LONGITUDINAL OCCURRENCE OF SELECTED DISEASE SYNDROMES AND UTILIZATION OF COMMUNITY HEALTH CARE SERVICES AMONG RESIDENTS IN SUNA WEST SUB-COUNTY IN MIGORI COUNTY, KENYA

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Longitudinal occurrence of selected disease syndromes and utilization of community health care services among residents in Suna West Sub-County in Migori County, Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree at any other university.

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

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DEDICATION

To my father Mr. Peter Mokaya, mother Rodah Chweya, sister Sharon Chweya, and brother Geoffrey Chweya. And to me my friend Celine Anyango.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIC	Akaike information criterion
AIDS	Acquired immunodeficiency syndrome.
ANNI	Average Nearest-neighbor index
BIC	Bayesian information criterion
CHV	Community health volunteers
DALY	Disability-adjusted life years
GI	Gastrointestinal illness
GIS	Geographical information system
GLMM	Generalized linear mixed model.
GPS	Geographical positioning system
HH	Household
HIV	Human immunodeficiency virus infection
ICC	Intra-class correlation coefficient
ID	Identification

ILI	Influenza-like illness
IRR	Incidence rate ratio
KSH	Kenya shillings
OR	Odds ratio
PHC	Primary health care
Sq. Km	Square kilometers
USD	United States dollar
WASH	Water, sanitation, and hygiene practices
YLL	Years of life lost

ABSTRACT

In developing countries, quantifying disease burden is still a challenge. Disease syndrome studies could overcome this challenge since it is inexpensive, easy to collect self-reported data, and longitudinally track disease events. Moreover, such studies in communities could estimate the occurrence and burden of disease syndromes for targeted public health interventions. This study determined the occurrence of selected disease syndromes and utilization of community health care services among communities in Suna West Sub-County. The selected study disease syndromes include influenza-like illness (ILI), gastrointestinal illness (GI), and injuries. This study adopted a prospective cohort study design with households forming the cohort. We generated 92 random points using QGIS version 3.6.1 and used them to recruit 92 households best proximal to the random points in Wasweta II ward, Suna West sub-county. From these households, 390 study participants were cluster sampled, enrolled, and followed weekly for 12 weeks through a phone call for a report of illness. Upon a report of illness during the weekly call, a visit to the affected household was made within the week and a questionnaire seeking to characterize the reported illness was administered. The illnesses were then grouped into syndromes based on the study case definition. This study yielded highly structured data necessitating a Poisson and logistic multilevel data analysis depending on the distribution of the syndrome responses. The individual and household levels were included as the random effects, while independent variables were identified at the significant level of $P \leq 0.05$. The study outcome variable was the count of attained GI and injuries, which followed a Poisson distribution, and the number of attained ILI syndrome that followed a binomial distribution. Adjusting for sex and age, making a visit outside the local sub-county of residence (Odds ratio (OR) =2.7, 95% CI 1.8, 4.1) and living in a cement floored house (OR=1.9, 95% CI 1.1, 3.3) independently predicted the attainment of ILI syndrome. On the other hand, making a visit outside the local sub-county (incidence rate ratio (IRR)=3.9, 95% CI 2.3, 6.4) and the presence of stagnant water due to rain (IRR=1.9 95% CI 1.1, 3.5) predicted the attaining of GI syndrome. Additionally, the independent risk factors for the occurrence of injuries included making visits outside the local sub-county

(IRR=2.2, 95% CI 1.5, 3.1) and keeping domestic animal (IRR=0.13, 95% CI 0.02, 0.72). The burdens of attaining ILI, GI syndromes, and injuries across the 12 weeks were 1.6, 1.5, and 1.2 episodes per participant, and 3.7, 2.4, and 1.5 episodes per household respectively. Across time (Level 1), the intra-class correlation coefficient (ICC) of weekly repeated measures was highest in ILI syndrome (ICC=0.82) compared to GI (0.73), and injuries (0.64). At the participant level (Level 2), clustering was highest in injuries (ICC=0.31) compared to GI (ICC=0.18) and ILI (ICC=0.04). At the household level (Level 3) the contextual or household influences were highest in ILI syndrome (ICC=0.14) compared to GI (0.08), and injuries (0.05). Disease prevention measures targeting individuals and households should be instituted to reduce ILI, GI, and injury burden. Besides, a deeper understanding of gender and age roles in determining the occurrence of ILI, GI, and injuries is needed to reduce the burden. Studies are needed to establish granular exposures associated with the increasing risks of making a visit outside the local sub-county of residence, living in a cement-floored house, and owning domestic animals. As well, there is a need to increase community awareness of risks associated with stagnant pools of water within households and support interventions using community health volunteers (CHV) in implementing community disease prevention activities to reduce the burden caused by ILI, GI, and injuries.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

The global burden of disease provides a framework to quantify the magnitude of health loss due to diseases, injuries, and risk factors (Frings et al., 2018). In Low Middle-Income Countries, quantifying disease burden is still a challenge (Wang et al., 2017). Disease syndrome studies could be used to overcome these challenges since it is inexpensive, easy to collect data, and possible to longitudinally track disease events in form of self-reports (Mandl et al., 2004). Disease syndrome studies employ case definitions based on a cluster of clinical symptoms that consistently define a medical condition in the absence of clinical or laboratory diagnosis (Chami et al., 2018). Recognized disease syndromes include hemorrhagic fever, severe acute respiratory illness, influenza-like illness, gastrointestinal illnesses, and neurological syndrome (May et al., 2009).

In rural setups, there is a disproportionate use and support of disease syndrome data, especially on the occurrence of diseases such as malaria with fever, respiratory and influenza-like illnesses, gastrointestinal syndrome including exhibiting diarrhea, vomiting, bloating, and stomach pains, as well as injuries. Gastrointestinal illness (GI) characterized by stomach pain, diarrhea, nausea, vomiting, fever heartburn, bloating, fullness, belching, and flatulence are common, and occurrences may at times overlap in the community (Gathecha et al., 2018; Locke et al., 2005; Stockwell et al., 2014). Besides, community members experiencing GI illness in most instances never visit the health facility for their symptoms (Halder et al., 2007).

Influenza-like illness (ILI) characterized by fever, persistent running nose, malaise, joint pains, muscle pains, cough or sore throat, mucoid nasal discharge, and breathing difficulty contributes to the community's disease burden (Stockwell et al., 2014). These ILI observable signs could be used to identify the occurrence of ILI events in the community as well as identifying cases not reaching the primary health facilities. Further, existing literature shows data on ILI in the community is rarely carried out (Stockwell et al., 2014).

In rural settings, household injuries are more prevalent at home commonly characterized by falls and cuts (Gathecha et al., 2018). In developing countries, information on injuries, including data on events of the location of the injury, is inadequate. However, self-reported data on events of injuries are used to advocate for prevention intervention at home and the workplace, as well as reducing their burden (Phelan et al., 2011; Tayeb et al., 2014).

In rural settings, Community Health Volunteers (CHVs) positively influence the utilization of health care services and improve health service coverage. The roles CHVs play in identifying syndromes are still not adequately documented in most African settings. However, they could be used to identify diseases including syndromes to inform on their occurrence for targeted medical intervention as well as provide true estimates of the burden in the communities (World Health Organization, 2010).

Longitudinal studies are could be effective in analyzing disease syndromes since they are powerful in revealing cause and effect as well as quantifying patterns (Caruana et al., 2015). These studies yield a multilevel data structure that could be used to estimate the intra-cluster correlation coefficient (ICC) used to identify levels for targeted interventions (Peugh & Heck, 2017). Longitudinal studies focused on disease syndromic surveillance are rare in Kenya. The goal of this study was to determine the longitudinal occurrence of attaining the threshold of ILI, GI syndrome, and injuries among study participants, across time (weekly), and to assess the utilization of the community and primary health care services (PHC). To mitigate the burden associated with illness in communities, awareness of illness attaining thresholds of ILI, GI syndrome, and injuries in the community, is still required, particularly in Suna West sub-county.

1.2 Statement of the problem

In Kenya, 78.3% of total disability-adjusted life years (DALYs) are constituted by years of life lost (YLL) due to premature mortality caused by Human immunodeficiency virus infection and acquired immunodeficiency syndrome (HIV/AIDS), lower respiratory infections, diarrheal diseases, tuberculosis, and malaria. Migori County exhibit a higher average disease burden between 0.4 and 0.7 YLL/person against a national average of 0.4 YLL/person (Frings et al., 2018). In Migori county, this disease burden has not been adequately studied despite other neighboring regions showing burdens of ILI, GI syndromes, and injuries. Besides, longitudinal studies that

could reveal more accurate inferences in quantifying the occurrence of ILI, GI, and injuries have not been carried out in rural settings. Also, the intercluster correlation coefficients and associated risk factors for the occurrence of ILI, GI, and injuries and ICCs have not been determined, limiting the design of prevention and control strategies. Moreover, the specific roles that community health volunteers play in reducing disease burden are not adequately documented, therefore, increasing health information gaps in the community (World Health Organization, 2010).

1.3 Justification of the study

This study aimed to identify episodes of longitudinal occurrences of attaining ILI, GI syndrome, and injuries among study participants, across time (weeks) and assess how community health volunteers are utilized as a component of the community health services through household visits or referrals to the PHC in Suna West Subcounty. Awareness of the occurrence of ILI, GI, and injury among clinicians and researchers is vital to mitigating the associated burdens in the Subcounty. Studies on occurrences of attaining ILI, GI, and injuries provide rich longitudinal data that could improve community health information, especially in the study area. Additionally, insights into the health challenge could support decision-making. Further, intercluster correlation coefficients (ICCs) could be estimated and utilized to design targeted interventions to improve health practices among individuals or households. Indeed, findings from such studies could be used to improve policies to target ILI, GI syndromes, and injuries in communities as well as provide a better understanding of the utilization of community health care services within the study area. These can be used to improve policies for community health care services by strengthening the community health strategy, improving the community health data, and using Community Health Volunteers (CHV) to reduce the burden of the syndromes through referrals and follow-up.

1.4 Objectives

1.4.1 General objective

To determine longitudinal occurrence of selected disease syndromes and utilization of community health care services among residents in Suna West sub-county, Kenya.

1.4.2 Specific objectives

1. To determine the longitudinal occurrence of selected disease syndromes among residents in Suna West sub-county, Migori County
2. To determine utilization rates of community health services among residents in Suna West sub-county, Migori County
3. To determine factors associated with the longitudinal occurrence of selected disease syndromes among residents in Suna West sub-county, Migori County.

1.5 Research questions

1. What is the longitudinal occurrence of selected disease syndromes among residents in Suna West sub-county, Migori County?
2. What are the utilization rates of community health services among residents in Suna West sub-county, Migori County?
3. What are factors associated with the longitudinal occurrence of selected disease syndromes among residents in Suna West sub-county, Migori County?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Selected disease syndromes and case definitions

A syndrome is a collection of observable patterns of symptoms that often occur together (Stockwell et al., 2014). These symptoms are usually recognizable and indicate a specific condition that is not necessarily understood (Calvo et al., 2003). Commonly recognized disease syndromes include hemorrhagic fever, severe acute respiratory illness, influenza-like illness, gastrointestinal illnesses, and neurological syndrome (Calvo et al., 2003; May et al., 2009), which is also evident in the study area. Literature links a disease syndrome to a particular illness, however, some syndromes could be linked to a simple physical finding (Calvo et al., 2003).

Disease syndromes studies could be used to identify illness clusters before disease diagnosis confirmation, which could influence public health interventions and mobilization of resources to reduce the disease burden (Kalimeri et al., 2019; Pavlin, 2003). Additionally, the disease syndromes studies can be used to give insights into disease trends in the community, including the study site, and give evidence of outbreak events that could occur. Further, by integrating the disease syndrome approach into the existing disease surveillance methods disease outbreaks can be detected earlier than they would have been when using the traditional methods since data can be automated data to check disease indicators in real-time (Pavlin, 2003).

Adopting the disease syndrome approach in syndromic surveillance, potential disease outbreaks can be detected easily using the electronically available demographic data that can define the epidemic and influence efforts toward disease control measures (Lazarus et al., 2001; Pavlin, 2003). Indeed, the growing threat of emerging and re-emerging infections has led to the development of new disease surveillance systems that use and complement the existing surveillance methods using the existing medical and nonclinical data. These systems use the data in new ways that are currently not used by the traditional systems (Pavlin, 2003).

The disease syndrome data when obtained, consist of all events and subjects rather than focusing on one disease event or a sample population (Lazarus et al., 2001; Pavlin, 2003). Disease syndrome provides a new surveillance tool that is more sensitive than traditional systems due to several

events of illness captured, thus making it differ slightly from the traditional systems in the investigation of diseases and outbreaks (Pavlin, 2003). Gaps exist in the statistical methods for analysis and interpretation of syndromic surveillance data especially in the "real world" conditions and in the public health decision-making process (Duchin, 2003). While disease syndromes and surveillance could be useful, it does not replace traditional public health surveillance and is unlikely to detect an individual case of a particular illness or replace the critical contribution of physicians in the early detection and reporting of unusual diseases and events. The selected disease syndromes for this study include influenza-like illness (ILI), gastrointestinal (GI), and injuries (Table 2.1).

2.1.1 Influenza-like illness (ILI) syndrome

Influenza-like illness (ILI) is associated with a significant morbidity burden that is common among all age groups (Wang et al., 2016). In developing countries including Kenya, infectious and non-infectious etiologies of ILI including bacteria, viruses, and allergens circulate year-round and generate symptoms such as malaise, fever, cough, and nasal discharge among others (Porter et al., 2011; Zambon et al., 2001). Community surveillance of influenza-like illness (ILI) could mitigate delays in reporting and provide true estimates of burdens. Additionally, medically unattended ILI illness could be identified and subsequently classified into syndromes, to quantify such burden in communities (Stockwell et al., 2014).

Despite the established surveillance systems in developing countries including Kenya, Influenza-like illness still cause significant morbidity and mortality, with its seasonality and patterns not being established in most settings (Tadesse et al., 2020), including the study area. Additionally, ILI is associated with higher hospitalization rates among children in developing countries, with challenges extending to quantifying the ILI burden in these rural settings (Tadesse et al., 2020; Tsuzuki & Yoshihara, 2020). Syndromic surveillance can address these challenges given the mild symptoms that require the use of diagnostic tests or in the management of illnesses (Tsuzuki & Yoshihara, 2020). Nevertheless, a well-defined ILI syndrome case definition could be used to quantify illnesses, therefore, providing a platform to establish diagnosis and treatment for healthcare providers (Kasper et al., 2010).

Influenza-like illnesses are at times non-specific, not different from other respiratory illnesses, and transmitted through the respiratory route (Kasper et al., 2010). Moreover, the ILI is associated with higher medical consultation among children, who are likely to spread the ILI-causing agents within the household (Mughini-Gras et al., 2016). Excess ILI within households is known to have a socioeconomic impact associated with the medication costs, absenteeism from work or school, and increasing the burden of ILI in the community. However, good sanitation and hygienic practices, including handwashing, vaccination, treatment, and isolation could be implemented to improve reduce the impacts associated with the burden of ILI (Mughini-Gras et al., 2016). Further, studying the occurrence of ILI in communities could inform health officials on events of ILI in the study area, therefore, contributing to tracking of ILI illness and estimation of the burden in the community (Stockwell et al., 2014).

2.1.2 Gastrointestinal (GI) syndrome

Gastrointestinal (GI) illnesses adversely affect public health in multiple ways (Cissé, 2019). In Kenya, GI illnesses are mostly attributed to foodborne intoxications and infections, usually due to inadequate water, sanitation and hygiene practices (WASH) (Acheson, 2009). Additionally, other leading risk factors include inadequate regulatory food control systems, low socioeconomic status, and inadequate surveillance systems (May et al., 2009). In rural settings, GI illnesses are common and sometimes their occurrences may overlap due to a chronic illness. As such, these GI illnesses are distinctly identified using recognizable upper and lower abdominal symptoms that could be categorized into GI syndrome. Community members experiencing GI illness in most cases never visit a health facility for their symptoms (Halder et al., 2007).

Gastrointestinal illness is a public health issue in most developing countries, affecting the stomach and intestines. While most gastrointestinal illnesses could be mild and resolved without treatment, they are also likely to result in higher morbidity and mortality in children, the elderly, and those with compromised immunity or suffering from chronic illnesses (Burd & Hinrichs, 2016). Indeed, given the wide range of causative etiologies of gastrointestinal illness, characterizing such etiologies is challenging in rural settings due to the similarity of symptoms resulting from different etiologies (Burd & Hinrichs, 2016). Categorizing such illness as a gastrointestinal illness syndrome could address the challenges of quantifying the burden. Additionally, innovative approaches are

warranted in the prevention of gastrointestinal illness, including better food handling practices (Rotheram et al., 2020).

In both developed and developing countries outbreaks of gastrointestinal illness resulting from food poisoning due to consumption of contaminated food or water, caused by bacteria, parasites, toxins, and viruses such as *Bacillus cereus*, *Campylobacter*, *Salmonella*, enterotoxigenic *Escherichia coli*, *Giardia lamblia*, *Cryptosporidium* and norovirus (Burd & Hinrichs, 2016; Rotheram et al., 2020). Also, fungal infections by fungi transmural invasion are recognized to cause gastrointestinal illness(Lamps et al., 2014). Increased risk for GI infection from such microorganisms is due to spread from person to person or traveling to endemic countries. (Burd & Hinrichs, 2016). However, while it is crucial to identify disease-causing etiologies in the treatment of GI infections, rehydration, antibiotics, and antiparasitic medication can be used to replace lost fluids, and get rid of the parasite and bacteria, respectively (Burd & Hinrichs, 2016)

The common chronic gastrointestinal illness is irritable bowel syndrome (IBS) characterized by bloating and bowel movements or abdominal pain and discomfort (Mazzawi & El-Salhy, 2017). While IBS can result from eating diets rich in fermentable carbohydrates that can induce variations in GI cell densities, dietary guidance including intake of high soluble fiber and dietary changes of protein, fat, and carbohydrates could reduce irritable bowel syndrome symptoms as well as improve their quality of life. Gaps exist quantifying the burden of chronic gastrointestinal illness and resultant social and economic impacts in developing countries (Mazzawi & El-Salhy, 2017).

In Africa, the burden of food-borne diseases is among the leading causes of gastrointestinal illness frequently caused by diarrheal disease agents (Bisholo et al., 2018). Food-borne diseases are predicted to increase in most developing countries due to the consumption of uninspected fresh produce, fish, and meat (Bisholo et al., 2018). Incidents of food-borne diseases can be managed through effective epidemiological surveillance, however, gaps exist in estimating their associated morbidities and mortalities due to inadequate data and surveillance systems (Bisholo et al., 2018). Further, data collected through surveillance of food-borne diseases can be used for targeted interventions to advocate for food safety (Yu et al., 2021).

2.1.3 Household injuries

Globally, injuries impose an enormous public health burden across all age groups. Largely injuries result from road traffic injury, violence or self-inflicted injury, and falls (Diamond et al., 2018; Garcia, 2020; Onywera & Blanchard, 2013). In Kenya, injuries are attributable to rapid urbanization, poor enforcement of road safety regulations, inadequate road networks, and poor quality of health care (Botchey et al., 2017; Janeway et al., 2019). Additionally, inadequate surveillance systems and epidemiological data on injury limit the current understanding of the burden of injuries in the country (Batte et al., 2018; Botchey et al., 2017).

In rural settings, injuries occur due to the interactions between individuals and their physical and social environments. Falls and cuts are the commonly known injuries most prevalent at home (Ballard et al., 2015). Studies reveal inadequate surveillance of household injuries, including the location of the injury, especially in rural setups. Besides, safety at home is backed through collaborative efforts, and resource allocation support injury prevention efforts (Gielen et al., 2015). As a result, emphasis on the quality and completeness had been adopted using self-reported data on a household injury. Further, Injuries can be categorized as either unintentional to include accidents or intentional to include interpersonal and self-harm injuries in the community (Gielen et al., 2015).

In low-income countries, data on injuries are frequently obtained from hospital records (Diamond et al., 2018; Garcia, 2020). However, the records are commonly prone to inadequate record-management systems and are not population-wide representative, and are generally inaccessible therefore contributing to underestimation of sub-national injury-related burden (Bhalla et al., 2009). To address these challenges, self-reported data on injuries could be obtained to estimate the associated burden and their impacts in rural settings (Bhalla et al., 2009).

2.2 Utilization of community health services and the role of community health volunteers

In developing countries, community health volunteers (CHV) are associated with improved maternal and child health, reduced malnutrition rates, and prevention of communicable diseases including malaria, pneumonia, HIV/AIDS, and diarrhea (Perry et al., 2014). CHV interventions are considered cost-effective when compared to other alternatives or no interventions (Wanduru

et al., 2016). Besides, CHVs make routine household visits and provide counseling to promote good health-seeking behaviors (Republic of Kenya Ministry of Health, 2013). In Myanmar, CHVs are considered more accessible to community members compared to health facility staff in providing malaria screening and are as good as the facility staff (Linn et al., 2018). Moreover, CHVs promote the distribution, and appropriate use of insecticide-treated nets in endemic areas for mosquito-borne diseases, thus contributing to reductions in malaria cases (Owusu Adjah & Panayiotou, 2014). Further, in developing countries, CHVs are involved in engaging women groups to improve personal health and that of their newborns through the uptake of health services including family planning (Scott et al., 2015). CHV interventions in urban and rural settings have demonstrated a positive leap forward in halting and reversing the spread of diseases and infection (Perry et al., 2014). In general, CHVs play an important role in-home visits, referrals for symptomatic patients, influencing treatment compliance, and reducing stigma among community members (Rachlis et al., 2016).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study site

This study was conducted in Suna-West Sub-County, in Migori County. The study site borders Migori town and has a population of 128,890 and a land area of 287.5 square kilometers (sq. Km) with an estimated population density of 448 persons per sq. Km (Kenya National Bureau of Statistics, 2019). Suna-West Sub-County has 4 administrative wards including Wiga, Wasimbwete, Wasweta II, and Ragana-Oruba. For the study, one ward (Wasweta II) was randomly selected (Figure 3.1)

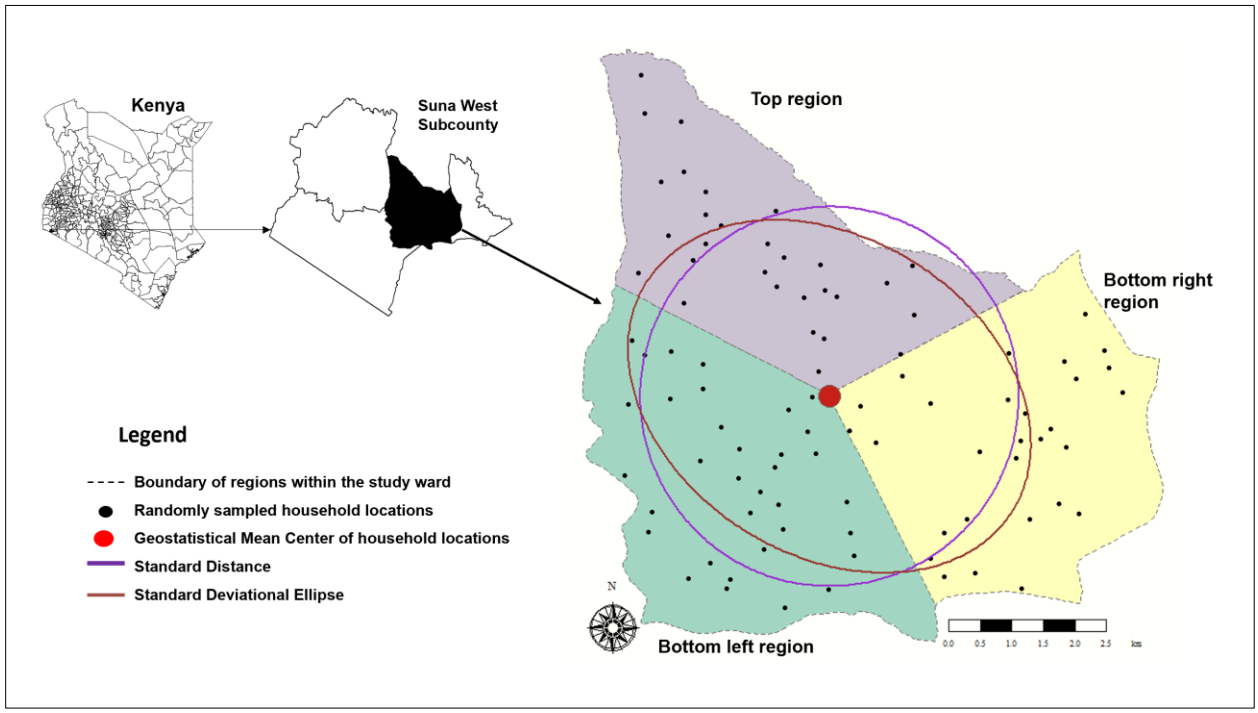

Figure 3.1: Map of the study area. Left: A map of Kenya showing the location of the Suna West sub-county. Middle: a map of Suna West sub-county showing the location of the study area, Wasweta II ward in the black polygon. Right: a map of Wasweta II ward showing the location of randomly sampled households in black points. The red circle in the middle of the study site is the computed geospatially mean center of household locations. The large blue and brown circles are the standard distance and standard deviational ellipse of household locations, respectively. The study area was arbitrarily divided into three regions namely top, bottom left, and bottom right. The scale applies to the Wasweta II ward only.

3.2 Study design

This study adopted a prospective cohort study design, longitudinally following recruited household members to study selected disease syndromes for 12 weeks (3 months).

3.3 Study population

The study population constituted 390 individuals cluster sampled from 92 households in Suna-West Sub-county. The 92 households were determined using a formula as described below. The unit of measurement was the sampled individuals, however, to account for the clustering of responses, Individuals and households were included in the analysis

3.4 Sampling

3.4.1 Sample size determination

$$\mathbf{n}= \frac{[z\alpha/2\ (r)(1-r)(f)(1.1)]}{[(0.12*r)^2\ (p)nh}$$

Adapted from Multiple indicator cluster Survey Manual, 2005 (UNICEF, 2005)

Where ***n*** represented the required sample size, expressed as the number of households, ***4*** is a factor to achieve the 95 percent level of confidence, ***r*** is the assumed binomial distribution of the syndromes being estimated (50%), ***1.1*** is a factor to raise the sample size by 10 percent for nonresponse, ***f*** is the symbol for *deff (deff- takes account of extra-variation encountered due to cluster sampling as opposed to random sampling)*, ***0.12r*** is the margin of error to be tolerated at the 95 percent level of confidence, defined as 12 percent of ***r*** (*12 percent thus represents the relative sampling error of r*), ***p*** is the proportion of the total population upon which the indicator, ***r***, is based, it is 100%, and n_h is the average household size, estimated at 5 household members

$$\mathbf{n}= \frac{[4\ (0.5)(0.5)(1.5)(1.1)]}{[(0.12*0.5)^2\ (1)5} = \mathbf{92\ Household}$$

3.4.2 Sampling techniques

The study participants were selected using a multi-stage cluster sampling method described as follows. Suna-west is comprised of 4 wards namely Wiga, Wasweta II, Wasimbwete, and Ragana-

Oruba (Kenya National Bureau of Statistics, 2019). One ward was randomly sampled to represent the study locations and 92 households were recruited for the study. To sample the 92 households, 92 random geographical points were generated in QGIS software within the Wasweta II ward boundary. The 92 selected geographical points were downloaded into a geographical positioning system (GPS) gadget, and the closest household proximal to the generated points were enrolled in the study and mapped for follow-up. The map of the sampled household points in the study area was created using R studio version 4.0.0 (Figure 3.1). To determine the random distribution of the sampled households, the Average Nearest-neighbor index (ANNI) was computed (Wilson & Din, 2018).

3.4.2.1 Inclusion criteria

This study included:

1. A household with at least 2 members consenting.
2. A member aged below 18 years old whose parent assented to join the study.
3. A consenting member living consistently in the household before the study (3 months)
4. A household with a functional mobile phone or capacity responding to weekly follow-up.
5. All study participants in a household aged above 5 years old

3.4.2.2 Exclusion criteria

This study excluded:

1. A household with members who declined to consent or those aged below 18 years old whose parent declined to assent.
2. A household head who is unwilling to respond to the weekly follow-up.
3. Individuals with chronic conditions acquired congenitally.

3.5 Study variables

The dependent variable for this study was the weekly counts of attained Gastrointestinal illness (GI) syndrome and injuries and the number or success of attaining influenza-like illness (ILI) syndrome. The independent variables were categorized into two classes namely the fixed effect that was constant across individuals, and random effects that were assumed to vary across

individuals and households. The fixed effects instituted of time-invariant and time-variant variables. The time-invariant variables were collected during the recruitment of study participants and included age in years, gender, and household income. These variables were repeated across multiple records for each study participant in the study database. On the other hand, the time-variant variables were collected at each time point (weekly) i.e., the household size, illness reported, CHV visits, and weather indices. Further, the random effect was measured at two levels to model changes attaining weekly attained GI or injures and ILI (Level 1), and how they vary across individuals (Level 2) and households (Level 3) (Diez-Roux, 2000; Peugh & Heck, 2017). Confounding and interactions were assessed and appropriately adjusted for in the analysis to yield precise effect estimates (Pourhoseingholi et al., 2012).

3.5.1 Conceptual framework

The study conceptual framework is shown in figure 2.1

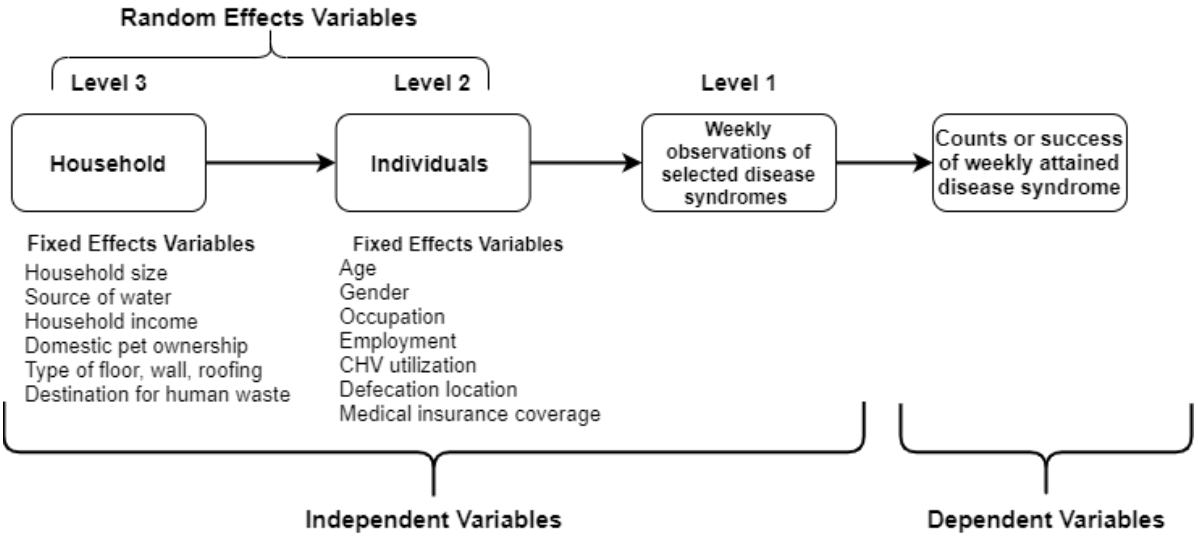

Figure 3.2:Figure of the study conceptual framework

3.5.2 Case definition of the syndromes under the study

In this study from each study participant recruited, weekly pre-specified illnesses experienced during the follow-up were collected and grouped into ILI or GI syndrome and injuries based on case definitions (Table 3.1)

Table 3.1: Table of Case definitions

Syndrome	Syndrome and symptoms of definition
Influenza-like illnesses (ILI) syndrome	Attaining ILI syndrome was based on weekly reporting ≥4 of the prespecified ILI symptoms(Casalegno et al., 2017). 1. Cough defined as rapid onset of forced respiratory expulsive maneuvers, usually associated with a characteristic "cough" sound for ≥3 days(Morice, 2006) 2. Fever defined as an elevated rise in body temperature or hotness of the body(Ogoina, 2011) 3. Sore throat defined as a burning sensation in the throat and pain on swallowing (Farrer, 2012) 4. Joint and or Muscle pain characterized by pain in a body muscle or joint. 5. Malaise defined as a general feeling of discomfort, illness, or lack of well-being. 6. Breathing difficulty defined as perceptions of difficulty or distress related to breathing (WHO, 2018); 7. Persistent running nose defined as persistent watery mucus discharge running for >3 days (Mustafa et al., 2015) 8. Mucoid nasal discharge defined as transient nasal discharge running for ≤3 days (Mustafa et al., 2015).
Gastrointestinal (GI) syndrome	Attaining GI syndrome was based on weekly reporting ≥3 of the pre-specified GI symptoms. 1. Flatulence defined as a condition in which the abdomen feels full and tight (Lacy et al., 2011). 2. Diarrhoea defined as the passage of loose or watery stools ≥ 3 times in 24 hours (Gidudu et al., 2011). 3. Fever. 4. Nausea and/or vomit defined as an urge or forcing the contents of the stomach up through the oesophagus and out of the mouth. 5. Stomach pain defined as an unpleasant abdominal distress sensation (WHO, 2018)
Injuries	Injuries were assessed using a standardized questionnaire with questions adapted from the World Health Organization (WHO) survey tool for injuries (Sethi D et al., 2004) • All injuries were classified based on the nature, severity, mechanism, and intent of the injury characterized at the household level.

3.6 Pre-testing data collection tools

Questionnaires were subsequently used to probe and characterize the reported illness as an influenza-like illness (ILI), gastrointestinal Illness (GI) syndrome, or injury per the study case definitions in Table 3.1. Also, the utilization of community health services by household members through the referrals and visits made to households by CHVs was assessed.

To pretest and validate the study questionnaire tool we obtained responses from 49 participants dwelling in 10 households in the study population. The validity and reliability of the study questionnaire instrument (Appendix 3.1) were tested using exploratory factor analysis (EFA) and reliability analysis. Overall internal reliability (Cronbach's alpha=0.7) and test-retest reliability (0.85) of the questionnaire were high. The differences in scores between participants were significant ($p<0.001$) indicating the questionnaire has satisfactory construct validity. The measures of each factor score adequacy include correlation of (regression) scores with factors Cronbach's alpha=0.96), multiple R square of scores with factors (Cronbach's alpha= 0.92), and the minimum correlation of possible factor scores (Cronbach's alpha=0.84) were all having high reliabilities.

To ensure accuracy in the data collection exercise, data were double-checked, cleaned, and analyzed. In addition, in the pre-test exercise, the flow and wording of questions and responses were observed. The research assistant was trained on identifying the study predetermined syndrome for each of the syndromes and the consent form. All the collected data were screened every week for any errors before linking it with the household and individual characteristics data collected at recruitment

3.7 Data collection

In this study, the 92 households were followed weekly through phone calls to the household head of any reports of illness or injury. Upon a report of illness, the affected households received home visits by the research assistant. Additionally, households that did not respond during the phone calls received visits from the research assistant. In this study, each recruited study participant weekly experienced illnesses during the follow-up and were collected and grouped into ILI or GI syndrome and injuries based on case definitions (Table 3.1). The data flow chart depicting data

collection and descriptive profile is shown in Figure 4.1. Data was collected using An interviewer-administered questionnaire in English and Dholuo language (Appendix 10).

3.8 Data management and analysis

The weekly follow-up data were collected using a standard questionnaire (Appendix 10). This yielded highly structured longitudinal data with repeated weekly observations among study participants nested within households. The data was entered into R software, then cleaned, and exploratory data analyses were conducted. The descriptive statistics were performed and the data were presented in charts and summarized tables in proportion and frequencies. The attained ILI, GI, and injuries were expressed as rates/study participants or household/week. Inferential analysis was done for the count data for attained GI and injury, and the successes or numbers of the attained ILI and presented in the form of counts or numbers for the respective syndrome per study participant across households. All analyses were performed using R software version 3.6.2

3.8.1 The rationale for Multilevel data analysis

The multilevel model analysis involves simultaneously fitting data to include group- and individual-level effects on the outcome to account for the independence of responses at each level of data aggregation (Diez Roux, 2004). The nature of the data in longitudinal studies warrants a multilevel analysis. The multilevel analysis differs from other statistical data analytical approaches, first, by concurrently investigating the household- and individual-level variables independently. Secondly, the analysis independently accounts for the independence of responses at household and individual levels of data aggregation. Thirdly, the analysis adjusts for the correlation of responses from higher group levels such as the households usually sampled from a larger population of households. Lastly, the variation of responses between household members and households could be estimated and the contextual influences of the higher group levels on outcomes are determined.

In the multilevel analysis, variables are assigned to respective group levels including those that refer to the higher-group level context. Assigning a variable to the respective groups ensures that the variable is measured to the level it belongs (Hox, 2010). Multilevel data has a hierarchical structure with higher levels (e.g., households). individual observations in such data samples are

not completely independent and tend to be similar. While statistical tests assume the independence of the observations, the multilevel analysis considers the similarity of responses in a cluster (Hox, 2010). This study, therefore, used the multilevel analysis to handle the micro-level individuals' variables and higher-level i.e. household variables concurrently (Diez-Roux, 2000; Peugh & Heck, 2017).

3.8.2 Clustering analyses of attaining influenza-like illness (ILI) syndrome, gastrointestinal illness (GI) syndrome, and injuries

The structure of the longitudinal data collection yielded multilevel data whose distinctive features were outcomes among participants within households signifying a cluster. Ideally, participants' responses in a cluster are likely to be similar and vice versa. Using the obtained weekly observations, a participant was considered a cluster in which multiple observations were grouped. Participants nested within households formed a higher-level cluster. This level of data aggregation made it possible to possible to assess the similarity of responses among cluster members using intra-cluster correlation coefficients (ICC). The ICCs were computed using the total variance in the outcome partitioned into residual (σ^2) or, a participant (σ^2_j), and household (σ^2_k) variance components also denoted as the u-terms u_j and u_k respectively, obtained from fitting mixed-effect multilevel Poisson and logistic regression models depending on the distribution of the attained ILI, GI, and injury responses. Level 2 ICC was defined as the correlation of the syndrome between participants residing in the same household computed as the proportion of the total variance ($\sigma^2_k + \sigma^2_j + \sigma^2$) attributed to variance at the participant level (σ^2_j) (Peugh & Heck, 2017). Finally, contextual or household (Level 3) influences were assessed on the disease syndromes by computing three different ICCs at the household level. First, the proportion of total variation in the syndrome attributed to variance at the household level was estimated as $\sigma^2_k / (\sigma^2_k + \sigma^2_j + \sigma^2)$ and interpreted as the expected correlation between two measures of the attained disease syndrome drawn completely at random from any study week from two participants within the same household (Peugh & Heck, 2017). A different Level 3 ICC estimate was computed as to the proportion of variation of the combined participant and household levels attributed to variance at the household level as $\sigma^2_k /(\sigma^2_k + \sigma^2_j)$ and interpreted as the expected correlation between the mean frequency of the attained disease syndrome across the 12 study weeks from two participants

drawn completely at random from the same household. Lastly, a Level 3 ICC was computed as the proportion of total variation in the disease syndrome attributed to combined variance at the participant and household levels as $\sigma^2_j + \sigma^2_k / (\sigma^2_k + \sigma^2_j + \sigma^2)$ and interpreted as the expected correlation of the syndrome between two study weeks sampled from the same participant (Peugh & Heck, 2017). A high ICC computed at any level reflected a higher degree of similarity in the disease syndrome at that level (Wong et al., 2018).

3.9 Estimating the association between disease syndrome and independent variables

Influenza-like illness (ILI) syndrome, gastrointestinal illness (GI) syndrome, and injuries were each modeled separately to account for the distribution of each syndrome response.

3.9.1 Multilevel logistic regression for attaining influenza-like illness (ILI) syndrome

ILI syndrome responses followed a binomial distribution, therefore, to examine the effect of the independent variables on attaining ILI syndrome, generalized mixed effect models (GLMM) with a logit function were fitted, adjusting for clustering at the participant- and household levels. First, a univariable analysis was conducted using a less-restrictive level of significance of $P \leq 0.1$ to identify single significant variables associated with attaining ILI. Secondly, a multivariable analysis was conducted to identify significant independent variables associated with the disease syndrome. The GLMM was fitted by the maximum likelihood using Laplace approximation with the household and individual identification included as the random effects. Independent variables were examined and included as fixed effects in the model. In the multivariable analyses step, sex and age were included in the models to account for their confounding characteristics. The final model was selected based on low values of Akaike information criterion (AIC) and Bayesian information criterion (BIC), signifying a better-fitted model (Appendix 4). Noting the 3-multilevel data structure organized as follows: 1) Level 3: households, denoted by *k, 2)* Level 2: individual household members denoted by *j* and *3)* Level 1: repeated weekly measure, denoted by *i.* The model specification was as follows;

$$\text{logit}\left(P(Y_{jik} = 1 | \mu_{0j}, \mu_{0ik}\right) = \beta_0 + \sum_{l=1}^{p} \beta_{1l} X_{lijk} + \sum_{l=1}^{q} \beta_{2l} Z_{lijk} + \mu_{0j} + \mu_{0ik}$$

where Y_{jik}denoted ILI syndrome measured across week *i* on the *j*th subject within *k*th household, X_{lijk}represents p time-varying covariates (including Time), Z_{lijk} represents q time-invariant covariates, with respective effects β_{1l} and β_{2l}. Also, $\mu_{0j} \sim N(0, \sigma_j^2)$ and $\mu_{0ik} \sim N(0, \sigma_k^2)$ are random effects associated with subject and household. All analyses were conducted in R software version 3.6.2

3.9.2 Multilevel Poisson regression for the attained gastrointestinal illness (GI) syndrome and injuries

GI syndrome and injury responses followed a Poisson error distribution, therefore, to examine the effect of the independent variables on attaining GI and injuries, generalized mixed effect models (GLMM) with a log link function was fitted, adjusting for clustering at the participant- and household levels. First, a univariable analysis was conducted using a less-restrictive level of significance of P≤0.1 to identify single significant risk factors associated with attaining either GI syndrome or injuries. The GLMMs were implemented in a Bayesian setting using the bglmer function in R Studio (Vincent Dorie et al., 2016). Secondly, a multivariable analysis was conducted to identify significant independent risk factors associated with attaining either GI syndrome or injuries. All GLMMs were fitted by the maximum likelihood using Laplace approximation with flat covariance priors and normal fixed priors, with the household- and individual- group ID included as the random effects. Examined independent variables were included as fixed effects in the model while age and gender were included in the models to account for their confounding characteristics. The final model was selected based on low values of Akaike information criterion (AIC) and Bayesian information criterion (BIC), signifying a better-fitted model (Appendix 5 & 6). Further, to assess suppression effect for variables that were not significant at the univariable step but turned significant at the multivariable step using Sobel mediation (Gaylord-Harden et al., 2010).

3.10 Ethical consideration

This study protocol was presented to the Ethics and Scientific Review Committee in AMREF health Africa for review. The study was approved under reference number P635/2019 (Appendix 11). Approval was also obtained from the county health department in Migori County under

reference number MIG/DPHO/VOL 2/45 (Appendix 12). During recruitment, Once the household was identified, the household head was consulted on whether they can allow all members of his/her household to participate in the study before their consent to participate was formally sought. Once the household head agreed to participate in the study, the household was enrolled in the study. All members aged above 18 years were approached for consent, while for those aged below 18 years parental consent was sought and were assented to in the presence of parents (Appendix 7-9). All study participants aged above 5 years were followed weekly for 12 weeks to track any pre-specified symptoms of interest in the study. All the collected data were saved in a password-safe database, and only the principal investigator was able to access the database.

CHAPTER FOUR

4.0 RESULTS

4.1. Distribution of individual characteristics

Table 4.1 shows the descriptive characteristics of the 390 participants. While 55% of recruited participants were females, 48% of all participants were <18 years ranging between 5 years and 83 years. The median age of participants was 19 years with the interquartile range of 11 and 42 years. 53% of participants were still schooling. Of the 47% of non-schooling participants, 46% and 1% engaged in informal and formal occupations, respectively. At least 84%of participants had attained primary education.

Table 4.1: Description of individual-level variables of study participants (n=390)

Variables	Level	Frequency	%
Age in years	≥5-17	187	48.0
	18-54	156	40.0
	>54	47	12.0
Gender	Female	215	55.1
	Male	175	44.9
Employment status	Formal	3	0.8
	Informal	180	46.2
	School going	207	53.1
Education level	Primary	327	83.8
	Post-primary[a]	63	16.2

[a]Study participants with the secondary, university, or vocational studies

Table 4.2 describes the household-level variables for the 92 households. The mean, standard deviation, and median of the sampled household size (SD) were 5.1, 2.1, and 5.0 respectively, ranging from 2 to 12 household members. 83% of the household heads were earning a monthly income of ≤10,000 Kenya shillings (KSH) with a maximum of 30,000 KSH. Only, 15% of the households reported having active medical insurance. 73% of the households sourced water from springs, wells, and rain. However, 89% of the households treated drinking water, while 95% had domestic animals including cattle, sheep, goats, poultry, dogs, or cats (Table 4.2). Further, for all

sampled 92 households the determined nearest neighbor index for the random distribution was 0.98.

Table 4.2: Description of 92 households, and area-level variables (n=92)

		Households		No. of study participants nested in the households	
Variables	**Level**	**Frequency**	**%**	**Frequency**	**%**
Income	0-10,000	76	82.6	323	82.8
	>10,000	16	17.4	67	17.2
Medical insurance	Yes	14	15.2	63	16.2
	No	78	84.8	327	83.8
Floor-type	Cement floor	13	14.1	57	14.6
	Earth floor	79	85.9	333	85.4
Wall type	Brick wall	13	14.1	53	13.6
	Mud wall	79	85.9	337	86.4
Roofing type	Aluminum sheets	90	97.8	380	97.4
	Thatch roofing	2	2.2	10	2.6
Drinking water	River	25	27.2	110	28.2
source	Other sources[a]	67	72.8	280	71.8
Treat drinking water	Yes	82	89.1	353	90.5
	No	10	10.9	37	9.5
Water treatment	Filtration/decantation	34	41.5	140	39.7
method	Chlorine/boiling	48	58.5	213	60.3
Human waste	Pit latrine	84	91.3	361	92.6
destination	Open defecation	8	8.7	29	7.4
Trash disposal	Garden disposal	24	26.1	96	24.6
	Garbage pit	68	73.9	294	75.4
Domestic animal	Yes	87	94.6	376	96.4
owned	No[b]	5	5.4	14	3.6
Presence of ill	Yes	32	36.8	151	40.2
animal[b]	No	55	63.2	225	59.8
animal death reported	Yes	13	14.9	53	13.6
	No	74	85.1	323	82.8
No. of cattle	<4	44	71.0	192	69.3
	≥4[c]	18	29.0	85	30.7
No. of sheep	<2	8	53.3	32	50.0
	≥2[d]	7	46.7	32	50.0
No. of goat	<2	17	50.0	64	41.8
	≥2[e]	17	50.0	89	58.2
No. of poultry	<15	51	65.4	201	59.3
	≥15[f]	27	34.6	138	40.7
No. of dogs	1	20	40.8	97	42.0
	>1[g]	29	59.2	134	58.0

No. of cat	1	43	71.7	207	75.8
	≥1[h]	17	28.3	66	24.2
Area-level variable - region variables[i]	Top	29	31.5	133	34.1
	Bottom right	28	30.4	106	27.2
	Bottom left	35	38.0	151	38.7

[a]Other sources include spring, well water, municipal tap system, and rainwater; [b]Number of households with domestic animals = 87; [c]Maximum number of cattle = 18; [d]Maximum number of sheep =17; [e]Maximum number of goats = 14; [f]Maximum number of poultry = 110; [g]Maximum number of dogs = 11; [h]Maximum number of cats =5; [i]Arbitrary generated study site regions

4.2. Enrollment and retention of study participants

The 390 participants across the recruited 92 households were followed weekly for 12 weeks (Figure 4.1). A total of 4261 reports against the expected 4680 reports (390*12 weeks) were obtained, yielding a response rate of 91% (Figure 4.1). Also, full reports of each study week were consistently obtained from 48% of the 390 study participants (n=188) across 51% of the 92 households (n=47), while only 15 study participants across 3 households were lost to follow up (Figure 4.1).

4.3. Longitudinal distribution of participants reporting illness.

Of the 4261 reports obtained during the follow-up weeks covering August 2019 to October 2019, 14% of these reports (n=592) described an illness eligible to be investigated for attaining ILI, GI, and injuries (Figure 4.1).

4.3.1. Longitudinal distribution of participants attaining influenza-like illness (ILI) syndrome.

Out of the 592 illness reports, 278 (48%) attained the threshold for ILI syndrome using the study case definition (Figure 4.1). In the 12 weeks of follow-up, these 278 reports came from 176 participants comprising 45% of the 390 participants (Figure 4.1). Of these 176 participants, 53% were females. Of these 176 participants, 51%, belonged to the young age category (5-17 years), 38% were middle-aged (18-54 years) and 11% were from the old age category (>54 years). Respectively, each participant attained, on average, 1.6 episodes of ILI in the 12 weeks of follow-up yielding a mean of 0.13 episodes of ILI syndrome per week.

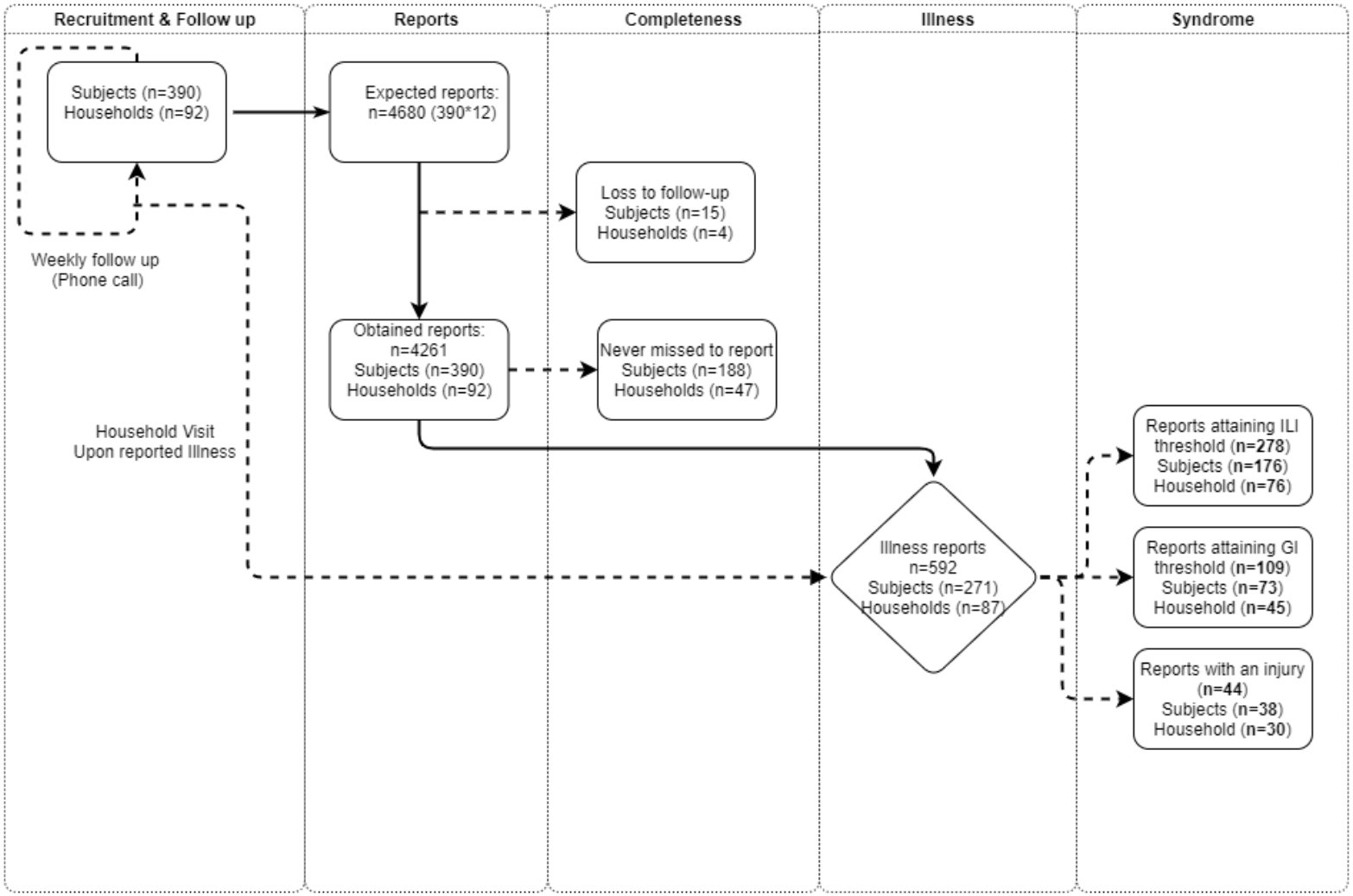

Figure 4.1: Schematic diagram showing the flow of the profile of the descriptive findings.

In the entire study period, the frequency of reports of illness from females (n=339) was higher than those from males (n=253) however this difference was non-significant (P=0.1). These reports of illness decreased over time in both sexes (Figure 4.2).

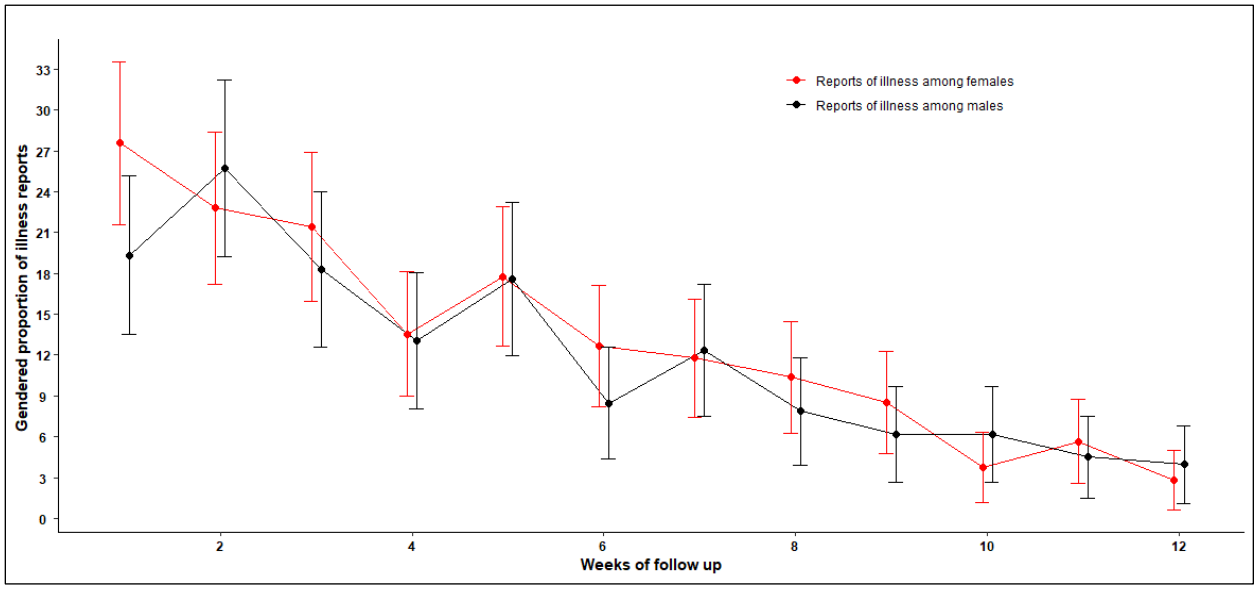

Figure 4.2: Longitudinal distribution of reports describing an illness

During the first 5 and 6 weeks of the study, participants were more likely to report an illness that did not meet the threshold for ILI. In contrast, later in the study period, reported illnesses were more likely to attain the threshold for ILI with frequencies overlapping between male and female participants (Figure 4.3).

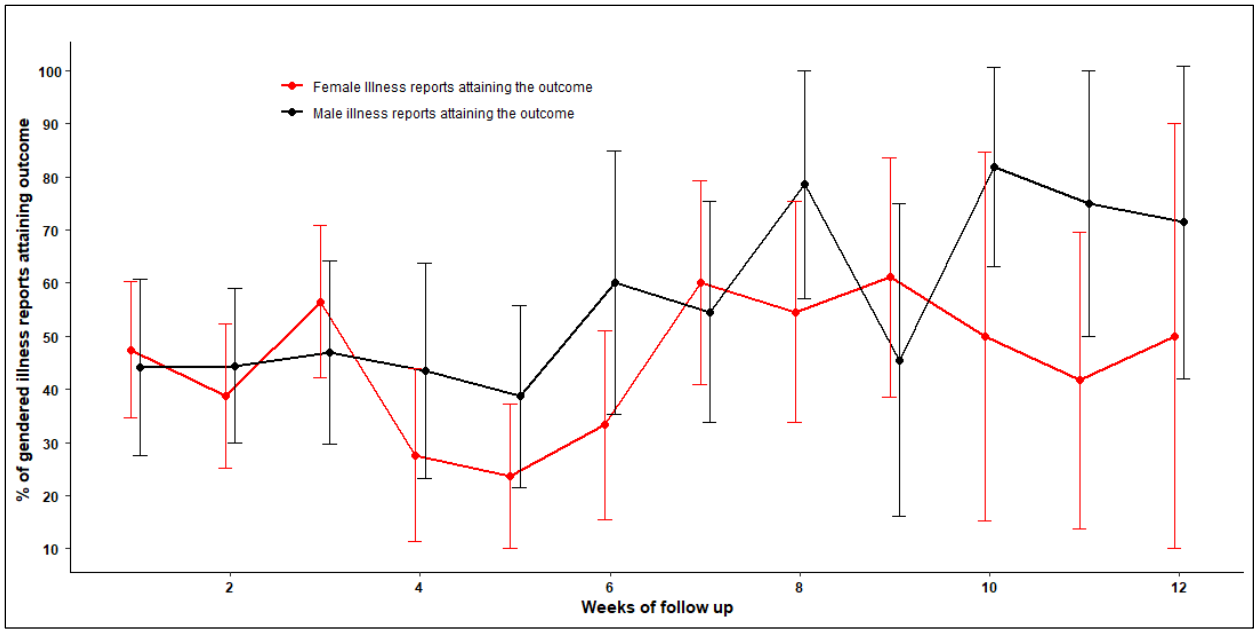

Figure 4.3: Longitudinal distribution of reports attaining the ILI syndrome.

4.1.1. Longitudinal distribution of participants attaining Gastrointestinal illness (GI) syndrome.

Out of these 592 -illness reports, 109 (18%) attained the threshold for GI syndrome using the study case definition. In the entire 12 weeks of follow-up, the 109 reports came from 73 participants comprising 19% of the 390 study participants. Of these 73 participants, 51% were females while male participants were 49%. Of these 73 participants, 41% were young participants aged 5-17 years, 44% were middle-aged at 18-54 years, and 15% were older participants aged >54 years respectively. Each of the 73 study participants attained, on average, ~1.5 episodes of the ILI across the 12 weeks of follow-up, yielding a mean of 0.12 episodes of GI syndrome per week. During the entire study period, the frequency of reports of ill health from female participants (n=339) was higher than those from male participants (n=253) though this difference was not significant (P=0.1). These reports of illness decreased over time, and this pattern is maintained in both male and female participants. During the first 6 weeks of the study, few reports of illness met the threshold of GI. In contrast, reports of illness beginning in week 7 were more likely to meet the threshold of GI (Figure 4.4).

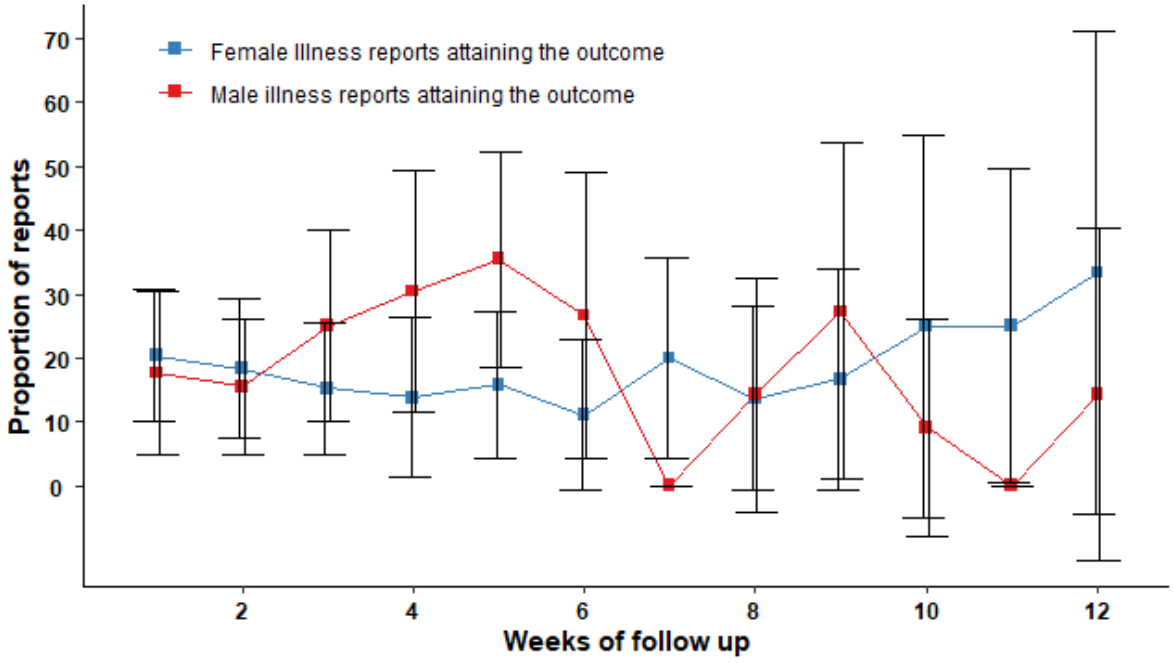

Figure 4.4: Longitudinal distribution of reports describing an illness and those attaining GI syndrome.

4.1.2. Longitudinal distribution of participants attaining Injuries.

Of the 592 -illness reports, 44 (7.4%) had an injury. In the 12 weeks of follow-up, these 44 reports came from 38 participants making up 10% of the entire 390 study participants. Of these 38 participants, 55% were female while male participants were 45%. Additionally, of these 38 participants, 34% belonged to the young age category (5-17 years), 50% were middle-aged (18-54 years) and 16% were from the old age category (>54 years). Each of the 38 study participants had on average, ~1.2 episodes of injuries across the 12 weeks of follow-up, yielding a mean of 0.17 injuries per week. In the entire study period, female participants (n=339) had a higher frequency of the 592 reports describing illness compared to their male counterparts (n=253). This difference was non-significant (P=0.1), with reports of illness decreasing over time in both genders. On the other hand, among the reports describing illness, more injuries were likely to be obtained in the first two weeks of the study relative to later weeks, with their frequencies overlapping between male and female participants (Figure 4.5).

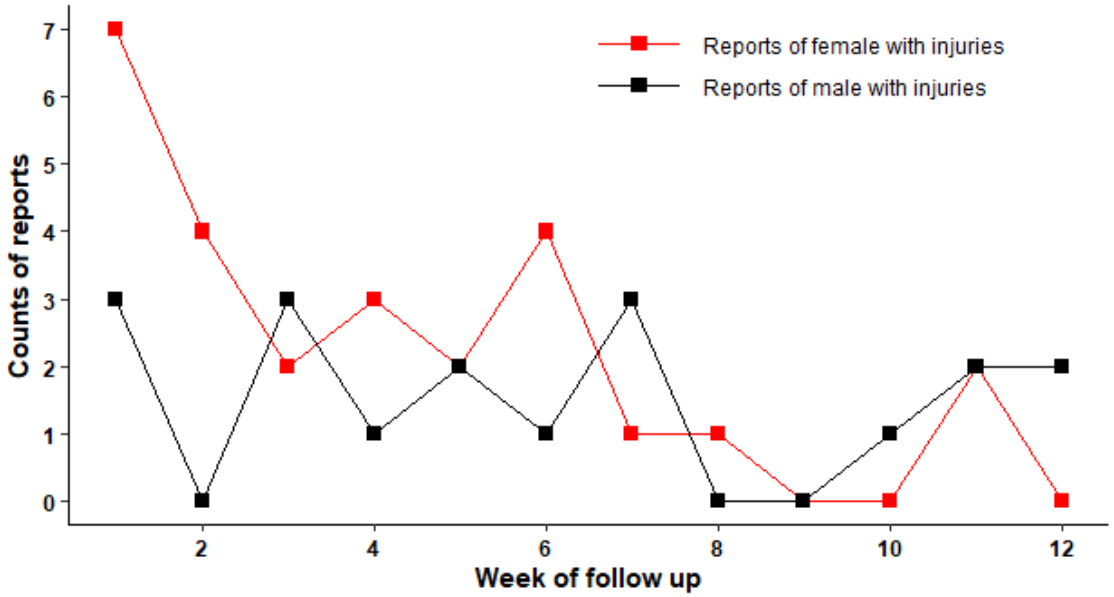

Figure 4.5: Longitudinal distribution of injuries reports

4.2. Longitudinal distribution of households whose members attained the syndrome.

The 592 illness reports were obtained from 87 of the 92 study households. Out of the 5 households that did not report an illness, only one was lost to follow-up

4.2.1. Longitudinal distribution of households whose members attained influenza-like illness (ILI) syndrome.

The 278 reports that attained the threshold for ILI syndrome came from 176 participants. The 176 participants whose reports attained the ILI syndrome were distributed across 76 of the 87 households that had a report of illness (87%) (Figure 4.1). The number of times ILI syndrome was cumulatively attained by participants across the 76 households was ~3.7 episodes of the ILI syndrome across the 12 weeks of follow-up, corresponding to ~0.31 episodes/ household/ week.

4.2.2. Longitudinal distribution of households whose members attained Gastrointestinal illness (GI) syndrome.

The 109 reports that attained the threshold for GI syndrome came from 73 participants. The 73 study participants whose reports met the threshold of GI syndrome were distributed across 45 of the 87 study households (52%) that had a report of illness (Figure 4.1). The number of times GI syndrome was cumulatively attained by participants across each of the 45 study households was ~2.4 episodes of GI syndrome across the 12 weeks of follow-up, corresponding to ~0.2 episodes/ household/ week.

4.2.3. Longitudinal distribution of households whose members had injuries.

The 44 reports that had an injury came from 38 participants. The 38 study participants whose reports had an injury were distributed across 30 (34%) of the 87 study households that had a report of an illness (Figure 4.1). The number of times injuries were reported by participants across each of the 30 study households was ~1.5 injuries across the 12 weeks of follow-up, corresponding to ~0.21 injuries/ household/ week.

4.3. Distribution analyses of symptoms attaining the syndrome.

4.3.1. Distribution of symptoms attaining Influenza-like illness (ILI) syndrome.

Malaise was tallied in 78% (n=217) of the 278 reports that attained the threshold for ILI syndrome. Tallies of the other symptoms were proportional as follows in descending order: 77% cough (n=215), 72% transient mucoid nasal discharge (n=199), 61% breathing difficulty (n=170), 59% fever (n=164), 48% sore throat (n=134), 42% joint and/or muscle pain (n=116), while the persistent running nose was tallied in 26% of the reports (n=72)

4.3.2. Distribution of symptoms attaining Gastrointestinal illness (GI) syndrome.

Flatulence was tallied in 87% (n=95) of the 109 reports that met the threshold for the outcome. Tallies of the other symptoms in descending order were proportional as follows; 84% stomach pain (n=91), 60% fever (n=65), 60% nausea/vomiting (n=65), while diarrhea was tallied in 57% of the reports (n=62).

4.3.3. Distribution of injuries

The types of injuries tallied in the 44 reports of injuries were 64% cuts and open wounds (n=28), 20% bruises and superficial injuries (n=9), 7% dislocations (n=3), 5% animal bites (n=2), while a burn and a fracture were tallied in 2.3% of the reports (n=2).

4.4. Utilization of primary and community health care service

Of the 278 reports attaining the threshold for influenza-like illness (ILI) syndrome, 17% (n=48) were associated with study participants primarily visiting a primary health care facility (PHC), while 82% of the reports were associated with self-medicating (n=117) and taking no action (n=113. On the other hand, 22% of 109 reports (n=24) attaining gastrointestinal (GI) syndrome threshold were linked to visiting PHC while 77% of reports were associated with self-medication (n=49) and taking no action (n=36) (Table 4.3). Additionally, 31% of the 44 reports of injury (n=14) were associated with visiting PHC while 67% were associated with self-medicating (n=16) and taking no action (n=14). Lastly, none of the reports attaining ILI, GI, or injuries were associated with study participants ever contacting a Community Health Volunteer (Table 4.3).

In this study, the secondary health care seeking response was evaluated only for those who visited a PHC facility as the primary response. Out of the 48 ILI reports that show study participants visited the PHC facility the first time, 75% of the reports show study participants secondarily visited the PHC facility again (n=5) and self-medicated (n=31) (Table 4.3). In contrast, out of the 24 GI attaining reports of participants visiting the PHC facility for the first time, 12% were associated with secondarily self-medicating (n=14) and taking no further action (n=9) (Table 4.3). Additionally, in the 14 injury reports of participants visiting the PHC facility for the first time, 50% of the reports were associated with visiting the PHC facility again (n=3) and self-medicated (n=4) (Table 4.3).

Table 4.3: Utilization of community health care among participants

Utilization of community health care	ILI (n=278)	GI (n=109)	Injuries (n=44)
PHC visits	48 (17%)	24 (22%)	14 (31%)
Self-medicating	117 (42%)	49 (44%)	16 (36%)

Taking no action	113 (40%)	36 (33%)	14 (31%)
No CHV contacted.	0 (0%)	0 (0%)	0 (0%)
Secondary response after visiting a PHC facility			
Visited the PHC facility again	5 (10%)	1 (4%)	3 (21%)
Self-medicated	31 (65%)	14 (12%)	4 (29%)
Took no further action	12 (25%)	9 (38%)	7 (50%)

4.5. Univariate analyses of the disease syndromes

ILI, GI, and injuries were each modeled separately to account for the distribution of each syndrome response.

4.5.1. Univariate analyses for attaining Influenza-like illness (ILI) syndrome

Univariate logistic regression analyses factored in the correlation of responses at individual and household levels. This analysis assessed the relationships between dichotomized attained ILI syndrome (yes versus no) and risk factors returning ten significant factors at $P<0.1$(Appendix 1). Among these ten factors, making a visit outside the local sub-county of residence was the only significant factor measured at the participant level ($P<0.001$). On the other hand, two household-level factors related to housing structure and materials were significant and included house floor type ($P=0.041$) and house wall type ($P=0.092$). The other seven household-level significant factors included the use of untreated drinking water ($P= 0.084$), method of treating drinking water ($P<0.001$), the presence of stagnant water due to rain around the household ($P=0.010$), household trash disposal ($P<0.001$), human waste disposal destination ($P<0.001$), reports of animal deaths ($P=0.019$) and the number of domesticated animal species ($P<0.001$) (Appendix 1). Additionally, the time in weeks treated as a risk factor turned significant ($P<0.001$). However, the area-level variable was not significant (Appendix 1).

4.5.2. Univariate analyses for attaining Gastrointestinal illness (GI) syndrome.

Univariate Poisson regression analysis factored in the correlation of responses at individual and household levels. This analysis evaluated the relationships between dichotomized attaining GI

syndrome (yes versus no) and risk factors and returned five significant factors at P<0.1 (Appendix 2). Among these five factors, the significant individual-level variable included making a visit outside the local sub-county of residence (P<0.000) and employment type (P=0.027). On the other hand, the significant household-level variables included ill domesticated animals (P=0.028) and reports of animal death (P=0.054). Additionally, the time in weeks treated as a risk factor turned significant (P<0.001). However, the area-level variable was not significant (Appendix 2).

4.5.3. Univariate analyses for Injuries

Using univariable Poisson regression analysis at P<0.1, returned two significant factors (Appendix 3). Among these two factors, visits outside the local sub-county of residence was the only significant factor at the participant level (P<0.001). The household-level significant factor included owning a domestic animal (P=0.0081). Additionally, the time in weeks treated as a risk factor turned significant (P<0.001). However, the area-level variable was not significant (Appendix 3).

4.6. Multilevel regression analysis models

4.6.1. Multilevel Logistic regression model for attaining Influenza-like illness (ILI) syndrome.

Adjusting for age and sex, the multilevel logistic regression model factoring individual and household random effects returned three significant factors at P≤0.05. These included making visits outside the local sub-county of residence (P<0.001), living in a cemented-floor house (P=0.032), and the study week (P<0.001) (Table 4.3). The risk of attaining ILI syndrome decreased by 9% weekly (Table 4.3). Participants who made a visit outside the local sub-county of residence were ~3 times higher at risk of attaining ILI syndrome at any study week relative to those who did not make a visit, holding all risk factors constant (Table 4.3). Participants living in the cement-floored house were ~2 times higher at risk of attaining ILI at any study week relative to those living in the earthen-floored house, holding all risk factors constant (Table 4.3). Accounting for significant risk factors, the variance estimate that quantified the variation in the frequency of ILI syndrome across all the 92 households (Level 3) was 0.57 (Table 4.3). Likewise, the variance estimate among the 390 participants (Level 2) was 0.14, while the estimated residual variance was (π^2/3) ≈ 3.29. The ICC at the level of the participants was 0.04 computed as (0.14/ [0.57 + 0.14

+ 3.29]) (Level 2), denoting the correlation of ILI in random time t and t` (t ≠ t`) of a random participant. A separate ICC at the level of the participants was 0.18 computed as (0.57+0.14/[0.57+0.14+3.29]) (Level 2), denoting the correlation of ILI syndrome in random time t and t` (t ≠ t`) of a random participant drawn from a random household. The ICC at the household that assessed contextual or household influence (Level 3) in attaining ILI syndrome across the 87 households was calculated as (0.57/[0.57+0.14+3.29]) = 0.14 (Table 4.3). This ICC estimate denoted the correlation between attaining ILI syndrome in random time t and t` (t ≠ t`) of two different participants from the same household (Table 4.3).

Table 4.4: A Random-intercept Logistic regression model analysis for the attainment of ILI syndrome

Variable	Levels	OR*	OR (95% CI)	P-value
Week		0.89	[0.86,0.93]	<0.001
Visits outside	Yes	2.73	[1.83,4.08]	<0.001
	No	*Ref.*		
Household floor	Cement	1.87	[1.06,3.31]	0.032
	Earthen	*Ref.*		
Gender	Male	0.97	[0.75, 1.26]	0.797
	Female	*Ref.*		
Age		1.00	[0.99, 1.00]	0.994
Random Parameters				
Variance	Household (Level 3)	0.57		
	Study participant (Level 2)	0.14		

**OR-Odds ratio; CI-confidence interval; AIC 1913.8; BIC 1964.7; Log-Likelihood -948.9; Deviance 1897.8*

4.6.2. Multilevel Poisson regression model for attaining Gastrointestinal illness (GI) syndrome.

Using the Multilevel Poisson regression model factoring individual, and household random effects returned three variables significant at P≤0.05. The significant variables included the presence of stagnant water due to rain (P=0.02), making visits outside the local sub-county (P<0.001), and study weeks (P<0.001) (Table 4.4). Surprisingly, the presence of visible stagnant water was not significant at the univariate level (Table 4.4) but turned significant in the multivariable model (Table 4.4). This shows a classical suppression effect of time in weeks on the presence of stagnant water variable which was significant (z = -0.61, P<0.000).

Accounting for clustering at the participant and household levels, the risk of attaining GI decreased by 13% across the study week. Study participants making visits outside the study site were ~4 times more at risk of attaining GI syndrome at any given study week than those staying in their residence without making a visit and reporting the presence of stagnant water around the household. Similarly, study participants within households reporting the presence of visible stagnant water due to rain were 98% at risk of attaining GI syndrome at any given week of follow-up, than those staying in their residence without making a visit and not having visible stagnant water around the household (Table 4.4). Accounting for significant risk factors, the variance estimate that quantified the variation in the mean count of GI syndrome across all the 92 households (Level 3) was 0.63 (Table 4.4). Likewise, the variance estimates among the 390 study participants (Level 2) mean count of GI was 1.40, while the residual variance (Level 1) that quantified the variation in repeated measures of GI across the study weeks was 5.54 (Table 4.4). 76% of the overall variation occurred across the repeated measures yielding an ICC of 0.76 as follows (5.54 / [5.54 + 1.40 + 0.63]) (Level 1). On the other hand, ICC at the level of the study participants was 0.19 as follows (1.40 / [5.54 + 1.40 + 0.63]) (Level 2). Subsequently, contextual or household (Level 3) influences on GI by study participants (Level 2) were assessed over time. Here, three different ICCs were computed to assess the influence of households on attaining GI over time. First, the ICC of counts of GI across the 92 households was estimated as (0.6 / [5.54 + 1.40 + 0.63]) = 0.08 (Table 4.4), denoted as the expected correlation between two outcomes drawn completely at random from any study week from two study participants within the same household. a different Level 3 ICC estimate was then computed as (0.63 / [1.40 + 0.63]) = 0.31 and interpreted as the expected correlation between the mean count of GI syndrome across the 12 study weeks from two study participants drawn completely at random from the same household (Table 4.4). Finally, a Level 2 ICC was computed as follows: ([1.40 + 0.63] / [5.54 + 1.40 + 0.63]) = 0.27 interpreted as the expected correlation of GI syndrome between two study weeks sampled from the same study participants.

Table 4.5: A Random-intercept Poisson regression model analysis for the attainment of GI syndrome

Variable	Levels	IRR	IRR (95% CI)	P-value
Week		0.87	[0.81, 0.93]	<0.001
Visits outside	Yes	3.87	[2.34, 6.41]	<0.001
	No	*Ref.*		
Visible stagnant water	Yes	1.98	[1.13, 3.50]	0.019
	No	*Ref.*		
Gender	Male	1.05	[0.62, 1.78]	0.854
	Female	*Ref.*		
Age		1.01	[0.99, 1.03]	0.657
Parameters				
Variance	Household (Level 3)	0.63		
	Study participants (Level 2)	1.40		
	Residual (Level 1)	5.54		

**IRR-incident rate ratio; CI-confidence interval; AIC 890.5;BIC 941.4; Log-Likelihood -437.3; Deviance 874.4*

4.6.3. Multilevel Poisson regression model for attaining Injuries.

Adjusting for age and sex, the multilevel Poisson regression model factoring individual, and household random effects returned two significant factors at P≤0.05. These included making visits outside the local sub-county (P=0.007), domesticating an animal (P=0.020), and the study week (P= 0.038) (Table 4.5). The risk of having an injury decreased by 10% weekly. Participants who made a visit outside the local sub-county were 3 times higher at risk of having an injury during any study week relative to those who did not make a visit and domesticating an animal (Table 4.5). Also, participants who domesticated animals were 74% least likely to have injuries during any study week than those who did not domesticate animals and making visits outside the study site.

Table 4.6: A Random-intercept Poisson regression model analysis for the attainment of injuries

Variable	Levels	IRR*	IRR (95% CI)	P-value
Week		0.90	[0.82, 0.99]	0.038
Visits outside	Yes	2.16	[1.54, 3.11]	0.007
	No	*Ref.*		
Domesticate animals	Yes	*0.13*	[0.02,0.72]	0.020
	No	*Ref.*		
Gender	Male	0.87	[0.37, 2.04]	0.748
	Female	*Ref.*		
Age		1.00	[0.99, 1.03]	0.454
Random Parameters				
Variance	Household (Level 3)	0.63		
	Study participant (Level 2)	4.05		
	Residual (Level 1)	8.28		

**IRR-incident rate ratio;CI-confidence interval; AIC 464.9; BIC 515.8; Log-Likelihood -224.5; Deviance 448.9*

CHAPTER FIVE

5.0 DISCUSSION

5.1. General discussion on the selected disease syndromes

This study established the longitudinal occurrence of disease syndrome similar to that reported in studies in low-resourced settings. Unlike the traditional way of depending on data from medical records routinely collected at the health facilities, obtaining the weekly reports of illness from study participants that were probed and categorized into a disease syndrome as per the study case definitions (Table 2.1). While no study has that classified symptoms into syndromes using an approach similar to this study, direct comparisons with other studies were not straightforward. In addition, the study findings highlight the differences in longitudinal reports of illnesses attaining influenza-like illness (ILI) syndrome, gastrointestinal illness (GI) syndrome, and those with injuries among study participants.

The study analysis reveals the use of disease syndrome studies could be informative. Indeed, the burden of ILI was higher than GI and injuries perhaps due to the existence of ILI etiologies that circulate all year round in Kenya as identified in studies conducted in a similar setting (Nyatanyi et al., 2012). Additionally, the burden of ILI, GI, and injuries was higher among females relative to males. On the other hand, the ILI burden was higher among young subjects while GI and injury burden was among middle-aged subjects suggesting the role of age and gender in attaining the syndrome. Consistent with other studies in developing countries, the study findings provide insights for interventional studies to reduce aetiological exposures. Further, studies are needed to identify mechanisms and pathways behind these differences (Saraei et al., 2018).

The high intra-cluster correlation coefficients (ICCs) obtained at the level of repeated measures (Level 1 ICC >0.7) suggested similarity in attaining the syndromes between subjects across time. These differences justified the use of a multilevel analytical approach

including the higher levels of aggregation including subjects and household Levels. Additionally, while the low ICCs at the level of the subject implied that subjects attained the low counts of the syndrome, the majority (71%) of the subjects had a low frequency of the syndromes. Consistent with previous findings, the study findings suggest future studies examining ILI, GI, and Injuries should sample more subjects from fewer households and follow them for a relatively shorter time which could be more cost-effective and logistically useful (Galbraith et al., 2010). Further, the Low ICCs at the household level (ICC<0.14) suggested some contextual effects, signifying a common household exposure within households for the syndromes. Policy and strategies focusing on intervention at the household level could effectively reduce the ILI, GI, and injuries.

5.1.1. Influenza-like illness (ILI) syndrome

Malaise and cough were frequently (>78%) reported ILI symptoms, suggesting exposure and infection (Haenen et al., 2019). Cough and malaise indicate a sequel of the common cold and undifferentiated illness respectively (Domínguez et al., 2020). Malaise was more frequently reported by old female subjects, while coughs were commonly reported by the young male subjects. While malaise may be a sign of illness, previous findings show the majority of post-menopausal women complain of a constant feeling of discomfort or lack of well-being due to hormonal imbalance experienced during the transition from active to inactive reproductive life, easily confused with an illness (Nappi & Cucinella, 2020). On the other hand, Coughs among young male subjects likely resulted from their outgoing adventurous behavior with greater exposure relative to young females who are more likely to remain indoors in rural settings (Doust & Del Mar, 2004).

Subjects making a visit outside the local sub-county of residence were >2 times at risk of attaining ILI syndrome. Similar studies show such visits supported livelihood, with the mobile visit increasing exposure to contaminated surfaces or affected subjects and through contacts (Kloos et al., 2010). Further, female subjects were more likely to attain ILI syndrome relative to their male counterparts by statistically non-significant 10% points, yet they were

38% less likely to make a visit outside the local sub-county of residence relative to male subjects. This finding suggests that either the purpose and or the destination of the visit imperiled female subjects to differential exposures that increased their risk of attaining the ILI relative to male subjects. Further studies are needed to relate patterns of daily activities by gender to better explain variability in exposure and clinical presentation of ILI symptoms.

Although the majority (71%) of the young subjects attained ILI only once, they generally were more likely to attain ILI by 13% and 40% points relative to the middle-aged and old subjects respectively due to their higher proportion in the sample. This finding was expected, as ideally, an increase in the frequency of illness increases linearly with age (Haenen et al., 2019; Klein et al., 2010). The study findings suggest that behavioral factors among the young subjects could have played a role in influencing the risk of attaining ILI (Beauté et al., 2015; Klein & Flanagan, 2016). Reported behavioral activities lead to concentrated contacts that are likely to be contaminated with aetiological agents in schools and playgrounds during play (Aunger et al., 2016; Beauté et al., 2015; Rabie & Curtis, 2006).

Subjects living in the cemented-floored house were ~2 times at higher risk of attaining ILI syndrome relative to those living in an earthen-floored house suggesting an influence of the house structure and materials in attaining ILI. Previous studies have established cemented-floor dwellings to be cooler than any other floor, thus, contributing to a cooler household environment that can affect human health (Teare et al., 2020). Studies in developing countries, show older adults, pregnant women, and children are more likely to spend up to 90% of their time indoors, however, cool household conditions can predispose them to respiratory illness, including coughs that were studied (Brasche & Bischof, 2005; Teare et al., 2020). Further research is needed to understand the influence of house structure and materials on ILI and how they relate to health in rural settings to help inform interventions targeting housing and human health.

The Household-level ICC of 0.14 suggested some contextual effects in attaining ILI, signifying a common household exposure and perhaps resulting in the similarity of ILI within

households. This suggests that ILI interventions focused on the household level could effectively reduce ILI.

5.1.2. Gastrointestinal Illness (GI) syndrome

Stomach pain and flatulence were the most often (>84%) reported GI illnesses. Compared to previous findings, such symptoms are commonly associated with the consumption of flatulence-triggering foods commonly consumed in rural areas including wheat and dairy products and lentils known to trigger flatulence followed by stomach pain and nausea/vomiting (Hasler, 2007). Previous studies have associated stomach pain with increasing age perhaps as a proxy of cumulative exposures as found among male subjects >54 years in this study, therefore, further research on GI clinical epidemiology is needed (Ananthakrishnan & Xavier, 2020).

Female subjects were more likely to attain GI syndrome relative to males, reporting symptoms of nausea/vomiting and fever frequently; in addition to infections and other exposures, which could be associated with pregnancy as well. Previous studies show nausea and vomiting occur in up to 74% of pregnant women, and 50% experience vomiting alone (Louik et al., 2006). This study's findings highlight the need to elucidate the infectious and non-infectious etiologies of these symptoms.

Middle-aged subjects attained higher frequencies of GI syndrome than the rest, suggesting a role of age in attaining the syndrome. These findings are consistent with studies showing age to be a determinant of GI illnesses (Julia Lindsey Newton, 2004). This study theorizes that the increased occurrence of GI illnesses including flatulence, stomach pain, and nausea/vomiting among those aged 18 and 54 years was circumstantial as this group is more likely to seek waged labour, often eating out in poor hygienic places. Further, studies are needed to determine granular exposures associated with the increased risk of GI etiologies.

Consistent with previous findings linking GI illnesses and rainfall, stagnant water within household compounds due to rains was independently associated with attaining GI

syndrome, (Carlton et al., 2013). Indeed, on average, 16% of each of the study symptoms were from subjects reporting stagnant rainwater within their household compounds. Potential contamination of water for use with GI pathogens from these stagnant pools was probable for the reason that the study subjects largely sourced water from shallow and spring wells located within household compounds (Gleason & Fagliano, 2017).

Subjects making visits outside the local sub-county were 4 times at risk of attaining GI. To underscore this point, study subjects attaining the GI had an average of ~1.4 visits ranging from one to five while those reporting an illness that did not attain GI had an average of ~1.3 visits ranging between one and four. While this difference may look slight, it is important to note that these constitute 12 weeks of follow-up time. Although this study did not gather information about the reasons for these visits, they were more related to work, education, or socio-economic activities (e.g., market) requiring subjects to be more mobile as also identified in other studies from similar settings (Kloos et al., 2010). Moreover, previous findings show movements outside places of residence are been associated with the spread and transmission of GI infections through the fecal-oral route, with diarrhea being the dominant sign, therefore, suggesting the need for public health interventions such as hand washing (Gushulak et al., 2004).

The high within-subject ICC of 0.7 indicated GI syndrome was likely to be attained by the same subject. The trend of attaining GI syndrome across time revealed endemicity suggesting consistency in infectious or non-infectious exposures (Ananthakrishnan & Xavier, 2020; Taulo et al., 2008).

5.1.3. Injuries

Injuries were commonly reported by middle-aged subjects relative to other age groups suggesting age-related differential exposures. Previous findings link high injury frequencies among adults and communities with low levels of education and poverty similar to the study area (Ferrante et al., 2013; Gielen et al., 2015). Indeed, the most (70%) of the middle-aged

subjects reporting injuries had primary or no education, earning a low monthly income of >10,000KES (~100USD). Female subjects had more frequent reports of injuries, contrasted with findings from a cross-sectional study conducted elsewhere in Kenya (Gathecha et al., 2018), possibly due to more women taking up more strenuous roles in male-dominated sectors (Abdalla et al., 2017). The findings suggested varied risk exposures between gender and their physical or social environments. Consistent with previous studies, individuals with low levels of education in rural settings are likely to engage in occupations with increased risks for injuries, therefore, advancing the need for targeted public health interventions to promote home and occupational safety in rural areas (Ferrante et al., 2013).

On average 0.21 injuries were documented weekly from 34% of the 87 study households that reported an illness with the majority (61%) of the injuries resulting from falls and person-related assaults or hit by an object. These injuries resulted from the undertaking of daily chores including farming, household chores, and schooling among others, which could have potentially increased the risk of injury exposures. Indeed, while studies in developing countries associate such daily chores and activities with the occurrence of unintentional injuries across all age groups, gaps still exist in the documentation of their impact in the low-resourced settings (Odero et al., 2007). Nonetheless, injuries could be preventable through investing in-home or occupation safety in rural areas (Tayeb et al., 2014).

Owning a domestic animal was unexpectedly associated with an 87% reduced risk of reporting injuries, signaling the minimal exposure to injury-prone inanimate farm machines, tools, or structures in livestock farming. Indeed, Indeed, those domesticating animals were likely to use them, particularly cattle, for draught power compared to those not domesticating and therefore likely to use risky hand tools or outdated machinery during farming or in any other activities. Such tools and machines increased the likelihood of injuries, as also identified in cross-sectional studies conducted in Nepal and Ethiopia(Bhattarai et al., 2016; Yiha & Kumie, 2010). Nevertheless, there is still a need to create awareness on occupational safe handling of domestic animals (Langley, 2005; Weaver et al., 2017).

5.1.4. Utilization of the Community health care services for influenza-like illness (ILI) syndrome, gastrointestinal illness (GI) syndrome, and Injuries

Of the 278, 109, and 44 reports of ILI, GI, and injuries, 59%, 66%, and 67% were associated with either seeking health care at PHC or self-medication at home, respectively, suggesting that illnesses could be the leading drivers of healthcare-seeking behaviors in the study population. The study participants who visited PHC were perhaps a reflection of the severity of the corresponding clinical symptoms or prompt access to primary health care. To interrogate the latter, the study site has a high population density of approximately 450 persons/sq. km (Kenya National Bureau of Statistics, 2019). Previous studies show that population density is an underlying determinant of health utilization either as an independent variable or as a function of distance/travel time. Those studies have consequently concluded that health services are more easily provided to dense populations relative to sparse populations (Gabrysch et al., 2011; Hanlon et al., 2012). While self-medication is not entirely harmful particularly when employed to treat conditions that rationally do not necessitate medical consultation, widespread insufficient knowledge on the importance of formal medication among communities poses health risks (Bennadi, 2014; Shafie et al., 2018). Fortunately, a negligible number (<2) of study participants attaining ILI and GI and injuries who self-medicated as the first response subsequently visited the PHC within the study week suggesting "responsible" self-medication that might have worked. However, studies are needed to determine factors associated with self-medication in low-resource settings.

Undesirably, the study findings highlighted the extremely low utilization of CHVs in the study area. Previous studies that pursued factors associated with CHV under- or low utilization have highlighted ambiguity on the role of CHVs, unsatisfactory community participation in the selection of CHVs, and perceived low capacity to attend to health support (especially of supplies, commodities, and confidentiality) among communities and weak supervisory systems (Karuga et al., 2019; Nougtara et al., 1989; Rachlis et al., 2016). Many other factors could affect the utilization of CHVs but were not studied here.

5.1.5. Strength of the study

The strength of this study lies in the longitudinal design where a high response rate of ~91% of the expected repeated measures was obtained. The study design ensured longitudinal diversity and representation of the underlying population, differentiated by age and sex. Moreover, collecting information from large numbers of people is far more informative when diverse ages and sex are included in the underlying population. Longitudinal studies can show cause and effect; in our context, this study design enabled us to quantify the trends and patterns of ILI, GI syndrome, and injuries across time. Consequently, the study findings are more applicable in designing contextually relevant interventions. The multilevel statistical approach adopted accounted for the correlation of repeated measures within a subject, correlation of responses between subjects, and between households, thus, the study findings and conclusions are thereof accurate and valid (Caruana et al., 2015).

5.1.6. Limitations of the study

This study recognizes three limitations. First, is the reliance on self-reported ILI ill health, which is liable to bias and validity issues though earlier studies show that self-reported weekly measures of ill health are relatively credible and dependable (Althubaiti, 2016; Thumbi et al., 2015). Secondly, longitudinal studies are prone to loss of follow-up, however, the multilevel model that was employed statistically adjusted for the missing data (Kwok et al., 2008). Lastly, corresponding with a decreasing rate of reporting illness over time, the risk of attaining ILI decreased by 9% with a statistically non-significant overlap between male and female subjects. This finding suggested that initially, subjects overemphasized their ill health that could nevertheless not attain the set threshold. This limitation was overcome during the study design phase through blinding of the ultimate grouping of the syndrome from the study participants.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

1. The burden of attaining influenza-like illness syndrome, gastrointestinal illness (GI) syndromes, and injuries were 0.13, 0.12, and 0.17 episodes per individual per week respectively, while at the household levels the burden of ILI, GI, and injuries were 0.31, 0.2, and 0.21 episodes per household per week respectively.
2. The study reports low utilization (0%) of Community Health Volunteers (CHVs) in the management and referral of the ILI and GI syndrome and injuries to the primary health care facilities.
3. Independently, making a visit outside the local sub-county of residence and living in a cement floored house were significantly associated with the longitudinal occurrence of ILI. Similarly, making a visit outside the local sub-county of residence and the presence of stagnant water within the household were independently associated with the longitudinal occurrence of GI. Moreover, injuries were independently associated with making a visit outside the local sub-county of residence and owning domestic animals.

6.2. Recommendations

The study findings recommend.

1. Disease prevention and control interventions targeting individuals, and households should be instituted to reduce ILI, GI, and injury burden. The intervention could target common exposures at the household level or among individuals resulting in the similarity of illnesses and diseases.
2. Target CHV interventions could be instituted to reduce the burden of influenza-like illness syndrome, gastrointestinal illness syndrome, and injuries as well as the associated social and economic impacts of such illness.
3.

a. Studies are needed to establish granular exposures defining the increased risk associated with making a visit outside the local sub-county of residence, living in a cement-floored house, and owning domestic animals.
b. Community awareness and reducing associated risks and exposures to stagnant pools of water by clearing the pools within households should be provided.

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APPENDICES

Appendix I: Univariate analysis of attaining Influenza-like illness syndrome (ILI)

Table S1: Distribution and analyses of attaining ILI syndrome by risk factors across the follow-up period

Risk factor	Factor levels	Outcome		*P-values*
		Present (%)	**Absent (%)**	
Gender	Female	149 (54)	2152 (54)	0.958
	Male	129 (46)	1831 (46)	
Employment type	Non-school going[1]	143 (51)	1876 (47)	0.556
	School going	135 (49)	2107(53)	
Education level	Post-primary	45 (16)	640 (16)	0.841
type	Primary	233 (84)	3343 (84)	
Household				
Household income	0-10,000	236(85)	3255 (81)	0.973
	>10,000[2]	42 (15)	728 (19)	
Insurance cover	Yes	32 (12)	706 (18)	0.125
	No	246 (88)	3277 (83)	
Floor-type	Cement floor	65 (23)	566 (14)	0.026
	Earth floor	213 (77)	3417 (86)	
Wall type	Brick wall	52 (19)	505 (13)	0.084
	Mud wall	226 (81)	3478 (87)	
Roofing type	Iron/aluminum sheets	275 (99)	3876 (97)	0.145
	Thatch roofing	3 (1)	107 (3)	
Drinking water	Other sources[2]	206(74)	1156 (27)	0.692
source	River	72 (26)	2863 (72)	
Treating drinking	Yes	240 (87)	3214 (81)	0.079
water	No	38 (13)	769 (19)	
Water treatment	Filtration or	91 (38)	1189 (38)	<0.001
method	decantation			
	Chlorine or boiling	147 (62)	1972 (62)	
Waste destination	Pit latrine	257 (92)	3689 (93)	<0.001
	Open defecation	21 (8)	294 (7)	
Trash disposal	Garbage pit	204 (73)	2984 (75)	<0.001
	Garden disposal	74 (27)	999 (25)	
Domesticate animal	Yes	266 (96)	3865 (97)	0.369
	No	12(4)	118 (3)	
No. of animal	0	12 (4)	118 (3)	<0.001
species[3]	1	15 (5)	289 (7)	
	2	44 (16)	477 (12)	
	3	67 (24)	1064 (27)	
	4	101 (36)	1219 (31)	

	5	37 (13)	566 (14)	
	6	2 (1)	250 (6)	
Ill animal	Yes	43 (16)	666 (17)	0.708
	No	222(84)	3199 (83)	
Animal death	Yes	22 (10)	192 (5)	0.014
	No	209 (90)	3346 (95)	
Visible stagnant water	Yes	25 (9)	512 (13)	0.006
	No	253 (91)	3471 (87)	
Visits outside study site	Yes	49 (18)	203 (5)	<0.001
	No	229 (82)	3780 (95)	
Region[4]	Top	108 (39)	1330 (33)	0.410
	Bottom right	72 (26)	1065(27)	
	Bottom left	98 (35)	1588 (40)	

[1]Consist of a study participant with formal or informal employment;[2]Other sources consist of springs, wells, municipal water, and rainwater; [3]Consist of domesticated animals, cattle, sheep, goats, poultry, dogs, and cats; [4]Consist of the generated regions of the study site;

Appendix II: Univariate analysis for Gastrointestinal illness (GI) syndrome

Table S2: Distribution and analyses of GI syndrome by risk factors across the follow up period

Risk factor	Factor levels	Outcome		*P-values*
		Present (%)	**Absent (%)**	
Gender	Female	59(54)	2242 (54)	0.520
	Male	50 (46)	1910 (46)	
Employment type	Non-school going[1]	38 (35)	2204(53)	0.027
	School going	71(65)	1948(47)	
Education level type	Post-primary	14 (13)	671 (16)	0.186
	Primary	95 (87)	3481 (84)	
Household				
Household income	0-10,000	90 (83)	3401 (82)	0.514
	>10,000[2]	19 (17)	751 (18)	
Insurance cover	Yes	23 (21)	715 (17)	0.675
	No	86 (79)	3437 (83)	
Floor-type	Cement floor	22 (20)	609 (14)	0.323
	Earth floor	87 (80)	3543 (86)	
Wall type	Brick wall	14 (13)	543 (13)	0.904
	Mud wall	95 (87)	3609 (87)	
Roofing type	Aluminum	108 (99)	4043 (97)	0.237
	Thatch roofing	1 (1)	109 (3)	
Drinking water source	River	36 (33)	1156 (27)	0.221
	Other sources[2]	73 (67)	2996 (73)	
Treating drinking water	Yes	78 (72)	3377 (81)	0.529
	No	31 (28)	775 (19)	
Water treatment method	Filtration or decantation	28 (36)	1252 (38)	0.625
	Chlorine or boiling	49 (64)	2070 (62)	
Waste destination	Pit latrine	99 (91)	3847 (93)	0.496
	Open defecation	10 (9)	305 (7)	
Trash disposal	Garbage pit	77 (71)	3111 (75)	0.454
	Garden disposal	32 (29)	1041 (25)	
Domesticate animal	Yes	108 (99)	4023 (97)	0.588
	No	1 (1)	129 (3)	
No. of animal species[3]	0	1(1)	295 (7)	0.901
	1	9(8)	258 (7)	
	2	13 (12)	508 (12)	
	3	25 (23)	1106 (27)	
	4	43 (39)	1277 (31)	
	5	18 (17)	585 (14)	

	6	0	252 (6)	
Ill animal	Yes	28 (26)	681 (17)	0.028
	No	80 (74)	3342 (83)	
Animal death	Yes	10 (11)	204 (6)	0.085
	No	82 (89)	3473 (94)	
Visible stagnant water	Yes	19 (17)	518 (13)	0.586
	No	90 (83)	3634 (87)	
Visits outside study site	Yes	34 (31)	218 (5)	0.000
	No	75 (69)	3934 (95)	
Area-level variable-Region[4]	Top	44 (40)	1394 (34)	0.489
	Bottom right	26 (24)	1111(26)	
	Bottom left	39 (36)	1647 (40)	

[1]Study subjects with formal or informal employment;[2]Other sources include springs, wells, municipal water, and rainwater; [3]Consist of domesticated animals, cattle, sheep, goats, poultry, dogs, and cats;[4]Consist of the generated regions of the study site.

Appendix III: Univariate analysis for Injuries

Table S3:Distribution and analyses of injuries by risk factors across the follow-up period

Risk factor	Factor levels	Outcome		*P-values*
		Present (%)	**Absent (%)**	
Gender	Female	26 (59)	2275 (54)	0.713
	Male	18 (41)	1942 (46)	
Employment type	Non-school going[1]	26 (59)	1993 (47)	0.193
	School going	18 (41)	2224 (53)	
Education level type	Post-primary	9 (20)	640 (16)	0.860
	Primary	35 (80)	3343 (84)	
Household				
Household income	0-10,000	35 (80)	3456 (82)	0.932
	>10,000[2]	9 (20)	761 (18)	
Insurance cover	Yes	10 (23)	728 (17)	0.648
	No	34 (77)	3489 (83)	
Floor type	Cement floor	11 (25)	620 (15)	0.458
	Earth floor	33 (75)	3597 (85)	
Wall type	Brick wall	8 (18)	549 (13)	0.634
	Mud wall	36 (82)	3668 (87)	
Roofing type	Iron/aluminum sheets	44 (100)	4107 (97)	0.749
	Thatch roofing	0 (0)	110 (3)	
Drinking water source	Other sources[2]	24 (55)	3045 (72)	0.121
	River	20 (46)	1172 (28)	
Treating drinking water	Yes	37 (84)	3418 (81)	0.599
	No	7 (16)	799 (19)	
Water treatment method	Filtration or decantation	17 (46)	1263 (38)	0.131
	Chlorine or boiling	20 (54)	2099 (62)	
Waste destination	Pit latrine	40 (91)	3906 (93)	0.493
	Open defecation	4 (9)	311 (7)	
Trash disposal	Garbage pit	30 (68)	3158 (75)	0.518
	Garden disposal	14 (32)	1059 (25)	
Domesticate animal	Yes	40 (91)	4091 (97)	0.008
	No	4 (9)	126 (3)	
No. of animal species[3]	0	4 (9)	126 (3)	0.086
	1	1 (2)	303 (7)	
	2	3 (7)	518 (12)	
	3	18 (41)	1113 (27)	
	4	15 (34)	1305 (31)	
	5	3 (7)	600 (14)	

	6	0 (0)	252 (6)	
Ill animal	Yes	9 (22)	700 (17)	0.371
	No	31 (78)	3391 (83)	
Animal death	Yes	3 (9)	211 (5)	0.411
	No	29 (91)	3526 (95)	
Visible stagnant water	Yes	6 (14)	531 (13)	0.716
	No	38 (86)	3686 (87)	
Visits outside study site	Yes	11 (25)	241 (5)	<0.000
	No	33 (75)	3976 (95)	
Region[4]	Top	15 (34)	1423 (34)	0.942
	Bottom right	14 (32)	1123 (26)	
	Bottom left	15 (34)	1671 (40)	

[1]Consist of a study participant with formal or informal employment;[2]Other sources consist of springs, wells, municipal water, and rainwater; [3]Consist of domesticated animals, cattle, sheep, goats, poultry, dogs, and cats;[4]Consist of the generated regions of the study site.

Appendix IV: Consent Form

Consent Form To Individual Participation In Research Study

[This ICF should only be used for those who **have attained** the age of majority, 18 years

Study Title	Occurrence of selected disease syndromes and utilization of community health care services among communities in Suna West Sub-county in Migori County, Kenya
Investigator(s)	Principal Investigator: ▪ Reagan Ngoge Chweya Tel: 0704023161
Study Sponsor(s)	Self-Sponsored
Collaborators	None

This Informed Consent Form consists of two parts:

- **Information Sheet for information about the study**
- **Certificate of Consent for your approval if you choose to participate**

You will be provided with a duplicate of the full Informed Consent Form

Part I: Information Sheet

The Principal investigator, from the School of Public Health, (JKUAT) is researching to identify the occurrence of disease syndromes among individuals in a household at 12-time points (weekly) for 12 weeks. We are giving you this information because we would like you to participate in this research project. If you prefer not to participate, you have the opportunity to do so. However, you will continue to receive the health services that you normally do, with no negative impact. This consent ensures you have all the information that you need before you decide. Members of our team are here to help you understand more about the project. If you do not understand any of the ideas that you see on this form, please ask us to explain the information to you. You can reach out to anyone from the team.

Why is this Project Important?

This study is to identify the self-reported events of influenza-like illnesses and acute respiratory infections (ILI/ARI) syndromes, Gastrointestinal (GIT) syndromes, and household injuries among household members and assess how CHVs are utilized as a component of the community health services, through household visits and syndrome referrals in Suna West sub-county among

selected households. This study will provide information on identified or referred events of self-reported ILI syndromes, GIT syndromes, and household injury syndromes.

Who Can Participate?

You have the opportunity to take part in this research project because we feel that your experiences with reporting the study disease syndrome, will help in achieving the study objectives. You will be included in this study since your household was randomly selected and you have been included in the study.

Participation is Your Choice

Your part in this study is purely voluntary. You will choose whether you will participate or not. If you decide not to associate yourself with the study, you will continue to receive all of the services that you usually get in your community.

What Is Involved in this Project?

If you are part of this study, you will receive phone calls weekly as a follow-up. Upon reporting any of the selected disease syndromes you will be required to complete a questionnaire that will be provided within the week. The questions will collect information on the reported syndrome, to characterize the syndrome reported. The questions will take 20 minutes.

How long will the Project Last?

This study takes place over 12 weeks/ 3 months.

What are the Risks?

You may provide personal or confidential information unknowingly or may feel uncomfortable about study topics. However, we do not anticipate this to happen. You will be required not to answer questions that are too personal or that make you feel uncomfortable.

What are the Benefits?

There will be no direct benefit to you, but your participation is likely to help us find out more about how to improve reported selected disease syndromes specific to your age group among

household members. This information will contribute to the early detection of problems, monitoring progress towards health goals

How will we protect your Information and Confidentiality?

In this research, your information will not be shared with anyone outside the study and will be kept private. Any information about you will have a unique number on it instead of your name. Only the researchers will know what your number is, and we will lock that information up with a lock and key. It will not be shared with or given to anyone outside of our project.

What will happen with the Results?

Any information from the study with you and your community before being shared publicly. A summary of the results will be provided, and also a small meeting will be held to share this information. The results will be published so that others can also learn.

Can I Refuse to Participate or Withdraw from the Study?

You may choose not to take part in this study. You continue to receive all of the normal services you receive. If you wish to stop participating in the study after you begin, you can stop at any time by telling someone on our project team. If you choose to stop taking part, you will still get all of the normal services that you usually get in your community.

Who Can I Contact?

If you have any questions, you can ask anyone from our team now or later. If you have questions later, you may contact [Reagan Chweya, 0704023161, reaganngoge@gmail.com].

Do you have any inquiries this time?

Part II: Certificate of Consent

I have read all information. I have asked many questions about the study and all questions I have been given responses to my satisfaction. I consent voluntarily to be a part of the study.

Name of study Participant	[at least forename and surname]
Signature of Participant	
DD/MM/YYYY	

If visually impaired, physically impaired, mentally impaired, or illiterate

I have observed the true reading of the consent form to the likely participant, and the individual has had the opportunity to ask questions. I approve that the participant has given his approval freely.

Print Name of Participant	[at least forename and surname]
Thumb/Footprint of Participant	
Signature of Witness	[A witness must sign and be designated by the participant and MUST have no link with the research team.
DD/MM/YYYY	

Statement by the researcher investigator taking consent

I have truly read out the info sheet to the likely participant, and to my capacity made sure that the participant recognizes that the following will be done:

1. **A member of the research team will visit a household every week upon reporting any study-selected disease syndrome.**
2. **During the visit the participant will complete a 20-minute questionnaire.**
3. **The participant's data will be kept confidential.**

I approve that the member was given a chance to ask questions about the study, and all inquiries asked to have been responded to correctly. I approve that the member has not been forced into approving the consent.

A duplicate of this ICF has been left with the participant.

Name of the study investigator	[at least forename and surname]
Signature of Researcher/person taking the consent	
DD/MM/YYYY	

Appendix V: Parental Consent

Parental Consent form for individual participation in the study

[This ICF should only be used for those who have **not** attained the age of majority, 18 years**]**

Study Title	Occurrence of selected disease syndromes and utilization of community health care services among communities in Suna West Sub-county in Migori County, Kenya
Investigator(s)	Principal Investigator: ▪ Reagan Ngoge Chweya Tel: 0704023161
Study Sponsor(s)	Self-Sponsored
Collaborators	None

This Informed Consent Form consists of two parts:

- **Information Sheet for information about the study**
- **Certificate of Consent for your approval if you choose to participate**

You will be provided with a duplicate of the full Informed Consent Form

Part I: Data Sheet

The Principal investigator, from the School of Public Health, (JKUAT) is researching to identify the occurrence of disease syndromes among household members at 12-time points (weekly) for 12 weeks. We are giving you this information because we would like your kid to partake in our research project. You may choose your child not to be part of the study but will continue to receive normal health services. We will provide you with all the information that you need before you decide if your child can partake in the study. Members of our team are here to help you understand more about the project. In case you do not understand any ideas in this form, please ask us to explain the information to you. You can reach any person from our study.

Why is this Research Important?

This study will pursue to identify the self-reported events of influenza-like illness/ acute respiratory infection (ILI) syndrome; Gastrointestinal (GI) syndromes and household injuries among household members and assess how CHVs are utilized as a fragment of the community health services, through household visits and syndrome referrals in the Sub-county among selected households. This study will provide information on identified or referred events of self-

reported ILI syndromes, GI syndromes, and household injuries syndromes and will contribute toward improving community health information

Who Can Participate?

Your child is requested to partake in this research study because we feel that the child`s experiences with the study`s disease syndrome (ILI, GI, and injuries) may be of interest to this study. Your child has been included in the study after your household was selected randomly, and all household members older than 5 years are included in the study. You are hereby requested to permit your kid to partake in this study carried out by the researcher. This form summarizes the research study and your child`s role.

Participation is Your Choice

The participation of your child in the study is purely voluntary. You will choose whether your child will participate or not. If you choose your child to not take part, your child still receives his/her normal health services from your community. Your child will be requested to partake in the study, even if you give your permission the child can decide not to be part of or leave the study.

What Is Involved in this Project?

If your child will partake in the study, he/she will be requested to complete a questionnaire upon reporting any of the selected disease syndromes. Also, the weekly follow-up to the household will be by phone call. You may be involved by helping the child to respond to questions that the child may find difficult to answer. Taking part in answering the questionnaire will take 20 minutes.

How Long will the Project Last?

This study takes place over 12 weeks/ 3 months.

What are the Risks?

There is a risk that your child may provide personal or confidential information unknowingly or may feel uncomfortable about study topics. However, we do not anticipate this to happen. Your

child will be required not to answer questions that are too personal or that make you feel uncomfortable.

What are the Benefits?

There will be no direct benefit to your child, but your child`s participation is likely to help us find out more about how to improve information on the selected disease syndromes being reported among household members. This information will be helpful since it will contribute to the early detection of problems, monitoring progress towards health goals

How will we protect your Information and Confidentiality?

In this research, your child`s information will not be shared with anyone outside the study and will be kept private. Any information about your child will have a number on it instead of your name. Only the researchers will know what your number is, and we will lock that information up with a lock and key. It will not be shared with or given to anyone outside of our project.

What will happen with the research findings?

Any information from the study will be shared with you and your community before being shared publicly. A summary of the results will be provided, and also a small meeting will be held to share this information. The results will be published so that others can also learn.

Can I decide not to Partake or Withdraw from the Study?

Your child may choose not to take part in this study. He/she will continue to receive all of the normal services you receive. If you wish to stop participating in the study after your child has been part of the study, you can stop at any time by telling someone on our project team. If you choose to stop taking part, you will still get all of the normal services that you usually get in your community

Who Can I Contact?

If you have any questions, you can ask anyone from our team now or later. If you have questions later, you may contact [Reagan Chweya, 0704023161, reaganngoge@gmail.com]. If you have questions about your rights as a research participant,

Do you have any questions at this time?

Part II: Certificate of Consent

I have read all information. I have asked many questions about the study and all questions I have been given responses to my satisfaction. I consent voluntarily to be a part of the study.

Name of study Participant	[at least forename and surname]
Signature of Participant	
DD/MM/YYYY	

If visually impaired, physically impaired, mentally impaired, or illiterate

I have observed the true reading of the consent form to the likely participant, and the individual has had the opportunity to ask questions. I approve that the participant has given his approval freely.

Print Name of Participant	[at least forename and surname]
Thumb/Footprint of Participant	
Signature of Witness	[A witness must sign and be designated by the participant and MUST have no link with the research team.
DD/MM/YYYY	

Statement by the researcher investigator taking consent

I have truly read out the info sheet to the likely participant, and to my capacity made sure that the participant recognizes that the following will be done:

1. A member of the research team will visit a household every week upon reporting any study-selected disease syndrome.

2. During the visit the participant will complete a 20-minute questionnaire.

3. The participant's data will be kept confidential.

I approve that the member was given a chance to ask questions about the study, and all inquiries asked to have been responded to correctly. I approve that the member has not been forced into approving the consent.

A duplicate of this ICF has been left with the participant.

Name of the study investigator	[at least forename and surname]
Signature of Researcher/person taking the consent	
DD/MM/YYYY	

Appendix VI: Child Assent Form

Child Assent Form To Individual Participation In Research Study

[This form should only be used for those who are **under** the age of majority, 18 years**]**

Study Title	Occurrence of selected disease syndromes and associated utilization of community health care services among communities in Suna West Sub-county in Migori County, Kenya
Investigator(s)	Principal Investigator: • Reagan Ngoge Chweya Tel: 0704023161
Study Sponsor(s)	Self-Sponsored
Collaborators	None

This Informed Consent Form consists of two parts:

- **Information Sheet for information about the study**
- **Certificate of Consent for your approval if you choose to participate**

You will be provided with a duplicate of the full Informed Consent Form

Part I: Information and data Sheet

The Principal investigator, from the School of Public Health, (JKUAT) is researching to identify the occurrence of disease syndromes among individuals in the household at 12-time points (weekly) for 12 weeks. We are giving you this information because we would like you to participate in our research project. If you prefer not to participate, you have the opportunity to do so. However, you will continue to receive the health services that you normally do, with no negative impact. This consent ensures you have all the information that you need before you decide. Members of our team are here to help you understand more about the project. If you do not understand any of the ideas that you see in this form, please ask us to explain the information to you. You can reach out to anyone from our team.

Why is this Project Important?

This study will pursue to identify the self-reported events of influenza-like illness (ILI) syndrome; Gastrointestinal (GI) syndromes and household injuries among household members and assess how CHVs are utilized as a fragment of the community health services, through household visits and syndrome referrals in the Sub-county among selected households. This study will provide

information on identified or referred events of ILI syndromes, GI syndromes, and household injuries syndromes and will contribute to improving community health information

Who Can Participate?

You have the opportunity to take part in this research project because we feel that your experiences with reporting the study disease syndrome, will help in achieving the study objectives. You will be included in this study since your household was randomly selected and you have been included in the study. You have been selected as a possible participant for this research after your home was randomly picked and you are 5-17years. This age group is all included in the study, as you can have a self-reliant decision.

Participation is Your Choice

Your part in this study is purely voluntary. You will choose whether you will participate or not. If you decide not to associate yourself with the study, you will continue to receive all of the services that you usually get in your community.

What Is Involved in this Project?

If you are part of this study, you will receive phone calls weekly as a follow-up. Upon reporting any of the selected disease syndromes you will be required to complete a questionnaire that will be provided within the week. The questions will collect information on the reported syndrome, to characterize the syndrome reported. The questions will take 20 minutes.

How Long will the Project Last?

This study takes place within 12 weeks/ 3 months.

What are the Risks?

You may provide personal or confidential information unknowingly or may feel uncomfortable about study topics. However, we do not anticipate this to happen. You will be required not to answer questions that are too personal or that make you feel uncomfortable.

What are the Benefits?

There will be no direct benefit to you, but your participation is likely to help us find out more about how to improve reported selected disease syndromes specific to your age group among household members. This information will contribute to the early detection of problems, monitoring progress towards health goals

How will we protect your Information and Confidentiality?

In the research in this setting, you may be asked questions by fellow community members. Your information will not be shared with anyone outside the study and will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is, and we will lock that information up with a lock and key. It will not be shared with or given to anyone outside of our project.

What will happen with the Results?

Any information from the study with you and your community before being shared publicly. A summary of the results will be provided, and also a small meeting will be held to share this information. The results will be published so that others can also learn.

Can I Refuse to Participate or Withdraw from the Study?

You may choose not to take part in this study. You continue to receive all of the normal services you receive. If you wish to stop participating in the study after you begin, you can stop at any time by telling someone on our project team. If you choose to stop taking part, you will still get all of the normal services that you usually get in your community.

Who Can I Contact?

If you have any questions, you can ask anyone from our team now or later. If you have questions later, you may contact [Reagan Chweya, 0704023161, reaganngoge@gmail.com].

Do you have any inquiries at this time?

Part II: Certificate of Consent

I have read all information. I have asked many questions about the study and all questions I have been given responses to my satisfaction. I consent voluntarily to be a part of the study.

Name of study Participant	[at least forename and surname]
Signature of Participant	
DD/MM/YYYY	

If visually impaired, physically impaired, mentally impaired, or illiterate

I have observed the true reading of the consent form to the likely participant, and the individual has had the opportunity to ask questions. I approve that the participant has given his approval freely.

Print Name of Participant	[at least forename and surname]
Thumb/Footprint of Participant	
Signature of Witness	[A witness must sign and be designated by the participant and MUST have no link with the research team.
DD/MM/YYYY	

Appendix VII: Questionnaire (English/Dholuo version)

Main Study Questionnaires (Buk mar penjo mar nondro)

A. Socio-Demographic Status

1. Week Number for Data collection for the Household (Juma mane mar timo nondro)
2. Week no for Data__?
3. GPS Location (area mar ot)
4. Location of the Household (ot ni kane)
5. Date of data collection (Today`s date) (Tarik mar luorwuok)
6. The week start period for data collection (The period for a start-Last 7 days) (juma mane luorwok ochakore)
7. The week end period for data collection (The period end of the week of data collection) (juma mane luorwuok orume)
8. Household Number (Namba ot!)?
9. Household Unique ID?
10. Household Size (joma nitie e ot) ?
11. Number of household individuals (Joma nitie e dala) ?
12. Village (Village/ location name) (Gweng/ Aluora) ?
13. Household member ID(namba ng`ato ka ng`ato e ot) ?
14. What is the gender of the respondent with/out the syndrome? (Ng`ama ne e iyudo e ot!)
    a. Male (di chuo)
    b. Female (dhako)

B. Socio-Demographic Status

15. Do you have employment? (bende in gi tich!)
    a. Yes (eeh)
    b. No (ooyo)
    c. Not Applicable (onge)
16. What is the type of your employment? (Itiyo tich mane)

a. Formal employment (tich sirikal)
b. Informal employment (mari I wuon)
c. If, informal employment, are you currently engaged this week? (ka en mari I wuone, be i dhi kode mbele e jumani)
    i. Yes ((eeh)
    ii. No(ooyo)

17. What is your Education level? (i somo nyaka Kanye!)
    a. No education (ok adi skul)
    b. Primary education (primari)
    c. Secondary education (sekondari)
    d. Vocational training (somo tije mag lwedo)
    e. Tertiary education (koleg kata univasiti)
18. What is the monthly income of the household head? (yuto ni romo nade a due)
    a. 0 Kshs -10,000 Kshs (dirom nono nyaka alufu apar)
    b. 10,001Kshs - 20,000Kshs (alafu apar nyaka alufu piero ariyo)
    c. 20,001 Kshs.- 30,000 Kshs. (alafu piero ariyo nyaka alfu piero adek)
    d. >30,000 Kshs. (koso okadho alfu piero adek)
19. Does the household head have any health insurance coverage? (Bende baba/ mama nigi kadi mar thieth)
    a. Yes (eeh)
    b. No (ooyo)
    c. Don't know (akia)

C. Syndrome-Broad factors

20. Were there any self-reported conditions of illness or injuries reported in the last one week? (Bende ne nitie ranyisi mag tuoche kata inyruok e juma achiel machien)
    a. Yes (eeh)
    b. No (ooyo)

c. If yes, did the affected member make a visit of more than >2 day to the outside sub-county? (Kane ne nitie, bende ng`at mane nigo nodhi manyo thieth oko mar divison)
    i. Yes (eeh)
    ii. No (ooyo)

21. How did you 1st respond to the reported signs of illness? (ere kaka ni itemo geng`o chal mar tuono—oyieni *duoko magèny*)
    a. First-aid (thieth mokuongo)
    b. Self- medicated (ne Ithiethori kendi)
    c. Visited the Primary Health Care facility (nilimo osibital mag gweng)
    d. Did nothing (onge gima ne atimo)
    e. Contacted Community Health Volunteer (ne inyiso nyamrewa mag gweny)
    f. Other (not mentioned) (kod maok openji)
22. If other ways of managing reported signs of illness, kindly mention (Other way managed signs of illness)_____(ka onge kuom mapenji go niysa yoo mane itiyogo)
23. What was the 2nd line of management of the illness? (ere kaka ne itimo kendo mar geng`o tuo no, kendo—oyieni duoko magèny)
    a. First-aid (thieth mokuongo)
    b. Self- medicated (ne Ithiethori kendi)
    c. Visited the Primary Health Care facility (nilimo osibital mag gweng)
    d. Did nothing (onge gima ne atimo)
    e. Contacted Community Health Volunteer (ne inyiso nyamrewa mag gweny)
    f. Other (not mentioned) (kod maok openji)
24. If other ways of managing reported signs of illness, kindly mention_____(ka onge kuom mapenji go nyisa yoo mane itiyo go)

D. Syndrome-Broad factors

25. Was fever signs reported? (Bende ne nitie del maliet)
    a. Yes (eeh)

b. No (ooyo)

26. Was persistent running nose reported? (be ne nitie uum machwero othinj pii)
    a. Yes (eeh)
    b. No (ooyo)
27. Was a malaise sign reported? (bende ne nitie del maremo)
    a. Yes (eeh)
    b. No (ooyo)
28. Were joint pains reported? (bende ne nitie fuoni maremo)
    a. Yes (eeh)
    b. No (ooyo)
29. Was muscle pains reported? (bende ne ring` del maremo)
    a. Yes (eeh)
    b. No (ooyo)
30. Was cough reported? (bende ne in gi aonda)
    a. Yes (eeh
    b. No ooyo)
31. Was sore throat reported? (bende ne in gi duol maremo)
    a. Yes(eeh)
    b. No (ooyo)
32. Was the nasal discharge reported? (bende ne ni gi athung`a)
    a. Yes(eeh)
    b. No (ooyo)
33. Was a breathing problem reported? (bende ne in gi chandruok eyuoyo)
    a. Yes (eeh)
    b. No (ooyo)
34. When did the reported signs (respiratory illness) start/occur?
    Date_____ ranyisi mag tuoni no chakore karaang`o)
35. From the reported disease symptoms, can the ILI syndrome be classified present?
    (kuom tuoche mi wacho go bende ne nitie mar kor ?)

a. Yes (eeh)
b. No (ooyo)

36. Was stomach pains reported? (bende ne nitie ich maremo/ malit)
    a. Yes (eeh)
    b. No (ooyo)
37. Was diarrhea sign reported? (bende ne nitie diep)
    a. Yes (eeh)
    b. No (ooyo)
38. Was nausea or vomiting reported? (bende ne chunyi lewi kata ng`ok
    a. Yes (eeh)
    b. No (ooyo)
39. Was bloating, fullness, belching and flatulence reported? (bende ne nitie gi ich mo kuot, ma mor kata ma ng`ielore)
    a. Yes (eeh)
    b. No (ooyo)
40. When did the GI signs (gastrointestinal illness) reported star/occur? Date_____ (ranyisi mag touche go no chakore karaang`o)
41. From the reported signs, can the GI syndrome be classified present? (kuom mago bende nitie thagruok moko mag ich)
    a. Yes (eeh)
    b. No (ooyo)
42. Was there any reported illness (signs) that is not among the study interest?_____ (kuom mago bende ne nitie moko maok apenji)
43. Did you have any injuries in the past one week? (bende ne in gi inyruok moro amora e juma achiel machien)
    a. Yes (eeh)
    b. No (ooyo)
44. What was the nature of your injury?_____ (ne inyori nade)
45. When did the injury reported star/occur? Date_____ (ne inyori kara ang`o)

46. How can the injury be by categorized by type of injury or intent of the injury? (ang`o mane okelo inyruok ni)
    a. Unintentional (i.e. accidental); (ka oki ing`eyo kata ajali)
    b. Intentional (i.e. deliberate (ka ing`eyo)
47. What was the severity of the injury observed or reported? (ni inyori e okang` mane)
    a. Serious enough to require hospitalization (mi nyal teri e osipital)
    b. Slight (treated at locally or at home)) (koso ni tiethori kendi kata gi yethi magi nyaluo)
    c. Other (e yoo moro)
        i. If, other what was the severity of the injury reported_____(ka en yoo moro, to en mane)
48. What was the mechanism of injury?_____ (angò mane oinyi)

E. Utilization of CHVs

49. Did the household receive any Community Health Volunteer visit(s) in the last 1 week? (Bende ne olimi gi nyamrerwa mag kor gweny
    a. Yes (eeh)
    b. No(ooyo)
50. What was the nature of the Community Health Volunteer visit? (ang`o mane okelo gi)
    a. Syndrome-triggered (tuoche)
    b. Routine visit (luor ruok ma pile)
51. For the reported sign of illness (syndrome), and upon CHV visit were any referrals by CHV provided? (ka ne nitie tuo, bende ne gi nyisi mondo ithii e osipital moro amora)
    a. Yes (eeh)
    b. No(ooyo)
52. What was the cost of treatment in the Primary health care visited?_____ (ka nidhi e osiptal no thiethi gi pesa adi)

53. What was the cost used for transport to the Primary health care visited?_____(ne itiyo gi pesa adi e transpot)
54. Do you own a domestic animal? (be in gi le mag dala)
    a. Yes (eeh
    b. No (ooyo)
55. What species of domestic animal do you own? (in gi le mage mag dala)
    a. Cattle (dhook)
        i. What is the number of cattle's in the household(dhook adi)_____
    b. Sheep (rombe)
        i. What is the number of sheep domesticated in the household (rombe adi)?_____
    c. Goats (diek)
        i. What is the number of goats domesticated in the household?_____ (diek adi
    d. Pigs (anguro)
        i. What is the number of pigs domesticated in the household(anduro adi)_____?
    e. Poultry (gwen0, atudo, mbata, kod akuru,)
        i. What is the number of poultry domesticated in the household (gin adi)_____?
    f. Dog (guok)
        i. What is the number of dogs domesticated in the household (guok adi)
    g. Cat (paka)
        i. What is the number of cats domesticated in the household (paka adi)
56. Has any illness of any domestic animal been observed? (bende le mag dala gi, ni gi ranyisi mag tuoche)
    a. Yes(eeh)

b. No(ooyo)

c. If any domestic illness has been observed, what clinical signs observed (kane le mag dala ne tuo, ni fwenyo nade)?_____

57. Has any death of an animal been reported in the household? (bende ne nitie le moro amora mo tho)
    a. Yes (eeh)
    b. No (ooyo)
58. Did it rain in the past one week? (bende koth osechwee a juma achiel ma chien)
    a. Yes (eeh)
    b. No (ooyo)
59. Are there visible stagnant or standing water pools around the household due to rains? (bende ne nitie kama ne pi ogudoree, tok koth)
    a. Yes(eeh)
    b. No (ooyo)

F. Household factors

60. Household, Type of flooring? (dier odi olos gi ang`o)
    a. Ceramic or cement floor (simiti)
    b. Dirt floor (omuon gi loo)
    c. Timber floor (olos gi bau)
    d. Other types of floor (kata e yoo moro amora)
    e. Other types? Specify(to ka nitie en mane)
61. Household, Type of Walls? (kor ot olos gi ang`o)
    a. Brick wall (matafari)
    b. Thatch wall (gi lum)
    c. Wood wall (yien)
    d. Other types of wall (kod ma moko)
62. Household, Type of Roofing? (tado olos ga ang`o)
    a. Tile roofing ()
    b. Iron/Aluminum sheets roofing (mabati)

c. Thatch roofing (gi lum)
d. Other roofing types (kod ma moko)
e. Other roofing types, Specify (ka mamoko en mane)

63. Source of water used for drinking? (pi motho ugolo Kanye)
    a. Municipal tap water system (mar sirikal)
    b. Spring or Well water (yao kata sokni)
    c. River or reservoir water (aora
    d. Rainwater (pi koth)
    e. Other Sources (kuonde mamoko)
        i. if other sources of drinking water, mention_____ (ka kuonde ma moko nyisa)
64. Do you treat your drinking water? (be ithietho pi motho)
    a. Yes (eeh ooyo)
    b. No(ooyo)
65. If you treat drinking water, how do you treat your water? (ka ithietho pi motho to ithietho nang`o
    a. Using Chlorinate (iketo yath)
    b. By boiling water (ichwako)
    c. By filtering, or decanting drinking water (ichungo pi)
    d. Other ways to treat water (koso itiyo gi yo moro)
        i. Other ways to treating drinking water? Specify_____ (to ka en yo moro en mane)
66. Household, Predominant destination of human waste? (in gi choo aina mane)
    a. Septic system (en mitiyo gi pi madhi e bugo mo kuny oko)
    b. Pit latrine (choo man oko)
    c. Open defecation (e pap kata bungu)
    d. Other disposals of human waste (kod mamoko)
        i. Other disposals of human waste, Specify (kama moko to en mane)
67. Household, Defecation location (udhi e cho Kanye)

a. Indoor household toilet (choo man e ot)
b. Outdoor toilet (choo ma oko)
c. Outdoors- open defecation (e pap kata bungu)
d. Other defecation location (kod mamoko)
    i. Other defecation location? specify_____(kama moko to en mane)

68. What is the household trash disposal method? (upuko yugi mag dala Kanye)
    a. Collected by removal service (nitie jok machoko gi)
    b. Buried, burned (uiko koso uang`o)
    c. Discarded in a river/other (uwito e aora)
    d. Household garbage pit (uwito e bugo mokuny)
    e. Other household disposals (kod mamoko)
        i. Other household disposals? Specify? (to kama moko to en mane)

Appendix XI: Ethical approval

amref health africa

Amref Health Africa in Kenya

REF: AMREF – ESRC P635/2019 **June 19, 2019**

Reagan Ngoge Chweya
Jomo Kenyatta University
P.O. Box 62 000 – 00200
Nairobi, Kenya
Tel: 0794022161
Email: Reaganngoge@gmail.com

Dear Mr. Chweya,

RESEARCH PROTOCOL: OCCURRENCE OF SELECTED DISEASE SYNDROMES AND ASSOCIATED UTILIZATION OF HEALTH CARE SERVICES AMONG COMMUNITIES IN SUNA WEST SUB-COUNTY, MIGORI COUNTY, KENYA

Thank you for submitting your protocol to the Amref Ethics and Scientific Review Committee (ESRC).

This is to inform you that the ESRC has reviewed and approved your protocol. Your application approval number is P635/2019. The approval period is from June 19, 2019 to June 18, 2020 and is subject to compliance with the following requirements:

a) Only approved documents (including informed consents, study instruments, advertising materials, material transfer agreements etc.) will be used.
b) All changes including (amendments, deviations, violations etc.) are submitted for review and approval by Amref ESRC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the Amref ESRC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to Amref ESRC within 72 hours.
e) Clearance for export of biological specimen must be obtained from the relevant government authorities for each batch of shipment/export.
f) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
g) Submission of an executive summary report within 90 days upon completion of the study to the Amref ESRC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and innovation (NACOSTI) https://oris.nacosti.go.ke/ and obtain other clearances needed.

Please do not hesitate to contact the ESRC Secretariat (esrc.kenya@amref.org) for any clarification or query.

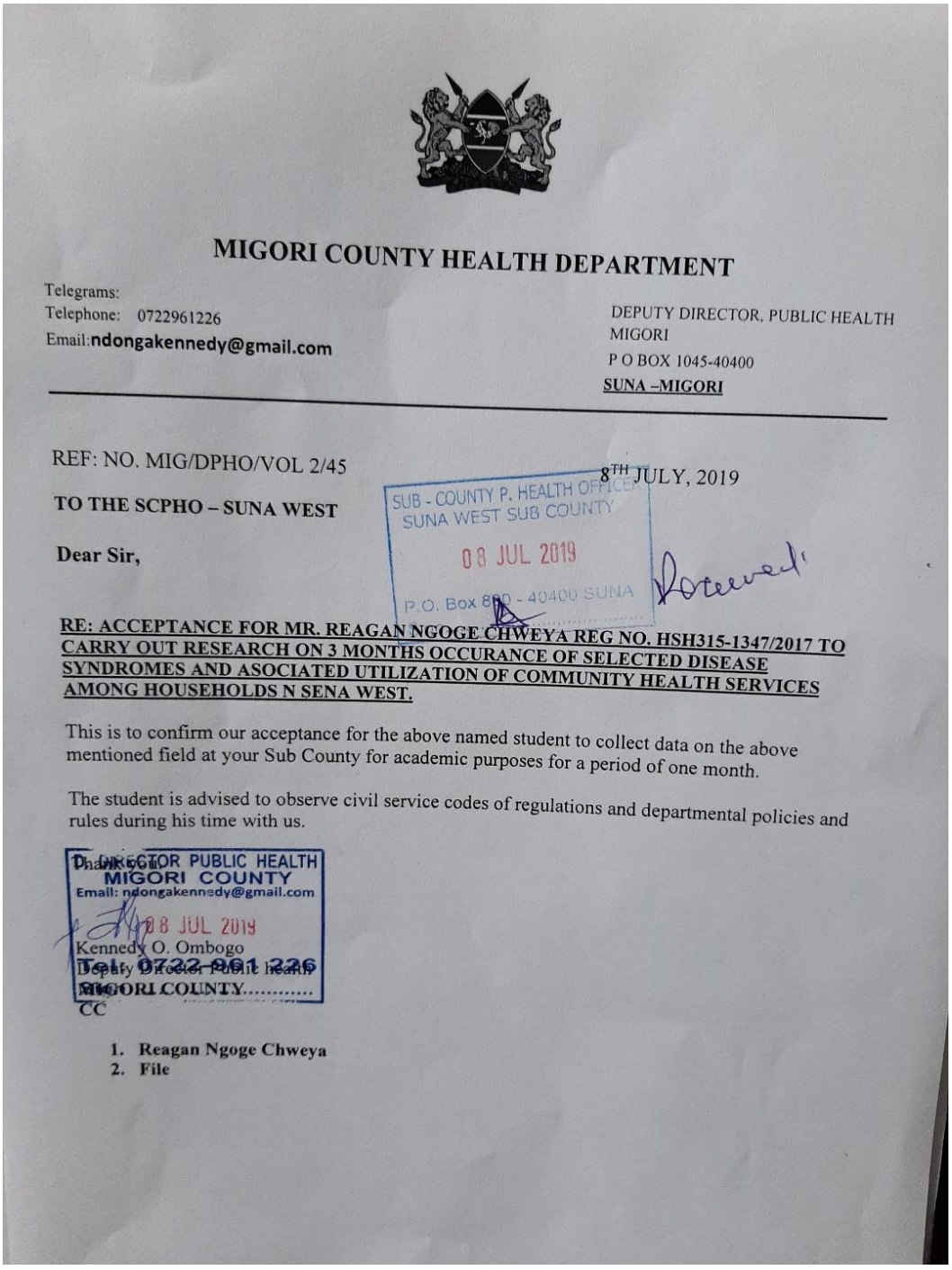
Yours sincerely,

AMREF - ESRC P.O. Box 27691 - 00100, NAIROBI 19 JUN 2019

Prof. Mohamed Karama
Chair, Amref ESRC

CC: Samuel Muhula, Monitoring & Evaluation and Research Manager, Amref Health Africa in Kenya.

Appendix XII: Introduction letter



MIGORI COUNTY HEALTH DEPARTMENT

Telegrams:
Telephone: 0722961226
Email:ndongakennedy@gmail.com

DEPUTY DIRECTOR, PUBLIC HEALTH
MIGORI
P O BOX 1045-40400
SUNA –MIGORI

REF: NO. MIG/DPHO/VOL 2/45

8TH JULY, 2019

SUB - COUNTY P. HEALTH OFFICER
SUNA WEST SUB COUNTY
08 JUL 2019
P.O. Box 800 - 40400 SUNA

Received

TO THE SCPHO – SUNA WEST

Dear Sir,

RE: ACCEPTANCE FOR MR. REAGAN NGOGE CHWEYA REG NO. HSH315-1347/2017 TO CARRY OUT RESEARCH ON 3 MONTHS OCCURANCE OF SELECTED DISEASE SYNDROMES AND ASOCIATED UTILIZATION OF COMMUNITY HEALTH SERVICES AMONG HOUSEHOLDS N SENA WEST.

This is to confirm our acceptance for the above named student to collect data on the above mentioned field at your Sub County for academic purposes for a period of one month.

The student is advised to observe civil service codes of regulations and departmental policies and rules during his time with us.

Thank you

DIRECTOR PUBLIC HEALTH
MIGORI COUNTY
Email: ndongakennedy@gmail.com
08 JUL 2019

Kennedy O. Ombogo
Deputy Director Public Health
MIGORI COUNTY.....
Tel: 0722 961 226

CC

1. **Reagan Ngoge Chweya**
2. **File**

Appendix XIII: Publication

International Journal of Community Medicine and Public Health
Chweya RN et al. Int J Community Med Public Health. 2021 May;8(5):2197-2205
http://www.ijcmph.com pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20211390

Original Research Article

The occurrence of self-reported illnesses and their analyses into influenza-like and gastrointestinal syndromes in a rural community in Western Kenya, 2019

Reagan N. Chweya[1]*, Susan N. Mambo[1], John M. Gachohi[1,2]

[1]School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Kenya
[2]Washington State University, Global Health Program, Kenya

Received: 14 March 2021
Revised: 25 March 2021
Accepted: 26 March 2021

***Correspondence:**
Reagan N. Chweya,
E-mail: reaganngoge@gmail.com

ABSTRACT

Background: Data-driven population studies focusing on clinical symptoms and syndromes with the potential to improve diagnostic strategies are rare in Africa. The objective of the study was to determine the prevalence of influenza-like illness (ILI) and gastrointestinal (GI) syndromes in a rural community in western Kenya.
Methods: Using a cross-sectional study design, we collected data on self-reported symptoms experienced during the week preceding the study and clustered them into syndromes using case definitions in western Kenya. The study randomly enrolled 92 households and recruited 390 subjects aged between 5 and 83 years. On one hand, reporting at least any four prespecified respiratory-related symptoms attained influenza-like illness (ILI) syndrome while on the other, gastrointestinal (GI) syndrome constituted the reporting of at least any three of prespecified GI system symptoms. Data on individual and household-level independent variables were collected using interviewer-administered questionnaires. Using multivariable logistic regression models, we assessed relationships between the occurrence of these syndromes and the independent variables at a significance level of $p \leq 0.05$.
Results: Respectively, 27% and 9% of subjects attained ILI and GI syndromes. Twenty-four subjects attained both syndromes. Visiting outside the local sub-county of residence was associated with attaining ILI (OR=2.3, 95% CI 1.4, 3.7) and GI syndromes (OR=3.4, 95% CI 1.6, 6.9). Besides, the absence of active medical insurance was independently associated with attaining GI syndrome (OR=0.12, 95% CI 0.02, 0.94).
Conclusions: Study findings suggested the existence of a higher burden of ILI relative to GI syndrome making the study area critical for investigating disease exposures related to visiting outside the study area and the link between medical insurance and ill health occurrence.

Keywords: Illness, Syndrome, Influenza-like, Gastrointestinal, Western Kenya

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