) and 2 community health extension workers (CHEWs). Each CHEW would have 25 CORPs under their supervision and each CORP would provide level 1 services to 20 households or 100 people [17]. Over the next several years, the term CORP was phased out in favor of the more common term, community health worker (CHW), which the successor to the National Health Sector Strategic Plan used exclusively [18]. The MOH estimated that it would need 6425 level 1 service units to deliver KEPH services which would have required 321,250 CHWs and 12,850 CHEWs [19].

Under the KEPH, CHWs were to be part time volunteer workers and paid a stipend by their local health committee on the basis of completed work [17]. By contrast, CHEWs would be considered formal employees of the health system and paid a salary. To become a CHW, volunteers first had to meet predefined criteria, jointly agreed on beforehand between the community and the health system. These could include literacy in the local language, respectability in the community, and a permanent residence in the community [17].

Volunteers that met the predefined criteria and had received a nomination from the community they would serve would then be vetted by that community at an open meeting. Once selected, prospective CHWs would receive 9 months of training from CHEWs spread in phases over 3 years to minimize the burden on the volunteer's livelihood. Most training activities would take place in the community but with periods of practice at various facilities. CHWs would be trained to complete the following tasks [17]:

- Recognize a health problem, classify it, and decide on an appropriate action
- Provide first aid treatment for minor illness and injuries, referring patients with more serious problems to health facilities
- Carry out baseline surveys and compile survey data
- Develop and maintain household registers by recording data from regular household visits
- Maintain records of daily activities of services delivered, produce reports, and submit them to the location development and health facility committees
- Manage resources, storing and distributing commodities and supplies
- Provide education on disease causation, control, and prevention
- Promote good health through advocacy, social mobilization, and by creating a dialogue with the community and its leaders
- Promoting inter-sector action for health, working with various extension workers
- Organize and file documentation
- Facilitate and participate in planning, implementation, monitoring, and evaluation of level 1 services

While CHWs would be trained to provide basic first aid, they would not be trained in the treatment of common diseases, possibly because of the results of an earlier CHW program conducted in Kenya: the Community Initiatives for Child Survival in Siaya project. Begun in 1995 by CARE Kenya, the project was based on research that showed that CHWs could be trained to use simple diagnostic algorithms based on a small number of clinical signs to detect and treat some of the most common causes of under-5 mortality such as malaria, pneumonia, and dehydration secondary to diarrhea [9], [20]. A study conducted in 1999 found deficiencies in the CHW's management of sick children, failing to identify many children with severe classifications (those that require referral to a medical facility) [9].

CHWs and CHEWs were to be supplied with sub-location kits by the health facility committees, which would also be responsible for the regular replenishment of the kit [21]. The contents of a standard CHW kit as of 2013 can be seen in **Table 1**. The list which was sourced from CHEW supervision checklists makes no mention of vitamin A supplements which were included in CHW kits as recently as 2012 [18]. This might be an oversight or it could indicate that the Kenyan Ministries of Health now consider level 2 to be the minimum tier for vitamin A supplementation. In 2006, the CHS discussed the possibility of supplying CHWs with phones, talk-time cards, and bicycles [17].

**Table 1. Contents of a CHW Kit as of 2013.** Information sourced from CHEW supervision checklists in the Kenyan Ministry of Health's 2013-2018 Integrated Community Case Management Monitoring and Evaluation Plan [22].

<b>Medicines</b>	
<b>Item</b>	<b>Quantity</b>
Oral Rehydration Salts (ORS) - 20.5mg	At least 12 packets
Artemether-Lumefantrine (AL) 1x6	At least 10 blister packs
AL 2x6	At least 10 blister packs

AL 3x6	At least 10 blister packs
AL 4x6	At least 10 blister packs
Zinc Sulfate - 20mg	Approximately 60 Tablets
Albendazole - 400mg	Approximately 20 Tablets
Paracetamol - 500mg	Approximately 36 Tablets
Tetracycline Eye Ointment - 1%	At least 6 5mg tubes
Combined Oral Contraceptives	At least 25 packs
Povidone Iodine Solution	At least 1 bottle
<b>Supplies</b>	
<b>Item</b>	<b>Quantity</b>
Timer	1
Mid Upper Arm Circumference (MUAC) Tape	1
Rapid Diagnostic Test Kits (RDTs)	N/A
Digital Thermometer	1
Salter Scale/Color Coded Salter Scale	1
Medical Dispensing Envelopes	N/A
First Aid Kit (Contains alcohol, disposable gloves, cotton wool, strapping, crepe bandage)	1
Water Quality Supplies (Chlorine/Flocculant (coagulant and disinfectant); Lavibond Comparator; DPD tablets)	N/A
Male Condoms	N/A
Community Treatment and Tracking Register	Enough blank pages for at least 10 cases
Sick Child Recording Form	1
CHS Job Aids/Counselling Cards (IEC Materials)	N/A
Blank Referral Slips	At least 3
Service Log Book (MOH 514)	1

The rollout of the KEPH was complicated by the 2007-2008 Kenyan crisis which began when incumbent President Mwai Kibaki was declared the winner of Kenya's 2007 presidential election. Post-election violence forced 600,000 people from their homes and left an estimated 1,500 dead. In February of 2008, a newly formed coalition government agreed to a new power-sharing deal [23]. As a result of the deal, the Ministry of Health was split into two new ministries: the Ministry of Public Health and Sanitation (MOPHS) and the Ministry of Medical Services (MOMS) [24]. Both new ministries were forced to compete for

resources, sharing a common budget which was not increased following the split. By 2008, posts for CHWs and CHEWs had vacancy rates of 97% and 95% respectively [25]. An evaluation conducted in 2010 found that resource allocation for the CHS strategy had been largely inadequate [21]. Limited resources led to only a few community units being supplied with CHW kits and information, education, and communication (IEC) materials while most CHWs were supplied only with the household registers for data collection. In some cases, even the CHW training was found inadequate, requiring further training. CHWs suffered a high attrition rate due to a combination of insufficient supportive supervision, lack of incentives, and inadequate materials [21].

### **Expected Outcomes of the Community Health Strategy**

The expected outcomes of the Community Health Strategy (CHS), and by extension the CHW program, include the following:

- An increase in complete immunization coverage (particularly for measles) and vitamin A supplementation for children less than five years old. The Kenyan health ministries consider a child fully vaccinated when they have received a BCG vaccine (protects against tuberculosis), three doses of the pentavalent vaccine (protects against Haemophilus Influenza type B, Whooping Cough, Tetanus, Hepatitis B, and Diphtheria), three doses of OPV (protects against polio), three doses of PCV (protects against pneumonia), and a measles vaccine.
- An increased prevalence of pregnant women receiving Intermittent Preventative Treatment (IPT). The Kenyan government's policy on IPT states that all pregnant women living in malaria endemic areas should receive sulfadoxine-pyrimethamine



(SP) for the prevention of malaria in pregnancy [26]. The first dose should be given at 16 weeks of gestation and subsequent doses administered during scheduled visits that are at least one month apart. In 2008, the proportion of women who received IPT during pregnancy was 14% [26].

- An increased prevalence of pregnant women making 4 or more antenatal care (ANC) visits. These visits follow the WHO's focused ANC guidelines, ideally occurring at 16 weeks, 24-28 weeks, 32 weeks, and 36 weeks. During each visit, the clinic would be expected to provide identification of pre-existing health conditions, early detection of complications arising during pregnancy, health promotion and disease prevention, and birth preparedness and complication planning [27]. Unfortunately, some pregnant mothers make only one visit to ANC to secure an ANC card for use in case of emergencies [13].
- An increased prevalence of deliveries by skilled birth attendants, such as doctors, nurses, and midwives. In 2008, 43.8% of births were delivered by a skilled provider [26].
- Increased prevalence of exclusive breastfeeding, where the infant only receives breast milk without any additional food or drink (not even water), for the first 6 months. The WHO additionally recommends that mothers initiate breastfeeding within the first hour of life, provide breastfeeding on demand (as often as the child wants), and not use bottles, teats, or pacifiers [28].

- An increase in the use of ITNs, especially among children under 5 and pregnant mothers. In 2008, 47% of children less than five years old and 49% of pregnant mothers slept under an ITN at night [26].
- An increased prevalence of hand-washing.
- An increase in latrine coverage. In 2008, 14.5% of Kenya’s population did not have access to any form of latrine and only 24.3% had access to an improved toilet facility that was not shared with other households [26].
- An increase in the prevalence of families seeking treatment within 48 hours when a child less than five years old contracts fever, diarrhea, or pneumonia. In 2008, 48.6% of families sought treatment from a health facility or provider when the child less than 5 years old developed a fever [26].

### Kenya’s CHW Performance to Date

In 2010, the Division of Community Health Services released an evaluation of the relevance, efficiency, and sustainability of the community health strategy [21]. Their results, summarized in **Table 2**, showed the CHWs could produce the Kenyan health ministries’ expected outcomes.

**Table 2. Results from 2010 Evaluation of the Implementation of the Community Health Strategy [21].**  
(1) A p-value less than or equal to 0.05 was considered significant.

Performance Indicator	Intervention Cluster	Control Cluster	p-value <sup>1</sup>
Immunizations in Children Aged 12 Months and Older			
Fully Immunized	84.2%	80.1%	=0.023
Polio Vaccine	95.5%	91.6%	<0.001
Measles Vaccine	93.1%	91.2%	<0.351
Children Aged 6 Months Exclusively Breastfeeding	27.1%	23.6%	=0.210

Children Less than 5 Years Old with Illness in Previous 2 Weeks			
Fever	32%	43%	=0.003
Diarrhea	21.6%	42.2%	<0.001
Pregnant Women who Attended at Least 4 ANC Visits	55.9%	44%	<0.001
Mothers who Received a Tetanus Vaccination During their Last Pregnancy	94.5%	72.4%	<0.001
Last Birth Attended by Skilled Birth Attendants	53.7%	44.4%	<0.001
Knowledge of at Least One Family Planning Method	86.6%	84.2%	=0.073
Access to Family Planning Services	87.2%	86.1%	N/A
Using Any Form of Family Planning	47.4%	47.2%	=0.940
Had at Least One Mosquito Net	64.8%	59.6%	<0.001
Children Slept Under a Mosquito Net the Previous Night	59%	37%	=0.0092
Households with Access to Latrines	87.7%	84.4%	=0.004
Practiced Proper Handling of Children's Stools	78.6%	73.5%	N/A
Treat their Water	29.1%	23.4%	<0.001

The evaluation also identified several important issues with the CHS. The evaluators argued that the policy of not paying CHWs was unsustainable and recommended that CHWs be given financial incentives such as an allowance, as had been done in other countries such as Ethiopia [21]. They also judged the annual budget for the CHS to be inadequate, making the strategy unsustainable. This was highlighted by the CHS having been implemented in the intervention districts by the Global Alliance for Vaccines and Immunization (GAVI), without which any intervention might not have been possible [21].

In 2013, researchers from the Boston University School of Public Health and Moi University resolved to conduct a cross-sectional study for the Kenyan Ministry of Public Health and Sanitation to assess the effectiveness of the CHWs in Kajiado County. The CHS rollout in Loitokitok District (which would be merged into Kajiado County in 2013 as a result of a high court ruling), began in May of 2008 [29], [30]. By June of 2012, the district had 22 active community health units and required an additional 11 community health units to provide full coverage.

### Kajiado County: Demographics and Health Challenges

Kajiado County is the 28<sup>th</sup> most populous county in Kenya with a population of 687,312 (2009) spread over 21,901 square kilometers [31]. Located in the former Rift Valley Province, the region is bordered by Nairobi in the north and the Tanzanian border in the south.

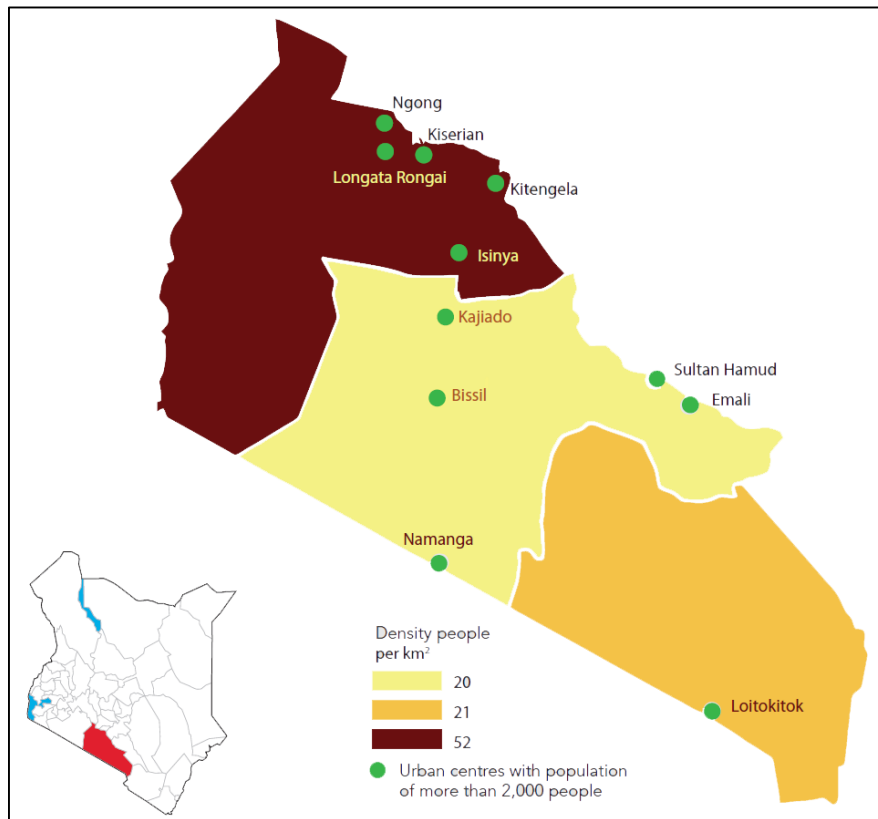


Figure 3: Map of Kajiado County: Color shade shows average population densities of its three districts. Bottom right shows a map of Kenya with Kajiado County’s position marked in red [32].

The region faces numerous health challenges. In 2005, the most prevalent diseases were malaria, respiratory infections, diarrhea, skin diseases, and eye infections [33]. In 2013, only 22.8% of children under the age of one in Kajiado County were fully immunized, the lowest ratio of any county [31]. The county’s health services are largely inadequate to address

the regions health challenges. In 2005, Kajiado's health services included 2 district hospitals, 19 health centers, 40 dispensaries, and 26 private health institutions [33]. Only 39.7% of mothers in Kajiado County gave birth in a health center [31]. In 2013, the doctor/population ratio was 1:253,046 (up from 1:66,412 in 2005) and the nurse/population ratio was 1:8,580 [31], [33]. For comparison, it has been suggested that 2.5 healthcare professionals per 1000 population is necessary to achieve an 80% coverage rate for deliveries by skilled birth attendants or for measles immunization [8]. The region has struggled to provide efficient health services because its fast population growth has outpaced investments in the health facilities [33]. Fortunately, Kajiado County has one of the lowest malaria test positivity rates in the country at 13.8%, compared to the nationwide average of 30.0% [34]. For this reason, CHWs operating in Kajiado County have not focused on IPT.

A significant portion of Kajiado County's population are Maasai, a semi-nomadic people that live in southern Kenya and northern Tanzania. The Maasai are one of the most visible cultural groups in modern Africa, known for wearing bright colors and beaded jewelry [35]. Although the Maasai traditionally lived as pastoralists, surviving off of their cattle, many have been forced to turn to farming as suitable grazing land becomes scarcer [35]. The majority of Kajiado's population practiced the traditional Maasai mode of life until land adjudication and sub-division of group ranches forced the pastoralists to move to drier parts of the county to the south [33]. In addition to political challenges that threaten to change the Maasai way of life, the Maasai face numerous health challenges arising from their lifestyle. The Maasai often live in homesteads, called bomas, each of which can house multiple families. Bomas often contain enclosures for the family's livestock with walls made from thorny branches to protect them from predation [36]. Living in such close proximity to

the livestock raises the risk of fecal contamination of their drinking water, exposing them to diseases that can cause diarrhea and other illnesses. A study conducted in 2002 found that 79% of water sampled in the Kajiado and Kitui districts contained gross fecal contamination [35].

### **Specific Aims and Objectives**

With this study, we sought to determine the effectiveness of the Community Health Strategy to produce its expected outcomes in Kajiado County. As a result of this study's cross-sectional design, it would not be possible to determine any temporal relationships. If the Kenyan government began its rollout of the CHW program in areas with poorer health outcomes, anything less than significant improvements would be masked. This analysis will try to compensate for the study design by relating health outcomes to the intensity of CHW effort and factors that could affect it, such as proximity to a healthcare facility. To accomplish this, the effects of the following variables on health outcomes and adherence to public health interventions will be tested:

- Distance by road to the nearest hospital (which might affect CHW access and thus involvement intensity)
- The time since the last CHW visit (preliminary analysis of the data showed a possible dose-response relationship between the time since the CHW's last house visit and respondent adherence to household level interventions)
- Respondent knowledge of their CHW's name (familiarity might result from greater activity by the CHW)

Each of these were selected because they allow stratification the data by a variable that can serve as a proxy for CHW involvement. The results of this study may allow the Kenyan government to better create policy for their CHS by pinpointing which aspects of how a CHW engages their community are most closely linked with better health outcomes.

## **METHODS**

### **Study Design and Participants**

We conducted a cross-sectional study, collecting data from 12 communities located in the areas of Rombo, Entonet, and Central Divisions of the Loitokitok sub-county within Kajiado County in rural South Kenya. Six of the selected communities had CHWs mobilized (Amboseli, Entonet, Enwemuanyi, Illasit, Oloolopon, and Rombo) and were the intervention communities. Six communities had no registered CHWs (Enkariak, Kuku, Lemong'o, Nolasit, Upper Illasit, Upper Njukiini) and served as the controls. These twelve communities were selected based on their proximity to the School for Field Studies' (SFS) Kilimanjaro Bush Camp near Kimana by Leah Nkuchia, District Director of the CHS, and Dr. Moses Okello, Director of the School for SFS Center for Wildlife Management Studies.

Eligibility to participate in the study was limited to permanent members of randomly selected households that housed at least one child less than five years of age and no active CHWs. Mothers of children less than five years of age were the preferred respondents. We selected households from a list of 7,865 eligible households provided by the Ministry of Public Health and Sanitation which had been compiled by community informants and CHWs. The sample size was set at 328 households as this would allow us to estimate single proportions with a response distribution of 50% (at 5.5% margin of error and confidence interval of 95%), see a 16% detectable difference between two groups (with power at 80%, allocation ratio at 1:1, and significance level of 5%), and account for any issues with data collection. The sample size of each community was determined by its ratio of eligible



households to the total number of eligible households from that community type (intervention or control). This ensured a 1:1 ratio of intervention and control communities. Households were selected using systematic random sampling stratified by community and each community was oversampled in case of non-response or study ineligibility.

The study instrument was a questionnaire designed to determine the respondent's knowledge, perceived risks, and practices regarding various health related topics. At the end of the survey, we recorded the immunization information of the youngest child and the middle upper arm circumference (MUAC) measurements for all children aged less than five years. Immunizations were recorded from the child's immunization card when possible, otherwise parental recall was used. The questionnaire avoided using open-ended questions and jargon that participants would be unfamiliar with. To limit information bias, restricted time periods were used for questions. An early version of the questionnaire was pretested at 18 households and we revised the questionnaire based on feedback from that test to produce the final version.

A waiver of protocol review was provided by the Boston University Medical Center Institutional Review Board and the study was given approval by the Kenyan MOPHS. Informed consent was provided using the basic elements of consent. All interviewees provided oral informed consent prior to their participation in the study.

### **Study Procedure**

Data collection was completed over a seven-day period in June of 2013 by fourteen teams. Communities were divided into sub-divisions from which a pre-calculated number of

questionnaires were collected and each team was given a randomly selected list of households to survey within each sub-division. Assistance locating households was provided by Elders, knowledgeable members of the community who were paid to act as community guides. Only one attempt was made to survey each household before moving on to the next household on the list. If a boma (an enclosure which often contained numerous households belonging to one extended family) had more than one household, a random number table was used to determine which household to survey. Surveys were verbally administered by researchers with the assistance of a translator providing translations between English, Swahili, and Maa. Translators were provided training prior to data collection and Swahili versions of the questionnaire. Participants spoke in the language of their choice and responses were translated and recorded in English by the researchers.

### **Primary and Secondary Outcomes**

The primary and secondary outcomes attempted to address as many of the CHS's expected outcomes as possible. The primary outcomes included measles immunization and vitamin A supplementation of children less than 5 years old; the number of antenatal care visits and utilization of skilled delivery during the most recent birth; exclusive breast feeding for more than 6 months; insecticide treated net (ITN) usage; hand washing frequency; home water treatment (HWT); latrine access; and the treatment of fever, diarrhea, and pneumonia within 48 hours. Secondary outcomes included knowledge of correct ITN, HWT, and latrine use. While increasing the use of Intermittent Preventative Treatment (IPT) was an expected outcome of the CHS, it was not one of the goals for Kajiado County South and we chose

not to include it among the primary or secondary outcomes as a result. The lack of interest in IPT for Kajiado County South was likely a result of the areas extremely low malaria incidence [34].

### **Statistical Analysis**

Data was entered into CSPro 5.0 by one researcher, verified by a second, and then exported into EpiInfo 7.1.1 for analysis. Google Maps was used to determine the distance of each community by road to Oloitokitok District Hospital (Level 4 Facility) and Rombo Mission Health Center (Level 3 Facility). If a route by road to a community could not be found, distance was determined by using a shortest distance line. Outcomes were compared using prevalence ratios with 95% confidence intervals. The association between the predictors and the average number of antenatal visits was evaluated with linear regression analysis. ‘Knowledge of Correct ITN Use’ was coded ‘yes’ if the respondent correctly explained how to use an ITN and, when asked who should be given priority to sleep under a net, responded with both pregnant women and children less than five years old. ‘Knowledge of Correct HWT Use’ was coded ‘yes’ if the respondent either treated their drinking water the last time they collected it or did not believe their drinking water to be clean if they did not treat it. ‘Knowledge of Latrine Use Benefits’ was coded ‘yes’ if the respondent did not have access to a latrine and believed that this posed a health risk. If the respondent had access to a latrine, then the variable was coded ‘yes’ if they could list at least one reason why they preferred using it over using the bush.

## RESULTS

### Demographics and Community Distances

Data was collected from 316 households, half of which were from intervention communities. The demographic characteristics of study participants are presented in **Table 3**. With the exception of the reported level of education for both the respondent and head of household, demographic variables for communities with and without CHWs were similar. In communities with CHWs, both the respondent and head of household were more likely to report a higher level of education. Respondents were most often women (96.8%), identified with the Maasai tribe (67.7%), identified Christianity as their religion (98.4%), were married (88.0%), and reported agriculture as their family's primary source of income (84.2%). **Table 4** displays the distances of each community by road to the nearest level 3 (health center) or level 4 (primary/district hospital) healthcare facility in kilometers. The average distance by road to either a Level 3 or 4 facility was 12.1 km for CHW communities and 15.9 km for non-CHW communities. The latter excludes one community (Nolasit) that Google Maps could not find a path to. Ignoring roads, the shortest distance between Nolasit and either health facility was 17.8 km to the Rombo Mission Health Center (level 3). None of the communities without active CHWs were within 1 km of a level 3 or 4 facility.

### Primary Outcomes

In the sample group, 41.3% of mothers made 4 antenatal care visits during their last pregnancy, 21.5% made more than 4, 27.3% made between 1 and 4, and 9.9% never visited

antenatal care. The median number of antenatal care visits was 4 in all categories used in subsequent tables. **Table 5** displays the primary outcomes stratified by the presence of CHWs in the community and its distance by road to the nearest level 3 or 4 facility. Stratifying CHW and non-CHW communities by distance revealed that a community's distance can significantly affect health outcomes, albeit inconsistently. Increasing proximity to either a level 3 or 4 facility was associated with improvements to some health indicators, such as greater vitamin A capsule uptake by children less than five years old and a higher prevalence of mothers giving birth at health facilities. CHW communities more than 12 km from the nearest level 3 or 4 facility exhibited significantly better measles immunization coverage than non-CHW communities at the same distance (PR: 2.04; CI: 1.15-3.61) and CHW communities less than 1 km away from a facility (PR: 1.88; CI: 1.04-3.39). While mothers in CHW communities were significantly more likely to give birth at a health facility (PR: 1.41; CI: 1.15-1.72) than in non-CHW communities, stratification by distance found no significant associations in each distance category. For communities 1-12 km away from the nearest level 3 or 4 healthcare facility, CHW presence was associated with a significant decline in mothers exclusively breast feeding for six months (PR: 0.45; CI: 0.20-0.99).

**Table 6** displays health outcomes in CHW Communities stratified by the time since the CHW's last visit. Households which had been visited by a CHW in the past 29 days experienced no significant improvements in any health outcome category over households which had not. We did find a significant decline in net usage by children less than five years old in households which had been visited in the past 29 days however (PR: 0.50; CI: 0.25-

0.98). The strongest positive association with the most recent CHW visit having occurred in the past 29 days was the youngest child being more likely to have taken a vitamin A capsule, although this relationship was not significant (PR: 1.42; CI: 0.93-2.16). **Table 7** displays health outcomes stratified by the respondent's ability to recall their CHW's name. There were no significant differences between both categories for any health outcome. While not a significant relationship, the youngest children of respondent's that were able to recall their CHW's name were more likely to have taken a vitamin A supplement than children of those that could not (PR: 1.50; CI: 0.96-2.34).

**Table 3. Demographic Information of Study Participants and Their Households.** In some cases, the respondent and the head of the household were the same individual. (1) Formerly married includes divorced, widowed and separated.

Demographic Variables	CHW Community (n=158)	Non-CHW Community (n=158)
Age		
Mean Age of Respondent (SD)	29.8 (9.8)	29.9 (9.9)
Mean Age of Head of Household (SD)	39.0 (12.4)	38.3 (13.4)
Mean Number of Persons in Household (SD)	3.3 (0.9)	3.4 (1.2)
Mean Number of Children Less Than 5 Years Old in Household (SD)	1.5 (0.69)	1.6 (0.82)
Sex of Respondent		
Male	8/157 (5.1%)	5/158 (3.2%)
Female	149/157 (94.9%)	153/158 (96.8%)
Sex of Head of Household		
Male	126/135 (93.3%)	133/140 (95.0%)
Female	9/135 (6.7%)	7/140 (5.0%)
Respondent Education Level		
None	64/157 (40.8%)	86/158 (54.4%)
Primary	69/157 (44.0%)	55/158 (34.8%)
Secondary	18/157 (11.5%)	12/158 (7.6%)
Tertiary	4/157 (2.6%)	2/158 (1.3%)
Did Not Respond	2/157 (1.3%)	3/158 (1.9%)
Head of Household Education Level		
None	45/135 (33.3%)	71/140 (50.7%)

Primary	56/135 (41.5%)	53/140 (37.9%)
Secondary	22/135 (16.3%)	7/140 (5.0%)
Tertiary	7/135 (5.2%)	5/140 (3.6%)
Did Not Respond	5/135 (3.7%)	4/140 (2.9%)
Respondent Tribal Affiliation		
Kamba	18/158 (11.4%)	17/158 (10.8%)
Kikuyu	32/158 (20.3%)	24/158 (15.2%)
Maasai	102/158 (64.6%)	112/158 (70.9%)
Tanzanian Tribe	3/158 (1.9%)	5/158 (3.2%)
None	3/158 (1.9%)	0/158 (0%)
Respondent Religion		
Christian	155/158 (98.1%)	156/158 (98.7%)
Muslim	1/158 (0.6%)	1/158 (0.6%)
No Religion	2/158 (1.3%)	1/158 (0.6%)
Respondent Marital Status		
Single	7/158 (4.4%)	8/158 (5.1%)
Married	140/158 (88.6%)	138/158 (87.3%)
Formerly Married <sup>1</sup>	11/158 (7.0%)	12/158 (7.6%)
Family Source of Income		
Agriculture	132/158 (83.5%)	134/158 (84.8%)
Business	10/158 (6.3%)	13/158 (8.2%)
Manual Labor	10/158 (6.3%)	10/158 (6.3%)
Other	6/158 (3.8%)	1/158 (0.6%)

**Table 4. Distances of Study Communities by Road to Nearest Level 3 or 4 Health Facility.** Each community's distance to the Oloitokitok District Hospital (Level 4) is listed. If the distance to the Rombo Mission Health Center (Level 3) was shorter, it is also listed. One community, Nolasit, had no road access but was determined to be 17.8 km point to point to the Rombo Mission Health Center.

	Distance by road to nearest Level 3 or 4 Health Facilities (km)
CHW Communities	
Oloolopon	0.4 <sup>4</sup>
Rombo	0.5 <sup>3</sup> ; 27.6 <sup>4</sup>
Illasit	9.4 <sup>4</sup>
Enwemuanyi	10.7 <sup>3</sup> ; 38.2 <sup>4</sup>
Entonet	18.2 <sup>4</sup>
Amboseli	33.4 <sup>4</sup>
Non-CHW Communities	
Upper Njukiini	3.5 <sup>3</sup> ; 31.1 <sup>4</sup>
Enkariak	8.0 <sup>4</sup>
Upper Illasit	10.9 <sup>4</sup>
Lemong'o	23.6 <sup>4</sup>

Kuku	33.5 <sup>4</sup>
Nolasit	N/A due to lack of roads

**Table 5. Health Outcomes Stratified by CHW Presence and Distance to Level 3 or 4 Facility.** (1) Only mothers who were no longer breast feeding were included. (2) Defined as a respondent correctly explaining how to use a net and answering that both pregnant women and children <5 should be given priority for using a net. (3) Defined as a respondent listing more than two occasions when they wash their hands, such as before eating or after using the toilet. (4) Defined as a respondent responding yes to both treating their water before drinking it after the last collection time and stating they did not perceive their water to be clean from the source. (5) Defined as a respondent having no access to a latrine and believing that this posed health risks for their family or the respondent having access to a latrine and preferring to use a latrine rather than the bush to prevent illness, cleanliness, or smell.

Outcomes	Distance of CHW Community			Distance of non-CHW Community		
	Less than 1 km (n=52)	1-12 km (n=51)	More than 12 km (n=55)	1-12 km (n=92)	More than 12 km (n=46)	No Road Access (n=20)
<b>Immunization Coverage of Youngest Child</b>						
Measles	17/34 (50.0%)	25/40 (62.5%)	33/45 (73.3%)	43/74 (58.1%)	16/35 (45.7%)	6/17 (35.3%)
Vitamin A Supplement	19/34 (55.9%)	19/40 (47.5%)	15/45 (33.3%)	36/75 (48.0%)	12/35 (34.3%)	5/17 (29.4%)
<b>Pregnancy and Infant Care for Most Recent Birth</b>						
Average Number of Antenatal Visits (SD)	3.7 (1.7)	3.5 (1.9)	3.6 (2.0)	3.9 (1.7)	3.4 (1.5)	3.6 (2.2)
Gave Birth At Health Facility	36/52 (69.2%)	29/51 (56.9%)	18/54 (33.3%)	41/89 (46.1%)	9/46 (19.6%)	2/20 (10.0%)
Exclusively Breast Fed for 6 Months <sup>1</sup>	20/22 (90.9%)	9/17 (52.9%)	16/22 (72.7%)	30/38 (79.0%)	7/12 (58.3%)	10/11 (90.9%)
<b>Insecticide Treated Nets</b>						
Net Used by Anyone in Household Last Night	48/49 (98.0%)	40/43 (93.0%)	30/33 (90.9%)	66/75 (88.0%)	24/28 (85.7%)	14/15 (93.3%)
Net Used by Children Under 5 Last Night	36/52 (69.2%)	29/51 (56.9%)	18/54 (33.3%)	41/89 (46.1%)	9/46 (19.6%)	9/14 (64.3%)
Knowledge of Correct ITN Use <sup>2</sup>	6/52 (11.5%)	10/51 (19.6%)	10/55 (18.2%)	19/92 (20.7%)	8/46 (17.4%)	4/20 (20.0%)
<b>Hand-washing</b>						
Washes Hands Frequently <sup>3</sup>	44/52 (84.6%)	39/51 (76.5%)	39/55 (70.9%)	70/92 (76.1%)	31/46 (67.4%)	10/20 (50.0%)
<b>Water Treatment</b>						
Treats Drinking Water	26/52 (50.0%)	26/51 (51.0%)	16/55 (29.1%)	43/92 (46.7%)	12/46 (26.1%)	6/20 (30.0%)
Knowledge of HWT Correct Use <sup>4</sup>	33/52 (63.5%)	32/51 (62.8%)	30/55 (54.6%)	55/92 (59.8%)	28/46 (60.9%)	10/20 (50.0%)
<b>Latrine Use</b>						
Access to Latrine	40/52 (76.9%)	34/51 (66.7%)	28/55 (50.9%)	68/92 (73.9%)	24/46 (52.2%)	0/20 (0%)
Knowledge of Latrine	42/52	30/51	33/55	66/92	32/46	14/20



Use Benefits <sup>5</sup>	(80.8%)	(58.8%)	(60.0%)	(71.7%)	(69.6%)	(70.0%)
Illness in children <5 in prior two weeks						
Fever	16/52 (30.8%)	19/51 (37.3%)	24/55 (43.6%)	36/92 (39.1%)	18/46 (39.1%)	11/20 (55.0%)
Sought Treatment Within 48 Hours	8/16 (50.0%)	10/18 (55.6%)	20/24 (83.3%)	29/36 (80.6%)	11/18 (61.1%)	8/11 (72.7%)
Cough	12/52 (23.1%)	15/51 (29.4%)	21/55 (38.2%)	37/92 (40.2%)	15/46 (32.6%)	9/20 (45.0%)
Sought Treatment Within 48 Hours	4/7 (63.6%)	13/15 (86.7%)	10/21 (47.6%)	30/37 (81.1%)	10/15 (66.7%)	6/9 (66.7%)
Diarrhea	4/52 (7.8%)	9/51 (17.7%)	3/55 (5.5%)	12/98 (13.0%)	7/46 (15.2%)	1/20 (5.0%)
Sought Treatment Within 48 Hours	2/4 (50.0%)	5/9 (55.6%)	3/3 (100%)	8/12 (66.7%)	6/7 (85.7%)	1/1 (100%)

**Table 6. Health Outcomes Stratified by Time since CHW's Last Visit to Respondent's Household.** (1) Only mothers who were no longer breast feeding were included. (2) Defined as a respondent correctly explaining how to use a net and answering that both pregnant women and children <5 should be given priority for using a net. (3) Defined as a respondent listing more than two occasions when they wash their hands, such as before eating or after using the toilet. (4) Defined as a respondent responding yes to both treating their water before drinking it after the last collection time and stating they did not perceive their water to be clean from the source. (5) Defined as a respondent having no access to a latrine and believing that this posed health risks for their family or the respondent having access to a latrine and preferring to use a latrine rather than the bush to prevent illness, cleanliness, or smell.

Outcome	Time Since Last CHW Visit		
	In the past 29 days (n=52)	1-3 months ago (n=22)	4 or more months or never (n=20)
Immunization Coverage of Youngest Child			
Measles	19/35 (54.3%)	7/13 (53.9%)	13/14 (92.9%)
Vitamin A Supplement	20/35 (57.1%)	5/13 (38.5%)	5/14 (35.7%)
Pregnancy and Infant Care for Most Recent Birth			
Average Number of Antenatal Visits (SD)	3.5 (1.7)	3.3 (1.6)	4.0 (2.1)
Gave Birth At Health Facility	28/52 (53.9%)	14/22 (63.6%)	12/20 (60.0%)
Exclusively Breast Fed for 6 Months <sup>1</sup>	15/19 (79.0%)	8/9 (88.9%)	9/12 (75.0%)
Insecticide Treated Nets			
Net Used by Anyone in Household Last Night	43/44 (97.7%)	19/22 (86.4%)	16/18 (88.9%)
Net Used by Children Under 5 Last Night	29/43 (67.4%)	17/19 (89.5%)	13/16 (81.3%)
Knowledge of Correct ITN Use <sup>2</sup>	8/52 (15.4%)	6/22 (27.3%)	5/20 (25.0%)
Hand-washing			
Washes Hands Frequently <sup>3</sup>	40/52 (76.9%)	18/22 (81.8%)	17/20 (85.0%)
Water Treatment			
Treats Drinking Water	28/52 (53.9%)	13/22 (59.1%)	8/20 (40.0%)
Knowledge of Correct HWT Use <sup>4</sup>	34/52 (65.4%)	14/22 (63.6%)	12/20 (60.0%)
Latrine Use			
Access to Latrine	31/52 (59.6%)	16/22 (72.7%)	17/20 (85.0%)

Knowledge of Latrine Use Benefits <sup>5</sup>	38/52 (73.1%)	16/22 (72.7%)	16/20 (80.0%)
Illness in children <5 in prior two weeks			
Fever	21/52 (40.4%)	5/22 (22.7%)	9/20 (45.0%)
Sought Treatment Within 48 Hours	13/21 (61.9%)	3/4 (75.0%)	7/9 (77.8%)
Cough	17/52 (32.7%)	6/22 (27.3%)	7/20 (35.0%)
Sought Treatment Within 48 Hours	10/17 (58.8%)	5/6 (83.3%)	6/6 (100%)
Diarrhea	8/52 (15.4%)	0/22 (0%)	1/20 (5.0%)
Sought Treatment Within 48 Hours	7/8 (87.5%)	0/0	1/1 (100%)

**Table 7. Health Outcomes Stratified by Respondent's Ability to Recall Their CHW's Name.** (1) Only mothers who were no longer breast feeding were included. (2) Defined as a respondent correctly explaining how to use a net and answering that both pregnant women and children <5 should be given priority for using a net. (3) Defined as a respondent listing more than two occasions when they wash their hands, such as before eating or after using the toilet. (4) Defined as a respondent responding yes to both treating their water before drinking it after the last collection time and stating they did not perceive their water to be clean from the source. (5) Defined as a respondent having no access to a latrine and believing that this posed health risks for their family or the respondent having access to a latrine and preferring to use a latrine rather than the bush to prevent illness, cleanliness, or smell.

Outcomes	Know their CHW's Name (n=74)	Don't Know Their CHW's Name (n=24)
Immunization Coverage of Youngest Child		
Measles	32/50 (64.0%)	10/16 (62.5%)
Vitamin A Supplement	27/50 (54.0%)	5/16 (31.3%)
Pregnancy and Infant Care for Most Recent Birth		
Average Number of Antenatal Visits (SD)	3.6 (1.6)	3.6 (2.4)
Gave Birth At Health Facility	41/74 (55.4%)	15/24 (62.5%)
Exclusively Breast Fed for 6 Months <sup>1</sup>	26/32 (81.3%)	8/10 (80.0%)
Insecticide Treated Nets		
Net Used by Anyone in Household Last Night	60/65 (92.3%)	20/21 (95.2%)
Net Used by Children Under 5 Last Night	45/60 (75.0%)	15/20 (75.0%)
Knowledge of Correct ITN Use <sup>2</sup>	15/74 (20.3%)	4/24 (16.7%)
Hand-washing		
Washes Hands Frequently <sup>3</sup>	60/74 (76.9%)	18/24 (75.0%)
Water Treatment		
Treats Drinking Water	37/74 (50.0%)	12/24 (50.0%)
Knowledge of Correct HWT Use <sup>4</sup>	47/74 (63.5%)	14/24 (58.3%)
Latrine Use		
Access to Latrine	49/74 (66.2%)	17/24 (70.8%)
Knowledge of Latrine Use Benefits <sup>5</sup>	51/74 (68.9%)	20/24 (83.3%)
Illness in children <5 in prior two weeks		
Fever	27/74 (36.5%)	8/24 (33.3%)
Sought Treatment Within 48 Hours	18/27 (66.7%)	5/7 (71.4%)

Cough	21/74 (28.4%)	9/24 (37.5%)
Sought Treatment Within 48 Hours	13/20 (65.0%)	8/9 (88.9%)
Diarrhea	7/74 (9.46%)	2/24 (8.3%)
Sought Treatment Within 48 Hours	6/7 (85.7%)	2/2 (100%)

## **DISCUSSION**

The results of this study show that the Community Health Strategy has been largely ineffective at producing its expected outcomes in Kajiado County as communities with active community health workers typically did not fare significantly better than non-CHW communities. These results bear little resemblance to the findings of the 2010 evaluation of the CHS conducted by the Division of Community Health Services which found that community health workers in Kenya could produce significant improvements in nearly all health indicators [21]. From these results several conclusions can be drawn. First, that community distance by road to the nearest level 3 or 4 health facility may have been a confounder in the relationship between a community's CHW status and certain health outcomes. Second, increasing proximity to a healthcare facility is associated with improvements in numerous health outcomes. Third, that the time since a CHW's last visit affects health outcomes inconsistently. Fourth, that the number of antenatal care visits mothers make is independent of healthcare facility proximity or CHW activity. Finally, that community beliefs may cause extreme variation in the prevalence of exclusive breast feeding. The evidence behind these conclusions will now be analyzed in sequence.

### **Health Facility Distance Acting as a Confounder**

The conclusion that a community's distance by road to a healthcare facility might be a confounder in the relationship between a community's CHW status and health outcomes arose from discrepancies in the data. For example, while the association between increasing vitamin A supplement coverage and increases in either indicator of CHW activity were

nearly statistically significant, stratifying the data by grouping communities into distinct distance categories based on their distance by road to the nearest level 3 or 4 health facility revealed no difference of coverage between CHW and non-CHW communities in the same distance categories. This stratification also revealed a clear trend where increasing proximity to the health facilities resulted in improved vitamin A supplement coverage. This suggests that the improvement in supplement coverage, which might be attributed to greater effort on the part of the CHWs, is actually the result of the community's close proximity to the healthcare facility, and that CHWs are more active in communities which are in close proximity to those facilities. Without taking a community's distance into account, it would be impossible to determine that the CHWs failed to either provide supplements or encourage mothers to take their children to a facility where they would be provided.

This relationship is inconsistent however. Stratifying measles immunization coverage by each community's distance by road to either a level 3 or 4 health facility revealed a trend of declining coverage in non-CHW communities and rising coverage in CHW communities. The paradoxical nature of these findings may be the result of earlier measles vaccination campaigns which could have focused their efforts unevenly, resulting in clusters of communities with abnormally high immunization rates. Regardless of the cause, the distance of each community by road to the health facility appeared to have a significant effect on health indicators in numerous categories. The average distance by road to those health facilities differed between CHW and non-CHW communities by nearly 4 km when one community, Nolasit, was excluded from the non-CHW community average. If Nolasit is included using its smallest direct path distance, the difference between the two averages

becomes even greater. This difference may be the result of selection bias created when the Kenyan health ministries chose which communities in Kajiado County to activate the CHS in first.

### **Increasing Proximity to Health Facilities Produces Better Outcomes**

Not all effects caused by the community health workers were washed out when the communities were stratified by distance. Increasing distances from either level 3 or 4 health facilities resulted in pregnant mothers being less likely to give birth at a health facility, possibly because of the greater burden on them to travel so far from home. The powerful effects of distance were made even more apparent by the results from Nolasit which exhibited the lowest prevalence of health facility births despite having a shorter point to point distance to the healthcare facilities than the distance by road for some communities. Many families we interviewed did not own a vehicle and some of the roads we used to access the communities become unusable during the rainy season. Pregnant mothers from those households might be forced to walk as much as 33 km to give birth in a facility. However, the negative effects caused by increasing distance on the prevalence of health facility births appears to be significantly mitigated by the presence of CHWs. This suggests that CHWs can fulfill the CHS's goal of creating demand for services at other service delivery levels. Once the data is stratified, the relationship ceases to be statistically significant for any distance category, although it is possible that we simply lack the statistical power to discern such a relationship because of the reduced sample size in each category after stratification. Despite

the loss of significance, a clear trend remains where CHW presence improves health facility utilization for delivery in all community distance categories.

Although not statistically significant, many health indicators displayed improvement as a community's distance by road to either a level 3 or 4 health facility decreased. These included hand-washing frequency, treatment of drinking water, knowledge regarding the correct use of home water treatment (HWT), latrine access, knowledge regarding the benefits of latrine use, and insecticide treated net (ITN) usage.

The trend of improving health outcomes with increasing health facility proximity was not universal however as results showed that close proximity to a hospital might have actually reduced the likelihood of parents seeking treatment for their children within 48 hours if they developed a fever, especially in CHW communities, although the results were not significant. These results could be an anomaly or the result of parents becoming complacent as a result of their easy access to both a hospital and CHW. If these results are caused by complacency, efforts would need to be made by CHWs in communities near the hospitals to convince families that waiting can have serious consequences.

### **CHW's Visit Households with Poor Outcomes More Often**

Results showed that many families who have ITNs are not having their children less than 5 years old use them. While CHWs may have had a moderate effect in reducing this discrepancy in CHW communities (relationships not significant), households which had been visited by a CHW in the last 29 days were less likely to have knowledge of correct ITN use and significantly less likely to have their children sleeping under the net. It is possible

that this is just an artifact of CHWs visiting households which need more attention more often. This would also explain why households without access to latrines were more likely to have been visited recently by a CHW than those with access.

A similar relationship is observed when measles immunization coverage is stratified by either indicator of CHW activity (time elapsed since last CHW visit and respondents knowledge of their CHW's name). The results show that different levels of CHW activity do not correlate with improved immunization coverage with one exception: households which have not been visited in 4 or more months have an exceptionally high rate of immunization. It is possible that these households have not been visited recently because their children are older and thus also more likely to be immunized.

### **Mothers Not Motivated to Exceed Four Antenatal Care Visits**

The average number of antenatal care visits by pregnant women was less than 4 in nearly all categories, despite recommendations by the Kenyan health ministries that pregnant mothers make at least 4 antenatal care visits [13]. This deficiency may be the result of the government's recommendation itself, which pregnant mothers may respond to by making the minimum recommended number of visits, negatively skewing the bell curve. Neither the presence of a CHW, nor a community's increasing proximity to a level 3 or 4 health facility, seemed to have any effect on the average number of antenatal visits by pregnant mothers as all differences between equivalent categories were statistically insignificant. It is possible that the average time between CHW visits is too long, preventing them from providing



continuous encouragement over the course of the pregnancy to yield a significant improvement.

### **Local Beliefs May Affect Exclusive Breast Feeding Prevalence**

Results from the study showed that mothers were less likely to exclusively breast feed for 6 months in CHW communities although the relationship was not significant and stratifying the data by distance revealed no clear trends. Communities less than 1 km from a level 3 or 4 health facility performed identically to Nolasit, which has no major roads and is over 17 km from the nearest facility. The intense variation between distance categories makes the finding that mothers in CHW communities 1-12 km from a facility were significantly less likely to exclusively breast feed than mothers in non CHW categories suspect. It is possible that local beliefs in the sampled communities are responsible for these variations, and that any effects the CHWs or health facility proximity might have had were washed out.

### **Study Limitations**

Despite taking preventative measures, the study had several limitations. The study's cross-sectional design prevented us from examining any temporal relationships, limiting us to the associations between the predictors and health outcomes at the time of the survey. Study communities were assigned by Kajiado County officials, creating the possibility that selection bias was introduced during selection. Only one attempt was made to survey each household which may have resulted in non-response bias. While efforts were made to

maintain the privacy of the respondent, non-participants were still occasionally present when we administered the survey, creating the potential for response bias.

### **Future of the Community Health Strategy in Kajiado County**

The results of this study suggest that while the CHS may have a future, it is unlikely to make significant progress towards its expected outcomes in Kajiado County. The clearest result from the study is that the enormous impact of healthcare facility proximity dwarfs any effects the CHWs had in intervention communities, which may have been further masked by CHWs focusing on problem households. Further study with a larger sample size and preferably a randomized set of communities would be required to determine if such a masking effect is actually occurring. Based on these results, the Kenyan health ministries should encourage CHWs to focus more heavily on persuading mothers to attend antenatal care and having their children immunized. CHWs should also attempt to address any local beliefs preventing mothers from exclusively breast feeding for 6 months or having their children less than 5 years old sleep under their ITNs. Finally, special attention be paid towards convincing families in CHW communities living near the hospitals of the importance of seeking treatment within 48 hours when the children less than 5 years old develop an illness.

## APPENDIX

### Questionnaire

Community (A-L): \_\_\_\_\_  
Team Number: \_\_\_\_\_  
Date (DD/MM/YYYY): \_\_\_\_\_  
Survey Number: \_\_\_\_\_  
Interviewer Initials: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_  
Translator: \_\_\_\_\_  
Language of Interview: \_\_\_\_\_

#### **Is there a child under five years old in your household?**

*If no – thank them for their time and leave*

*If yes – ask “**May I interview the mother of the child?**”*

*If no – ask “**May I interview the caregiver of the child?**”*

*If no – thank them for their time and leave*

*If yes – proceed with the interview*

*If yes – proceed with the interview*

Are you a CHW?

*If no – proceed with the interview*

*If yes – thank them for their time and leave*

Greetings

Introduce yourself

We are health students at the School for Field Studies (SFS). We are conducting an evaluation of the Community Health Strategy in selected communities in the district. We are interested in interviewing a mother of at least one child who is currently under five years old. If you choose to participate we will ask you questions about health topics such as water, sanitation, pregnancy, and community involvement. If you permit, we will measure the diameter of your youngest child’s upper arm. The survey will take about 45 minutes to complete.

If you choose to participate in our survey you will not receive any compensation for your time. However, we will be using the information we collect to make recommendations to government officials responsible for the Community Health Strategy in order to strengthen the program. This survey is completely voluntary. You can skip any uncomfortable questions and you can end your participation in the survey at any time. We will not record any personal information.

Do you have any questions for us about our survey?

If you have any additional questions about the conduct of this research you can contact Professor John Kiringe at +XXX XXXXXXXXXX.

### Demographic Survey

1. A household is defined as those who eat their meals together on a regular basis. Please list all members in your household.

No.	Age (years)	Sex	Education Level	Position in HH
Ex.	4, 12, etc.	Male, Female	Primary, Secondary, University, etc.	Read***
1				Respondent
2				Head of Household
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

\*\*\* Respondent is default position 1 and the head of household is always position 2.  
If same leave 2 blank\*\*\*

2. What is your marital status?
- 1 - Single
  - 2 - Separated
  - 3 - Married
  - 4 - Divorced
  - 5 - Widowed
  - A. [IF MARRIED FEMALE RESPONDENT]**  
Do you have any co-wives?
    - 1 - Yes
    - 0 - No
  - B. [IF MARRIED MALE RESPONDENT]**  
Do you have more than one wife?
    - 1 - Yes

- 0 - No
3. What, if any, **RELIGION** do you identify with? **[DO NOT READ ALOUD]**
- 1 - Christian
  - 2 - Muslim
  - 3 - No Religion
  - 4 - Other \_\_\_\_\_
4. What, if any, **TRIBE** do you identify with?  
**[DO NOT READ ALOUD]**
- 1 - Kamba
  - 2 - Kikuyu
  - 3 - Maasai
  - 4 - Tanzanian tribes
  - 5 - None
  - 6 - Other \_\_\_\_\_
5. What is the primary source of income for the household?  
**[DO NOT READ ALOUD]**
- 1 - Agriculture
  - 2 - Clerical
  - 3 - Skilled Manual Labor
  - 4 - Unskilled Manual Labo
  - 5 - Business
  - 6 - Other \_\_\_\_\_

**In the next set of questions, I would like to ask you about household illnesses and food intake.**

**HOUSEHOLD HEALTH MEASUREMENT R\_\_\_**

6. In the past 24 hours, what have your child or children under five eaten? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
- Herbs locally available
  - Breast Milk / Formula
  - Liver
  - Eggs
  - Fish
  - Butter
  - Red palm oil
  - Mangoes papayas
  - Carrots pumpkins
  - Dark green leafy vegetables
  - No food with Vitamin A micronutrient
7. In the past 2 weeks, has anyone in this household had a fever?
- 1 - Yes

- A. Is this person under 5 years old?
  - 1 - Yes
  - 0 - No
- B. Did this person seek treatment within 2 days?
  - 1 - Yes
  - 0 - No
- 0 - No
- 8. In the past 2 weeks, has anyone in this household had an illness with a cough?
  - 1 - Yes
    - A. Is the person under 5 years old?
      - 1 - Yes
      - 0 - No
    - B. Did this person also have short, rapid breathing?
      - 1 - Yes
      - 0 - No
    - C. Did this person seek treatment within 2 days?
      - 1 - Yes
      - 0 - No
  - 0 - No
- 9. In the past 2 weeks, has anyone in your household had 3 or more loose stools in a 24 hour period?
  - 1 - Yes
    - A. Is this person under 5?
      - 1 - Yes
      - 0 - No
    - B. Did this person seek treatment within 2 days?
      - 1 - Yes
      - 0 - No
  - 0 - No

**In the next set of questions, I would like to ask you about water and sanitation in the household.**

**WATER AND SANITATION R\_\_\_\_\_**

*Hand Washing*

- 10. When do you wash your hands? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
  - Before eating
  - After toilet
  - After cleaning a baby's bottom
  - Before food preparation
  - Don't wash their hands

**IF DON'T WASH, SKIP TO 12**

  - Other \_\_\_\_\_
- 11. How often do you use soap when you wash your hands?

- 1 - Rarely
- 2 - Consistently
- 3 - Almost always

*Water Treatment*

- 12. What is the **primary** source of water for your household? **[DO NOT READ ALOUD]**

- 1 - Piped water into the home
- 2 - Piped water outside the home
- 3 - Furrow
- 4 - Well water
- 5 - Rain water
- 6 - Spring water (chemi-chemi)
- 7 - River/stream
- 8 - Surface water (pond, etc.)
- 9 - Vendors
- 10 - Other \_\_\_\_\_

- 13. Did you do anything to your water to make it safer to drink the last time you collected it?

- 1 - Yes

- A. What do you usually do to make your water safer to drink? **[DO NOT READ ALOUD]**

- 1 - Boil
- 2 - Add bleach or chlorine
- 3 - Use water filter
- 4 - Solar disinfection
- 5 - Let it stand and settle
- 6 - Other \_\_\_\_\_

- 0 - No

- B. Why not? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**

- Taste
- Cost
- No need to treat the water/water is perceived to be clean
- Unfamiliar with treatment methods
- Don't know where to get water treatment products
- I only treat in the rainy season/it is not necessary in the current season
- Other: \_\_\_\_\_

*Latrines*

- 14. Do you have access to a latrine?
  - 1 - Yes
    - A. Do you share this latrine with other households?
      - 1 - Yes
        - a. How many?
          - \_\_\_\_\_
      - 0 – No

**NOW GO TO Q15**

- 0 – No

**IF NO, SKIP TO 19 AFTER ANSWERING B&C**

- B. Why not? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
  - High cost of latrine construction
  - Insufficient labor available
  - Lack of instructions
  - Lack of materials
  - Prefer not to have a latrine
  - They don't like using latrines
  - It is against culture/beliefs
  - The location is too far
  - Other \_\_\_\_\_
- C. Do you believe that this poses any health risks?
  - 1 - Yes
  - 0 - No

- 15. What kind of toilet facility do members of your household usually use? **[DO NOT READ ALOUD. PROMPT]**

- 1 - Bush or no facility
  - IF BUSH or NO FACILITY, SKIP TO 19**

- 2 - Pit Latrine
- 3 - Pit Latrine with slab
- 4 - Ventilated improved pit latrine
- 5 - Flush or pour flush toilet
- 6 - Other \_\_\_\_\_

- 16. Does everyone in your household use latrines?

- 1 - Yes
- 0 - No
  - A. Why not? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**



- Gender
  - Age
  - Don't want to
  - Other \_\_\_\_\_
17. How long does it take to walk to the nearest latrine? **[DO NOT READ ALOUD]**
- 1 - Less than 5 minutes
  - 2 - Between 6 and 15 minutes
  - 3 - Between 16 and 30 minutes
  - 4 - 31 minutes or more
18. Why do you choose to use a latrine rather than the bush? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
- Prevent illness
  - Cleanliness
  - Smell
  - Other \_\_\_\_\_

**In the next set of questions, I would like to ask you about mosquito nets.**

**Household Level Interventions R\_\_\_\_\_**

*Insecticide Treated Nets*

19. Do you think there are health risks associated with mosquitoes?
- 1 - Yes
    - A. Can you name any risks? **[DO NOT READ ALOUD]**
      - 1 - Malaria
      - 2 - Yellow Fever
      - 3 - Death
      - 4 - Cannot name any risks

**IF CAN'T NAME, SKIP TO 20**

    - 5 - Other \_\_\_\_\_
  - B. Do you think your family is at risk for these?
    - 1 - Yes
    - 0 - No
- 0 - No
20. Does your household own a mosquito net?
- 1 - Yes
    - A. Where did you get it?

**[DO NOT READ ALOUD]**

- 1 - Clinic
- 2 - Voucher
- 3 - Market
- 4 - Other: \_\_\_\_\_

0 - No

**IF NO, SKIP TO 24**

21. Did anyone in your home sleep under a mosquito net last night?

1 - Yes

A. Who slept under the net? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**

- Children under 5
- Pregnant women
- Other \_\_\_\_\_

B. How often do you use the net?

- 1 - Every night
- 2 - Five to six days per week
- 3 - One to four days per week
- 4 - Seasonally

C. Why do you use it? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**

- Prevent Malaria
- Protect against mosquitos
- Protect against other insects
- Other \_\_\_\_\_

D. When does it need to be treated again? **[DO NOT READ ALOUD]**

- 1 - Doesn't know answer
- 2 - Knows answer

0 - No

22. Would you explain how you use a mosquito net? **[DO NOT READ ALOUD, NOTE SLEPT UNDER, FULLY ENCLOSED]**

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23. Who do you believe should be given priority for using a mosquito net? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**

- Pregnant Women
- Children Under 5
- Other \_\_\_\_\_

- 24. If you wanted to buy a (additional) mosquito net, could you buy one?
  - 1 - Yes
  - 0 - No
- 25. If you need a (additional) mosquito net, where would you go to get one?
 

**[DO NOT READ ALOUD]**

  - 1 - Market
  - 2 - Clinic
  - 3 - Cannot identify one
  - 4 - Other \_\_\_\_\_

**In the next set of questions, I would like to ask you about your community.**

**Community Involvement and Health Programs R\_\_\_\_\_**

- 26. Does your community hold meetings?
  - Yes
    - A. Has there been one in the last year?
      - 1 - Yes
      - 0 - No

**IF NO, SKIP TO 27**

    - B. Have you attended one of the meetings?
      - 1 - Yes
      - 0 - No
    - C. Does the leader of these meetings listen to your concerns?
      - 1 - Yes
      - 0 - No
    - D. Do you feel comfortable approaching the leader of the meeting with your concerns?
      - 1 - Yes
      - 0 - No
  - 0 - No
- 27. Who do you think is most responsible for your health? **[WAIT FOR RESPONSE. PROMPT]**
  - 1 - You
  - 2 - Your community
  - 3 - The government
  - 4 - A higher power
  - 5 - Other \_\_\_\_\_
- 28. Who makes health decisions in your household? **[DO NOT READ ALOUD]**
  - 1 - Respondent
  - 2 - Husband/partner
  - 3 - Husband/partner jointly
  - 4 - Other: \_\_\_\_\_

- 29. Who do you approach if someone in your family has a fever for three days?  
**[DO NOT READ ALOUD]**
  - 1 - Relative
  - 2 - CHW
  - 3 - Religious leader
  - 4 - Traditional Medicine Practitioner
  - 5 - Government health facility
  - 6 - Private health facility
  - 7 - Other \_\_\_\_\_
- 30. Do you think that your community is capable of handling health issues without outside support or assistance?
  - 1 - Yes
  - 0 - No
- 31. Have health issues ever been discussed at your religious institution?
  - 1 - Yes
  - 0 - No
- 32. Does your culture have any practices intended to improve health?
  - 1 - Yes
  - 0 - No
- 33. Have you ever sought advice or treatment from a traditional healer?
  - 1 - Yes
    - A. What influenced your decision to seek traditional care? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
      - Family opinions
      - Past experiences
      - Trust in practitioner
      - Comfort with treatments
      - Closer than hospital
      - Cost
      - Cultural or tribal affiliations
      - Other: \_\_\_\_\_
  - 0 - No

*Community Health Workers*

- 34. Does a Community Health Worker work in your community?
  - 1 - Yes
  - 0 - No

**IF NO SKIP TO 45**
- 35. Do you know who your CHW is?
  - 1 - Yes
    - A. Do you know their name?
      - 1 - Yes
      - 0 - No
    - B. Did you know your CHW before he or she became a CHW?

- 1 - Yes
  - a. How did you know him or her? **[DO NOT READ ALOUD]**
    - 1 - Friend
    - 2 - Family
    - 3 - Neighbor
    - 4 - Business
    - 5 - Other \_\_\_\_\_
  - 0 - No
- 0 - No
- 36. When did your CHW last come to visit your home? **[DO NOT READ ALOUD]**
  - 1 - In the past 29 days
  - 2 - One to three months ago
  - 3 - Four to six months ago
  - 4 - Seven months to one year ago
  - 5 - Over one year ago
  - 6 - Has never visited
- 37. How long has your CHW been working in your community? **[DO NOT READ ALOUD]**
  - 1 - Zero to six months
  - 2 - Seven months to one year
  - 3 - Over one year to two years
  - 4 - Over two years
  - 5 - Don't know
- 38. Do you know where you can reach your CHW?
  - 1 - Yes
    - A. How much time does it take to reach your CHW? **[DO NOT READ ALOUD]**
      - 1 - Under 30 minutes
      - 2 - 30 minutes to two hours
      - 3 - More than two hours
      - 4 - Don't visit my CHW
    - 0 - No
- 39. Does your CHW call for meetings?
  - 1 - Yes
    - A. Did you attend the last meeting that was held?
      - 1 - Yes
      - 0 - No
    - 0 - No
- 40. Do you feel that the CHW's health priorities are aligned with what is important to you?
  - 1 - Yes
  - 0 - No

- 41. How frequently have you consulted your CHW for health concerns or advice?  
**[DO NOT READ ALOUD]**
  - 1 - Rarely
  - 2 - Occasionally
  - 3 - Almost always
  - 4 - Does not consult
- 42. How often do you follow through with your CHW's recommendations?
  - 1 - Rarely
  - 2 - Occasionally
  - 3 - Almost Always
- 43. How much do you trust your CHW with caring for your health?
  - 1 - Not very much
  - 2 - A little
  - 3 - Some
  - 4 - Much
  - 5 - Very much
- 44. How often do you understand the information your CHW provides you for your health?
  - 1 - Rarely
  - 2 - Occasionally
  - 3 - Almost always
  - 4 - Never provided any advice

**In the next set of questions, I would like to ask you about your general health and last pregnancy.**

**General Health**

**R\_\_**

- 45. Please list all the health care providers that you have heard of in your community. **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
  - Traditional Healer
  - Traditional Birth Attendant
  - Level 2
    - Government Dispensary
    - Private Clinic
  - Level 3
    - Government Health Center
    - Maternity/Nursing Center
  - Level 4
    - Government District Hospital
    - Private/Mission Hospital
  - Other: \_\_\_\_\_
- 46. The last time you sought health care for any of your children under five, what was it for? **[DO NOT READ ALOUD]**
  - 1 - Preventative care
  - 2 - Burn

- 3 - Chronic disease care
- 4 - Malaria
- 5 - Tetanus
- 6 - Tuberculosis
- 7 - Hepatitis B
- 8 - Diarrhea
- 9 - Skin disease
- 10 - Respiratory diseases
- 11 - Eye infections
- 12 - Dysentery
- 13 - Insect or snake bites
- 14 - Intestinal worms
- 15 - Typhoid
- 16 - HIV/AIDS
- 17 - Polio
- 18 - Measles
- 19 - Wound
- 20 - Fever
- 21 - Other \_\_\_\_\_

*Antenatal Care*

- 47. Did you see anyone for care during your last pregnancy?
    - 1 - Yes
      - A. How many visits did you attend? \_\_\_\_
    - 0 - No
- IF NO, SKIP TO 50**

- 48. What services were provided to you during these visits? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
  - Complications screening
  - Fetal growth measurement
  - Maternal nutritional support
  - Maternal immunizations (tetanus, etc.)
  - Other: \_\_\_\_\_
- 49. Where did you receive pregnancy related care while you were last pregnant? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
  - Your Home
  - Other Home
  - Level 2
    - Government Dispensary
    - Private Clinic
  - Level 3
    - Government Health Center
    - Maternity/Nursing Center
  - Level 4
    - Government District Hospital
    - Private/Mission Hospital
  - Other: \_\_\_\_\_

*Delivery*

- 50. Where did you give birth to your last child? **[DO NOT READ ALOUD]**
  - 1 - Your Home
  - 2 - Other Home
  - 3 - Level 2
    - Government Dispensary
    - Private Clinic
  - 4 - Level 3
    - Government Health Center
    - Maternity/Nursing Center
  - 5 - Level 4
    - Government District Hospital
    - Private/Mission Hospital
  - 6 - Other: \_\_\_\_\_



- A. [IF ANSWER WAS YOUR HOME or OTHER HOME]** Why did you choose where you delivered? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY.]**
- Cost Too Much
  - Facility Not Open
  - Too Far/No Transportation
  - Don't Trust Facility
  - Poor Quality Service
  - No Female Provider at Facility
  - Husband/Family Did Not Allow
  - Not Necessary
  - Other \_\_\_\_\_
- B. [IF ANY OTHER LOCATION BUT YOUR HOME]** During your last pregnancy how did you travel to the place of delivery? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
- Walking
  - Household Vehicle
  - Other Vehicle
  - Donkey
  - Bus
  - Motorbike
  - Other \_\_\_\_\_
51. Who assisted with the delivery during your last pregnancy? **[DO NOT READ ALOUD. PROMPT. CHECK ALL THAT APPLY]**
- Doctor/Nurse/Midwife
  - Traditional Birth Attendant
  - Traditional Healer
  - Community Health Worker
  - Relative/Friend
  - No One
  - Other: \_\_\_\_\_
52. What are the health risks associated with delivery? **[DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
- Hemorrhage(bleeding)
  - Continued Eclampsia (High Blood Pressure)
  - Severe Tearing
  - Infection
  - Breach birth
  - Abnormal fetal heart rate
  - Extreme exhaustion
  - Don't know any risks
  - Other \_\_\_\_\_

*Postnatal Care*

53. Are you still breastfeeding your youngest child?

- 1 - Yes
- A. Did the child consume anything other than breast milk in the past day?
- 1 - Yes
- 0 - No
- IF NO, SKIP TO 54**
- B. How many months did you exclusively breast feed that child?  
\_\_\_\_ Months
- 0 - No
- C. How many months did you exclusively breast feed that child?  
\_\_\_\_ Months
54. Do you think your youngest child is at risk for any ailments?
- 1 - Yes
- A. What ailments are they at risk for?
- [DO NOT READ ALOUD. CHECK ALL THAT APPLY]**
- Malaria
- Tetanus
- Tuberculosis
- Hepatitis B
- Diarrhea
- Skin disease
- Respiratory diseases
- Eye infections
- Dysentery
- Insect or snake bite
- Intestinal worms
- Typhoid
- HIV/AIDS
- Polio
- Measles
- Other \_\_\_\_\_
- 0 - No
55. Do you have a child welfare card with your youngest child's vaccinations?
- 1 - Yes
- A. May we see it?
- B. May we please record your child's vaccinations?

Vaccination/Vitamin Shot	Shot Location
<input type="checkbox"/> BCG	<input type="checkbox"/> Lower Left Arm
<input type="checkbox"/> DPT - Dose 1 <input type="checkbox"/> DPT - Dose 2 <input type="checkbox"/> DPT - Dose 3	<input type="checkbox"/> Right or Left Thigh
<input type="checkbox"/> OPV - Dose 0	<input type="checkbox"/> Orally

<input type="checkbox"/> OPV – Dose 1 <input type="checkbox"/> OPV – Dose 2 <input type="checkbox"/> OPV – Dose 3	
<input type="checkbox"/> PCV – Dose 1 <input type="checkbox"/> PCV – Dose 2 <input type="checkbox"/> PCV – Dose 3	<input type="checkbox"/> Right or Left thigh
<input type="checkbox"/> Pentavalent – Dose 1 <input type="checkbox"/> Pentavalent – Dose 2 <input type="checkbox"/> Pentavalent – Dose 3	<input type="checkbox"/> Right or Left thigh
<input type="checkbox"/> Measles	<input type="checkbox"/> Upper Right Arm
<input type="checkbox"/> Vitamin A Capsule 6 months-Blue 12 months -Red	<input type="checkbox"/> Orally

- 0 - No
- C. Can you tell me what vaccinations your youngest child has had?  
**[ATTEMPT TO FILL IN ABOVE TABLE IN PART B]**

56. May we measure the upper arm of your children that are less than five?  
**[SEEK PERMISSION TO MEASURE MIDDLE UPPER ARM CIRCUMFERENCE OF ALL CHILDREN <5YRS]**

CHILD	MUAC

This concludes our survey. Thank you very much for your time and participation. Do you have any questions for us?

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## CURRICULUM VITAE

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### Education

Boston University School of Graduate Medical Sciences January 2015  
M.A. in Medical Sciences  
*Thesis Research:* Community Health Workers in Kajiado County: An Evaluation of the  
Community Health Strategy in Rural Kenya

Boston University School of Public Health January 2015  
M.A. in Public Health  
Concentration: Global Health

University of California: Davis March 2010  
B.S. in Biotechnology  
Specialization: Animal Biotechnology  
Minor: History

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### Skills and Qualifications

Registered Emergency Medical Technician Basic (EMT-B) trained at Boston University  
(August 2012)  
Research Laboratory Experience: Animal Cell Culture, Western Blots, PCR, IHC Staining  
Experience with Labview, EpiInfo, CSPro, Solidworks and Photoshop

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### Experience

Researcher/Student May 2013-June 2013  
School for Field Studies, Kimana, Kenya  
Conducted a cross-sectional study on the effectiveness of the Kenyan Ministry of  
Health's Community Health Worker program  
Created a survey instrument, collected approximately 300 field surveys in 7 days,  
manually input data and conducted analysis using CSPro and EpiInfo  
Presented a power point presentation and a written report of findings to the Ministry  
of Health and local community at a public forum in multiple languages

Laboratory Intern July 2012-April 2013  
Boston University, Boston, MA



Studied the effects of inflammation proteins on blood vessel smooth muscle and atherosclerosis using a combination of Western Blots, PCR, IHC Staining, and Animal Cell Culture  
Trained to work with radioactive labeling compounds

Research Assistant

April 2009-June 2010

University of California: Davis, Davis, CA

Conducted field and green house trials of various herbicides to determine their suitability for use on food crops  
Worked in league with local farmers to perform trials

Laboratory Intern

March 2009-June 2010

UCD Horwitz Lab, Davis, CA

Lead and trained a team of students in an undergraduate laboratory  
Conducted research on the effects of oxygen deprivation to neural hippocampus cells  
Presented and defended research at the Experimental Biology Convention 2010

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**Posters and Publications**

Brown, T., Lewis, C., Liepart, G., Ordaz, J., Hamilton, J., Horowitz, J., Horwitz, B. (2010). *Effects of an Anoxic Insult on Hamster Hippocampal CA1 Pyramidal Cells Are Attenuated With Decreased Temperature*. Poster presented at the 2010 Experimental Biology Convention.