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HOUSEHOLDS' PERCEPTION, PRACTICES AND MAINTENANCE CULTURE IN END OF USEFUL LIFE OF INSECTICIDE TREATED NETS IN THE SHAI OSUDOKU DISTRICT

BY

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DECLARATION

I, the undersigned, confirm that the work that I have presented as my dissertation is entirely my own work. Reference to, quotation from, and discussion of the work of any other person has been duly acknowledged within the work in accordance with University guidelines for the production of a dissertation. I further declare that this dissertation has not been submitted for any degree programme in this university or other universities elsewhere.

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DEDICATION

I am pleased to dedicate this research work to my former boss, Mr. Emmanuel Fiagbey former Country Director of Johns Hopkins University Centre for Communications Programme, Ghana, whose passion for public health and SBCC in health inspired me to pursue this course. May Almighty God bless you.

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ABSTRACT

The widespread use of Insecticide Treated Nets (ITN) has contributed to the reduction in malaria cases highlighting its effectiveness in reducing malaria transmission. With the decline in donor funding in the supply of nets, the focus is being given to the question of how to sustain these successes, particularly the improvement in field durability in Long-Lasting Insecticidal Nets (LLIN).This study explored household's perception of the end of useful life of ITNs and practices towards care and repair in the Shai-Osudoku District. A descriptive cross-sectional study design using a qualitative approach was used for this study. The study employed both focus group discussions and in-depth interviews in order to provide an in-depth understanding of the households' perceptions. Data were collected from 38 participants who participated in 4 in-depth interviews (IDIs) and 4 focus group discussions (FGDs) in 4 communities in the Shai Osudoku District. Multiple criteria such as the physical condition of the net, the age of net and perceived potency of the net was used to determine the end of useful life of ITNs. Reported net care and repair practices varied among the respondents. Proper handlings, washing of dirty nets, keeping nets out of reach of children were the major care and repair behaviours among households. Repurposing of old nets was most prominent in farming activities. The results indicate that generally households' decisions regarding the end of net life vary among community members. Guidelines on cues to the disposal of nets should be developed and communication around net care should stress regular net inspections, prompt repairs, and clarify misconceptions about proper washing frequency and technique in order to prolong the useful life of ITNs.

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ANC	-	Ante Natal Clinic
CWC	-	Child Welfare Clinic
CD	-	Continuous Distribution
GDHS	-	Ghana Demographic Housing Survey
GSS	-	Ghana Statistical Service
GTS	-	Global Technical Strategy
HBM	-	Health Belief Model
ITNs	-	Insecticide Treated Nets
LLINs	-	Long Lasting Insecticidal Nets
SBCC	-	Social and Behavioural Change Communication
UC	-	Universal Coverage
WHA	-	World Health Assembly
WHO	-	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Malaria is one of the most severe public health problems worldwide emerging as the primary cause of mortality and disease in many developing countries. World Health Organization (WHO) estimates that about 3.2 billion people representing almost half of the world's population are at risk (WHO, 2015a). In 2015, the highest global burden was recorded in sub-Saharan Africa with an incidence of 88% resulting in a mortality of about 90% (WHO, 2015a). Malaria is endemic in Ghana and remains one of the leading causes of disease and death, mainly among children under five and pregnant women (PMI, 2015).

It is worthy of mention that substantial progress has been made in controlling malaria within the African sub region. According to the WHO (2016), malaria is no longer the leading cause of death among children in sub-Saharan Africa. Since 2000, deaths resulting from malaria has decreased by 66%, translating into a little over six million lives saved, with the majority of them being children (WHO, 2016). The most powerful tool in achieving this success has been the use of insecticide-treated net (ITN), which is widely known to provide protection from malaria-carrying mosquitoes (WHO, 2013a).

More than one billion insecticide-treated nets were distributed in malaria-endemic countries between the years 2000 and 2015 (WHO, 2015b). WHO declared that "the rapid scale-up of insecticide-treated nets has been by far the largest contributor to the impressive drops in the incidence of malaria, highlighting their effectiveness in reducing or interrupting malaria

transmission when there are high population coverage and usage (WHO, 2016). Despite the progress being made towards the achievement of universal coverage with insecticide-treated nets (ITNs) in Sub Sahara Africa (WHO, 2013b) sustaining the success mostly through improvement in field durability in long lasting insecticide nets (LLINs) is being given crucial attention. Field durability is not the only determinant of prime time for replacement of nets in order to sustain universal coverage, but also to find an ideal cost of LLINs reduced procurement (cost per year of use). The lifetime of LLINs are short thereby loses its insecticide concentration, develops holes and tear over time. Surveys conducted indicate that the average life expectancy for a net to be useful is three years with a range varying between 18 months and seven years as defined by WHO (Allan, Reilly, Gilbos, & Kilian, 2012). On the other hand, some other studies suggest that nets may reach degraded condition much faster in field condition because the anticipated lifespan could be exaggerated. Climatic conditions, the structure of the household and socioeconomic condition are factors that can influence the durability of the LLIN (Mutuku et al., 2013).

In the context of continually shifting resources for distribution of LLINs (Loll et al., 2013) and inevitable wear and tear of nets, it is important to understand factors at the household level that affect net durability as well as perceptions and behaviours towards net damage, care, and repair. In the quest of describing perceptions and experiences of households with net care and repair, it may be possible to develop better approaches to encourage reliable behaviours with preventing damage to nets and repairing. Consequently, nets may last longer before becoming an ineffective necessitating replacement. Although other studies have focused on the physical integrity and durability of the net, the ultimate decision to dispose of the net lies in the power of the householder.

1.2 Problem Statement

The use of Insecticide Treated Nets (ITNs) stands out as a key vector control measure in line with the WHO assertion that ITNs can reduce the occurrence of malaria among children under 5 years of age by approximately 50% and all-cause mortality by 17% (WHO, 2012). However, the success of ITNs relies on factors such as the readiness of people to use ITN and behaviour of the local vectors (Teklemariam, Awoke, Dessie, & Weldegebreal, 2015).

Reports from the 2014 GDHS suggest that there has been a significant increase in ownership of insecticidal nets at the household level, nevertheless structure of the house and user behaviour is becoming barriers for optimal use. The report also shows that since 2008 there has been an increase in the ownership of any type of net from 45% to 70% and ITN, 42% to 68%. However, the increase in ownership did not match up with its use. This is evident in the report that showed that 48% of household who own ITNs slept under it the night before the study (GHS, 2014). The difference between the percentages shows that irrespective of access to ITN, use is low at the household level.

Many studies have attributed individual's choice to use an ITN to barriers such as "structural inconveniences, perceptions of low malaria risk, perceptions of net ineffectiveness misconceptions of malaria symptoms and transmission, issues related to discomfort, use of nets for other purposes, and other social factors" (Babalola et al., 2016; Moon et al., 2016; Ngondi et al., 2011; Ossè et al., 2013; Teklemariam et al., 2015). Other studies such as that conducted by Batisso et al., 2012 in Ethiopia showed that the principal reasons for not using nets included torn nets (46%); of which only 4% of users had repaired their nets in the three

years after a mass distribution with 32% of nets been discarded. Another barrier identified is if the condition of the net is in a poor state as perceived by the owner (Hetzel et al., 2014).

According to the 2014 GDHS report, over the past one year, 17% of the households disposed of a treated net with 83% giving torn nets as the main reason. Of these, 55 % of them dispose of the net after using them for less than two years, a worrying situation as the WHO asserted that ITNs are supposed to be used at least for three years. Again an observational data in Tanzania showed that approximately 16% of nets that were expired were used for other purposes such as curtains for protecting chicks rather than preventing malaria (Mutuku et al., 2013).

On the other hand, studies conducted by (Leach-kemon et al., 2012; Pigott, Atun, Moyes, Hay, & Gething, 2014), showed that donor funding has stagnated and the number of ITNs procured has decreased since 2010. Hence, ITNs will need to be used longer by users in order to reach it minimum usage of three years with the consequent effective calculation of universal coverage. Even with high coverage and adherence, ITNs do not provide personal protection unless they are in good condition and all holes fully repaired (Malima et al., 2008), since hole formation is concurrent with insecticide loss.

The behaviour of net users, such as net care and repair practices, may also affect the duration of the useful life of nets. There are mixed research findings on the relationship between the protective lifespan of LLINs and net care and repair behaviour, including the frequency and technique of washing LLINs (Mutuku et al., 2013). It is therefore vital to gain insight into

the factors that influences households to classify LLINs as no longer useful in the Shai-Osudoku and repair and care behaviours.

1.3 Research Questions

1. What are the household's perceptions of ITNs end of life in the district?
2. What household knowledge, attitudes, and practices towards ITNs care and maintenance affect the life span of ITNs in the district?
3. What factors account for misuse and repurposing of ITNs in the district?

1.4 General Objectives

The main objective of this study is to explore household's perception of the end of useful life of ITNs and practices towards care and repair in the Shai-Osudoku District.

1.4.1 Specific Objectives

The specific objectives are:

2 To examine households' perception on the end of useful ITNs life.

3 To explore knowledge, attitudes, and practices towards ITNs care and maintenance in the district.

4 To examine factors accounting for misuse and repurposing of ITNs in households in the district.

1.5 Justification of Study

Despite the significant progress achieved in reducing malaria, a lot still needs to be done if the global aim of reducing malaria incidence and mortality rates by at least 90% by 2030 compared with 2015; and to eliminate malaria from at least 20 malaria endemic countries are to be achieved. Malaria remains a regional and global priority as reflected in the Sustainable Development Goals and the Global Technical Strategy (GTS) for malaria (2016–2030) adopted by the World Health Assembly (WHA) in May 2015. Mosquito nets have had the greatest impact, accounting for about 68% of cases prevented through these interventions (WHO, 2013a). ITN is a highly cost–effective intervention, with nets usually provided free or at a heavily subsidized price.

Even though a number of ITNs have been distributed over the past few years with ownership relatively high at 59%, it is important to ensure that ITNs are being used to its required life span. According to the GDHS report (2014), 55% of households disposed of their treated nets after using them for less than two years, with the main reason as nets been torn. These torn nets accounted for 83 % indicating that nets in the country are not lasting as long as expected (GSS, GHS, 2015).

With the nationwide goal to achieve 85% coverage not only among the vulnerable groups but also among the rest of the population (NMCP, 2016), the need to monitor use, care and maintenance of nets has become necessary. This study will provide valuable information that could be utilized in social behavioural change communication programmes towards improving net use and maintenance culture. To address this gap and provide key information,

this study will explore local practices towards care and repair of LLINs in the Shai Osudoku district.

1.6 Theoretical Framework

The Health Belief Model (HBM) is one of the recommended theoretical methods used in understanding health-related behaviour and adherence to health intervention. It is the most widely used socio-cognitive models to predict health behaviour and promote the uptake of health services. The HBM was developed by Hochbaum, Rosenstock and Kegels (1950) in response to the failure of free tuberculosis (TB) health screening programme (Glanz, Rimer, Viswanath, 2008). The HBM has been adapted to explore a variety of long- and short-term health behaviours, including sexual risk behaviours and the transmission of HIV/AIDS. The HBM has been adapted in various studies to understand health behaviour in sexual risk behaviours and HIV/AIDS transmission. Apart from the HBM used as for its original purpose thus low participating in medical screening programmes, it is widely used for a wide range of health related behaviours. According to the HBM, "an individual will take preventive action if they believe that action will prevent illness and if they have the desire to avoid that illness" (Koenker et al., 2013, p2.).

The model has six elements:

i. Perceived susceptibility of the individual to the condition;
ii. Perceived severity of the condition as having serious medical and social consequences;

iii. Perceived benefits of taking the health action in reducing the disease threat as well as other additional benefits;

iv. Perceived barriers to taking the health action, which should not overweight the benefits. These four perceptions are elements that determine the readiness to take the action. They are activated by;

v. Cues to action such as presence of mosquitoes which trigger this readiness and lead to specific behaviour action (e.g., net care and/or repair); and

vi. Self-efficacy, which is the conviction that one can successfully execute the health behavior (Glanz, Rimer, Viswanath, 2008).

The theory has proven to be useful in interpreting malaria behaviours in previous studies (Beer et al., 2012; H. M. Koenker, Loll, Rweyemamu, & Ali, 2013). In this study, the HBM framework was used to explore the perceptions, practices and maintenance culture of households in end of useful life of ITNs. The study identified the cues to net disposal at the household level and described attitudes and perceptions around net care and repair behaviours in the Shai Osudoku district. The conceptual model below (Figure 1) is an adaptation of the HBM applied to the behaviours of net care and repair. The HBM postulates that "for people to change their behaviour, they must feel threatened by their current situation (perceived severity and susceptibility), believe that a change in behaviour will have an overall favorable outcome despite the costs (perceived benefits), and believe that they are competent (self-efficacy) to overcome any perceived barriers to change and take action. According to HBM, behaviour change is likely in the context of cues to action, or situations that trigger behaviour" (Glanz, Rimer, Viswanath, 2008). In this model, potential modifying

factors are included as they are likely to affect the individual-level beliefs of perceived threat of malaria, perceived benefits of net care and repair, perceived barriers to net care and repair, and self-efficacy to care for and repair nets. These four components affect the likelihood that people will take action to promote the integrity and durability of their nets.

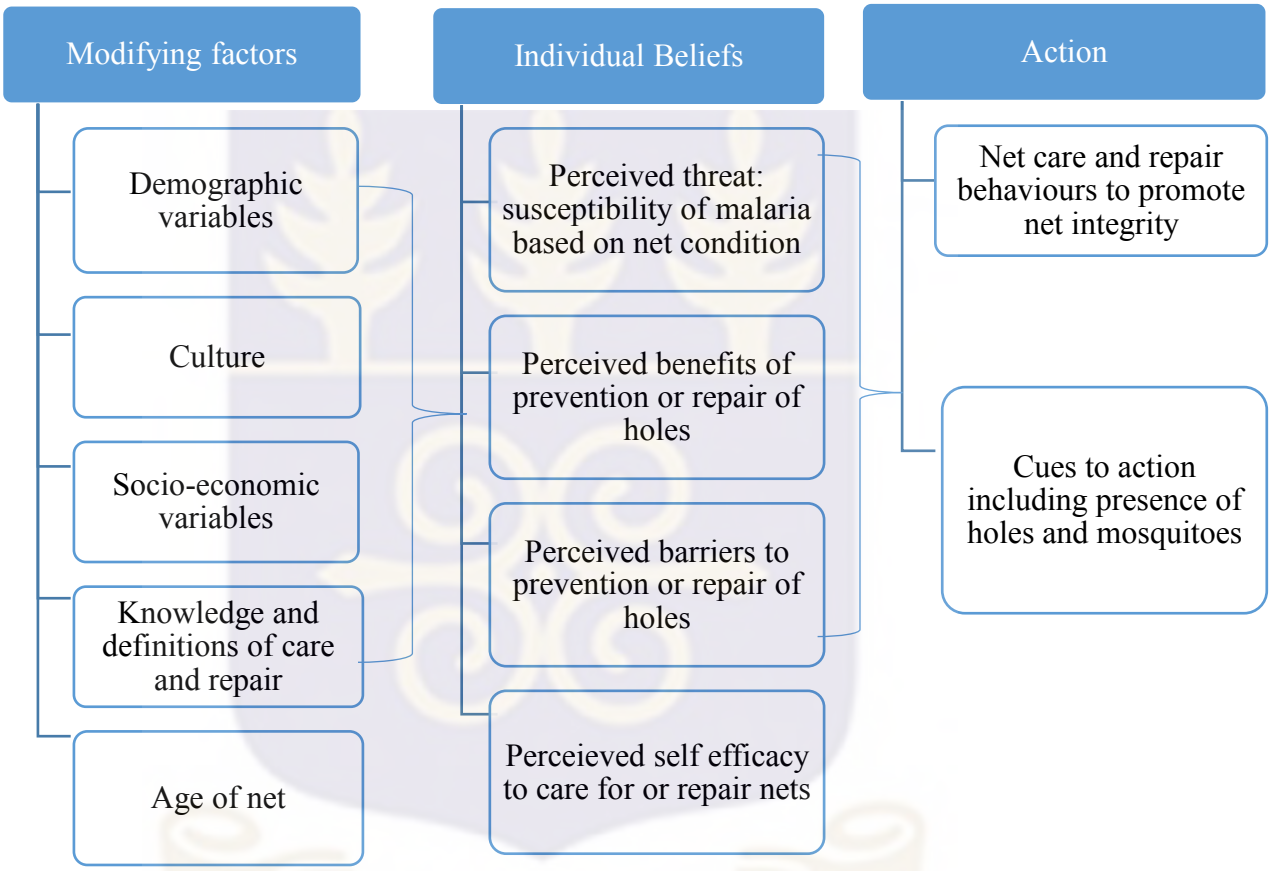

Figure 1.1: Conceptual Model for net care and repair adopted from Loll et al., 2014

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section presents a review of other studies that have been carried out regarding household's perception on ITNs useful life span and maintenance. It focuses on the perception on end of use of ITNs in the households and explored knowledge, attitudes, and beliefs towards ITNs maintenance. It should be noted that many studies have been carried out on ITNs, especially with regard to its availability, accessibility, and utilization in general, but this study seeks to explore household's definition of the end of useful life of insecticide treated nets and practices towards care and repair.

2.1 Global Malaria Problem and Epidemiology

Malaria is a life-threatening disease caused by *Plasmodium* parasites, transmitted through the bite of infected female Anopheles mosquitoes. There are five parasite species that cause malaria in humans, and two of these species – *P. falciparum* and *P. vivax* – pose the greatest threat. *P. falciparum* is the most prevalent malaria parasite in the African continent and responsible for most malaria-related deaths globally. *P. vivax* is the dominant malaria parasite in most countries outside of sub-Saharan Africa (WHO, 2017).

According to the WHO (2015), approximately 3.2 billion people forming about half of the world's population were at risk with most of the incidence and deaths occurring in sub-Saharan Africa. Malaria affects about 95 countries and territories worldwide. Estimates

released in December 2015 by WHO, shows that, there were about 214 million cases of malaria in 2015 and 438 000 deaths.

In sub-Saharan Africa, children under five bear the highest burden of malaria and mortality. Other vulnerable groups are primiparous women, people living with HIV/AIDS as well as migrants who are not immune, especially in their first pregnancy and patients with HIV/AIDS. In low and unstable transmission area, malaria can cause complications such as the risk of abortion, stillbirth and maternal mortality in low and unstable transmission areas; It can also cause low birth weight resulting in an impact on child survival (WHO, 2015b).

2.2 Malaria Problem and Epidemiology in Ghana

Malaria is currently mesoendemic in Ghana. The 2014 Demographic and Health Study in children under 5 years showed that parasite prevalence ranged from 11.2% (Greater Accra) to 40% (Northern Region) (GDHS, 2015). With parasite prevalence of 39%, rural Ghana shoulders three times as much burden compared to urban settings (13%). The level of malaria transmission as measured by the entomological inoculation rate shows that transmission is heterogeneous across the country (NMCP, 2013). In the northern Sahel Savannah area, which is mostly drier throughout the year, transmission is highly seasonal and the heaviest transmission occurs from June to October. In the transitional, forest and southern savannah areas, transmission is all year round with slight variation. The principal vectors are *Anopheles gambiae* s.l. and Anopheles *funestus* group, commonly found in rural and peri-urban areas. Both actively bite late in the night, mainly indoors. This has important implications for vector control specifically with LLINs.

2.2 Prevention of Malaria

While the development of new control tools is essential, it is equally recognized that much of the morbidity and mortality associated with malaria could be reduced, provided that existing tools are made accessible and are effectively used (RBM, 2008). Preventing mortality and reducing illness through improved access to prompt diagnosis and effective treatment remain key targets of the current global malaria control strategy (WHO, 2015a).

However, since the resurgence of malaria is compounded by the spread of drug resistance, prevention, and selective vector control have become quite significant (Cui, Mharakurwa, Ndiaye, Rathod, & Rosenthal, 2015). Among these, insecticide-treated bednets (ITNs) and curtains have emerged in recent years as the most practical (WHO, 2007b).The health impact of insecticide-treated bed nets was determined in research trials in The Gambia (Alonso, Lindsay, & Fegan, 1991), Ghana (Binka et al., 1996) and the Kenyan coast (Nevillts et al., 1996).

LLIN remains the most common and effective tool used to prevent malaria (WHO, 2014). Between 2004 and 2013, the ownership rate of LLIN strongly increased from 5 to 67 % (WHO, 2014). Some randomized control studies have already shown that LLIN implementation leads to significant protection against malaria infection, morbidity, and mortality (Lengeler, 2004). According to the WHO, nearly 70% of reductions in malaria cases are attributed to vector control interventions of which 69% are attributable to ITNs, 21% to ACTs and 10% to IRS (WHO, 2015b).

2.2.1 Insecticide-Treated Bed nets (ITNS)

Effective application of insecticide-treated bed nets for malaria control comprises three main components including bed net acquisition or ownership, regular retreatment of bed nets with insecticide, and using bed nets correctly and/or consistently (Ovadje, 2014). The successes achieved in efficacy trials have been associated with strict research conditions to maintain regular use of bed nets and bed net re-treatment (Malaria Consortium, 2016). Due to their effectiveness as a vector control method, the WHO recommends that every person at risk from malaria, in areas identified for ITN use should sleep under a net (WHO, 2007b). Nonetheless, findings from studies suggest that the major barriers to achieving optimal coverage are supply and cost. Discomfort, difficulty in hanging up nets, lack of space and low awareness of need, perceived low mosquito density were the reasons cited for not using ITNs (Hetzel et al., 2014; Singh, Brown, & Rogerson, 2013).

In Ghana, Afoakwah, Nunoo, & Andoh (2015), found that survival rate of children under five who sleep under ITN is enhanced than those who do not sleep under ITN. There is an 18.8% reduced risk of not acquiring malaria when children under five sleep under bed nets than among children who do not sleep under treated bed nets. According to Auta, (2015) in Nigeria, ITN coverage and its utilization among women and children are low in rural areas, southwest region, and households with the lowest wealth quintile. The implication is that it does not matter how efficacious an intervention is, rather if compliance with use is low, the effectiveness will be poor. If ITNs are to be successful against malaria, their effective implementation, promotion, and sustainability over time will require appropriate behavioural changes, not just distributing bed nets to increase coverage.

To increase ownership and use of ITNs in all households, Ghana adopted the Universal Coverage (UC) of LLINs distribution in 2009, which sought to give one LLIN to every two persons in a household across the country. This strategy was a nationwide LLINs door-to-door mass distribution and Hang up Campaign from 2010 to 2012, which led to a nationwide coverage of 98%. To maintain the gains made through the mass LLINs Hang up Campaign, a Continuous Distribution of LLINs (CD) was introduced (PMI, 2015). This strategy uses Antenatal Clinic (ANC), Child Welfare Clinic (CWC) and Primary Schools, the main push channels to distribute LLINs free of charge while maintaining commercial distribution. The targets for the ANC are pregnant women attending ANC for the first time (registrants), children 18-24 months due for measles booster for CWCs and pupils in primary two and six for Primary Schools (NMCP, 2016).

Findings from a study conducted by GHS nationwide in August 2008 indicated ITN/LLINs use of 43.0% amongst children under five years and 32.3% amongst pregnant women (GHS 2015b). However, findings from the Ghana Demographic Health Study (GDHS) conducted in 2014 revealed that ITNs/LLINs use has increased to 47% amongst children under five years and 43% amongst pregnant women. ITNs ownership amongst households has increased consistently over the years; 3.0% in 2003, 33.0% in 2008 and 68.0% in 2014. Further data from 2014 GDHS, indicates a rural household ITN/LLIN ownership of 79% compared to 61% for the urban. Average number of LLINs per household is 1.3. In addition, ITN/LLIN usage was 37% for both treated and untreated nets and 36% for treated nets only.

In spite of the gains made, the challenge remains in increasing the awareness and knowledge on how to maintain bed nets in order to increase its lifespan. In this regard, a very limited study has been conducted in Ghana. As such, the study seeks to fill this gap by assessing households' perception on how to maintain and handle ITNs.

2.3 Households' perceptions of end of useful ITNs life

Malaria prevention with LLINs has seen an intensive scale-up in sub-Saharan Africa in recent years. As many countries have now achieved high ownership coverage with LLIN and are approaching the universal coverage target of one net for every two people of the population at risk as recommended by WHO, the question of how these successes can be sustained, i.e., high coverage levels be maintained, becomes the focus of discussion. In this context, the importance of net durability and the 'average useful life' of a net are increasingly recognized as critical factors that determine the frequency at which nets need to be replaced.

Whereas information on ITNs robustness has been accruing in contemporary times (Mutuku et al., 2013; Okumu et al., 2013) comprising formative qualitative research on attitudes towards net care and repair (H. Koenker et al., 2015; Loll et al., 2014) there is an indication that it may vary by environmental or climatic conditions. Allan et al., (2012) found the physical condition of polyester nets in Eastern Chad to be much poorer than would have been expected from similar nets seen in the more moderate climate of Western Uganda (Kilian et al., 2011).While a 2006 case study described a behavioural change

communication (BCC) intervention and its effect on prevalence of repairs to nets (Batisso et al., 2012), no data at all are available on how the durability of a net is influenced by behaviour of net maintenance, care and repair, and whether BCC could significantly impact on median net lifespan.

Improvements in knitting pattern or other aspects of textiles themselves have the potential for extending net life but have been difficult to implement due to lack of evidence for their impact on overall net life in field conditions, and procurement practices that maintain a focus on lowest price (WHO, 2013a). Should improvements in net durability be possible via BCC interventions? The period between net replacements could in theory be extended leading to overall cost savings for programme planners and donor agencies. Any minimum, improved condition of nets would protect more people for longer periods between resupply.

From the literature reviewed above, repair and maintenance of ITNs seem the way forward in the fight against mosquitoes. However, little studies have been conducted in Ghana to assess the rationale behind the short life span of ITNs in rural communities.

2.4 Perceptions, attitudes, knowledge and beliefs of using ITNs

Insecticide treated nets (ITNs) are the mainstay of malaria prevention. As a vector control intervention, they are effective in preventing malaria morbidity and mortality in a range of epidemiological settings. In reducing densities and infectivity of malaria vectors, they reduce overall transmission and protect all individuals within a community (WHO, 2007a). ITNs

have been advocated as the most preventive tools against malaria especially in sub-Saharan Africa (WHO, 2016).

In a study carried out in Mbarara in Uganda on the perceptions about malaria prevention it was found that, avoiding mosquitoes was the most common method mentioned for prevention of malaria (Nuwaha, 2002). While most people in this study said ITNs were efficacious both in preventing mosquito bites and in malaria, they expressed ignorance of insecticide treated nets and could not tell whether a bed net was treated or not. There were some doubts about the bed net efficacy in preventing malaria. Participants mentioned that some households sleep under mosquito nets but their children die of malaria, whether mosquito nets work or not remains a myth in the minds of some people.

In a baseline study on malaria in Uganda, it was found that 99% of respondents knew about malaria with a high level of knowledge that mosquitoes are the main cause of malaria. Nearly half of the urban respondents 48.3% observed that the use of nets was the most effective way to prevent malaria. While among rural respondents there was limited knowledge of the best method for prevention (Nuwaha, 2002). In another study conducted to assess the distribution, knowledge, and utilization of ITNs in selected malaria prone areas of Ethiopia, (Animut, Medhin, Balkew, & Seyoum, 2008) indicated that 60.1% of the respondents had knowledge about nets.

A recent study conducted in Southern Ethiopia to assess knowledge and utilization of ITNs among freely supplied households showed that 62.6% of the 650 respondents indicated ITNs

as the main preventive measure of malaria. Most (97.5%) of the respondents believed that sleeping under ITN has a benefit and only a little above five % (5.2%) of the respondents reported problems associated with sleeping under ITN (Towns, Zone, & Tesfa, 2012). From this finding, it is clear that not all people will use ITNs to prevent malaria. Some people prefer other methods of protection against mosquito bites. Similarly, (Um et al., 2010) in his study indicated that respondents knew that mosquito nets were useful preventive measure against malaria and that pregnant women and children less than five years are supposed to sleep under nets since they are the most vulnerable groups.

In Ghana, a study conducted by Kudom & Mensah, (2010) in secondary schools and tertiary institutions in Ghana revealed that 93.9% of respondents in the senior high school and 86.7% in the tertiary institutions stated that ITNs are either used to protect oneself from mosquito bites or to prevent malaria. Accordingly, 79.8% of the respondents in senior high schools and 86.9% in tertiary institutions mentioned ITN as an effective strategy for protection against mosquito bites. These findings suggest that most high school and tertiary students in Ghana have adequate knowledge about ITNs and its usage in the prevention of malaria.

From the above literature review, it seems that there are factors within the household, which hinder ITN use that needed further investigation. Barriers towards the use of bed nets include; being expensive, being difficult to keep from holes, being inconvenient by increasing heat and sweating, causing suffocation and that inability to buy a net for everybody in a big family. Paradoxically, most ITNs are provided to households free of

charge by NGOs. Perhaps, the sloppiness of households in handling ITNs could not be readily ascertained.

2.5 Knowledge, attitudes and practices towards ITNs care and maintenance

According to World Health Organization Pesticide Evaluation Scheme (WHOPES) specifications, LLINs are expected to confer protection against mosquitoes for at least 20 washes under laboratory conditions and three years of use under field conditions (WHO, 2013a). Recent studies have shown that LLIN durability can vary depending on product-specific or environmental issues such as region, socioeconomic status, and climatic conditions (Allan et al., 2012; H. Koenker et al., 2015; Malima et al., 2008).

Prolonging LLIN durability could reduce the frequency of net replacement, potentially resulting in significant cost-savings in procurement and distribution. Keeping nets in good condition is essential to ensuring household use: studies in Ethiopia, Ghana, Kenya, and Senegal found that nets were used regularly when new, but increasingly withdrawn from use as their physical condition deteriorated (Loll et al., 2013; Mutuku et al., 2013; Ngondi et al., 2011; States, Baume, Reithinger, & Woldehanna, 2009).

Household practices, such as frequency and method of washing and drying, affect net longevity (Allan et al., 2012; Kilian et al., 2011; Norris & Norris, 2011): beating nets on rocks or hanging them in the sun may deplete their insecticide and cause fabric to wear prematurely, making nets less protective against mosquitoes (Atieli, Munga, Ofulla, & Vulule, 2010; Norris & Norris, 2011). Alternatively, care behaviour, such as proper washing

frequency, careful handling, and tying up nets when not in use may mitigate wear and tear (Erlanger & Enayati, 2004). Protective care behaviour may also improve owner perceptions of net effectiveness and foster more consistent use (Batisso et al., 2012). Given the potential significant cost-savings and public health benefit associated with extending the useful life of a net, preventing and mitigating damage will become ever more critical to maintaining adequate LLIN coverage (WHO, 2013a).

2.6 Factors accounting for misuse and repurposing of ITNs

The effectiveness of ITNs is not only measured by the coverage but also includes proper adherence to net use. Many people in the rural areas are not yet fully convinced of the effectiveness of ITNs for malaria prevention. The non-adherence to use of ITNs has been associated with disruption of sleeping patterns due to visitors, funerals, house constructions and other events and the perception that malaria has multiple causes (Alaii, 2003).

Non-adherence issues aside, there are reported cases of net misuse with nets being diverted to economic uses such as fishing, drying fish, protecting the nursery (cabbages and other crops) as well as for making wedding dresses (Atkinson et al., 2009; Minakawa, Dida, Sonye, Futami, & Kaneko, 2008). A study in south western Kenya found unpacked new nets reserved for visitors or diverted to other uses such as table clothes, wall hanging and curtains (Kibe, Kamau, Gachigi, Habluetzel, & Mbogo, 2015; Mulualem & Fentie, 2015). The misuse of mosquito nets necessitates more studies to find out how the ITNs are being used and develop ways of increasing their efficient use.

2.7 Conclusion

The literature reviewed shows that the need to eliminate malaria has attracted much attention from researchers, international organizations, and local governments. In addition, a large body of literature available shows that treated bed nets offers some degree of protection. However, as global funding decreases and attrition of nets becomes higher due to improper care and maintenance behaviours, households' definition of the end of the useful life span of ITNs becomes relevant.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents an overview of the study design and methodology. It presents how the study was conceptualized, designed and executed. It shows the methods, the sample size and sampling procedures that were used. It also gives the ethical standard that was followed and problems that were encountered during the data collection exercise.

3.1 Study Design

This was a descriptive cross-sectional study design using a qualitative approach of focus group discussions (FGDs) and in-depth interviews (IDIs) for data collection. These two techniques were used to provide an in-depth understanding of the end user experiences.

3.2 Study Area

The study was carried out in the Shai Osudoku district situated in the southeastern part of Ghana, one year after the 2016 universal coverage mass campaign in the district. The district is one of the 16 Districts in the Greater Accra Region with Dodowa as its capital. The Shai-Osudoku district is the largest district in terms of land surface area in the region and occupies a total land area of about 968.361 square km with a population of about 60,710 living in about 167 communities (DHD, 2015). It shares boundaries with the North Tongu District to the North-East, Yilo and Lower Manya Districts to the North-West, Akwapim North District to the West, Kpone Kantamanso District to the South-West, Ningo Prampram District to the South and the Ada West District to the East. The Volta River washes the North-Eastern portions of the district. The district is divided into two administrative sub-Districts, namely

Dodowa (Shai) Sub-District, and the Osudoku Sub-District, representing the two traditional areas (Shai and Osudoku) within the district (DHD, 2015).

Shai Osudoku district forms part of the central portions of the Accra plains. The relief is generally gentle and undulating, a low plain with heights not exceeding 70 meters. The district is largely rural engaged in agriculture as the dominant occupation (GSS, 2010). The main economic activities include farming, fishing, and small-scale traders. The people in the district are predominately Dangme speaking, though there are other ethnic groups such as the Ewes, Akans, and people of Northern descent. The majority (85.3%) of the population in Shai-Osudoku is affiliated with Christianity with Muslims and Traditionalists constituting of just about 7.6% and 2.0% respectively. The highest level of education attained by the majority of the people is primary (49.8%) with 17.8% having attained JSS/JHS status. About 48.1% of the population aged 11 years and older are literate in English language (GSS, 2010). Majority of the households in the district live in compound houses rooms (49.0%) followed by separate houses (35.8%) and huts/buildings (same compound) constitute 4.6 percent. More than half of households (54.1 percent) in the district occupy a single room, with a further 26.3 percent occupying two rooms.

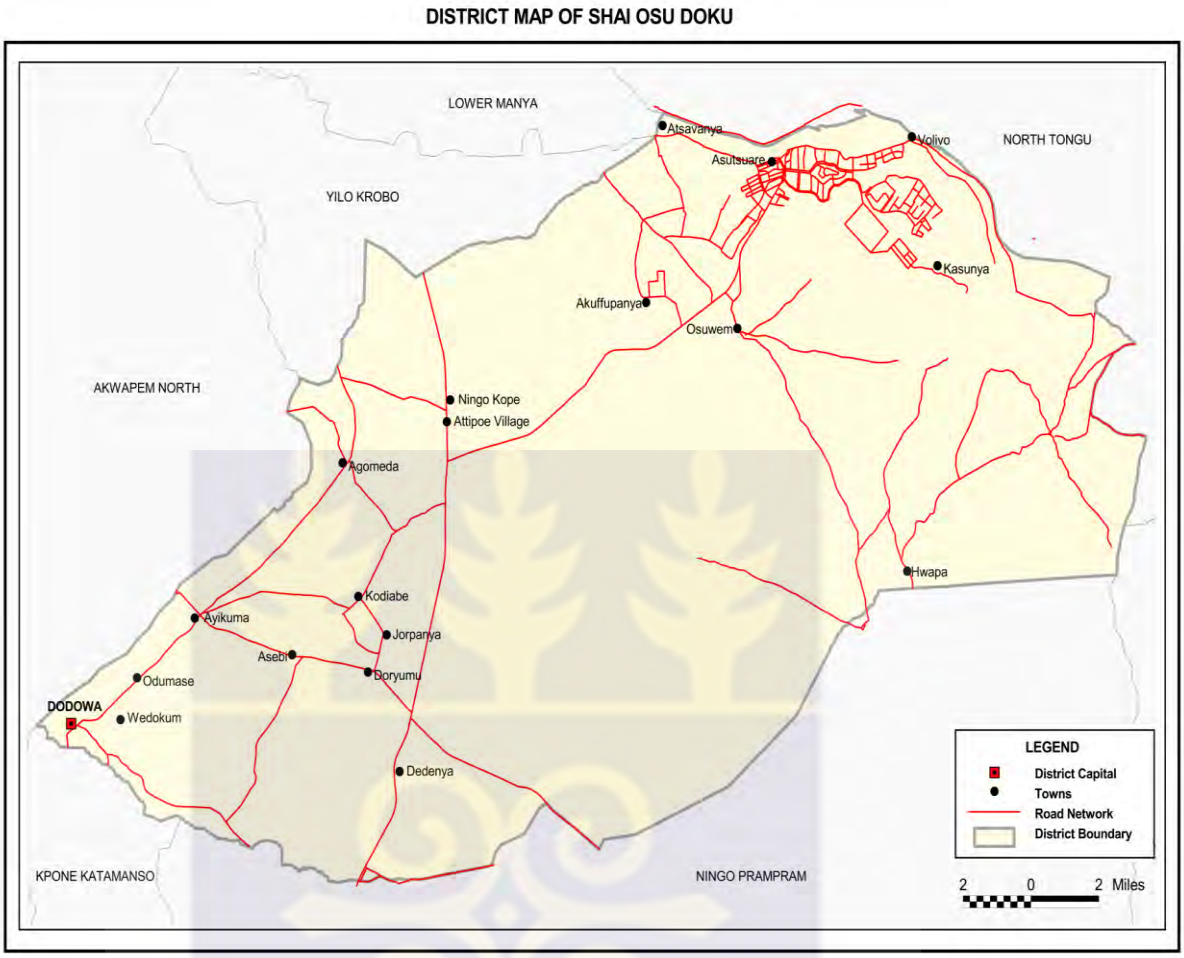

Figure 3.1: Location of study sites within Shai Osudoku district, Source GSS, 2010

3.3 Population and Sampling

The Shai Osudoku district was purposively chosen because it is among the districts where malaria is endemic in the Greater Accra region. The National Malaria Control Programme carried out also free bed net distribution in all communities in the district in 2016. Selection of participants and communities were purposively done to maximize variation in household characteristics and perspectives of respondents. This was done in two stages and focused on a subpopulation and area in which the respondents shared similar characteristics. In stage

one; two communities each were purposively selected from the two sub districts to include one peri-urban and a rural community. The selection of the communities also took into consideration the variations in the vegetation of the district to include the forested areas and the coastal Savannah. The district health director together with the district malaria focal person helped in selecting the communities.

In stage two; between eight to nine household heads or their representatives were purposively selected to participate in each Focus Group Discussions in each of the four communities. Participants were adult members of the household, 18 years of age or older, usually the head of household or their spouse. Eligibility criteria included heads of households or their spouse who owned at least one net. In each community, community health workers assisted with purposively selecting households for FGDs and IDIs. 38 participants were involved in the study, which included 20 males and 18 females. The IDIs were done with four household heads purposively selected one each from the four communities.

3.4 Data Collection

Semi-structured discussion guides were used during the FGDs and IDIs. The main topics explored in both the IDIs and FGDs included perspectives on cues to the disposal of nets, alternative uses of nets, knowledge, and practices on care and repair of nets and factors influencing the misuse of nets in the district. The research questions were pretested a week before the actual data collection in Gbogbojri, a community located closer to the district capital. Some of the questions were modified based on the findings from the pretest.

In addition to the researcher, two research assistants assisted in the collection of data in the communities. The research assistants were taken through a one-day training on the objectives of the research, FGDs approach and rehearsal of the demonstration on the projective scenario to illicit participants views on cues to discarding of nets. Four in-depth interviews (IDIs) and Four FGDs one in each of the communities were conducted. All IDIs and FGDs were audio recorded, transcribed verbatim and translated into English. Participants for the IDIs and FGDs were purposively selected based on age, sex, and net ownership.

During the FGDs, participants were presented with two nets in different conditions in order to understand their decision-making process related to the retirement of the nets. First, participants were shown an old, torn net and were asked about their perceptions of the net. Participants were asked to share what they will do if the net belonged to them and the reasons for this decision. In the second scenario, participants were asked to imagine what they will do if they have a one-year-old net that had no or only a few small holes should they receive a new net. All participants completed a one-page background questionnaire that captured household demographics and net ownership.

3.5 Data Management and Analysis

Focus group discussions and In-depth interviews were audio recorded, transcribed verbatim in Ga Dangbe, and translated into English. This was compared with the hand-written field notes prepared during the FGDs and IDIs. The transcribed and translated material was also sample checked by a researcher knowledgeable in both Ga Dangbe and English to ensure precise transcriptions and translations. After proofreading and corrections, the transcripts for

both FGDs and IDIs were saved on a password-protected computer and Google drives online platform. The FGD transcripts were entered into QSR NVivo version 11 qualitative data analysis software. They were then analyzed according to the framework for conducting thematic analysis outlined by Braun & Clarke (2006). The FGD and IDI transcripts were read and re-read to ensure familiarity with the content of the transcripts.

Those sections of the interviews and FGDs relevant to the research question were then coded according to their semantic and latent content; codes were generated, following the main topics included in the IDI and FGD guides and emergent codes to capture new themes that arose during analysis. The codes and the data located under them were then collated into potential themes and reviewed to ensure that they were coherent and reflected the content of the data set. The names of the final themes were then determined.

3.6 Ethical Consideration/Issues

Ethical approval was secured from the Ghana Health Services Ethical Review Committee (GHSERC). Permission was sought from the District Director of Health Service and Chiefs (traditional leaders) in each community before the study. Respondents were informed about the purpose of the study in the local language Ga Dangme and written consent was obtained from each participant. Before each FGD and interview, an information sheet was read out to each person, or group of people in the case of the focus group discussions, to explain the objectives of the study, benefits and risks and freedom to participate or not, as well as information on confidentiality and respondent rights.

If anyone had further questions following this introduction, they were addressed immediately. Emphasis was placed on the fact that any participation in the study was voluntary and that withdrawal of consent was possible at any time without repercussions to that individual. Participants in each facet of this study were assured of confidentiality. Each participant was given one bar of key soap as an incentive for participating in the study.

3.7 Limitations of the Study

This study had some limitations. Firstly, the study utilized primarily qualitative methods and captured the experiences and perceptions of a small number of participants. Participants were purposively selected to reflect the experiences of people throughout the district. The four communities may possibly not be representative of all communities in the district. While the study provides in-depth insights into the perception and practices of these respondents, it is limited in that the sample of 38 people cannot be generalized to other populations or contexts. The study targeted the head of household as a proxy to the knowledge, attitudes, and practices held by all members of the household. Ideally, the research team should have interviewed every adult in the district, which was not possible due to time and funding constraints. Therefore, the results may not accurately represent the community's perspectives as a whole. The FGD and IDIs questions primarily focused on households' perception on the end of useful life of ITNs and care and repair practices. Differences in responses based on gender became apparent during the research, but guide questions were not specifically structured to examine gender experiences in care and repair.

CHAPTER FOUR

RESULTS

4.0 Introduction

This section presents results on the socio-demographic characteristics of study participants and the major themes identified in the study. Six themes emerged from analysis of the data: (1) when ITNs are no longer useful (2) factors determining disposal of ITNs (3) barriers to care and maintenance of ITNs (4) motivation for care and maintenance of ITNs (5) disposal mechanisms and re-use of old ITNs (6) misuse versus repurposing of ITNs.

4.1 Demographic characteristics

A total of 38 persons participated in the study. Approximately a quarter of this was drawn from each of the participating communities. Slightly more than half (20) of the participants were males while 18 were females. More than half of the participants (67.6%) had attained primary education. Christianity (84.2%) was the main religious denominations among the study participants. The study participants were drawn from various occupational categories mostly comprising of farmers (47.4%). The ages of the participants ranged from 22 to 72 years with a mean age of 43 years. The ages of the participants were categorized into 10-year intervals. Those aged 50 years and above dominated the sample with 34.2 percent. The average household size was 7.38. Overall, 88.2% of the households owned at least one ITN while 11.8% did not. The mean number of ITNs owned per household was 2.2. Table 1 below summarizes participant demographic characteristics.

Table 4.1: Socio-Demographic profile of participants

Category	Sub-Category	Frequency (n=38)	Percentage (%)
Sub District	Osudoku	19	50.0
	Shai	19	50.0
Community	Kasunya	10	26.3
	Ayikuma	10	26.3
	Abonya	9	23.7
	Tokpo	9	23.7
Sex	Male	20	52.6
	Female	18	47.4
Age	20-29	7	18.4
	30-39	8	21.1
	40-49	10	26.3
	50+	13	34.2
	Don't know	0	0
	Mean Age	43.1	0
Marital Status	Never married	6	14.7
	Married	24	67.6
	Divorced	5	11.8
	Widow(er)	3	5.9
Educational Level	Basic	20	52.6
	Secondary	8	21.1
	Higher	4	10.5
	None/ No formal educational	6	15.8
Religion	Islam	2	5.3
	Christianity	32	84.2
	Traditionalist	4	10.5
Main Occupation	Farmer	18	47.4
	Petty trader	9	23.7
	Fishing	4	10.5
	Civil servants (teacher/nurse)	3	7.9
	Unemployed	3	7.9

4.2 Perception on end of useful life of ITNs

Participants in FGDs were asked about how they decided a net is no longer useful for protection against malaria. From the discussions, a number of reasons emerged regarding the cues considered in determining when a net was no longer useful. The majority of participants said that a net was no longer useful when torn beyond repairs and not necessarily the age of the ITNs. They indicated that when a net has many holes and torn beyond repairs it increases the risk of being bitten by mosquitoes due to the holes in the net. Mosquitoes can still have access to bite them when they are sleeping in ITNs that are torn. One participant from Abonya community during the FGD stated that;

> *"Before I dispose of a net, it must be very weak and torn to the extent that friends may even be laughing at me when they see it''* (FGD Participant, Rural-Abonya).

However, some respondents also indicated the actual age of the net as a determining factor and reported that ITNs should be replaced after 6 months, one, two or three years of use. Respondents noted that the condition of ITNs begins to diminish with age. However, there was no definitive age given by respondents as to when they perceive as the end of the useful life of ITNs. Most participants noted that even though the age of the net matters, the ITNs must, however, begin to tear or be torn beyond repairs before disposing of it or use for another purpose. To them, certain features begin to show, such as fading of the color of the ITNs; getting torn whiles washing and stretching of the material which influences their

decision to dispose of the ITNs. Generally, participants indicated that the useful life of the ITNs depends on how you take care of the ITNs.

> *"I will say 3 years but if you look after it properly it could exceed the 3 years but in the course of washing the manner in which the net tears tells you the time is up for you to dispose of "* (FGD Participant, Peri-urban-Ayikuma).

Another important theme arising from the discussion was on the perceived potency of the insecticides in the ITNs after some time of using it. Participants also mentioned that when the insecticides concentration in the net begin to diminish you are able to see mosquitoes landing on the ITNs, it makes it less useful for sleeping and hence the need to replace such ITNs and dispose of the old one. In response to the above theme, some participant said;

> *"To me, the mosquito net loses its efficacy a year after its use, the mosquitoes die when they come into contact with a fresh net but when it loses some of its efficacy they can settle on it and even bite you in the net"* (FGD Participant, Peri-urban-Ayikuma).

> *"As for me and my family the moment the net is dirty we wash it but when the net is even less than a year and has started developing holes we change it, at times we buy it ourselves"* (IDI Participant, Peri-urban-Abonya).

Even though there was no definitive answer from the study participants about the when ITNs expire, most respondents agreed that ITNs are active for a maximum of three years and their activeness is largely dependent on the care of the net.

4.3 Net care/maintenance practices

When asked to describe care practices, respondents generally cited measures taken to prevent damage to ITNs. These included proper handling, washing when dirty, not hanging clothes on hanged ITNs, seasonal non-use of ITNs and keeping ITNs out of children's reach by tying them up. Participants stressed the importance of putting away the net immediately upon waking up in the mornings by folding it or tying it up, and being very careful when arranging the net over the sleeping space in the evenings as other practices of caring for the bed ITNs. Some of the responses from the participants are quoted below;

> *"I do not allow anyone to dry clothes or hang clothes on it. It will weaken it when we put our clothes on it"* (FGD Participant, Rural-Abonya).

> *"Everything you use whether it will last long or not depends on how you care for, you can wash a net after 3 or 4 months, so, it depends on how you use it and mine is over 3 years now since I started using mine"* (FGD Participant, Peri-urban, Ayikumah).

The majority of participants made reference to washing ITNs as an important part of caring for ITNs. However, ideas on how to do this varied greatly. Washing a net too frequently was

seen as a way to damage a net; at the same time, not washing a net often was also seen as potentially damaging. Some respondents noted that ITNs should not be washed frequently and not aired directly under sun rays after washing since this could affect the insecticide concentration. They further said that such ITNs should be washed with mild soap as a response from a participant below suggest.

> *"We must remember to wash it every 3 months with 'key soap' and dry it under a tree. We must also make sure the children do not play with it and if it gets torn we must immediately repair it, but if you do otherwise you might think the net is not good"* (FGD Participant, Peri-urban-Ayikumah).

A small number of participants mentioned other preventive measures, such as following care instructions given by providers of the ITNs, immediately sewing holes at the first sign of damage to keep them from getting larger and daily inspections of the net condition. The preventive behaviour was mentioned less frequently than keeping ITNs away from children and rodents, washing, and careful handling of ITNs.

4.4 Motivations to care and repair ITNs

When asked what motivates participants to care and repair their ITNs, many respondents said it is important to take care of a net because it protects them from malaria and from mosquito nuisance. Motivations to care for and repair ITNs most commonly concerned health, citing both overall well-being and prevention of malaria and mosquito bites specifically. Some responses from participants have been highlighted below;

> *"What motivates me to repair my net is that, I have gotten it freely, it protects and prevent the mosquitoes from biting me and in case I get malaria and am not having money, how can I treat myself?"* (FGD Participant, Rural-Tokpo).

> *"For me, I value the net because it protects my family and my unborn child. That is why I make sure that is in good shape and I repair it anytime it gets torn because I don't want mosquitoes to bite me or any member of my family"* (IDI Participant, Peri-urban-Kasunya).

Another slightly less common motivator was to save money on health expenses. The desire to increase the longevity of ITNs until the next free distribution also came up as an important motivation for caring for ITNs.

> *"Knowing it will take the next three years to expire or before I can get a new one, so I will care and repair it within that period"* (FGD Participant, Rural-Tokpo).

4.5 Barriers to care and repair of ITNs

Respondents discussed the reasons why people may not care for or repair their ITNs. Reasons include not having the time to care for and repair ITNs, laziness, the extent of damage to the net, the availability of free ITNs distribution through the various distribution channels and not knowing the value of the net. A common theme running through the

discussions was that people generally do not place any value on the ITNs and therefore did not make time to care for or repair their ITNs. Even though most participants agreed that ITNs protect them against malaria, they did not see the need to attach any such significance to ensuring that ITNs are kept in good shape. To them ITNs should simply be replaced with a new one when torn as suggested by one participant below;

> *"Some people are just lazy and do not care about the state of their ITNs. They do not place any value on the net because it is free"* (FGD Participant, Rural-Abonya).

Other frequently mentioned reasons for not caring for the ITNs were that they are distributed freely at frequent intervals and from different channels. Some respondents indicated that ITNs are given to pregnant women, children in school, and through national mass distribution campaigns every three years as well as the distribution of ITNs occasionally in some of the communities by NGOs. Hence, respondents perceived repairing ITNs as needless since it will be constantly replaced.

> *"Previously we were not given the net like these days because when I got pregnant and went to the hospital I was given a net and that same year I was also given another one when they distributed in the community. When my baby was 18months he was also given another net, so they know that when they are pregnant they will be given at the facility so because of that people use it anyhow they like"* (IDI Participant, Peri-urban -Tokpo).

Other respondents also stated that they would want to dispose of ITNs that have developed a lot of holes or large holes instead of repairing. They preferred using a new net instead of repairing ITNs when torn. Respondents stated that sometimes in trying to repair ITNs it may cause further damage, making net repair not a good option for them.

> *"Sometimes when there are holes in the net the mosquitoes pass through the holes to bite us. The more you sew the more it develops holes and the material keeps getting weaker so you have to replace it"* (FGD Participant, Rural-Kasunya).

Another barrier to net repair was the preference among respondents for a new net rather than repairing an old one. When a one-year-old torn ITNs was shown to elicit participants' views on what they would do if the ITNs belonged them, most participants indicated that they would prefer using a new net than repairing the old one. In some of the communities, however, different opinions were found. Respondents indicated they would give the older ITNs to other members of the household and use the new net. Others said they would keep the new net until the time the old net becomes unrepairable.

> *"As for me, the moment the net is one year, I know it's old and needs to be changed, so if the one I am using is one year old with holes in it and by Gods' grace I am given one, then I have to change it but if I have children then they will use the new one provided, whiles I continue to use the old one"* (FGD Participant, Urban-Ayikuma).

> *"I put mine down in case I receive any visitor I hang it on them and even without the insecticide active in them it protects them from the mosquito bites"* (IDI Participant, Peri Urban-Tokpo).

A minority of the participants also cited the expected number of years ITNs are supposed to last, as a reason why they may not care for it. They believed that when ITNs last for 3 years and after that there is no need to keep repairing or take care of it; hence, care and repair are only done when ITNs have not reached this number of years.

> *"I will only not care or repair if it's over the 3year period we were told the ITNs will last for when it was given but if it gets torn before that, then I will sew it"* (FGD Participant, Peri Urban-Tokpo).

Almost all responses to barriers to net care and repair were linked to the households' valuation of the net and of the protection, it offered versus the cost and time to repair it.

4.6 Repurposing and Misuse of ITNs

Respondents in both FGD and IDI most commonly stated that old ITNs are those used for other purposes than sleeping and not new ones. Respondents described what they and other community members do with old ITNs. Respondents stressed that ITNs that are due for disposal either as a result of the age of the net or damaged, are those that could be repurposed. Alternative uses of ITNs included using ITNs for fencing gardens, fishing, and window

screening, stuffing pillows, enclosing poultry farm, drying fish and pepper and covering refuse on mopeds. For instance, a respondent noted this;

> *"We use the damaged ones to fish in a dam behind us in the community. It is better than dumping it on the compound"* (FGD Participant, Rural-Abonya).

Another participant had this to say:

> *"We sometimes used the old torn ITNs as window nets and on our kitchen doors to prevent the mosquitoes and mice from entering"* (FGD Participant, Rural- Abonya).

4.7 Perception on benefits ITN use

In order to elicit participant's knowledge on ITNs and its uses participants were asked about what they know about ITNs and its uses. The majority of the respondents indicated that ITNs repel mosquitoes, kill mosquitoes, prevent malaria and kill some insects. Knowledge on ITNs and its rightful use were very well known by the participants. However, some respondents noted that ITNs are useful only during the rainy season. A participant had this to say about the usefulness of ITNs.

> *"Prior to the free distribution of nets, I used to take my first to the hospital frequently and we were told its malaria but since we got the net, in fact,*

malaria has stopped worrying him so the nets are very good in preventing against mosquito bite and malaria" (FGD Participant, Peri-urban-Tokpo).

Respondents mentioned that they are motivated to use the net because of reduction in malaria cases in their houses particularly among children. Net use was encouraged among community members because of their perception on how well ITNs worked at preventing malaria and continued using them will keep them safe from bite and malaria.

CHAPTER FIVE

DISCUSSIONS

5.0 Introduction

The purpose of this study was to explore households' perception of the end of useful life of ITNs and practices towards care and repair. Specifically, the researcher examined households' perception of the end of useful ITN life and explored local knowledge, attitude, and practices towards ITN care and maintenance. The factors accounting for misuse and repurposing of ITN in households in the Shai Osudoku District were also examined. This study was a qualitative prospective study in the month of June 2017.

5.1 Household perception on end of useful life of ITNs

The results from this study show that factors that determine the end of useful life of ITNs as perceived by the household were physical condition of the net, the age of the net, perceived potency of the insecticide and fading of its color. Physical condition entailed the presence of holes (number and size) in the nets, which permitted mosquito entry and also makes the nets difficult to repair.

The results also show that the receipt of a new net is not likely to itself serve as a cue to retiring a net. Upon receipt of a new net, somewhat old but still useful nets were likely to be shared with others or saved until an old net became worn. In addition, this work shows that when nets are very torn, participants preferred to get a new net if they are able. In this case, torn nets are thrown away or repurposed through alternative uses. The results provided

insights into households' perception on end of net life that are consistent with and build upon existing literature.

While the results showed a number of cues to retiring a net, most of the criteria were related to the physical integrity of the net. Respondents reported that they would often use a net until they perceived it to be irreparably damaged and determined that it had expired due to the presence of holes in the net or the mosquitoes in the net at night due to the holes. This is consistent with other research, which found that the condition of the net often determines whether the net is used (Loll et al., 2013; Pulford, Hetzel, Bryant, Siba, & Mueller, 2011).

Since the integrity of the net is the most salient criteria for determining whether a net is useful, the way that a net is cared for and repaired becomes increasingly important for preventing and repairing the damage. Existing research has shown that net care and repair behaviours are likely to impact net longevity and durability by prolonging the protective lifespan of LLINs (Loll et al., 2014).

ITN's diminishing knock-down effect over time was perceived as a sign of ineffectiveness. The results on the perceived loss of net effectiveness due to diminishing insecticide as a factor for determining the end of net life is also similar to results of the study by Pulford and colleagues (Pulford et al., 2011).

The results showed that the availability of a new net was unlikely to be a trigger for discarding an existing net in decent condition. Most of the study respondents reported that if

they were in a situation where they had a usable net and received a new net, they would save the old net for later use until the old one becomes un repairable or share with other members of the family. This suggests that an over-supply of nets within a given household would likely be used or redistributed to family members without access to a net. However, in some of the communities such as Abonya and Tokpo, respondents mentioned that they would prefer to switch to the new net and used the old net for alternative purposes. This could be due to reasons such as using the old nets for fishing and drying of small fish "keta school boys".

5.2 Practices towards care and repair

Households' heads were knowledgeable about the causes of damage to their nets and ways to mitigate that damage. Respondents listed several causes and specific examples of how nets can be damaged in their homes, indicating they have experience with net use and net damage. There was a consensus among respondents that the major cause of damage to nets is primarily children, followed everyday handling that is not gentle. This is consistent with studies conducted elsewhere (Elvet, 2005).

Net users in Shai Osudoku linked many of their net care practices to mitigation of net damage. In this context, net care primarily involves careful handling, keeping ITNs out of reach of children, washing when dirty and seasonal non-use of ITNs. In addition, avoiding hanging clothes on hanged ITNs and immediately sewing holes at the first sign of damage to keep them from getting larger were other net care behaviours discussed during the FGDs. Furthermore, net washing and drying practices were variable and often respondents stated

washing as and when is dirty. This could shorten the efficacy of the nets as shown by previous studies, (Loll et al., 2013, 2014; Scandurra, Acosta, Koenker, Kibuuka, & Harvey, 2014).

There were a number of perceived barriers to net care and repair including lack of time to care for and repair ITNs, laziness, the extent of damage to the net, the availability of free ITNs distribution. People generally preferred to seek out a new net rather than repair their existing net. This was largely related to the challenges of repair and the feeling that repairs could cause even more holes or result in a net that was weaker than before.

5.3 Misuse and repurposing of ITNs in households

In contrast to other studies on the misuse of bed nets, it was also observed that the majority of the nets that were re-used for various purposes were old, expired or torn beyond repair. The results show that nets are highly valued in these communities and that often, nets that have reached the end of their useful life are repurposed for alternative uses. The alternative uses of the old and torn nets employed were driven by residents' needs and priorities, and necessitated by the lack of official guidance on how old nets should be disposed of after expiry.

In this study, it was reported that most often expired rather than active nets are used by people in their communities for purposes such as fencing gardens, fishing, window nets, stuffing pillows, enclosing poultry, drying fish and pepper and covering refuse on mopeds. This finding supports what were reported in other studies, where old nets were used for other

purposes (Koenker et al., 2013; Loll et al., 2013; Mutuku et al., 2013). However, the researcher did not find repurposing of new nets as reported in other studies (Lover, Sutton, Asy, & Wilder-smith, 2011).

Only a few studies reporting on alternative uses of nets provide evidence on net condition at the time of repurposing (Leontsini et al., 2013). From the findings, only torn nets or expired nets, which were no longer useful for mosquito control, were repurposed for alternative use. These findings support other research findings that it is primarily old nets or nets that were torn beyond repair that were used for other purposes (Kibe et al., 2015).

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Conclusion

The results of this research provide us with important information on the cues for retiring or repurposing of nets as well as perceived causes of net damage and barriers to net care and repair in the district. Households' as cues to discarding a net use criteria such as the physical condition of ITNs. Respondents reported various ways in which nets can become damaged; barriers as well as motivations to the repair of ITNs were also reported.

Nets are typically damaged by behaviours related to daily use. Behaviour that prevents and mitigates net damage, such as care and repair, are important for maintaining net integrity and durability. Given the public health benefit and potential cost-savings of improving the net integrity and thus durability, it is critical to understand the full range of the barriers, motivators, and attitudes surrounding net care and repair, to ensure that protective behaviour is promoted and that nets last their full, protective lifespan in the household.

6.1 Recommendations

Following from the discussions, the following recommendations are made to the for the National Malaria Control Programme (NMCP) and its partners implementing vector control interventions such as VectorWorks and Communicate for Health in order to lengthen ITNs useful life span

- Even though it is important that people care for and repair their nets to prolong net life, nets will ultimately become too damaged to use and will need to be replaced. Since no universally accepted definition of the end of life of a net exists and responses varied, the NMCP should develop guidelines on determining the appropriate end of net life and communicate to net users. Net users need to have an increased understanding of how long nets are expected to last, how best to care for, repair the net, and at what point the net is no longer protecting them from mosquito bites and for that matter malaria.

- Efforts should be made to promote specific actions on net care and repair in future net distributions and routine malaria prevention communication this will potentially delay the deterioration of ITNs in households. Behavioural change interventions aimed at promoting the benefits of net care and repair as well as providing people with doable actions to overcome the barriers to net care should be promoted through Social and Behavioural Change Communication programmes. Messages should be developed on actions that promote storing or tying up as an easy daily routine done by responsible, caring individuals that takes little to no time. Emphasize proper washing practices and frequency – wash net 3–4 times a year in a basin or bucket with water and mild soap, not detergent or bleach. Position nets as special, not to be treated like clothes, to be washed infrequently to protect the insecticide. Keep nets tied up and/or stored when not in use to prevent dirt. Other actions that promote benefits of repair such as malaria prevention; saving money on purchasing a new net and on treatment for malaria should be active part such SBCC programmes. The

messages should also emphasize checking nets for holes routinely and repairing small holes immediately and position repair as an intelligent and efficient use of resources.

- Alternative uses of old and worn out nets should not be interpreted as misuse but seen as an innovative way of using them. Therefore, there is the need to promote viable ways of using old and torn nets, in particular for uses that contribute to mosquito control. For example, people could be encouraged to use them in a way that compliments malaria control efforts such as using them as window screens and covering water wells.

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APPENDICES

Appendix I: Focus Group Discussion and In-depth Interview Guide for Household Heads

Moderator: _____ Note taker: _____

Date: _____ No. of participants: _____

Community: _____ Site: _____

Start: _____ End: _____

	TOPIC	MAJOR QUESTIONS
1	**Knowledge on ITNs**	1. What do you know about mosquito nets (ITNs)? 2. What are the uses of mosquito nets (ITNs)?
2	**Perceptions on end of ITN life**	3. When is the mosquito net no longer useful? (When to decide to use mosquito nets (ITNs) for other purposes than sleeping) 4. How do you decide that a net is ready for disposal? (illicit their views on factors that may influence their decision to repurpose or misuse nets) 5. What do you do with old and torn nets? (Participants were shown an old, torn net and were asked about their perceptions of the net. Participants were then asked to reflect on what they will do if the net belonged to them and the reasons for this decision) 6. What will you do if you have a useful net and you are given a new one? (Participants were asked to imagine what they will

		do if they have a one-year-old net that had no or only a few small holes should they receive a new net)
3	**Care and Maintenance Practices**	7. What measures do you take to care for your mosquito nets (ITNs)? 8. What will you do to repair damaged ITNs? 9. What motivates you to repair your nets? 10. What are the reasons why you may not care/repair your nets?
5	**Misuse and Repurposing of ITNs**	11. How are old ITNs used and when? 12. Apart from using mosquito nets for sleeping, what are the other uses of the net?

Appendix II: Socio-Demographic Characteristics of Participants

1. Community _____
2. Name of Household Head _____
3. Sex ☐ Male ☐ Female
4. Age of household head _____
5. Marital status ☐ Single ☐ Married ☐Divorced ☐Separated ☐Other
6. What is your ethnicity? _____
7. What is your religion? ☐Islam/Muslim ☐Christian ☐Traditionalist ☐Others (specify)_____
8. Highest educational level attained ☐ Primary ☐ Secondary ☐ Tertiary ☐ None
9. What is your occupation? ☐Farming ☐ Petty trader ☐ unemployed ☐ Others (specify) _____
10. What is your household size? _____
11. Do you have bed net (s) in this household? ☐ Yes ☐ No
12. How many nets do you have in your household? _____

Appendix III: Information Sheet for Household Heads/Spouse

Principal Investigator: Robert Opoku, School of Public Health, University of Ghana, Legon, Tel:

0208935785, email:Robert.opoku@yahoo.com.

Introduction

You are invited to participate in a focus group discussion on the study on "Household's Perception, Practices and Maintenance Culture in end of Useful Life of ITNs in the Shai Osudoku District". I am going to give you information and invite you to be part of this research. Before you decide, you can talk to anyone you feel comfortable with about the research. This consent form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me.

Purpose of the research

If you choose to participate you will be participating on the discussion on mosquito nets. You might expect questions on what you know about the end of useful life of ITNs and the different ways that people use mosquito nets other than its original purpose and local knowledge, attitudes and practices towards care and repair of mosquito nets.

Procedures

If you accept, you will be asked to take part in a discussion with 7-8 other persons with similar experiences. I will guide this discussion. I will ask you questions about the mosquito

nets and give you time to share your knowledge. I will not ask you to share personal beliefs, practices or stories and you do not have to share any knowledge that you are not comfortable sharing. The discussion will take place where no one else but the people who take part in the discussion and myself will be present during this discussion. The entire discussion will be tape-recorded, but no-one will be identified by name on the tape. The information recorded is confidential, and no one else except other members of the research team will have access to the tapes. This is study is purely an academic work which forms part of my requirement for the award of a Master of Public Health degree. The discussion will be held once and will take about one hour.

Voluntary Participation

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate it will not involve any penalty. You are free to withdraw consent and discontinue participation in this discussion at any time without prejudice from the study team.

Risks and Discomforts

I do not anticipate any potential risks of participation to you. Most of the interview questions and discussions are not particularly sensitive. Nevertheless, if for some of the questions you are embarrassed or feel reluctant to discuss them, you can choose not to answer or discuss any question, and you can choose to drop out at any time, even in the middle of the discussion. You do not have to give me any reason for not responding to any question, or for

refusing to take part in the discussion. There will be no costs for participating in the discussion

Benefits and Reimbursement

There will be no direct benefit to you, but your participation is likely to help me find out more about cues to end of useful life of mosquito nets and practices toward care and repair. You will not be provided any incentive to take part in the research. However, I will give you a bar of key soap for your time. It is hoped that experiences gathered at this discussion will be shared with policy makers, academia, and other stakeholders to improve education on the use and care of ITNs.

Confidentiality and Anonymity

All information gathered from the discussion will remain confidential. Your identity as a participant will not be disclosed to any unauthorized persons. Any information about you will be coded and I will lock that information up with a lock and key. Nothing that you tell me today will be shared with anybody outside the research team, and nothing will be attributed to you by name. Any references to your identity that would compromise your anonymity will be removed or disguised prior to the preparation of the reports and publications.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so, and choosing to participate will not affect you in any way. You may stop participating in the discussion at

any time that you wish without you being affected. I will give you an opportunity at the end of the interview/discussion to review your remarks, and you can ask to modify or remove portions of those, if you do not agree with my notes or if I did not understand you correctly.

Who to Contact

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact the principal investigator Mr. Robert Opoku (0208935785).This proposal has been reviewed and approved by the Ghana Health Service Ethical Review Committee, which is a committee whose task it is to make sure that research participants are protected from harm. If you wish to find about more about the ERC, contact Hannah Frimpong (0243235225/0250704223)

Appendix IV: Certificate of Consent

I have been invited to participate in the research about **"Household's Perception, Practices and Maintenance Culture in end of Useful Life of ITNs in the Shai Osudoku District".**

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

Name of Participant: _____

Signature of Participant: _____

Date: _____

Thumb print of
Participant unable to sign

I certify that I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the purpose of the study, procedures to be followed as well as risks and benefits involved.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of Researcher: _____

Signature of Researcher: _____

Date: _____

Appendix V: Ethical Approval Letter

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com

MyRef. GHS/RDD/ERC/Admin/App/583
Your Ref. No.

Robert Opoku
University of Ghana
School of Public Health
Legon, Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC: 139/02/17**
Project Title	Households' Perception, Practices and Maintenance Culture in end of Useful Life of Insecticide Treated Nets in the Shai Osudoku District.
Approval Date	1st June, 2017
Expiry Date	31st May, 2018
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report **after completion** of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra