Strengthening Community Health Strategy in Kenya through Public Private Partnership –Implementation Research

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This thesis is dedicated to my parents who have made a lot of sacrifices for us to succeed in life, true educators at heart.

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Summary

This PhD thesis focuses on three areas namely infectious diseases (diarrheal and respiratory infections), maternal and child health and non-communicable diseases (diabetes mellitus and hypertension) and discusses how community health workers can play a role in improving the health and wellbeing of the people.

In chapter two we evaluated a community health education program that was implemented by private sector with an aim of reducing diarrhea and respiratory infections. Recognizing the highest proportion of outpatient attendance in Kenya is due to preventable diseases especially those related to water, sanitation and hygiene, the program through trained community health educators provided group education sessions at the community level. We used a facility based case-control study design to compare risk of diarrhea and respiratory infections among those exposed to the community education program and those not exposed. We found that participants exposed to the education program had a 38% lower odd of having diarrhea or respiratory infection. The findings have a bearing on water sanitation and hygiene initiatives as they indicate the need for information, education and communication (IEC) activities. Participants residing in areas with water improvement initiatives also reported 35% lower odds of having diarrhea or respiratory infections further highlighting the need for infrastructure development.

Chapter three focuses on care seeking dynamics of patients diagnosed with diabetes and/or hypertension. Diabetes and hypertension are chronic conditions that affect an individual over a life time once diagnosed. Understanding how chronic patients residing in rural settings navigate the healthcare system is important for ensuring continuation of care. We used a cross-section survey to explore the health seeking behaviour of these patients as well as determine predictors of appropriate health seeking behaviour. Majority of the participants were diagnosed in the public sector and continued to seek care in the public sector. Almost all the respondents, 89% were on conventional medicines. Nearly two-thirds reported having regular scheduled clinic visit with their healthcare provider. Financial constrain and thinking the disease was not serious were the most common reason for dropping out of treatment. The findings provide evidence on the need to strengthen the public facilities in order to protect rural patients from health complications resulting from non-treatment. It also highlights the need for patient education on hypertension and diabetes in order to encourage adherence to therapy.

Chapter four we conducted a cross-sectional survey to assess utilization of maternal child health services. The purpose of this study was to provide a monitoring framework for the effectiveness of community health worker program in increasing uptake of maternal child health services.

Maternal mortality remains high in Kenya at 362 per 100,000 live births and way above the sustainable development goal target of 70 per 100,000 live births. Nearly all mothers, 97% reported having attended at least one antenatal care clinic during the last pregnancy in the last two years prior to the survey. The world health organization recommends at least four antenatal care clinic visits during pregnancy and should start during the first trimester. Approximately 38% of the mothers interviewed did not have a minimum of ANC visits during their last pregnancy and only 22% had their first during the first trimester. Despite the high ANC attendance, there was poor knowledge of danger signs in pregnancy as well as danger signs for newborns. This highlights the need to review education provided during ANC and find strategies of sharing vital information at every ANC attendance, that is, to focus on the quality of every clinic visit. The findings also highlight the need to leverage close to community strategies such as community health workers to provide education to the mothers and to encourage ANC attendance.

The findings of this research lend themselves to the support of community health workers in prevention of infectious disease, promoting wellbeing of pregnant mothers and children as we as supporting patients with chronic diseases and ensuring they are retained in care. The findings further review the reliance of rural communities on public health facilities for health services. This has a policy implication in that there is need to strengthen the public health facilities in order to protect the poor and the marginalized communities who depend on them for the health services.

List of Abbreviation

ANC-	**Antenatal Care**
ART-	**Antiretroviral Therapy**
BP-	**Blood Pressure**
CBHIS-	**Community Based Health Information System**
CHCs-	**Community Health Committees**
CHEWs-	**Community Health Extension Workers**
CHS-	**Community Health Strategy**
CHUs-	**Community Health Units**
CHVs-	**Community Health Volunteers**
CHWs	**Community Health Worker**
CREATES-	**Centre for Research in Therapeutic Sciences**
CUs-	**Community Units**
DHMT-	**District Health Management Team**
HIV-	**Human immunodeficiency virus**
HMIS-	**Health management information system**
IDI-	**In-depth Interview**
KEPH-	**Kenya Essential Package for Health**
LMICs-	**Lower and Middle Income Countries**
SDGs-	**Sustainable Development Goals**
MNCH-	**Maternal New-born and Child Health**
IUD	**Intrauterine Device**
MOH-	**Ministry of Health**
NCDs	**Non Communicable Diseases**
ORS-	**Oral Rehydration Solution**
PHC-	**Primary Health Care**
RTI-	**Respiratory Tract Infection**
Swiss TPH-	**Swiss Tropical and Public Health Institute**
SCHMT-	**Sub-County Health Management Team**
UNICEF-	**United Nations International Children's Emergency Fund**
WHO-	**World Health Organization**
RCT	**Randomized Controlled Trial**
WASH	**Water Sanitation and Hygiene**
IQR	**Interquartile range**
AMREF	**Africa Medical and Research Foundation**
IEC	**Information, Education and Communication**
OR	**Odds Ratio**
CI	**Confidence Interval**
SSA	**Sub Saharan Africa**
ODK	**Open Data Kit**
NHIF	**National Health Insurance Fund**
CRD	**Chronic Respiratory Disease**
KDHS	**Kenya Demographic Health Survey**

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1. Introduction

Universal health coverage as set out by the World Health Organization (WHO) and the United Nations General Assembly are a key priority for countries across the globe as captured in Sustainable Development Goal (SDG) three which aims at ensuring healthy lives and promote well-being for all at all ages and its linked target 3.8 on attaining Universal Health Coverage (UHC) by 2030[1-4]. A key challenge to achieving these goals is the shortage of health workers especially in the Low and Middle Income Countries (LMIC) [5].

The world health organization (WHO) estimates the shortage of health workers in Africa and Asia to be approximately 4.25 million and an approximately 400 million people globally to not have access to basic health services[6]. This shortage of health workers is further marked by inequitable distribution of the existing health workers majority being located in the private sector, in cities and high income countries leaving those in dire need, such as the poor, people living in rural settings and marginalized people and groups with inadequate care [7].

In response to this health worker crisis and in addition to the growing body of evidence on the effectiveness of community health workers (CHWs), a lot of the LMIC have renewed their interests and increased their investments in CHW programs [7-10]. Community health workers (CHWs) fall within a task-shift strategy to address the shortage of health workers[11, 12]. Different names have been used to refer to the CHWs including health auxiliaries, health volunteers, health promoters, family welfare educators, village health workers, community lay health aides, health agents and barefoot doctors among others[7, 13]

The WHO definition of CHWs is a worker who lives in the community they serve, is selected by the community and is accountable to the same community; they have short and defined training and are not necessarily attached to a formal institution[14]. In resource constrained settings, CHWs play a vital role of enabling the formal health systems through the delivery of preventative health care services, providing basic curative services directly to the community and at the same time linking the households with the formal health system[15]. Large scale CHW programs have the capacity to reach the most vulnerable and marginalized population with health services thus bridging the equity gap in accessing care[10]. Since the CHWs are often chosen from the locality,

they tend to be more embedded in their communities, they are more likely to stay in job and also understand and empathize with their community members [16]

Despite the evidence on the effectiveness of the CHWs and CHW programs as a solution to the shortage of health workers crisis especially in LMICs, a lot of implementation issues continue to pose a threat to their sustainability. They face weak political endorsement, lack of finances, fragmented oversight and technical support as well as lack of well-funded research agenda to create an evidence base of proven strategies to enhance and sustain the CHW programs[10]. Other challenges these programs face relate to motivation and performance of the CHWs, attrition rates and the quality of care delivered being low[17] These challenges provide an opportunity for increased cooperation between policy makers, public health practitioners and the private sector thus leverage on the strength of each partner to strengthen the health systems in the LMIC[10]. As countries across the globe strive to achieve UHC by 2030, the need for public private collaboration becomes more real as no one single organization can address the healthcare challenges on their alone. However such collaborations need to be accompanied by implementation research using rigorous evaluation designs in order to provide context specific evidence of sustainable strategies in addressing health related challenges in developing countries.[18, 19]

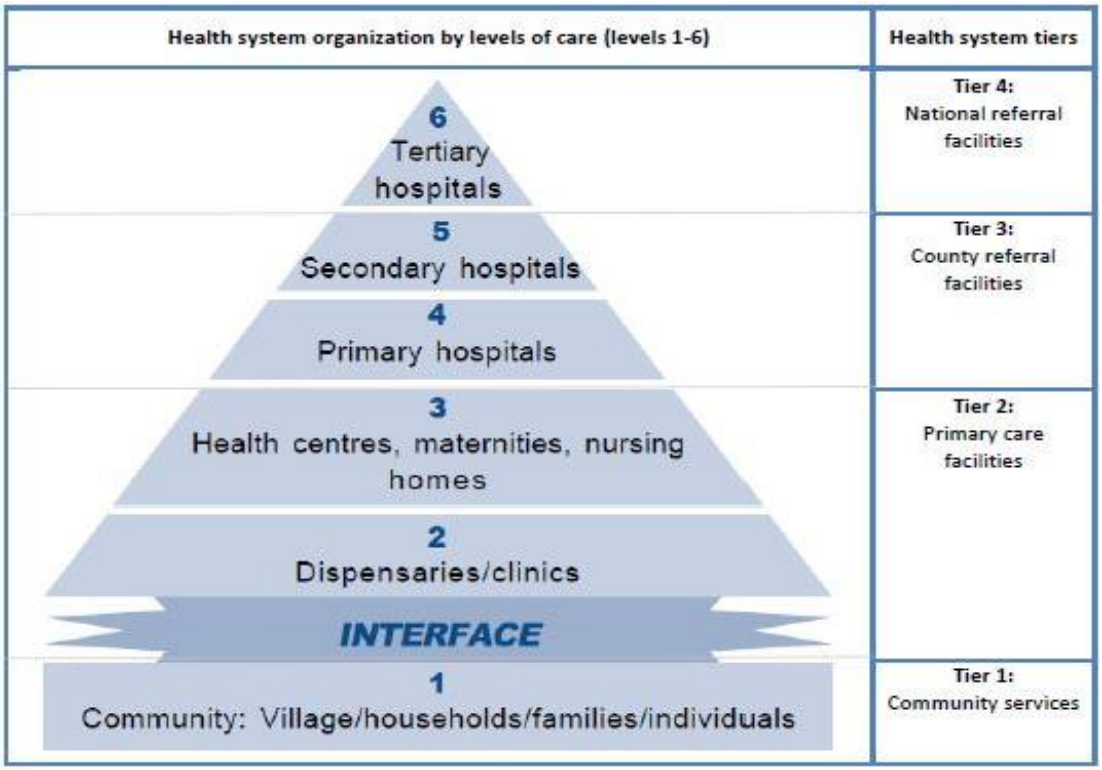
1.1. The Kenyan Health system and Community Health Strategy

The provision of health services in Kenya is organized around six levels of care fitting into four tiers that include the community, primary care, primary referral services (county) and tertiary referral services (national)[20] .The promotion of primary health care services to the community is centered on the lowest level of the six-level health system, level 1 (also referred to as the community health unit). The level 2 and level 3 health facilities which include dispensaries and health centers provide both preventative and curative services while the facilities at the higher level namely level 3, 4, 5 and 6 are mainly focused on curative and rehabilitative services. Child delivery services are found in all facilities from level 2 upwards while facilities from level 3 upwards offer health services on a 24 hour basis[5]. Following the devolution of government from Central to County governments, the implementation of health programs and delivery of health services became the responsibility of the sub-counties[20]. In 2006, the government of Kenya through its Ministry of Public Health and Sanitation developed a community health strategy to deliver Kenya

Essential Package for Health (KEPH) at the community level[21]. The strategy had an ambitious vision of reaching 3.2 million households (approximately 16 million people) by the year 2009 although this was not realized. The strategy provided a plan to expand community access to health care as well as providing a way of empowering households and communities to take charge of their health and the development issues related to health[22]

According to the strategy, the coordination of community health services within the sub-counties is the responsibility of the sub-county health management team (SCHMT) which was formerly known as the district health management team (DHMT). The delivery of health services in the sub-county is then focused around Community Health Units (CHU) also termed as first tier or level 1 as in figure 1 above (McCollum et al., 2015). [20]The (CHU) were established to serve a population of 5,000 people (approximately 1000 households). Within the CHUs the delivery of services to the communities is the responsibility of Community Health Volunteers (CHVs) who are elected and managed by the Community Health Committees (CHC).

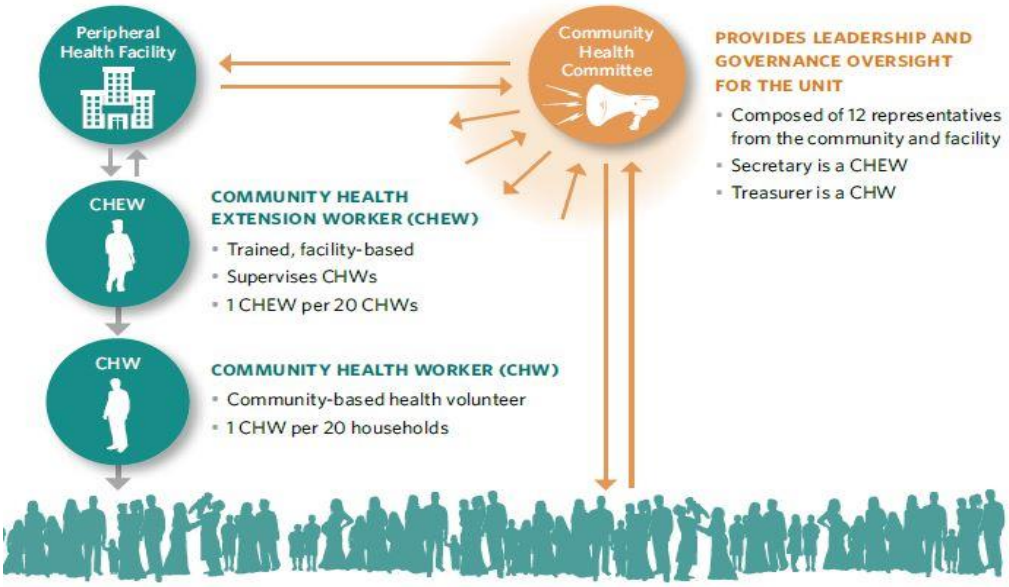
Figure 1: Kenyan Health system organized into four tiers and six levels of care (Source: Ministry of Health, 2014)



The CHCs are made up of voluntary community representatives and their role is to provide supervision and governance of CHVs as well to mobilize the community to take part in health related activities[20]. The CHVs are directly supervised by the community health extension workers (CHEWs) who are usually trained health personnel such as nurses or public health officers and are government employees through the Ministry of Public Health and Sanitation thus creating a link between the CHVs and the local health facilities[22]. The tasks performed by the CHVs falls into three main categories namely, disease prevention and control, family health services and hygiene and environmental sanitation. In the event of decentralization of governance some counties such as Siaya have adopted CHEWS as part of their health system and have formally employed them. There is need to generate more information on the role of the CHEWs in the county health system to facilitate the integration of CHEWs as part of the health system as voluntary work is not sustainable.

Figure 2: An illustration of the Kenya Community Health Strategy

(Source: Pathfinder International, 2014)

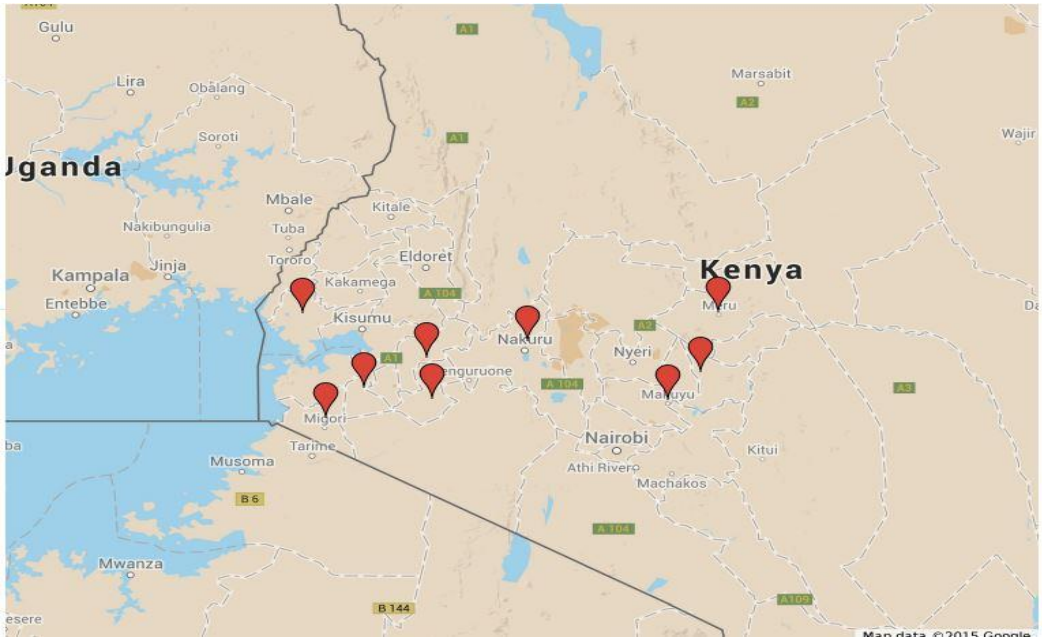


1.2. Community Health Worker Program

The work represented in this thesis was conducted within a broader collaboration between various county ministries of health and a Novartis Social Venture in Kenya called Familia Nawiri. Familia Nawiri which means healthy families in Swahili, was launched in Kenya in 2012– based on a previously successful Novartis initiative initially started in India (where it was called 'Arogya

Parivar')[23] .The overall aim of Familia Nawiri is to help improve access to healthcare services including access to quality medicines for populations living at the base of the economic pyramid[24]. Together with the various county ministries of health in Kenya, the partnership aim is to strengthen community health strategy through building capacity and competencies of the CHEWs and CHVs.

Figure 3: Map showing Familia Nawiri Project Sites in Kenya



1.3. Objective of the thesis

The overall aim of this thesis was to assess the effect of a community health worker initiative implemented in rural parts of Kenya through a private public partnership as well as inform future programming.

Specific objectives were

1. To evaluate a community-based health education program in reducing the risk of diarrhea and respiratory infections
2. To assess care seeking dynamics among patients diagnosed with diabetes and hypertension
3. To assess utilization of maternal child health services at baseline across the project sites

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Chapter 2: Risk reduction of diarrhea and respiratory infections following a community health education program - a facility-based case-control study in rural parts of Kenya

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2. Risk reduction of diarrhea and respiratory infections following a community health education program - a facility-based case-control study in rural parts of Kenya

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2.1. Abstract

Background: Diarrheal and acute respiratory infections remain a major cause of death in developing countries especially among children below five years of age. About 80% of all hospital attendances in Kenya can be attributed to preventable diseases and at least 50% of these preventable diseases are linked to poor sanitation. The purpose of this study was to assess the impact of a community-based health education program, called Familia Nawiri, in reducing the risk of diarrhea and respiratory infections among people living in three rural Kenyan communities.

Methods: Cases were defined as patients attending the health facility due to diarrhea or a respiratory infection while controls were patients attending the same health facility for a non-communicable disease defined as an event other than diarrhea, respiratory infection. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated using a logistic regression model to assess the risk of diarrheal or respiratory infection in association with exposure to the health education program.

Results: There were 324 cases and 308 controls recruited for the study with 57% of the cases and 59% of the controls being male. Overall, 13% of cases vs. 20% of control patients were exposed to the education program. Participants exposed to the program had 38% lower odds of diarrhea and respiratory infections compared to those not exposed to the program (adjusted OR 0.62, 95% CI 0.41-0.96). A similar risk reduction was observed for participants in the study who resided in areas with water improvement initiatives (adjusted OR 0.65, 95% CI 0.47-0.90). Variables in the adjusted model included water improvement projects in the area and toilet facilities.

Conclusion: Findings from this study suggest participants exposed to the education program and those residing in areas with water improvement initiatives have a reduced risk of having diarrhea or respiratory infection.

Keywords: Diarrhea, respiratory infection, health education, hygiene, case-control study

2.2. Background

Diarrhea and acute respiratory infections remain a major cause of death in low income countries especially among children below five years of age accounting for about 9 and 13% of annual deaths respectively [1-3]. In Kenya, about 80% of all hospital attendances can be attributed to preventable diseases. Among these preventable diseases, approximately 50% of them are water, sanitation and hygiene related. Diarrheal diseases are ranked among the top ten causes of morbidity and mortality in Kenya and in most rural healthcare facilities; diarrhea is ranked third among the leading causes of outpatient attendance [4]. Furthermore, in Kenya diarrheal diseases cause 16% of deaths among children below five years of age followed by pneumonia [4].

While notable progress has been made - including a 53% decrease in the worldwide mortality rate of children below five years between 1990 and 2015 [5] - still about 1 in 12 children die before their 5th birthday in low income countries compared to 1 in 147 in the developed world [6]. The Global Burden of Disease 2015 policy report also highlighted "Exposure to poor sanitation, indoor air pollution, and childhood under nutrition has dropped, resulting in dramatic declines in the burden of diarrhea and pneumonia in children" [7]. At a country level however, this should not result in any decrease in their infection control efforts, and there remains a need to identify interventions against common diseases affecting children such as diarrhea and respiratory infections [8]. The negative impact of poor sanitary conditions on health remains as much of a public health concern in the developing world today as when it was a surprising revelation to London during John Snow's pioneering epidemiological work on cholera infection over 150 years ago [9].

Hand washing is one of the best studied hygiene practices in resource constrained settings. Findings from randomized controlled trials (RCTs) and observational studies on hand washing with soap have shown reduction in diarrhea of between 30% and 47% [10, 11]. A 2006 quantitative systematic review of seven homogenous interventional studies reported a 16% (95% confidence interval [CI] 11–21%) reduced risk of respiratory infections through hand washing with soap [12]. Similar findings of a 47% risk reduction of diarrhea were also reported in a 2003 systematic review on the effect of hand washing with soap [13] and a 35% reduction in incidence of diarrhea in a 2017 RCT on hand washing with soap and Water, Sanitation and Hygiene (WASH) education intervention [14]. Recent RCTs assessing interventions promoting healthy behaviour related to WASH in improving child health outcomes like diarrhea have yielded negative results [15-17].

One of the studies found no benefit of individual interventions such as hand washing, sanitation, water treatment and nutrition[16] while the other found no additive benefit of the interventions over single interventions[17]. Another RCT conducted in Bihar, India on hand washing with soap among school children and their mothers showed little effect on targeted behaviour such as hand washing with soap after defecation and using soap for bathing[18].

A World Bank review found hygiene promotion including hand washing to be the most cost effective intervention for disease prevention at a cost of approximately $3.4 for each disability-adjusted life-year saved [19]. Despite the large body of evidence showing the cost effectiveness and benefits of hygiene promotion in reducing the burden of infectious diseases, there remains low investments in hygiene in the public health, water and sanitation sector [10]. Even more puzzling is the fact that despite the evidence on the ability to prevent diseases, hand washing with soap is still not common practice with some studies reporting 5-15% usage even at the critical times such as after toilet use [20]. This highlights that knowledge alone is insufficient when it comes to changing behaviour and also acknowledges that changing deep seated, private and culturally embedded hygiene practices is a complex and uncertain process [21].

The purpose of this study was to evaluate a community-based health education program in reducing the risk of diarrhea and respiratory infections after two years of its operation. The program was implemented by Familia Nawiri (a Swahili term for “healthy family”), a social venture program initiated in Kenya by Novartis, a multinational pharmaceutical company in three rural settings in Embu, Kirinyaga and Nakuru counties [22]. The education sessions were based on the assumption that through continuous education of community groups, the program would be able to conjure positive change in health related behaviour and thus, reduce the risk of preventable diseases such as diarrheal and respiratory diseases. There are various theories that have been developed and used to explain the relationship of factors that affect health related behaviour. These theoretical behaviour models have been applied to health education and health promotion - among other areas - sometimes with considerable success [23]. Though not applied to the Familia Nawiri program implementation, the RANAS (Risk, Attitudes, Norms, Abilities, Self-Regulation) model for behaviour change which is based on several behaviour change theories [24] has been applied to change behaviour in WASH with good success[25, 26]. The model groups factors that need to be favorable in order for a new behaviour to emerge into five categories (risk factor, attitude

factors, norm factors, ability factors and self-regulation factors) and these are matched with specific behaviour change interventions[24, 27].

2.3. Methods

2.3.1. Program Implementation

The program focused on community-based health education at a group level as a way of encouraging lasting behaviour change. The groups comprised of women, men, church, youth and table banking (informal money saving) groups with majority being women. The choice to deliver the health education through the group platform was based on the high prevalence of self-help and informal money saving group among others in the rural setting[28, 29]. Since the groups already existed prior to implementation of the program, this provided an easier entry route into the community with larger audience as opposed to individual house visitations. Existing groups in the project sites were mapped and approached for permission to deliver health education sessions during their usual meeting times. The education sessions were delivered by trained health educators who resided in the same communities as the attendees at the education sessions. The health educators had as a minimum a secondary school education level. Prior to initiation of the program, the health educators received training focused on content of hygiene education topics, communication skills and styles, adult learning and facilitation skills, time management and the overall format and structure of a group education session as they would occur in the community. After the training, the health educators were deployed to their communities where they provided health education to the various existing organized groups in their communities.

The hygiene education curriculum comprised two parts, namely, personal and environmental hygiene. Key messages under personal hygiene included body hygiene, dental hygiene, proper hand washing practices and the importance of good hygiene in preventing contagious diseases. Messages on hand washing were coupled with a demonstration on proper hand washing procedure. Key messages on environmental hygiene included main water sources, water treatment methods, importance of clean environment including household surfaces, floors, clothes, outside living area, bathroom, latrines, cooking areas and dishes. There was also an emphasis on having improvised hand washing stations with soap near the toilet facilities to encourage hand washing at critical times, including a demonstration on how to construct these hand washing stations. Each group received at least 2 sessions on each part of the hygiene curriculum, each session lasting 20-40 minutes. The education sessions took place during the regular meetings for the different groups.

The sizes of the groups differed depending on the purpose of the group's existence but mainly ranged from 10 to 200 - though not all members attended the education sessions. The education sessions were conducted in a participatory manner with both the health educators and the participants contributing to the questions and discussions.

2.3.2. Study design and setting

A health facility-based case-control design was used to assess the impact of the education program on reducing the risk of diarrhea and respiratory infections. The rationale for this approach was based on the fact that there were no baseline outcome measurements available to allow for a before and after design. An RCT or a prospective observational study would be a more appropriate design in certain situations to evaluate the effect of an intervention. However, in our case, the program sponsors designed and implemented the program without a specific plan to do an assessment of the effect of the program. When we decided to assess the program, it had already been implemented, and therefore, any prospective assessment was not feasible anymore, and therefore we decided to conduct a case-control analysis bearing in mind the limitations inherent to that design.

The study was carried out in three counties in Kenya, namely Nakuru (Molo constituency), Kirinyaga (Mwea constituency) and Embu (Manyatta constituency) which were the initial pilot sites for the Familia Nawiri community health education program.

2.3.3. Selection of cases and controls

A total of six health facilities in Nakuru County, eight in Kirinyaga County and five in Embu County were selected based on their location in the target areas where the education program had been implemented. Participants were eligible for the study if they attended the health facility during the study period (June 2014 to November 2014) and if they were residents of the same village for more than 6 months. Children who were accompanied to the health facilities by a parent or a legal guardian who was willing to take part in the study and able to provide written informed consent on behalf of the minor were also included in the study. Data were then obtained from the accompanying parent or guardian. Cases were defined as patients attending the health facilities because of diarrhea or respiratory infection. In line with the definition by the Ministry of Health of Kenya [30], the world health organization (WHO) definition for diarrhea namely, having three or more loose or liquid stools per day or more frequently than normal for the individual was applied

[31]. Respiratory infections were defined as patients having one or more of the following diagnoses and/or symptoms: Pneumonia, bronchitis, and cold/cough plus any of the following other symptoms: difficulty breathing, chest pain, sore throat, sneezing, or runny nose [32]. Controls were defined as patients attending the same health facility within 2 days of a case for a 'non-communicable disease' reason, i.e. an event other than diarrhea, respiratory infection.

2.3.4. Data collection

Mobile electronic data collection was employed for this study. The questionnaire used was adapted from a previously published World Health Organization questionnaire [33] that had been used to evaluate a water, sanitation and hygiene education intervention. The questionnaire was programmed in the Mezzanine mhealth software platform[34] and deployed onto Android mobile phones. After providing a written informed consent, the participants or their parents or guardians were asked questions from the electronic questionnaire and all the answers were captured on the mobile devices. The completed questionnaire was then automatically uploaded to a host server. In places where there was no network coverage, the completed questionnaires were stored securely on the device and later automatically uploaded when a signal was found. The data collectors were community health extension workers (CHEWs) who administered the questionnaire to the participants at the health facility. The case and control patients were referred to the CHEWs for participation in the study by the clinicians at the facility after consultation and diagnosis.

Data collected included socio-demographic factors, hygiene practices, and behaviour (e.g. age, sex, education level, number of people living in the house, type of house roof, floor and walls, distance to health facility, mode of transport to health facilities, main sources of water, storage of drinking water and water treatment practices). Personal hygiene was assessed using a series of practice and behaviour questions. Seven of the questions related to critical hand washing time points such as before eating, after handling child's stool and after visiting the toilet. The behaviour was then evaluated as a whole and awarded a composite score with each correct answer yielding 1 point while every wrong answer yielding zero points. Factors causing diarrhea and the health seeking behaviour for illness due to diarrhea and respiratory infections were assessed in a similar fashion.

The CHEWs underwent an intensive one-day training prior to commencing data collection. The training focused on the data collection protocol including basics of conducting interviews,

pretesting of the survey instruments for suitability and appropriateness, field logistics, general orientation to using the mobile devices and the data collection software, accessing the questionnaire on the phone, trouble shooting and handling technical difficulties with the mobile device. Special attention was paid during training on interview techniques especially the avoidance of asking 'leading' questions. A pilot test in which the CHEWs conducted interviews with each other and inputting dummy data into the app, was conducted prior to starting data collection in order to allow them to gain familiarity with the app, to test our processes and to allow minor adjustments to the data collection instrument.

2.3.5. Sample size estimation

The sample size for this frequency-matched case-control study was estimated using formulary as described by [35] for a binary outcome analysis using logistic regression. We calculated that a minimum sample size of 272 for either a case or control will be required based on 2-sided testing with a 0.05 level of significance and 80% power in order to detect a risk reduction of 0.5 (OR=0.5). The assumption made in calculating the sample size was that 20% of the controls would have been exposed to the Familia Nawiri hygiene education program. Accounting for 5% non-response rate, the final sample size was 286 for cases and 286 for controls; a minimum sample size total of 572 participants were therefore needed. In order to minimize selection bias and ensure controls were of a similar source population as the cases, participants were frequency-matched on the basis of recruitment by health facility and the time of diagnosis with controls being recruited within 2 days of a case.

2.4. Data analysis

Data were entered into Stata software, StataCorp.2013 [36] (for analysis. The age of the participants and the age of the mother were reported using median and interquartile range (IQR), while all the other study variables which were categorical were reported as percentages (%). Pearson's Chi-squared test was used for comparing categorical variables. Logistic regression analysis was used with diarrhea or respiratory infection as the dependent variable and attending Familia Nawiri health education sessions as the independent variable to estimate crude odds ratios (ORs) with corresponding 95% CIs in cases compared to controls. Other predictor variables included in the initial model based on scientific literature were: age, gender, having toilet facility, having other water improvement initiatives in the same localities (this included initiatives through government, community or private sector such as providing piped water into the homesteads or

community tapes, sinking of boreholes and water treatment products), having attended any other health education initiative in the same locality, and distance to health facility. For categorical variables, missing responses were put in a separate category and included in the regression model. There were no missing values for the continuous variables. To adjust for confounding and/or effect modification a backward stepwise deletion approach was used whereby variables were dropped one by one starting with those with highest p-value until a final model was obtained

2.5. Results

Overall, 640 questionnaires were completed by 330 cases and 310 controls. Out of the completed questionnaires, 8 (1.3%) were excluded on the basis of incomplete interviews, leaving 632 for the final analysis (324 cases and 308 controls). At least 153 (47%) of the cases and 143 (46%) of the controls from Embu County, while 85 (26%) of the cases and 82 (27%) of the controls were from Kirinyaga and 86 (27%) cases and 83 (27%) of the controls were from Nakuru County. The median age of cases was 20 years (IQR: 2-35 years) while that of controls was 23 years (IQR: 2-35 years). The proportion of males was higher, both in cases (57%), and controls (59%). Among the cases, 79% presented with respiratory tract infections while 21% presented with diarrhea. Among the controls, the most frequently mentioned presenting conditions included accident or injury 11%, Family planning services 11%, skin conditions 11%, burns 5%, sexually transmitted infections 5%, hypertension 4%, fever 4%, dental problems 2%, diabetes 1% among others. Table 1 presents an overview of the characteristics of the case and control patients. The majority of the participants had up to primary school as their highest level of education (cases 49% and 52% of the controls). Among the cases, a lower proportion, compared to controls, had attended Familia Nawiri education sessions (13% vs. 20%, respectively). About 34% of the cases compared to 45% of the controls reported residing in areas where there was water improvement initiatives. There was no difference noted in knowledge of causes of diarrhea, recognition of danger signs or critical times to seek medical attention for diarrhea and respiratory infection between the cases and the controls. The results from the logistic regression model indicate that exposure to Familia Nawiri health education reduced the risk of being a case with diarrhea or respiratory infection (adjusted OR 0.62, 95% CI: 0.41 - 0.96 ($p = 0.03$) [adjusted for other water improvement projects and presence of toilet facility]. Table 1 provides characteristics of cases and controls and crude ORs. Table 2 shows adjusted ORs of predictor variables used to arrive at the final statistical model.

2.6. Discussion

This study set out to evaluate the Familia Nawiri community health education program on risk reduction for diarrhea and respiratory infections. Findings from the study revealed favorable results for this hygiene education program. Overall, after adjusting for potential confounders, participants exposed to the hygiene education program had 38% lower odds of having diarrhea or a respiratory infection compared to participants who were not exposed to the hygiene education program (adjusted odds ratio 0.62, 95% CI: 0.41 – 0.96). Our findings are consistent with estimates from other studies assessing effects of hand washing with soap and WASH educational intervention on reducing the incidence of diarrhea and respiratory infections [11, 13, 14]. On the other hand, recent RCTs assessing interventions promoting healthy behaviour related to WASH, in improving child health outcomes like diarrhea and proper hand washing behaviour have yielded negative results [15-18]. For instance, a trial conducted in Rwanda assessing the impact of community-led health clubs promoting WASH interventions reported no effect on care-giver reported diarrhea among children below five years across the three arms of the study (control group, eight community health club sessions group and 20 community health club sessions group) [15]. A trial conducted in Kenya with seven arms (including: control arm, water intervention, sanitation intervention, hand washing intervention, combination of water, sanitation and hand washing intervention, nutrition intervention and combination of all the interventions [water, sanitation, hand washing and nutrition]) found no reduction in diarrhea in any of the intervention arms [16]. However, a trial from Bangladesh – with similar intervention arms as the study in Kenya – reported reduction in diarrhea in all intervention arms, except the intervention arm receiving water treatment only [17]. Although some of these recent studies have reported no effect of the interventions tested, the benefits of WASH for diarrheal diseases and other health outcomes should not be underestimated [37, 38]. The findings may also not be generalizable across all contexts and therefore should be viewed in light of the specific interventions and setting [37, 39, 40]. With regards to the intervention and the approach used to deliver the intervention, comparable examples in other low and middle income countries in Africa, have been provided by Sinharoy *et al*., Waterkeyn and Cairncross, and Lewycka et al [15, 41, 42]. However, findings from these interventions are varied. Cairncross, and Lewycka et al [41, 42] found that community health clubs and women's group interventions can be effective in achieving high levels of health knowledge and hygiene behaviour change in Zimbabwe and also to improve maternal and child health in

Malawi. On the other hand, Sinharoy *et al*., [15] found that the use of community health clubs as implemented under Rwanda's national Community-Based Environmental Health Promotion Program in western Rwanda had no effect on health outcomes such as diarrhea in children under five years old.

It cannot be excluded with certainty that unmeasured bias or confounding e.g. recall bias with respect to exposure to the Familia Nawiri education sessions, residing in areas with water improvement initiatives and attending other health education programs, may have impacted the results in either direction, i.e. either increasing or decreasing the odds ratio. However, since our findings were statistically significant (95% CI: 0.41 – 0.96, P=0.03), they provide some support of an association between hygiene education and morbidity of diarrhea and respiratory tract infections.

Some of the strengths of this study include the fact that both cases and controls were recruited from the same health facilities, therefore, taking regional practice aspects into consideration. Selection of cases and controls was within two days of attending the clinic which helped to minimize potential seasonal influence on the outcomes.

The findings from this case-control study should be interpreted in light of some limitations. There is potential risk to overestimate the health impact as a result of relying on self-reported measurements. This could have been avoided by employing direct observation methods at the household level. However, due to logistical reasons and inconveniences that such a method would entail, we decided to rely on the self-reported measurements. We believe however, that the resulting misinformation would have been non-differential between cases and controls – in other words - any misinformation that occurred while collecting the data at the health facility may have occurred to the same extent for both groups and would therefore rather mask than exaggerate the impact of the intervention. Another limitation for our study is the fact that the intervention was delivered to a highly selective target audience - participants in group activities such as church groups or women's groups. It can be expected that these people differ in many psychosocial parameters that may not reflect in the measured socio-economic indicators. Misclassification bias with respect to exposure is also very likely for this study. This is mainly because there was no objective way of verifying reported or non-reported exposure to the education sessions. This has a bearing on how the participants recall exposure to the intervention. However, for this study, both the cases and the controls were selected from participants seeking medical attention at health

facilities; hence, both cases and controls would have similar concerns regarding the causes of their illness making them comparable and thus minimizing differential recall bias. Approximately 60% of the cases and the controls reported having attended some form of hygiene education session apart from the Familia Nawiri program while 45% of the controls and 34% of the cases reported residing in areas where there had been water improvement initiatives. The presence of these other initiatives may account for the finding of no difference in knowledge of the causes of diarrhea among cases and controls. Although the selected subjects for the study were statistically similar, the fact that most of them were children and young adults could perhaps reflect ability to access a health facility and therefore our findings should be interpreted in that context. Since the cases and controls in this study were selected from health facilities in the area where the health education program had purposefully been implemented, we cannot be certain that the findings from this study apply to people in other geographical locations or other health facilities. It is also important to note that recruitment at the health facility level probably shifts to more severe cases that require attendance of the health facility. Therefore, it is not clear whether the results would also apply to less severe cases of diarrhea and respiratory infections. A final limitation for this study is the fact that we did not utilize theory of change in assessing the effect of the community health education program as the assessment was largely focused on clinical health outcomes and nor was an implementation framework utilized in the implementation of the community health education program. We are therefore limited in our understanding of how or why changes happened as a result of the implemented community health education program or which aspects of the program, if not all were effective.

2.7. Conclusion

This study was a first attempt to assess the effect of the Familia Nawiri community health education program. We found that being exposed to the education sessions and residing in areas with water improvement initiatives were both associated with lower odds of attending a health facility due to diarrhea or a respiratory infection. The findings have implications for planning and implementing community based health education, water, and sanitation and hygiene interventions as they indicate the need for information, education and communication (IEC) activities tailored to the social and cultural context and infrastructure development.

2.8. Abbreviations

OR	Odds Ratio
CI	Confidence Interval
WHO	World health Organization
RCT	Randomized Controlled Trial
WASH	Water Sanitation and Hygiene
CHEWs	Community Health Extension Workers
IQR	Interquartile range
AMREF	Africa Medical and Research Foundation
IEC	Information, Education and Communication

2.9. Declarations

Ethics approval and consent to participate

The protocol and informed consent forms for the study were reviewed by the Ethics and Scientific Review Committee of the Africa Medical and Research Foundation (AMREF), Nairobi, Kenya. Permission to conduct the study was granted by the County Departments of Health in Nakuru, Kirinyaga and Embu counties and also from the local health administration. All respondents and guardians were informed of the study procedures and voluntarily participated in the study and provided written informed consent.

Consent to publish

Not applicable

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

MK was supported by the Next Generation Scientist Fellowship Program, Novartis Pharma where she was an intern at the time of undertaking the study. RS, GP and AG were employed by Novartis at the time of this study. The authors declare that they have no other competing interests.

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Authors' contributions

Conceived and designed the study: MK, RS, GP, AG, BO. Performed data collection and questionnaire development: MK, RS, and GP. Analyzed the data and interpretation of the results: MK, EO, TE, GP, and RS. Wrote the paper: MK, RS, GP, BO, and AG. All authors read and approved the final manuscript.

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Table 1: Characteristics of cases and controls and crude odds ratio for diarrhea and respiratory infections in cases and controls exposed to Familia Nawiri Health Education Program

Variable	Cases (n=324)	Controls (n=308)	Crude	
			OR (95% CI)	P value
Median age of participant (IQR)	20 (2 -35)	23 (2 -35)	1.00 (0.99 - 1.01)	0.75
Gender, n (%)				
Male	186 (57.41)	183 (59.42)	1.00 (reference)	
Female	138 (43.59)	125 (40.58)	1.09 (0.69 - 1.37)	0.89
Highest level of education, n (%)				
Kindergarten and Primary level	158 (48.77)	161 (52.27)	1.00 (reference)	
Post-primary/vocational	6 (1.85)	5 (1.62)	1.60 (0.43 – 5.90)	0.48
Secondary/'a' level	120 (37.04)	111 (36.04)	1.11 (0.78 - 1.58)	0.57
College and University	27 (8.33)	19 (6.17)	1.77 (0.91 -3.48)	0.09
Missing	13 (4.01)	12 (3.90)		
Water improvement interventions, n (%)				
No	204 (62.96)	163 (52.92)	1.00 (reference)	
Yes	111 (34.26)	137 (44.48)	0.68 (0.48 – 0.95)	0.03
Missing	9 (2.78)	8 (2.60)		
Distance to health facility, n (%)				
10 mins	41 (12.65)	38 (12.34)	1 (reference)	
30 minutes	196 (60.49)	205 (66.56)	0.78 (0.47 - 1.29)	0.33
>1 hour	84 (25.93)	64 (20.78)	1.06 (0.59 – 1.92)	0.83
Missing	3 (0.93)	1 (0.32)		
Exposure to Familia Nawiri, n (%)				
No	272 (83.95)	239 (77.60)	1.00 (reference)	
Yes	43 (13.27)	61 (19.81)	0.62 (0.40 – 0.96)	0.03

Missing	9 (2.78)	8 (2.60)		
Toilet facility, n (%)				
No	8 (2.47)	2 (0.65)	1.00 (reference)	
Yes	308 (95.06)	301 (97.73)	0.23 (0.05 – 1.11)	0.07
Missing	8 (2.47)	5 (1.62)		
Improved water sources, n (%)				
No	66 (20.37)	62 (20.13)	1.00 (reference)	
Yes	251(77.47)	242 (78.57)	0.94 (0.62– 1.42)	0.76
Missing	7 (2.16)	4 (1.30)		
Attended any other hygiene education sessions apart from Familia Nawiri				
No	211 (65.12)	215 (69.81)	1.00 (reference)	
Yes	104 (32.10)	85 (27.60)	1.08 (0.57 - 1.13)	0.69
Missing	9 (2.78)	8 (2.60)		

Table 2: Final model showing crude and adjusted odds ratio for diarrhea and respiratory infections in cases and controls exposed to Familia Nawiri Health Education Program

Variable	Cases (n=324)	Controls (n=308)	Crude		Adjusted*	
			OR (95% CI)	P value	OR (95% CI)	P value
Exposure to Familia Nawiri, n (%)						
No	272 (83.95)	239 (77.60)	1.00 (reference)		1.00 (reference)	
Yes	43 (13.27)	61 (19.81)	0.62 (0.40 – 0.96)	0.03	0.62 (0.41 - 0.96)	0.03
Median age (IQR)	20 (2 -35)	23 (2 -35)	1.00 (0.99 - 1.01)	0.75	1.00(0.99 – 1.00)	0.79
Gender, n (%)						
Male	186 (57.41)	183 (59.42)	1.00 (reference)		1.00 (reference)	
Female	138 (43.59)	125 (40.58)	1.09 (0.69 - 1.37)	0.89	0.98(0.71 – 1.37)	0.93
Water improvement interventions, n (%)						
No	204 (62.96)	163 (52.92)	1.00 (reference)		1.00 (reference)	
Yes	111 (34.26)	137 (44.48)	0.68 (0.48 – 0.95)	0.03	0.65 (0.47 – 0.91)	0.01

*Adjusted for all variables in the table

Chapter 3: Care-Seeking Dynamics among Patients with Diabetes Mellitus and Hypertension in Selected Rural Settings in Kenya

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3. Care-Seeking Dynamics among Patients with Diabetes Mellitus and Hypertension in Selected Rural Settings in Kenya

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3.1. Abstract

Diabetes mellitus and hypertension are two common non-communicable diseases (NCDs) that often coexist in patients. However, health-seeking behaviour in patients with diabetes mellitus or hypertension has not been extensively studied especially in low- and middle-income countries. This study aimed to examine care-seeking dynamics among participants diagnosed with diabetes and/or hypertension across nine counties in rural Kenya. We conducted a cross-sectional study among adults diagnosed with diabetes and/or hypertension through face-to-face interviews. Of the 1100 participants, 69.9% had hypertension, 15.5% diabetes while 14.7% had both. The mean age of the respondents was 64 years. The majority of the respondents (86%) were on allopathic treatment. Hospital admission, having a good self-rated health status and having social support for illness, were positively associated with appropriate health-seeking behaviour while use of alcohol and pharmacy or chemist as source of treatment were negatively associated with appropriate health-seeking behaviour. Our study found a high prevalence of appropriate health-seeking behaviour among respondents with the majority obtaining care from government facilities. The results are evidence that improving public health care services can promote appropriate health-seeking behaviour for non-communicable diseases and thus improve health outcomes.

Keywords : diabetes ; hypertension ; non-communicable diseases ; chronic condition

3.2. Introduction

Non-communicable diseases (NCDs) are the leading causes of global health loss, accounting for more loss today compared to 1990. Out of the estimated 54.9 million deaths worldwide in 2013, two thirds were attributed to NCDs with approximately 80% of these deaths occurring in low- and middle-income countries (LMIC) [1, 2]. In the African region alone, NCDs accounted for 34% of the 8.8 million deaths and 29% of the 598.6 million disability adjusted life years (DALYs) that were reported in the region in 2016 [3, 4]. Diabetes mellitus (DM) and hypertension are two of the most prevalent NCDs worldwide. Hypertension is estimated to affect approximately one billion people globally and the number is postulated to rise to 1.56 billion by the year 2025 [5, 6]. On the other hand, the World Health Organization (WHO) estimated the prevalence of diabetes among adults globally to be 4.0% (135 million people) in 1995 and predicted this number would rise to 5.4% (300 million people) by 2025 [6]. Despite this information, a vast majority of hypertensive and diabetic individuals still remain undiagnosed/unaware of their condition and hence, do not seek treatment and/or preventative measures in order to avoid complications [7].

Similar to other countries in Sub-Saharan Africa (SSA), Kenya has not been spared from this upward trend of NCDs with approximately 50% of hospital admissions and over 55% of hospital deaths being attributed to NCDs [8, 9]. A cross-sectional study conducted in Kenya in 2008 across three rural communities among participants aged between 17 and 68 years reported a diabetes prevalence of 4.2% [10]. Several studies have shown varying prevalence of hypertension across different communities in Kenya. In 2010, a population-based household survey conducted in one of the informal settlements in Nairobi reported an age-standardized prevalence of hypertension of 22.8% [11]. Another cross-sectional study conducted across four SSA countries reported a prevalence of 21.4% in rural Kenya [12]. Other reports have indicated a prevalence of 12% and 6.6% for hypertension and diabetes in Kenya, respectively [13]. This second epidemic of NCDs combined with the continuous burden of infectious diseases has led to an increased pressure on the LMICs' health care systems which are already poorly funded and largely geared towards addressing infectious diseases and providing mother and child health services. This rapid transition in disease burden to NCDs highlights the need for health care systems in these regions to evolve rapidly in order to be able to respond adequately to the management and prevention of chronic diseases [14-19]. Unlike most infectious diseases, NCDs are chronic conditions that affect individuals over a prolonged period of time and require continuing care, and therefore place substantial demands, including financial, on patients, families, health care systems and governments [18, 20, 21]. The high cost implication of

managing diabetes and hypertension are a barrier to access of care, especially for the poor and other disadvantaged subgroups of the general population [22, 23]. Several other factors are known to influence access to care, including geography, transport, insurance coverage [24, 25], drug availability, as well as patients who might face other day-to-day challenges that may cause them to underestimate the benefits of treating a silent, asymptomatic condition like hypertension [26].

Although more than half of the population in Africa lives in rural settings, there is a dearth of data on the unique characteristics of patients with chronic conditions in these settings and challenges they face in navigating the health care system and managing their illness [25]. Understanding the care-seeking dynamics of people with chronic diseases is, therefore, an important step in preventing and managing these diseases. Strategies developed should ensure there is continuity of care at a cost that is affordable to all [24]. This study therefore seeks to explore care-seeking dynamics among respondents who self-reported having an NCD (diabetes mellitus and/or hypertension) in selected rural communities in Kenya.

3.2. Methods

3.2.1. Study Design and Setting

This was a cross-sectional study among participants who reported being diagnosed with hypertension and/or diabetes by a health practitioner. This study is part of a broader implementation research program between Familia Nawiri, a social venture program initiated in Kenya by Novartis, a multinational pharmaceutical company [27] and several County Ministries of Health in partnership with the Center for Research in Therapeutic Sciences at Strathmore University, Nairobi, Kenya, and the Swiss Tropical and Public Health Institute, Basel, Switzerland. The overall aim of the collaboration is to strengthen the Kenyan government's community health strategy (CHS) through training of community health workers and health promotion at the household level in order to improve health outcomes. The study was conducted in selected community health units (CHUs) across nine counties in Kenya. CHUs form the lowest level of the healthcare system in Kenya; each CHU is designed to serve a catchment population of approximately 5000 people and is linked to a government health facility. Four CHUs in each of the nine counties were purposefully selected to take part in the study based on the fact that Familia Nawiri had on-going CHS engagements in those areas. The counties included: Bomet, Embu, Kericho, Kirinyaga, Meru, Migori, Nairobi, Nakuru and Siaya as shown in Figure 1. All CHUs are located in rural areas where agriculture was the main economic generating activity with the exemption of Nairobi where the CHUs were located in the slum areas of the city.

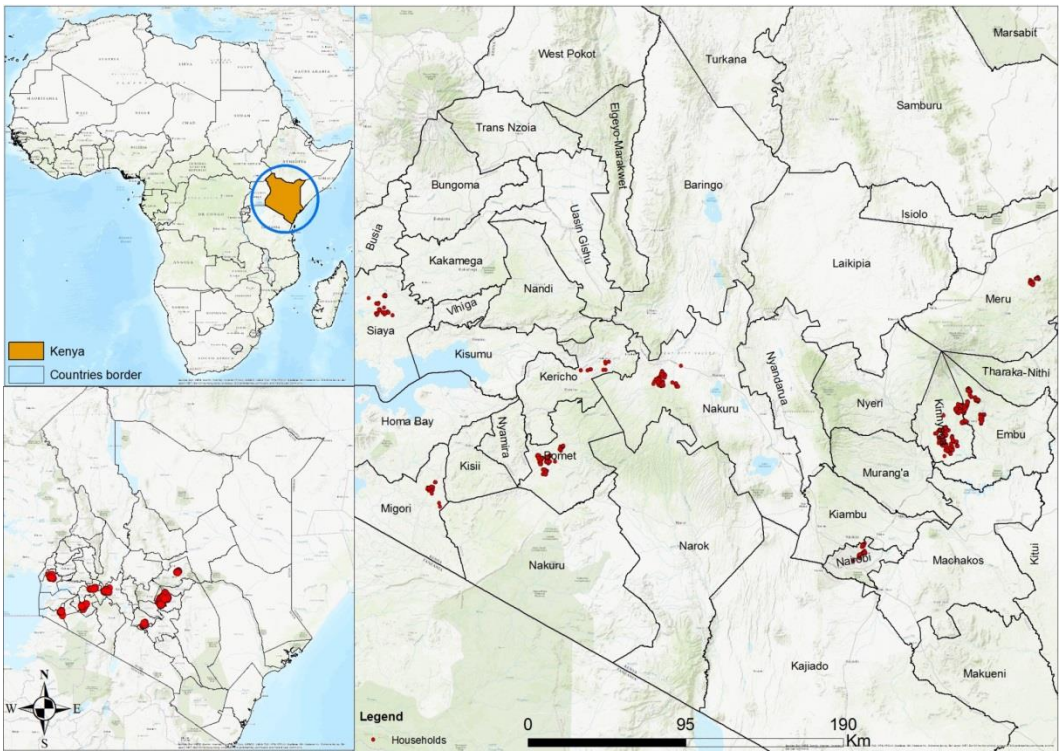


Figure 1. Map showing location of respondents across the nine counties included in the study.

3.2.2. Study Population and Sampling

The study population comprised of adults aged 18 years and above with diabetes and/or hypertension diagnosed by a health practitioner, residing in the selected CHUs who consented to take part in the study. A convenience sampling approach was used to identify participants as follows: the community health extension workers (CHEW) (based at the local health facility) and community health volunteers (CHV)—who are the key players at the primary health care level—approached community members with a known hypertension and/or diabetes diagnosis and informed them of the study. Trained data collectors then visited respondents who were willing to take part in the study at home.

3.2.3. Data Collection and Measurements

Data were collected between September 2016 and February 2017 by trained data collectors through face-to-face interviews using a predesigned structured questionnaire. The data collectors underwent a precedent training which included piloting of the questionnaire. The questionnaire included socio-demographics (age, gender, educational level, occupation, marital status, ethnicity, religion), treatment type (allopathic medicines, traditional medicines and dropped out of treatment), recent blood pressure, blood glucose and eyes check, overall health status, regular scheduled clinic visits, risk factors (family history of diabetes, hypertension and

stroke [family relation was defined as first-class close relation such as biological mother, father, brothers, sisters, immediate maternal or paternal grandfather or grandmother], smoking and alcohol consumption), health insurance and other chronic diseases among others. The structured questionnaire used for the interviews was deployed on android operating system tablet computers using the Open Data Kit (ODK) platform [28].

3.2.4. Statistical Analysis

Data were analyzed using STATA, version 14 (Stata Corp, College Station, TX, USA). The participating individuals were stratified into three groups namely hypertensive, diabetics and those who had both diabetes and hypertension. Continuous variables were described using means and standard deviation (SD), while frequencies and percentages were used for categorical variables. Chi squared tests at 5% level of significance and 95% confidence interval were used to examine any association between disease status and socio-demographics and health-seeking behaviour. In this study, we defined appropriate health-seeking behaviour as patients having regular scheduled clinic visits with their health provider while inappropriate health-seeking behaviour was defined as not having regular scheduled clinic visits. We developed a multivariate logistic regression model and calculated adjusted odds ratios (OR) with 95% confidence intervals (CIs) to identify factors predicting appropriate health-seeking behaviour in this study. Variables with a p value less than 0.2 from the bivariate analysis were included in the multivariate model. We used a backward elimination method to individually drop variables that were not significant until a final model was derived.

3.2.5. Ethical Approval

Ethical approval to conduct this study was provided by the Institutional Review Board of Strathmore University, Nairobi Kenya approval number SU-IRB 0017/15. Approval was also obtained from the different County Departments of Health in Kenya. Furthermore, permission was sought from local community leaders before visiting the households. The purpose of the study, voluntary participation, data privacy and anonymity was explained to the participants in a language comfortable for them after which an informed consent form was signed.

3.3. Results

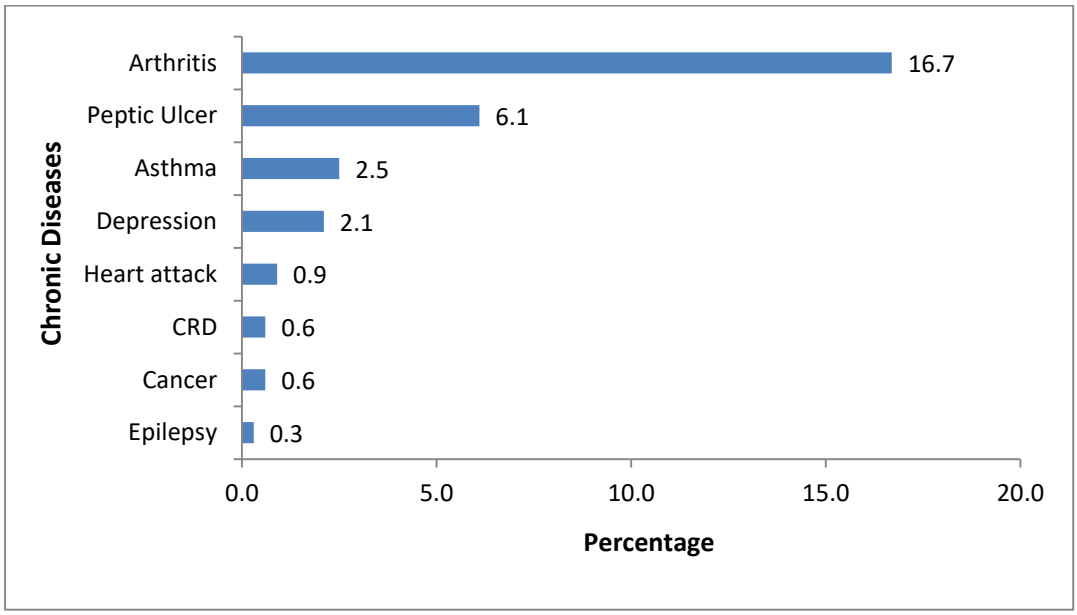
A total of 1100 participants (72.6% females) were included in this analysis. Hypertensive patients accounted for 69.8% of the study population while patients with diabetes accounted for 15.5%, with the remaining 14.7% having both diabetes and hypertension. The overall mean age of the participants was 64 (SD = 15) years, 62.5% of these were aged above 60 years. Half of the participants were married and about 60% were household heads. Approximately a quarter of respondents (24.6%) had some form of health insurance in their households with a

vast majority (>90%) being on the National Health Insurance Fund (NHIF), a Kenya government state corporation with a mandate to provide health insurance to Kenyans over the age of 18 [29], while a small proportion were on either community based medical cover or private health insurance cover (data not shown). There was some significant difference in age, gender, education level, ethnicity, having comorbidities and being in debt as a result of illness across the three disease status. A mmajority of those studied had only primary education, were Kikuyu, unemployed and were aged above 60 years. The social-demographic characteristics of the respondents are presented in Table 1.

Table 1: Socio-demographics of the respondents according to disease status.

Characteristics	Diabetes *N* = 170 *n* (%)	Hypertension *N* = 768 *n* (%)	Both *N* = 162 *n* (%)	Total *N* = 1100 *n* (%)	*p*-Value
Age group					0.009
Less than 40	18 (10.6)	56 (7.3)	2 (1.2)	76 (6.9)	
40 to 59	60 (35.3)	232 (30.2)	45 (27.8)	337 (30.6)	
60 to 79	73 (42.9)	381 (49.6)	95 (58.6)	549 (49.9)	
Above 80	19 (11.2)	99 (12.9)	20 (12.4)	138 (12.6)	
Mean age (SD), years	61 (16)	63 (15)	67 (12)	64 (15)	
Gender					<0.001
Male	72 (42.4)	185 (24.0)	42 (25.9)	299 (27.2)	
Female	98 (57.6)	581 (75.7)	120 (74.1)	799 (72.6)	
Missing	0 (0)	2 (0.3)	0 (0)	2 (0.2)	
Marital Status					
Single	25 (14.7)	69 (9.0)	15 (9.3)	109 (9.9)	0.276
Married	82 (48.2)	376(49.0)	87 (53.7)	545 (49.5)	
Widow/Widower/Divorced	63 (37.1)	321 (41.8)	60 (37.0)	444 (40.4)	
Missing	0 (0)	2 (0.2)	0 (0)	2 (0.2)	
Head of household					0.003
No	48 (28.2)	325 (42.3)	67 (41.4)	440 (40.0)	
Yes	122 (71.8)	442 (57.6)	95 (58.6)	659 (59.9)	
Missing	0 (0)	1 (0.1)	0 (0)	1 (0.1)	
Educational Level					<0.001
No education	38 (22.4)	252 (32.8)	52 (32.1)	342 (31.1)	
Primary	74 (43.5)	335 (43.6)	75 (46.3)	484 (44.0)	
Sec/Post primary	38 (22.4)	123 (16.0)	23 (14.2)	184 (16.7)	
College and University	20 (11.8)	30 (3.9)	7 (4.3)	57 (5.2)	
Others	0 (0.0)	28 (3.7)	5 (3.1)	33 (3.0)	
Ethnicity					<0.001
Kikuyu	89 (52.4)	312 (40.6)	89 (54.9)	490 (44.6)	
Luo	37 (21.8)	130 (16.9)	23 (14.2)	190 (17.3)	
Meru	1 (0.6)	64 (8.3)	0 (0.0)	65 (5.9)	
Embu	16 (9.4)	139 (18.1)	28 (17.3)	183 (16.7)	
Kalenjin	21 (12.3)	87 (11.3)	19 (11.7)	127 (11.6)	
Others	6 (3.5)	34 (4.4)	3 (1.9)	43 (3.9)	
Missing	0 (0)	2 (0.3)	0 (0)	2 (0.2)	
Occupation					0.147
Family farm/business	50 (29.6)	292 (38.1)	56 (33.9)	398 (36.2)	
Skilled/unskilled worker	28 (16.6)	106 (13.8)	23 (13.9)	157 (14.3)	
Unemployed	67 (39.6)	301 (39.3)	73 (44.2)	441 (40.1)	
Missing	1 (0.6)	3 (0.4)	0 (0)	4 (0.4)	
Health status					0.489
Good	63 (37.1)	258 (33.6)	47 (29)	368 (33.5)	
Average	86 (50.6)	399 (52.0)	85 (52.5)	570 (51.8)	
Poor	21 (12.3)	108 (14.0)	30 (18.5)	159 (14.4)	
Don't know	0 (0)	3 (0.4)	0 (0)	3 (0.3)	
Social support with illness					0.687
No	49 (28.8)	197 (25.6)	41 (25.3)	287 (26.1)	
Yes	121 (71.2)	568 (74)	121 (74.7)	810 (73.6)	
Missing	0 (0)	3 (0.4)	0 (0)	3 (0.3)	
Comorbidity					0.006
No	128 (75.3)	538 (70.1)	98 (60.5)	764 (69.5)	
Yes	39 (22.9)	222 (28.9)	63 (38.9)	324 (29.5)	
Missing	3 (1.8)	8 (1)	1 (0.6)	12 (1.1)	
Debt due to illness					0.036
No	135 (85.4)	597 (89.1)	139 (87.4)	871 (88.3)	
Yes	16 (10.1)	65 (9.7)	19 (12)	100 (10.1)	
Decline to answer	7 (4.4)	8 (1.2)	1 (0.6)	16 (1.6)	

Figure 2 shows about a third of the participants reported having other co-existing NCDs apart from hypertension and/or diabetes. Arthritis (16.7%) and peptic ulcer (6.1%) were the most frequently reported NCDs among participants.



Chronic Respiratory Disease (CRD)

Figure 2. Prevalent non-communicable diseases among study participants (*n* = 1100) with self-reported hypertension and/or diabetes.

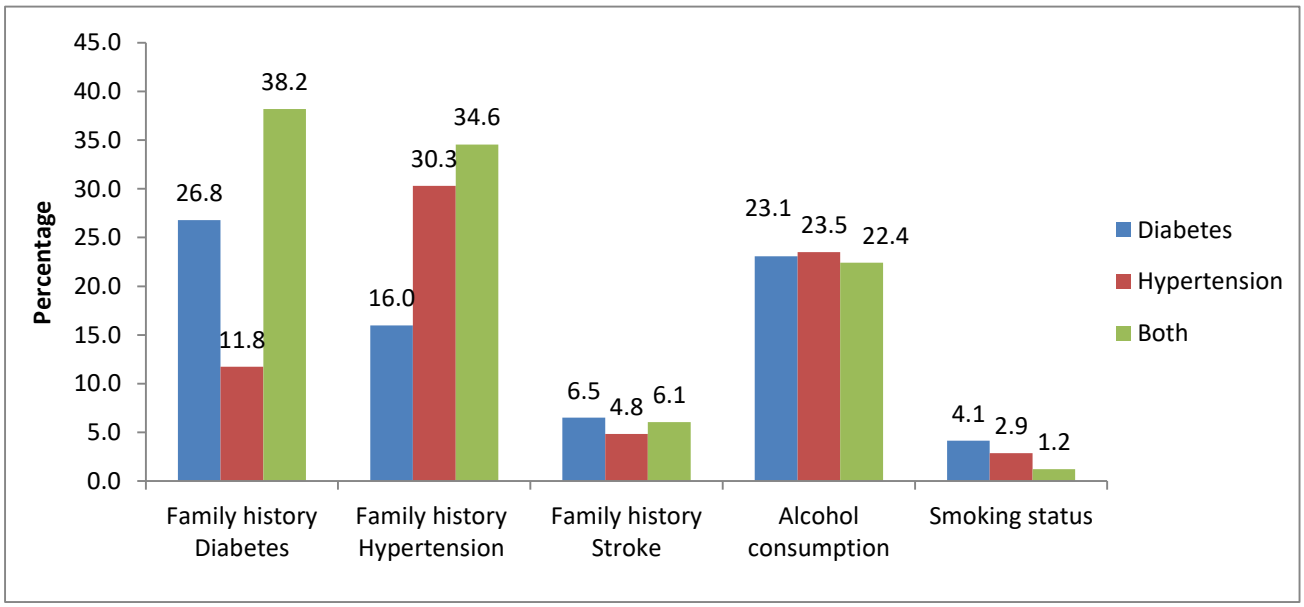


Figure 3. Proportion of respondents reporting selected behavioural and biological risk factors for non-communicable diseases.

Current smokers constituted 2.8% of the respondents, of which 77.4% reported smoking daily. About 23.4% of the respondents reported having ever consumed alcohol in their lifetime; of these, 19.5% had consumed alcohol in the 12 months prior to the interview. Almost a third of the participants (28.7%) had a family history of hypertension, 18.0% a family history of diabetes, while 5.3% reported a family history of stroke. The majority of the respondents (89.7 %) were on allopathic treatment as indicated in Table 2. Only 1% reported being exclusively on traditional medicines, while approximately 9% were not on any form of treatment for their ailment at the time of the interview.

Table 2. Description of health-seeking behaviour of respondents by disease status.

Characteristics	Diabetes *N* = 170 *n* (%)	Hypertension *N* = 768 *n* (%)	Both *N* = 162 *n* (%)	Total *N* = 1100 *n* (%)	*p*-Value
Place of diagnosis					0.004
Mobile clinic/screening	5 (2.9)	56 (7.3)	4 (2.5)	65 (5.9)	
Private clinic/lab	55 (32.4)	169 (22)	52 (32.1)	276 (25.1)	
Public facility	107 (62.9)	533 (69.4)	104 (64.2)	744 (67.6)	
Others	3 (1.8)	10 (1.3)	2 (1.2)	15 (1.4)	
Treatment type					0.001
Allopathic treatment	158 (92.9)	670 (87.2)	159 (98.2)	987 (89.7)	
Traditional treatment	1 (0.6)	10 (1.3)	1 (0.6)	12 (1.1)	
Not on treatment	11 (6.5)	88 (11.5)	2 (1.2)	101 (9.2)	
Current source of treatment					
Public hospital	75 (47.5)	309 (46.1)	67 (42.1)	451 (45.7)	0.429
Mission hospital	8 (5.1)	35 (5.2)	11 (6.9)	54 (5.5)	
Private hospital/clinic	14 (8.9)	78 (11.7)	18 (11.3)	110 (11.1)	
Pharmacy/chemist/shop	14 (8.9)	95 (14.2)	25 (15.7)	134 (13.6)	
others	47 (29.6)	153 (22.8)	38 (23.9)	238 (24.1)	
Regular/scheduled clinic visits					
No	63 (39.9)	307 (45.8)	48 (30.2)	418 (42.4)	0.001
Yes	95 (60.1)	363 (54.2)	111 (69.8)	569 (57.6)	
Last blood pressure check					<0.001
Less than a week	33 (19.4)	187 (24.4)	43 (26.5)	263 (24.0)	
1 month	85 (50.0)	418 (54.6)	99 (61.1)	602 (54.9)	
6 months	27 (15.9)	96 (12.6)	11 (6.8)	134 (12.2)	
1 year or more	13 (7.65)	50 (6.5)	8 (4.9)	71 (6.5)	
Don’t know	12 (7.1)	14 (1.8)	1 (0.6)	27 (2.5)	
Missing	0 (0)	3 (0)	0 (0)	3 (0)	
Last blood sugar check					<0.001
Less than a week	39 (22.9)	84 (11.0)	40 (24.7)	163 (14.8)	
1 month	97 (57.1)	219 (28.6)	98 (60.5)	414 (37.7)	
6 months	15 (8.8)	113 (14.7)	14 (8.6)	142 (12.9)	
1 year or more	10 (5.9)	147 (19.7)	9 (5.6)	166 (15.1)	
Don’t know	9 (5.3)	204 (26.6)	1 (0.6)	214 (19.5)	
Missing	0 (0)	1 (0)	0 (0)	1 (0)	
Last eye check-up					<0.001
Less than a week	6 (3.5)	33 (4.3)	8 (4.9)	47 (4.3)	
1 month	11 (6.5)	61 (8.0)	23 (14.2)	95 (8.7)	
6 months	12 (7.1)	59 (7.7)	13 (8.0)	84 (7.7)	
1 year or more	28 (16.5)	118 (15.4)	46 (28.4)	192 (17.5)	
Don’t know	113 (66.5)	495 (64.6)	72 (44.4)	680 (61.9)	
Missing	0 (0)	2 (0)	0 (0)	2 (0)	
Admission last one year					0.001
No	151 (88.8)	713 (92.8)	135 (83.3)	999 (90.8)	
Yes	19 (11.2)	55 (7.2)	26 (16.1)	100 (9.1)	
Missing	0 (0)	0 (0)	1 (0.6)	1 (0.1)	
Health insurance					0.007
No	123 (72.3)	598 (77.9)	108 (66.7)	829 (75.4)	
Yes	47 (27.7)	168 (22.1)	54 (33.3.7)	271 (24.6)	

Some reasons for dropping out of treatment or not taking up treatment upon diagnosis included lack of finances, feeling better and health facilities being far away—see Table 3.

Table 3. Reasons for not being on treatment (N = 101).

Reasons for non-treatment	Number	Percentage
No money for medication	38	37.6
Feeling better, don't think I need treatment anymore	30	29.7
Thinks that the disease is not serious	13	12.9
Treatment place too far	11	10.9
Disease got worse/no improvement/no hope of cure	8	7.9
Moved to other place	6	5.9
Not satisfied with treatment program	4	3.9
Medicines make me sick	4	3.9
Don't believe that I have the disease—feel alright	3	2.9
Advised by health provider	3	2.9
Too busy with daily business	2	1.9

More than 100% as Some Respondents Offered More Than One Reason

The most commonly prescribed antidiabetic drugs were metformin 196 (66%) and glibenclamide 126 (42.4%), while the most common antihypertensive drugs were nifedipine 359 (49.5%) and hydrochlorothiazide 325 (44.8%), as shown in Tables 4 and 5. About 48% of the diabetic patients were on one type of drug only, while most of the hypertensive patients (45.2%) were on a combination of two or more drugs.

Table 4. Use of antidiabetic drugs in patients with diabetes (N = 297 *).

Name of drug	Number	Percentage **
Metformin	196	66.0
Glibenclamide	126	42.4
Insulin	44	14.8
Saxagliptin	3	1.0
Pioglitazone	3	1.0
Gliclazide, Sitagliptin, Glimepiride	Less than 1% on each of these drugs	
Number of antidiabetic drugs per patient		
1	142	47.8
2	115	38.7
3	2	0.7
Missing	38	12.8

* Number of diabetic patients with medication, ** More than 100% as some respondents were on more than one drug.

Table 5. Use of antihypertensive drugs in patients with hypertension (N = 725 *).

Name of drug	Number	Percentage **
Nifedipine	359	49.5
Hydrchlorothiazide	325	44.8
Enalapril	132	18.2
Lorsatan	90	12.4
Atenolol	64	8.8
Furosemide	61	8.4
Amlodipine	39	5.4
Methyldopa	23	3.2
Spironolactone	11	1.5
Telmisartan, Lisinopril, Irbesartan, Propranolol, Carvedilol, Hydralazine, Vastarel, Nebivolol, Olmesartan, Candesartan Atacand, Indapamide, Felodipine	Less than 1% on each of these drugs	
Number of antihypertensive drugs per patient		
1	269	37.1
2	328	45.2
3	62	8.6
4 or more	11	1.5

* Number of hypertensive patients with medication, ** More than 100% as some respondents were on more than one drug.

The majority of the patients (67.6%) were diagnosed and 45.7% accessed care from a public health facility (District/Sub-district hospital, Health Center/Dispensary). A large proportion of respondents, (>90%) indicated having blood pressure and blood glucose checks during the last six months prior to the interview. More than half (57.9%) of the respondents reported having regular/scheduled clinic visits. Almost every tenth participant had been admitted to the hospital during the last year. Variables selected for multivariate analysis included; marital status, age group, ethnicity, having social support during treatment, source of treatment, family history of hypertension, alcohol use status and having health insurance. After conducting the multivariate analyses, we found that having support during treatment (OR 2.46, 95% CI; 1.81–3.35), having a high self-rated health status (OR 1.77, 95% CI; 1.16–2.70), being hospitalized in the last year (OR 2.06, 95% CI; 1.27–3.36) were positive predictors of appropriate seeking behaviour while using a pharmacy or chemist as a source of care (OR 0.42, 95% CI; 0.28–0.63) and alcohol consumption (OR 0.71, 95% CI; 0.52–0.98) were negative predictors of health-seeking behaviour for this study population as shown in Table 6. Variables adjusted for in the final model included having social support during treatment, self-rated health status, treatment source, alcohol use and having been admitted in the last year. A disease status-stratified multivariable analysis (detailed data not presented in this paper) revealed that having social support during treatment was a significant predictor of appropriate health-seeking behaviour among participants with diabetes only, hypertension only, both diabetes and hypertension and overall. Among those with hypertension only, we found that, participants having a family history of stroke were more likely to have appropriate health-seeking behaviour compared to those without (OR 2.69, 95% CI; 1.21–5.99). With regards to ethnicity and health seeking behaviour, we found that ethnicity was only significantly associated with health seeking behaviour for hypertension and not diabetes or having both conditions Among participants with both hypertension and diabetes, being employed as an agricultural worker, skilled or unskilled worker (OR 0.34, 95% CI; 0.13–0.88) was significantly associated with poor health-seeking behaviour compared to those who were unemployed. Those with both diabetes and hypertension and working in family businesses or farms showed a similar trend (OR 0.42, 95% CI; 0.17–1.03) although the association was not significant.

Table 6. Factors associated with health-seeking behaviour among respondents with diabetes and/or hypertension.

Characteristics	Inappropriate *N* = 418 *n* (%)	Appropriate *N* = 569 *n* (%)	Crude OR (95% CI)	*p* Value	Adjusted OR (95% CI)	*p* Value
Social support with illness *						
No	143 (34.3)	97 (17.1)	Reference			
Yes	274 (65.7)	471 (82.9)	2.53 (1.88–3.41)	<0.001	2.46 (1.81–3.35)	<0.001
Health status *						
Poor	73 (17.5)	67 (11.8)	Reference			
Average	217 (51.9)	296 (52.1)	1.75 (1.17–2.60)	0.006	1.54 (1.02–2.26)	0.038
Good	128 (30.6)	205 (36.1)	1.49 (1.02–2.16)	0.038	1.77 (1.16–2.70)	0.008
Current source of treatment *						
Public hospital	178 (42.6)	273 (47.9)	Reference			
Mission hospital	14 (3.4)	40 (7.0)	1.86 (0.99–3.52)	0.056	1.51 (0.78–2.89)	0.219
Private hospital/clinic	44 (10.5)	66 (11.6)	0.98 (0.64–1.50)	0.918	0.90 (0.58–1.40)	0.637
Pharmacy/chemist/shop	83 (19.9)	51 (8.9)	0.40 (0.27–0.60)	<0.001	0.42 (0.28–0.63)	<0.001
others	99 (23.7)	139 (24.4)	0.92 (0.67–1.26)	0.588	0.91 (0.65–1.27)	0.569
Admission last one year *						
No	392 (93.8)	498 (87.5)	Reference			
Yes	26 (6.2)	70 (12.3)	2.12 (1.32–3.39)	0.002	2.06 (1.27–3.36)	0.004
Alcohol status *						
No	308 (73.7)	451 (79.3)	Reference			
Yes	110 (26.3)	118 (20.7)	0.73 (0.54–0.98)	0.040	0.71 (0.52–0.98)	0.002
Age group						
Less than 40	21 (5)	40 (7)	Reference			
40 to 59	125 (29.9)	178 (31.3)	0.75 (0.42–1.33)	0.322		
60 to 79	204 (48.8)	291 (51.1)	0.75 (0.43–1.31)	0.310		
Above 80	68 (16.3)	60 (10.5)	0.46 (0.25–0.87)	0.017		
Gender						
Female			Reference			
Male	101 (24.2)	162 (28.5)	1.25 (0.94–1.67)	0.132		
Marital Status						
Single	37 (8.9)	55 (9.7)	Reference			
Married	186 (44.6)	304 (53.5)	1.00 (0.7–1.73)	0.683		
Widow/Widower/Divorced	194 (46.5)	209 (36.8)	0.72 (0.46–1.15)	0.170		
Ethnicity						
Kikuyu	189 (45.3)	261 (46)	Reference			
Luo	69 (16.6)	96 (16.9)	1.01 (0.70–1.45)	0.968		
Meru	11 (2.6)	36 (6.3)	2.37	0.016		

			(1.17–4.78)	
Embu	86 (20.6)	93 (16.4)	0.78 (0.55–1.11)	0.168
Kalenjin	42 (10.1)	66 (11.6)	1.14 (0.74–1.75)	0.556
Others	20 (4.8)	16 (2.8)	0.58 (0.29–1.15)	0.117
Smoking status				
No	405 (96.9)	558 (98.1)	Reference	
Yes	13 (3.1)	11 (1.9)	0.61 (0.27–1.38)	0.240
Family history of hypertension	274 (65.6)	351 (61.7)		
No	112 (26.8)	177 (31.1)		
Yes	274 (65.6)	351 (61.7)	1.23 (0.92–1.64)	0.148
Health insurance				
No	316 (75.6)	410 (72.1)	Reference	
Yes	102 (24.4)	159 (27.9)	1.20 (0.90–1.60)	0.213

*Final model adjusted for these variables

Respondents were asked if they had ever been visited at home in the last year by a Community Health Volunteer (CHV) and 26.7% had received a home visitation by CHV. Table 7 shows the topics the respondents mentioned having discussed the CHVs during home visitation.

Table 7. Education topics discussed with community health volunteer *N* = 294.

Education topics	**Number**	**Percentage**
Education on diabetes disease	78	26.5
Education on hypertension	158	53.7
Education on lifestyle change	63	21.4
Education on nutrition	78	26.5
Education on adherence to medication	63	21.4

More than 100% as some respondent had more than one topic

3.4. Discussion

This study assessed healthcare-seeking behaviour among respondents with diabetes and/or hypertension living in selected community health units across nine counties in rural Kenya and revealed the following main findings: (1) the majority of the hypertensive and/or diabetic patients (almost 90%) reported being on conventional treatment and 85% were able to produce their medication for verification; (2) more than half (58%) of the respondents had regular scheduled clinic visit with their health care provider; (3) diagnosis and treatment for the diseases were mainly sought in public health facilities; (4) respondents self-rated their health status as good (compared to poor health status), having social support during treatment, and being hospitalized were positively associated with appropriate health-seeking behaviour, while using a pharmacy or a chemist as a source of treatment and alcohol consumption were negatively associated with appropriate health-seeking behaviour.

Our findings that the majority of the respondents being on medication are similar to a recent study conducted in similar settings in Kenya which found, among participants diagnosed with hypertension, approximately 73.3% had their medications at home [30, 31]. However, they differ with those reported in the 2015 Kenya Stepwise survey for NCDs risk factors where they found among those diagnosed with hypertension, only 22%, while among those diagnosed with diabetes only 40% were on medication [9]. Another study conducted in Cambodia on access to treatment for diabetes and hypertension also reported a considerably lower proportion, with 51% of the respondents being on conventional medicines [17]. We observed a very small proportion (1.1%) of the respondents who were on traditional medicines; this was similar to the Kenya Stepwise survey for NCD which reported a 1% of the hypertensive and 4.5% of the diabetics using traditional medicines [9]. Similar to other studies, we found that the most commonly prescribed antihypertensive were calcium channel blockers and thiazides [30, 32]. For the antidiabetic medication, the most common drugs used by the study population were biguanides (metformin) followed by sulphonylureas (glibenclamide) which is similar to those reported by Yunus and colleagues (2018) in a study conducted in Malaysia [33].

The majority of the participants in our study were diagnosed in public health facilities. Our finding on diabetes diagnosis are in contrast with a study conducted by Wirtz et al. (2018) on access to treatment for diabetes, asthma and hypertension in Kenya [31] where they found majority of diabetes diagnoses were made in private facilities compared to public facilities as a result of the high cost of diagnosing diabetes. The preference in this population for using public health facilities for diagnosis and treatment could be a direct consequence of the type of facilities available in the areas that were predominantly rural and perhaps also a patient's

capacity to pay for services since government facilities are cheaper compared to private facilities. It also emphasizes the need to strengthen the public health care system in order to reduce inequality in accessing care for the poor.

Approximately 57.9% of the respondents reported having scheduled clinic visits to manage their condition. Although in our study we did not assess the frequency of the scheduled clinic visits, a similar proportion of 50% was reported for monthly scheduled clinic visits among diabetics in a cross-sectional survey conducted in Lesotho [34]. The high proportion of respondents with medication at home, scheduled clinic visits and regular blood sugar and blood pressure checks shows good self-reported health-seeking behavior in this study population. Our findings do not differ much with a household survey on access to treatment for diabetes and hypertension conducted in Brazil where they reported 85.4% and 70.2% of the diabetic and hypertensive participants having had their blood pressure and blood glucose checked in the last six months prior to the survey [35].

The association between social support and appropriate health-seeking behavior for chronic conditions has been documented [36, 37]. Results from this study show that respondents who had a good support system during treatment were 2.5-times more likely to have appropriate health-seeking behaviour for their condition. The finding that respondents who reported having hospital admission in the last one year were twice as likely to seek care is in line with the health belief model which states that a person's willingness to change behaviour is determined by several factors including perceived severity [38]. A hospital admission might therefore cause a patient to consider their worsening condition and hence seek care more.

Smoking and alcohol consumption were not common among the respondents, as 97.2% reported having never smoked and 76.7% had never consumed alcohol. Our findings were similar to those reported in a cross-sectional study assessing prevalence of undiagnosed diabetes among hypertensive patients conducted in Kiambu, Kenya, where they found 89% and 70% of the participants had never smoked or consumed alcohol respectfully [39]. However, the small proportion of respondents who smoked in our study could also be due to the fact that majority of our study participants were women (72.8%). The Kenya Stepwise survey of 2015 reported an overall prevalence of tobacco use to be 13% with a higher prevalence among men (22%) compared to women (4%).

The lack of health insurance or some form of group financial risk pooling has been documented as a barrier to accessing care especially for the rural population. This is because in the absence of health insurance, patients have to pay out of pocket even for the subsidized fee at the government facility in order to access care. We report in this study a high prevalence

(75.4%) of non-insurance among the households of the respondents. Similar findings have been reported in Western Kenya among diabetic patients where 83% reported not having health insurance [25]. Although a small percentage of the participants, 9.8% reported being in debt due to illness, and this is likely to be an under estimation because patients might avoid visiting health facilities even when there is a real need as a cost-prevention strategy as reported elsewhere [40]. The low level of debt reported among our respondents might also be due to the fact that other family members and relatives may be helping pay the bills for care. Several studies have documented cost/affordability as a barrier for access to care for people with NCDs [30, 31]. Our study builds on this evidence and found that lack of finances was the most frequently mentioned reason (in almost 40%) for dropping out of treatment or not initiating treatment upon diagnosis.

Also worthwhile noting is that a significant number of respondents, 30% indicated dropping out of treatment as a result of feeling better and, therefore, not needing treatment any more or thinking the disease was not serious. While the majority of the respondents reported a good health-seeking behaviour, this finding highlights that the need for patient education and counseling both at the clinic and community level remains. The Kenyan government rolled out a primary health care model (CHS) in 2006 with CHVs and community health extension workers as the main implementers at the household level. However, our study observed a low prevalence of household visitations by the CHVs (27.3%). Chronic conditions such as diabetes and hypertension affect patients over a long period of their life, therefore, there is the need to leverage on the existing close-to-community networks such as CHVs, in order to provide self-management support to those diagnosed with chronic illness [21, 25]. For the Familia Nawiri Community Health Worker partnership program with the various County Ministries of health in Kenya to be a success, there is a need to explore the barriers to household visitations as the program relies on the CHVs visiting the households and educating the households on prevention and management of chronic diseases in order to improve health outcomes. While many studies on chronic illness such as diabetes and hypertension have focused on the urban or urban poor population given the association between urbanization and NCDs, our study provides unique data on the health-seeking behaviour of the rural population diagnosed with hypertension and diabetes. These findings can be used to tailor interventions that are relevant to the rural settings.

Our study has some limitations. First, self-reporting of outcomes measures for health-seeking behaviour was used in this study and, therefore, may have the disadvantage of recall bias. In addition, self-reporting could also lead to an over estimation of health-seeking

behaviour since participants are more likely to give socially acceptable answers. An additional limitation is the fact that participants were not randomly selected; instead, a convenient sampling method of selecting participants was used and, therefore, results cannot be generalized. Finally, this being a cross-sectional study it is not possible to infer causation for some of the outcome measures.

3.5. Conclusions

This study reports a high prevalence of appropriate health-seeking behaviour among respondents with reported diabetes and/or hypertension. Our findings also indicate that the majority of the rural respondents obtain care from government facilities. This implies a need to strengthen the public health facilities in order to protect the poor and the marginalized communities who depend on them for the management of their chronic conditions. We also noted a low prevalence of health insurance coverage which would further expose chronic patients to catastrophic spending or failure to access care in order to avoid debt.

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4. Evaluation of a Community Health Worker Maternal Child Health Improvement Program-Results from a Baseline Survey

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This chapter is being prepared for submission.

4.1. Abstract

Background: Kenya has high maternal, newborn and child morbidity and mortality rates. Estimates from the Kenya Demographic Health Survey 2014, indicate maternal mortality rate of 362 deaths per 100,000 live births. Approximately half of the women deliver at home without skilled care and do not attend the recommended four antenatal care visits. Community Health Workers (CHWs) have been shown to be effective in increasing uptake of healthcare services, supporting and encouraging women and households to make healthier decisions and access care. The overall aim of this study is to provide baseline maternal child health indicators against which to monitor and assess the effectiveness of a community health worker program implemented through a public private partnership in rural parts of Kenya.

Methods/design: To evaluate the effectiveness of the CHW program, a quasi-experimental design with before and after cross-sectional household surveys are being used in the intervention ad control sites. The study is conducted in selected community health units across nine counties in Kenya. Cluster sampling technique was used to identify households as the primary sampling unit for this study.

Results: A total of 3735 households participated in the study. Majority of the households had male head of the household 84.16%. We report an overall high prevalence of 97% in ANC attendance across the sites. Only 22% of the mothers had their first ANC visit during their first trimester. Overall there was low knowledge of danger signs in pregnancy and newborn and birth preparedness among the respondents. Approximately 11% of the mothers reported having delivered at home during their last pregnancy.

Conclusion:

The findings provide evidence on the need to make use of both community based health education initiatives and facility based to emphasis the need for early ANC attendance and to educate women on the importance birth preparedness and complications readiness.

Keywords: Community health worker, maternal, birth preparedness, antenatal clinic, access, health services.

4.2. Background

Despite significant progress in reducing mortality, maternal and newborn deaths remain unacceptably high globally [1]. Approximately 536,000 women die every year worldwide as a result of pregnancy and childbirth complications. Of these deaths, approximately 50% occur in Africa and 35% in South Asia. In 2005, the lifetime risk of a woman dying from a maternal related issue in Sub-Saharan Africa was estimated to be 1 out of 22 while the risk of a woman in a developed country dying under similar circumstances was disparately lower at 1 out of 7300 [2]. In the past, many efforts have been directed towards increasing skilled birth attendance in order to improve pregnancy and newborns outcomes which led to an increase in the number of hospital deliveries in developing countries from 56% in 1990 to 68% in 2012 [1]. The World Health Organization (WHO) defines a skilled birth attendant as an accredited health professional such as a midwife, doctor or a nurse who has been educated and trained to proficiency in the skills needed to manage normal/uncomplicated pregnancies, childbirth and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns[3].

Most maternal deaths in developing countries are mainly due to three delays including: delay in making decision to seek care, delay in getting to the health facility, and delay in receiving the appropriate care[4, 5]. In order to address these delays, it is important for health workers to educate mothers on preparation that should happen prior to delivery. Birth preparedness and complication readiness (BPCR) is a strategy employed to encourage the use of skilled maternal and neonatal care during delivery and thus reduce these delays. Such preparations include selecting a skilled attendant for the delivery, selecting a health facility for the delivery, arranging travel plans to the facility and saving money [6-8].

The Kenya Demographic Health Survey (KDHS) of 2014, showed improved maternal, newborn and child health outcomes from 2003 to 2014. For example, the annual infant mortality has decreased from 52 to 39 per 1,000 live births; under-five mortality has also decreased from 74 to 52 per 1,000 live births, from 2003 to 2014. Similarly, neonatal mortality has decreased from 31 to 22 per 1,000 live births and maternal mortality has decreased from 488 to 362 per 100,000 live births over the same period of time [9-11].

The World Health Organization (WHO) recommends that pregnant mothers should attend four or more antenatal clinic (ANC) visits to ensure the health of the mother and the child. This prenatal care is more effective when received during the first trimester of pregnancy and continued throughout the pregnancy [12, 13]. ANC provides the opportunity to educate the

pregnant mothers on danger signs during pregnancy and delivery, preparation of birth plan and the importance of delivery under skilled attendant[8]. The KDHS 2014 showed there was improvement in the number of women attending ANC under skilled personnel from 92% in 2008 to 96% in 2014. However, only 58% of the women had the recommended minimum of four ANC visits. Although at a national level the KDHS 2014 showed improvements, there still remain challenges in addressing geographical, urban/rural and socioeconomic inequalities and disparities [10].

Research has shown there is a positive link between the density of health workers and improving health outcomes such as infant, under-fives and maternal mortality and morbidity [14-16]. A 2006 WHO report, entitled "Working Together for Health", estimated the shortage of health workers in the world to be approximately 4.3 million and the shortage is more severe in low and middle income countries [17]. This shortage poses a challenge in achieving the Sustainable Development Goals (SDGs) adopted by the global community in 2015 including a target of reducing maternal mortality to less than 70 deaths per 100,000 live births and less than 25 deaths per 1000 live births among the under-fives by 2030 [18-20].

In response to this global health worker shortage, there is a shift towards utilizing alternative cadres who can adequately deal with common health problems and improve equitable access to health services for all [21]. In particular, community health workers (CHWs) form such an alternative cadre to address the shortage of professional health workers [22, 23]. The WHO defines CHWs as paraprofessionals who live in the communities they serve, are selected by the community, are accountable to the same community, have a short and defined training and are not necessarily attached to a formal institution [24]. They mainly function at the household and community level providing essential health services, thereby acting as a bridge between the community and the more skilled health care workers and the health facility based services [25, 26]. Given the overwhelming body of evidence on the impact of CHW interventions leading to positive health outcomes among different populations [27-31], a lot of countries are scaling up CHW-based programs in order to improve health outcomes [28, 32].

Community Health Strategy in Kenya

The government of Kenya launched the Community Health Strategy (CHS) in 2006 as a means to expand community access to healthcare services [33, 34]. The provision of health services to the communities is focused around a Community Health Unit (CHU) also termed as level one of the Kenyan health system[35]. A CHU serves a catchment population of 5,000 people

(approximately 1000 households) through a network of community health extension workers (CHEWs), community health volunteers (CHVs) and community health committees (CHCs). The main implementers of the community health strategy in Kenya at the household level are CHVs [36]**.** The tasks performed by the CHVs falls into three main categories namely, disease prevention and control, family health services and hygiene and environmental sanitation[37]. The CHEWs who are usually trained formal health personnel such as nurses or public health officers employed by the government provide direct supervision, training and mentorship to the CHVs thus creating a link between the CHVs and the local health facilities[34]. The implementation of CHS by government has however been marked by various challenges including lack of resources, lack of community ownership, lack of supportive supervision and high attrition among others. This has led to the collapse of established CHUs as well as hindered establishment of new ones. To fill this implementation gap, Familia Nawiri (a Novartis Social Venture in Kenya) in partnership with Ministries of health in nine counties of Kenya developed a CHW program to implement CHS in selected areas within these counties. Components of the program includes establishment of new CHUs, adoption of collapsed or semi-functional CHUs, building capacity and competencies of the CHEWs, CHVs, putting governance structures of the CHUs in place, mapping and registration of all households in the CHUs and provision of promotive, curative and preventative services at the households as per CHS implementation guidelines. In this paper we present findings of a study conducted to establish maternal child health indicators at baseline for evaluating impact of the CHW program.

4.3. Methods

4.3.1. Study design

To assess the effectiveness of the program implemented based on a quasi-experimental design; a cross-sectional survey was used prior and after the implementation in the intervention and comparison sites.

4.3.2. Study setting

The study setting includes nine out of the 47 Counties in Kenya namely Bomet, Embu, Kericho, Kirinyaga, Meru, Migori, Nairobi, Nakuru and Siaya. The Counties were purposively selected based on the fact that Familia Nawiri has on-going activities in those counties and therefore would allow leveraging on existing infrastructure and resources. Within each County, two CHUs were selected to serve as intervention sites and two other CHUs to serves as comparison sites, with the exception of Kirinyaga County which had six intervention CHUs and six

comparison CHUs as the program has a presence in 3 different geographical areas in this county. The comparison CHUs were selected and matched on the basis of similarity in geographical location, ethnicity, means of earning a livelihood, having health facilities similar to those in the intervention sites, CHUs established around the same time as the intervention site and similar functionality status of the CHUs. In total, there were 22 intervention and 22 comparison CHUs. The total target population for both the intervention and non-intervention areas is estimated at approximately 220,000 inhabitants and 44,000 households given that every CHU covers approximately 1,000 households with an average household density of 5 people per household.

4.3.3. Sample size estimation

To estimate sample size for the baseline survey, we assumed a low initial coverage of 35% of the main indicator variable (4+ ANC visits) across all counties, 5% level of precision, 80% power and 95% confidence interval. This would result in a minimum of 356 mothers with at least a child below 2 years in each of the 10 sites (minimum of 3567). Accounting for a 10% non-response, the targeted sample size was 3924. The sample size was determined to establish an effect of at least 10% change (moderate effect size [38]) in coverage all maternal indicators as a result of the intervention using formula by Demidenko [39].

4.3.4. Sampling technique

We used a two-stage cluster sampling design involving the following steps: The first stage was randomly selecting clusters, whereby a cluster was defined as a village. A total of 272 (60%) villages (clusters) were selected to increase randomness of the sample. Of the 272 villages, 142 were in the intervention sites while 130 were in the comparison sites. The sampling frame was developed by obtaining the list of villages in each CHU from the CHEWs. In the second stage, a household served as a proxy sampling unit and was defined as people living and cooking together (eating from the same pot). All the households in selected villages were surveyed and those that were eligible and willing to take part in the study were included. A household was eligible if there was a mother with a child aged below two years.

4.3.5. Measurements

The baseline household survey focused on several indicators within the continuum of care of maternal, newborn and child health. These are indicators concerning utilization of health services for antenatal care, delivery care, postnatal care, family planning, childhood morbidity and care seeking behaviour for childhood illnesses. Other information collected included demographic characteristics such as age, gender, education level and marital status, household

characteristics, such as sources of water and toilet facilities. Also, of interest was access to any form of health insurance and previous visits to the household by the CHVs. The respondents included: 1) household heads who responded to questions on household characteristics and amenities and registration of household members, and 2) mothers who had children aged below 2 years who responded to the various questions on health services utilization from pregnancy to postnatal care and childhood illnesses.

4.3.6. Data collection

Baseline household data collection was conducted using a structured electronic questionnaire deployed on a mobile data collection application called Open Data Kit (ODK). The questionnaire was piloted before use to assess its practicability and changes were made where necessary. Data collectors underwent an intensive training which focused on the purpose of the baseline survey, how to conduct household interviews, informed consent process, fieldwork logistics, data confidentiality and use of the electronic application including saving complete and incomplete questionnaires and syncing of the data to the server among others. Mock sessions were also conducted with the data collectors during the training. Data collection in Bomet, Kericho, Migori, Nakuru and Siaya was done between August 2016 and November 2016 while data collection in Embu, Kirinyaga, Meru and Nairobi County was done between January 2017 and February 2017.

4.3.7. Data Management and Statistical analysis

Data collected on interviewer's devices were automatically uploaded to a secure, dedicated server, which was checked by the researcher for completeness and consistency. Different data modules were later merged using automatically generated unique identifiers for analysis. Data analysis was performed using STATA 14 (Stata Statistical Software: Release 14. College Station, TX: StataCorp LP). Descriptive statistics of percentage and frequency were used to summarize data, while Chi square test was used to assess whether distribution of categorical variables differed between intervention and comparison at baseline; significance was determined at 5% level ($p<0.05$).

4.3.8. Ethical consideration

Participation in the study was voluntary. Informed consent process detailing the risk, benefits and confidentiality of information collected was provided to the eligible participants. The study received ethical approval from the Ethics and Research Committee at Strathmore University, Nairobi, Kenya. In addition, permission to conduct the study was sought at the county, sub-county and community level in the different study areas.

4.4. Results

A total of 3735 households across the nine counties participated in the study of which 48.1% were from control sites and 51.9% were from intervention sites. Of those with complete information on household heads, 84.16% (2909) were male headed while 15.85% 548 were female headed households (Table 1).

Table 1: A summary of the socio-demographic characteristics of the respondents

Household head characteristics	Control N=1637	Intervention N=1822	Total (%) N=3459*	(P-value)
Gender				0.096
Male	1358 (83.06)	1551 (85.13)	2909 (84.16)	
Female	277 (16.94)	271 (14.87)	548 (15.85)	
Marital status (n=3456)				0.046
Single	188 (11.50)	186 (10.21)	374 (10.82)	
Married/currently in union	1356 (82.94)	1561 (85.72)	2917 (84.40)	
Widow/widower/divorced	91 (5.57)	74 (4.06)	165 (4.77)	
Highest level of education				0.095
No education	47 (2.87)	81 (4.45)	128 (3.70)	
Primary	745 (45.51)	923 (46.13)	1604 (46.24)	
Secondary/post primary	589 (35.98)	610 (33.48)	1199 (34.66)	
College & University	239 (14.60)	262 (14.38)	501 (14.48)	
Others	17 (1.04)	16 (0.88)	33 (0.95)	
Type of Occupation				<0.001
Family farm/own business	632 (38.61)	747 (41.00)	1379 (39.87)	
Agricultural paid labour	148 (9.04)	204 (11.20)	354 (10.18)	
Skilled employee	310 (18.94)	292 (16.03)	602 (17.40)	
Unskilled employee	366 (22.36)	319 (17.51)	685 (19.80)	
Unemployed	181 (11.06)	260 (14.27)	441 (12.75)	

*276 households had no information on household head

Of the households sampled in the intervention and control sites, we observed that a majority had improved water source (n=2396; 64.15%), while only 1.04% (n=39) of the households did not have any form of toilet facilities. Overall, we noted a high mobile phone penetration across all the households surveyed (n=3361; 89.99%). However, households in the control sites had a higher mobile penetration (n=1655; 92.05%) compared to the households in the intervention

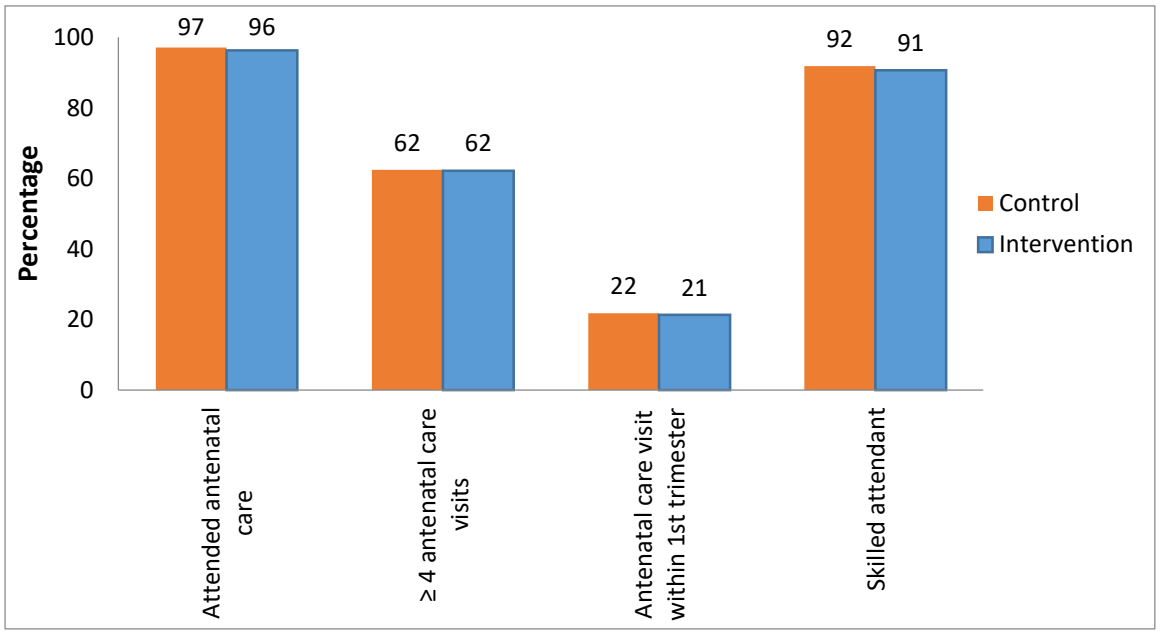
(n=1706; 88.07%), this difference was statistically significant (p<0.001). Table 2 shows further details on household characteristics.

Table 2: Comparison of household characteristics at baseline

Household characteristics	Control (48.1%) N=1798	Intervention (51.9%) N=1937	Total (%) N=3735	P value
Time to water source				**0.832**
Water on premises	444 (24.69)	460 (23.75)	904 (24.2)	
< 30 minutes	1057 (58.79)	1151 (59.42)	2208 (59.12)	
30 minutes - 1 hr.	256 (14.24)	272 (14.04)	528 (14.14)	
>1 hour	30 (1.67)	41 (2.21)	71 (1.9)	
Water source				**0.048**
Improved source	1190 (66.18)	1206 (62.26)	2396 (64.15)	
Unimproved source	595 (33.09)	714 (36.86)	1309 (35.05)	
Others	5 (0.28)	3 (0.15)	8 (0.21)	
Missing	8 (0.44)	14 (0.72)	22 (0.59)	
Treated drinking water				
Yes	1008 (56.06)	977 (50.44)	1985 (53)	**0.001**
No	790 (43.94)	960 (49.56)	1750 (46.85)	
Toilet facility				**<0.001**
Improved toilet	1743 (96.94)	1905 (98.35)	3648 (97.675)	
Unimproved toilet	37 (2.06)	11 (0.57)	48 (1.29)	
No toilet facility	10 (0.56)	7 (0.36)	17 (0.46)	
Missing	8 (0.44)	14 (0.72)	22 (0.59)	
Propotion who own				
Land	1,248 (69.41)	1,376 (71.04)	2,624 (70.25)	**0.420**
Electricity	683 (37.99)	769 (39.70)	1452 (38.88)	**0.231**
Television	634 (35.26)	733 (37.84)	1367 (36.60)	**0.078**
Mobile phone	1655 (92.05)	1706 (88.07)	3361 (89.99)	**<0.001**
Motorcycle	303 (16.85)	334 (17.24)	637 (17.05)	**0.613**
Bicycle	270 (15.02)	308 (15.90)	578 (15.4)	**0.436**
Health Insurance	428 (23.80)	434 (22.41)	862 (23.08)	**0.311**

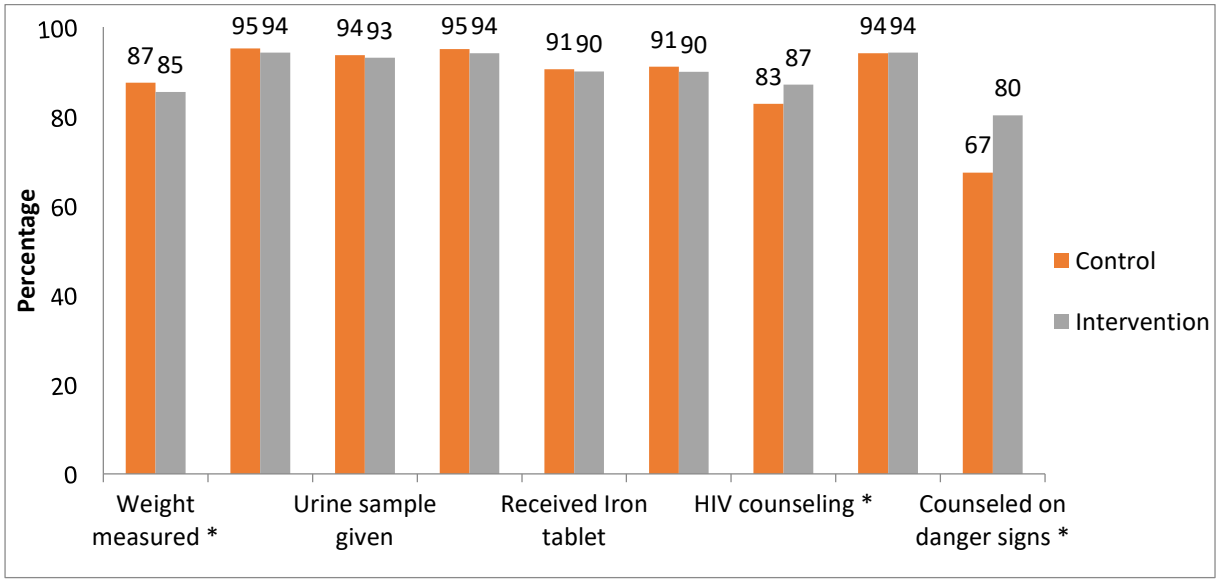
Of the households surveyed, (n=3611; 96.68%) mothers reported having attended ANC clinics for their last pregnancy during the last two years as shown in figure 1.

Figure 1: Utilization of antenatal care services in the control and intervention sites



Only 21.55% of the mothers reported having their first ANC visit during the first 12 weeks of their last pregnancy. We also observed a high prevalence of services provided during ANC visits in both the intervention and control sites as shown in figure 2.

Figure 2: Services provided during antenatal care visit



*= P<0.05

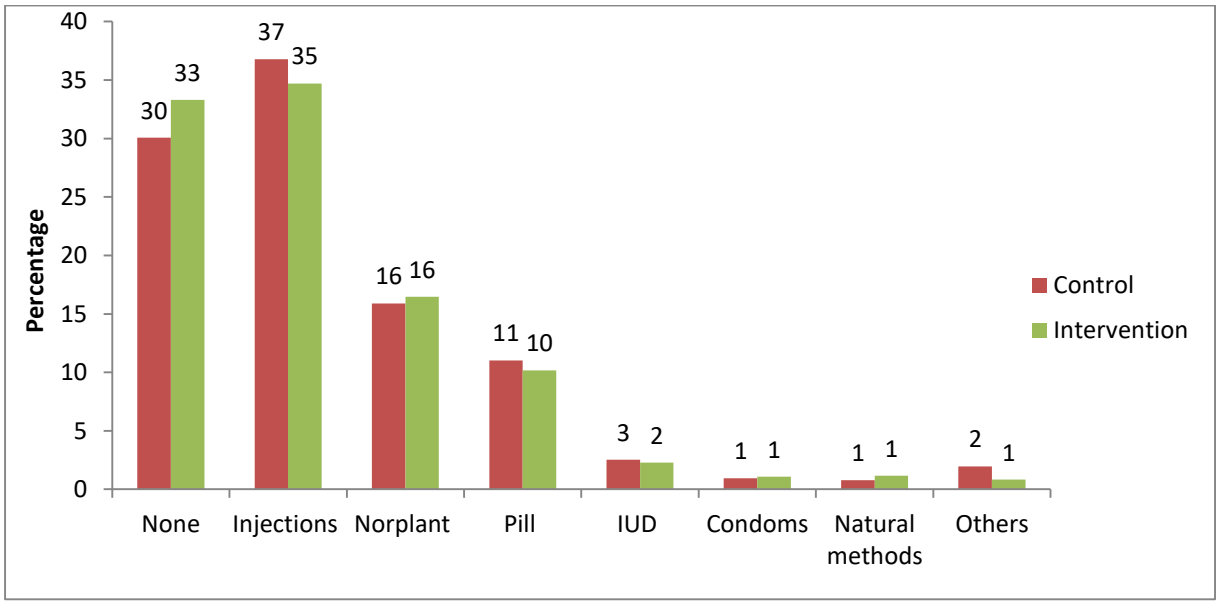
In terms of birth prepared during the last pregnancy in the last 24 months prior to the interview, we found that respondents in both the control and intervention sites were moderately prepared. We observed a statistically significant difference between the respondents in the two sites in terms saving money for the delivery or emergency, identifying a nearby facility for the delivery and also selecting a birth companion as outlined in table 3.

Table 3: Comparing birth preparedness arrangement steps taken for the last delivery

	Control (%) N=1798	Intervention (%) N=1937	Total (%) N=3735	P value
Birth Preparedness				
Saved money	1172(65.18)	1360(70.21)	2532(67.79)	0.005
Arranged transport	1035(57.56)	1116(57.61)	2151(57.59)	0.759
Identified birth companion	1008(56.06)	1162(59.99)	2170(58.1)	0.050
Identified place of delivery	1166(64.85)	1344(69.39)	2510(67.2)	0.006

From this study, we observed a contraceptive use prevalence of 67.71% (n=2529). The most commonly used form of contraceptives was the injectable as shown in figure 3.

Figure 3: Use of contraceptive methods among the respondents



*IUD = Intrauterine device and Norplant refers to Levonorgestrel

Overall, the most frequently identified pregnancy danger sign was heavy bleeding while in the newborn, poor feeding/suckling was the most frequently identified danger sign by the respondents. There was statistically significant difference in the knowledge of the danger signs,

with the intervention site seeming to have better knowledge of the same when compared to the control sites (Table 4).

Table 4: Danger signs during pregnancy and in the newborn identified by respondents

	Control (%) N=1798	Intervention (%) N=1937	Total (%) N=3735	P value
Proportion mentioning different danger signs after delivery				
Heavy bleeding	677(37.65)	1033(53.33)	1710(45.78)	0.000
Fast or Difficult breathing	198(11.01)	397(20.50)	595(15.93)	0.000
Fever	544(30.26)	815(42.08)	1359(36.39)	0.000
Headache/Blurred vision	343(19.08)	534(27.57)	877(23.48)	0.000
Convulsions or loss of consciousness	195(10.85)	293(15.13)	488(13.07)	0.000
Foul Smelling discharge from the	129(7.17)	140(7.23)	269(7.2)	0.950
Proportion of mothers mentioning different newborn danger signs				
Baby looks unwell	603(33.54)	579(29.89)	1182(31.65)	0.017
Poor suckling or feeding	793(44.10)	893(46.10)	1686(45.14)	0.220
Convulsions	242(13.46)	358(18.48)	600(16.06)	0.000
Fever	790(43.94)	829(42.80)	1619(43.35)	0.483
Fast / difficult breathing	259(14.40)	358(18.48)	617(16.52)	0.001
Baby feels cold	161(8.95)	190(9.81)	351(9.4)	0.371
Baby too small / born too early	101(5.62)	135(6.97)	236(6.32)	0.090
Yellow palms / soles	186(10.34)	178(9.19)	364(9.75)	0.234
Swollen abdomen	81(4.51)	110(5.68)	191(5.11)	0.104
Unconscious	85(4.73)	94(4.85)	179(4.79)	0.858
Pus or Redness of the umbilical chords	246(13.68)	288(14.87)	534(14.3)	0.301

Out of the households surveyed, 11.49% (n=429) of the mothers reported having a child below 5 years of age with diarrhea within two weeks prior to the survey; of these, more than half (69.93%) sought treatment for diarrhea. Similarly, a small proportion of the respondents reported their child suffering from respiratory tract infection (RTI), almost 80% of these reported having sought treatment for the illness as shown in table 5.

Table 5: Comparison of households reporting childhood illness among children below five years and use of health services for the same by group

	Control (%) N=1798	Intervention (%) N=1937	Total (%) N=3735	P value
RTI previous 2 weeks	93(5.17)	127(6.56)	220(5.89)	0.160
Treatment sort for RTI	74(79.57)	96(75.59)	170(77.27)	0.158
Diarrhoea Previous 2 weeks	231(12.85)	198(10.22)	429(11.49)	0.089
Sort treatment for diarrhoea	167(72.29)	133(67.17)	300(69.93)	0.022

In this study, less than half, 26.29% of the respondents reported having ever been visited by a CHW for health promotion purpose. Of those households visited by the CHVs, 27.59% were located in the control while 25.09% were located in the intervention sites and the difference between the intervention and control sites was not statistically significant. (p=0.212)

Table 6: Comparison of households reporting visits by community health volunteer

	Control (%) N=1798	Intervention (%) N=1937	Total (%) N=3735	P value
Visit by CHV				0.212
Yes	496(27.59)	486(25.09)	982(26.29)	
No	1291(71.80)	1437(74.19)	2728(73.04)	
Missing	11(0.61)	14(0.72)	25(0.67)	

4.5. Discussion

The main purpose of these analyses described in this paper was to provide information on specific indicators of maternal and child health services utilization, household and community characteristics to be used to monitor the progress of the CHW program implemented through a private-public partnership.

ANC is important as it helps to identify any negative pregnancy outcomes, especially when it is sought early enough during pregnancy. The WHO recommends that pregnant mothers should attend ANC at least four times during their pregnancy [12]. We found that 97% of the mothers who were interviewed had attended at least one ANC visit. This is very similar to the KDHS of 2014, which reported ANC attendance of 96%. The number of mothers attending at least 4 ANC visits during their pregnancy was slightly higher in our study (62%) compared to the

proportion reported in the KDHS 2014 (48%). We also observed a higher proportion of mothers reporting having skilled birth attendant for the last pregnancy in the previous 2 years (91%), compared to the national average of 61% [9]. The difference between intervention and control sites in ANC attendance and number of ANC visits was not statistically significant.

All the antenatal components had a high prevalence in both control and intervention sites. The majority of respondents went through HIV counseling and testing (94%) and were counseled on signs of complications during pregnancy (74%). Birth preparedness has been shown to be an important predicator of the place of delivery in that mothers who are well prepared are more likely to deliver at a health facility under a skilled attendant[5]. In this study, 34% of the respondents had not saved funds to cater for an emergency, 42% had not made advance transport arrangements in case of an emergency, 42% had not identified a birth companion and another 23% had not identified a facility where to deliver and were therefore not adequately prepared to reduce delays in seeking care in case of an emergency. This finding has implications for CHW programs or other health education programs at the community level as well as education during ANC at the facility level in that they need to encourage and educate mothers on BPCR. A significant proportion, 25% of maternal of deaths occur during pregnancy and therefore it is important for pregnant mothers to be able to identify danger signs during pregnancy in order to avoid delay in deciding to seek appropriate care[8]. Knowledge on common danger signs for mother and newborn after delivery was low in both the intervention and control sites and differences were statistically significant. The most common danger signs identified for the mother after delivery were heavy bleeding (46%) and fever (36%). On the other hand, poor suckling or feeding (45%) and fever (43%) were the most identified danger sign for the newborn by the mothers. A similar study conducted in Uganda [6] showed very low knowledge levels on danger signs for both mother and newborn. This was an interesting finding in our study given the high prevalence of ANC attendance and brings to question on the quality of ANC education provided to the mothers.

Of the mothers interviewed, 11% reported having a child with diarrhea two weeks prior to the survey. This rate is slightly lower than the national average of 15% reported in KDHS of 2014 [9]. Of the mothers reporting diarrhea, 69.93 % sought care for the children and the difference in seeking care for diarrhea when comparing intervention and control sites was statistically significant. About 6% of the mothers reported having a child suffering from respiratory tract infection two weeks prior to survey and out of these, 77% sought care for the illness. This proportion is lower than the national average of 9% of those seeking care in case a child has

RTI [9]. We also observed a low prevalence of household visitations by the CHVs as reported by the respondents; this observation was similar across the intervention 25% and the control sites 28% respectively. The main implementers of the community health strategy in Kenya at the household level are the CHVs and perform tasks related to disease prevention and control, family health services and hygiene and environmental sanitation [37]. This finding further suggests challenges in the implementation of the CHS specifically household visitations by the CHVs and a need for further research to tease out the barriers to the household visitations.

A key limitation for this study is the reliance on self-reported data as well as recall bias since mothers had to provide information relating to their last pregnancy during the last two years prior to the study.

4.6. Conclusion

In conclusion, although we report a high prevalence of at least one ANC attendance, we observed low knowledge on danger sign during pregnancy and for newborns as well as poor birth preparedness among the respondents. Our findings have implications for maternal child health initiatives in Kenya and suggest the need to leverage community based health education programs to educate pregnant women birth preparedness and complications readiness and thus reduce maternal and neonatal mortality rates in the country.

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5. Discussion and conclusion

Countries across the globe are investing in community health worker (CHW) programs as a key strategy for provide equitable access to health services for all people. Community health workers have been shown to be effective in extending the reach of inadequate health care systems in low and middle income countries as well as improving health outcomes. Despite the challenges these programs encounter, the global shortage of health workers implies the need for an alternative cadre. This means the implementation of CHW programs should go hand in hand with implementation research in order to document lessons learned and thus inform investment in CHW initiatives.

This thesis aimed at evaluating a community based health education program with had an aim of preventing water sanitation and hygiene related diseases. It was also the aim of this thesis to inform programming of a CHW program implemented through a public private partnership by assessing utilization of maternal child health services and health seeking behaviour for diabetes and hypertension and opportunities for CHW activities. As whole the thesis builds on existing evidence which shows the effectiveness of CHW in disease prevention and the need for health promotion and education of communities.

The findings in chapter two show that community based health education is effective in reducing diarrhea disease and respiratory infections. However the health education should also be accompanied by resources that are needed to support the healthy behaviour that is taught. We found that participants, who reported residing in areas with water improvement initiates such as boreholes and piped water to the compound, also reported a reduced risk of diarrhea or respiratory tract infections (RTI). This further supports the argument that health education should be accompanied by provision of resources and infrastructure necessary to sustain the behaviour. Although there was a strong association between attending the education sessions and having a reduced risk of diarrhea or RTI, the study design used in this study is not appropriate for claiming causation. The choice to use the design was informed by the fact that the program had already been implemented at the point of deciding to evaluate it.

Key findings in chapter three have implications for primary health care in Kenya. From the study, we confirmed that majority of diagnosis for chronic conditions are made in the public facilities and the patients choose to continue seeking care in the public facilities. There is therefore a need to ensure public facilities are well resourced. However we observed that most of the diagnoses for diabetes were made in the private sector. This is likely due to the inhibiting

cost of diagnosing materials and could be counterproductive for initiatives raising awareness on diabetes as people accessing diagnosis at a public health facility is not guarantee. In this study we found a high proportion of diabetic and hypertensive patients having their medicaments at home. This differs with findings of Kenya Stepwise Survey for non-communicable diseases which found a lower prevalence. Evidence from this study on reasons for dropping out of treatment for chronic disease suggests the need for close to community outreach/education on the chronic nature of diabetes and hypertension and the need for adherence to treatment.

Similar to chapter three, the key findings in chapter four have implications for the community health worker program as well as similar initiatives in general. The high prevalence of at least one ANC attendance and the low knowledge on danger signs in pregnancy and newborns indicates a missed opportunity to educate the pregnant mothers at every encounter with the health care providers. A recommendation for policy makers would be to tailor each ANC visit in a way that addresses crucial information on birth preparedness and complications readiness at each visit. The lessons could then be reinforced at the community level by the community health workers. We also observed inadequate birth preparedness and complications readiness which would lead to delay in deciding to seek care in case of an emergency and delay in getting to the health facility in the event of an emergency. Patient education should not just happen at the health facility level; instead there is an opportunity for community health workers to reinforce the lessons provided during ANC at the facility level.

In chapter three and chapter four we observed low health insurance coverage in the households surveyed. This could impact on appropriate health seeking behaviour since even the reduced fees at the government hospital would be out of pocket expense. This has implications for achieving universal health coverage without exposing the patients to financial ruin. Also in the last two studies, there was low coverage of households by community health volunteer. Only about a third of the households reported ever being visited at home by community health volunteers for service delivery. This has a huge bearing on the community health worker program implemented in this partnership. Further research is needed alongside program implementation to understand the barriers and facilitators of household visitation by community health volunteers and ways to address them in a sustainable way.

In conclusion, this PhD thesis contributes to the national and global discussion on investing and scaling up community health worker initiates. It provides evidence on the effectiveness of

the community health worker initiatives in disease prevention. It also highlights gaps that close to community initiatives and programs can fill by improving knowledge levels of the people as well as encouraging uptake of health services.

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Professional Preparation:

Swiss Tropical Public Health Institute, University of Basel, Switzerland	Epidemiology	PhD	2019
Stellenbosch University, Cape Town South Africa	Clinical Epidemiology	MSc	2014
Stellenbosch University, Cape Town South	HIV/AIDS Management	PgDip	2012
Nelson Mandela Metropolitan University, Port Elizabeth South Africa	Biochemistry and Microbiology	BSc	2010

A. Personal Statement

A Clinical Epidemiologist, with over ten years' experience relevant to both industry and academia. This includes local and international work experience in diverse fields including quality control, Microbiology, observational studies, community health, implementation research, clinical trials, project management and leading a research team. I am committed to using scientifically valid methods and apply this to explore questions concerning developing world health and health care systems.

02/2015 – 04/2019: **Doctoral Researcher/Project Management**
Swiss Tropical and Public Health Institute

- Designing and implementation of cross-sectional studies focusing on Maternal and Child Health and Health seeking behaviour for diabetes mellitus and hypertension among diagnosed individuals across nine counties in Kenya
- Collaborated and managed relationships with stakeholders in different Countries and regions within Kenya
- Recruitment, training and supervision of field workers and leading research team
- Data analysis using STATA and interpretation of results
- Monitoring project budget and Ensuring project was delivered on-time, within scope and within budget
- Authoring reports and publications for peer-reviewed journals
- Presentation of findings at local and international forums

04/2014 – 12/2014: **Next Generation Scientist Research Fellow-***Novartis, Basel, Switzerland*

- Design and implementation of epidemiological studies in rural Kenya relating to community health education and evaluation of community based health interventions.
- Study design and epidemiology expertise to ensure proper methodology relevant to local conditions in consultation with industry (Novartis) and academia (Strathmore, Stellenbosch University) experts.

- Proposal development, submission and follow-up interactions with Institutional Review Board

05/2011 – 03/2014: **Laboratory Researcher**

Task Applied Science, Cape Town, South Africa - A Clinical Research Organization conducting clinical trials for novel tuberculosis treatment

- Management of patient samples including specimen processing, slide preparation, slide staining, Microscopy reading, MGIT culturing, reading culture results, Gene Xpert testing, capturing results on database, QC checking results, autoclaving and completing temperature & apparatus usage logs.
- Development and execution of clinical research studies and programs.
- Routine data verification and quality control, ensuring data integrity and consistency with prescribed study protocol.
- Routine data analysis and interpretation using data analysis programs.

06/2013 – 08/2013: **Next Generation Scientist Intern -** *Novartis, Basel, Switzerland*

- As part of the global clinical epidemiology team successfully developed an epidemiological study to evaluate the outcome of a complex healthcare intervention (community health education program).
- Participated and conducted sessions on the various drug development topics including drug safety and regulation, clinical trials, ethics and corporate social responsibility and health systems.
- Facilitated other departmental activities such as providing support for Epidemiology colleagues for various literature reviews, searching for relevant information and drafting a document summarizing the identified information.
- Attended relevant Epidemiology internal educational sessions and staff meetings.

08/2008 – 07/2009 **Microbiologist/GMP Technologist**

Coca Cola Sabco, Port Elizabeth, South Africa

- Microbiological sampling and analysis using membrane filter technique as per CCSabco quality management system requirements.
- Root cause analysis in the event of non-conformances and Perform quarterly good manufacturing practice audits and active involvement in the HACCP team.

05/2007 – 07/2008 **Microbiologist** - Valor Fruit Processors, Port Elizabeth, South Africa
03/2006 – 05/2007 **Quality controller** Coca Cola Sabco, Port Elizabeth, South Africa

B. Skills

Research skills
Study design
Implementation research
Data analysis and interpretation

STATA
R for data analysis
Written and oral communication skills
Analytical skills
Project management
Leadership and team work
Evidence based medicine
Collaboration
Budgeting
Monitoring and Evaluation
Mentoring

C. Honours and Awards

2015: PhD Scholarship, Novartis Pharma, Basel, Switzerland
2014: Research Fellowship Grant, Novartis Pharma, Basel, Switzerland
2013: Masters Scholarship, Stellenbosch University

D. Publications

- **Karinja, M**., Schlienger, R., Pillai, G.C., Esterhuizen, T., Onyango, E., Gitau, A. and Ogutu, B., 2020. Risk reduction of diarrhea and respiratory infections following a community health education program-a facility-based case-control study in rural parts of Kenya. BMC Public Health, 20(1), pp.1-9.
- **Karinja, M.,** Pillai, G., Schlienger, R., Tanner, M. and Ogutu, B., 2019. Care-Seeking Dynamics among Patients with Diabetes Mellitus and Hypertension in Selected Rural Settings in Kenya. International Journal of Environmental Research and Public Health, 16(11), p.2016.
- **Karinja, M.,** Pillai, G., Schlienger, R., Tanner, M. and Ogutu, B., 2019. Evaluation of a Community Health Worker Maternal Child Health Improvement Program- Results from a Baseline Survey– **Under 1st review by Global Health Action Journal**
- Friedrich, S.O., Kolwijck, E., **Karinja, M.N.,** van der Merwe, L. and Diacon, A.H., 2019. Quantification of viable bacterial load in artificial sputum spiked with Mycobacterium tuberculosis. Tuberculosis.
- Kayigire, X.A., Friedrich, S.O., **Karinja, M.N.,** van der Merwe, L., Martinson, N.A. and Diacon, A.H., 2016. Propidium monoazide and Xpert MTB/RIF to quantify Mycobacterium tuberculosis cells.
- **Karinja, M.N.,** Esterhuizen, T.M, Friedrich, S.O., & Diacon, A.H. (2015). Sputum volume and mycobacterial load during the first two weeks of anti-tuberculosis treatment. Journal of Clinical Microbiology
- Kolwijck, E., Friedrich, S. O., **Karinja, M. N.,** Ingen, J., Warren, R. M., & Diacon, A. H. (2013). Early stationary phase culture supernatant accelerates growth of sputum cultures collected after initiation of antituberculosis treatment. Clinical Microbiology and Infection

E. Oral Presentations

- 3rd National Universal Health Coverage Conference, Kisumu Kenya, May 2019. Strengthening Community Health Strategy in Kenya through Public Private Partnership –Implementation Research

- Symposium on Community Health Workers and their contribution towards the Sustainable Development Goals, February 2017. Functionality assessment of selected community health units across ten Counties in Kenya
- Research Symposium, Strathmore University, Nairobi Kenya, November 2017. The effect of community health workers on utilization of health services and Improving health outcomes in five rural communities in Kenya – a mixed methods approach
- Kenya Paediatrics Association Annual Conference, Kisumu Kenya, April 2017. Community Health Workers and Health Seeking Behaviour for Childhood illnesses.
- Clinical Trials Management Workshop, Strathmore University, Nairobi Kenya, May 2016. Served as lead trainer on Reporting and Publishing of Clinical Research, Manuscript Writing
- Next Generation Scientist (NGS) Research Symposium on August 26, 2014. Karinja, M.N. NGS Fellow - Design and Execution of Epidemiology studies in rural Kenya.

F. Poster Presentation

- Science and Innovation Day, Novartis Pharma, Basel, February 2015. Miriam Karinja, Raymond Schlienger, Anthony Gitau, Surya Narayan, Bernhards Ogutu, Colin Pillai. Design and execution of a case control study in rural Kenya using mhealth methodology for data collection
- World Congress of Basic and Clinical Pharmacology, Jul 2014. Karinja, M.N., Esterhuizen, T.M, Friedrich, S.O. Sputum volume and mycobacterial load as candidate bio markers for treatment effectiveness in early bactericidal activity studies on patients with pulmonary tuberculosis.
- Poster presented at the Next Generation Scientist Research day, August 2013, Basel, Switzerland. Karinja, M.N., Schlienger, R., Martin, D., & Gitau, A. Reduction in risk of Diarrhoea and Respiratory Infections following a Community Hygiene Education Program in a rural Kenyan setting: A Case Control Study