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A Qualitative Assessment of the Community Perceptions of Indoor Residual Spraying (IRS) as a malaria prevention mechanism in Mwanza, Tanzania

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By

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Bachelor of Arts, Biology
Grinnell College
2012

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2014

ABSTRACT

A Qualitative Assessment of the Community Perceptions of Indoor Residual Spraying (IRS) as a malaria prevention mechanism in Mwanza, Tanzania

By Phyllis Frimpong

Background: The WHO estimated that in 2010, 219 million clinical cases of malaria occurred with an associated death toll of 627, 000 worldwide. Currently in Tanzania, malaria causes 60,000- 80,000 death annually, mainly in children and pregnant women. The successful elimination of malaria transmission in Tanzania is critical for the reduction of child and maternal mortality and reduction of strain on health facilities. To reduce malaria disease burden, the President's Malaria Initiative (PMI) implemented Indoor Residual Spraying (IRS) in Tanzania as a control strategy.

Objective: The main objective of this study was to examine perceptions about IRS as a malaria control mechanism for one particular district in Tanzania. Reasons for IRS refusal and acceptance and suggestions for improving IRS in the district were explored.

Methods: Qualitative methods were used to explore IRS perceptions, popular malaria prevention methods, issues stifling efficiency of IRS and suggestions for IRS improvement. Four focus group discussions and sixteen illness narrative interviews were conducted. All discussions and interviews were digitally recorded and, transcribed in Kiswahili and translated into English. Data was analyzed using Nvivo8.

Results: Participants were knowledgeable about the general causes of malaria. Two broad categories of people were identified: individuals whose homes had been sprayed and others whose homes had not been sprayed. Overall most homes had been sprayed but perceptions about IRS were mainly negative. This was due to inadequate community sensitization about IRS, increased prevalence of bed bugs and other insects, rumors, logistical hurdles and an unabated malaria and mosquitoes prevalence.

Discussion: To increase IRS acceptance and effectiveness, timely and detail-oriented community sensitization for subsequent IRS activities is stressed. Broader measures for malaria reduction in the environment and measures to counteract the rampant insect infestation following IRS are necessary. Improvement of sprayers utility in assisting women especially with the logistical hurdles is emphasized. Addressing the negative perceptions about IRS will improve communal experiences with IRS and enhance its delivery.

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CHAPTER 1: INTRODUCTION

Malaria is one of the deadliest infectious diseases worldwide causing an estimated 627,000 deaths annually. [1, 2]. Tanzania, like many African nations, continues to experience an up hill battle in attempts to rid the nation of malaria. Currently in Tanzania, malaria causes 60,000- 80,000 death annually, mainly in children and pregnant women. The successful elimination of malaria transmission in Tanzania is critical for the reduction of child and maternal mortality and reduction of strain on health facilities.[3] The high morbidity and mortality rates rampant in Tanzania has influenced the implementation of malaria control strategies both on the mainland and in Zanzibar where an estimated 41 million people are at risk [3].

The United States Centers for Disease control and Prevention and the World Health Organization, highlight the threat malaria poses to African children and pregnant women [1, 3]. In response to research evidence demonstrating the threat of malaria to these populations and a need for enhanced malaria control strategies, the United States Government launched the President's Malaria Initiative (PMI) in 2005 [3]. Considering Tanzania's need for a more robust approach for tackling malaria and local capacity to do so was inadequate, PMI partnered with the national government in Tanzania to implement four control strategies: Insecticide Treated Nets (ITNs), Indoor Residual Spraying (IRS) with pyrethroids, case management with Artemisinin-based

Combination Therapy (ACT), and Intermittent preventative treatment during Pregnancy (IPTp) [3].

IRS is one of the main components of the PMI malaria control efforts in Tanzania. It was launched in Tanzania in 2007, and by 2012, had been implemented at least twice in the Lake zone regions, where our study was conducted. In 2010, during the first round of spraying, an 84% coverage rate was achieved, while the second round conducted in 2011, reported a 97% coverage rate [3]. PMI funds all IRS activities in the lake zone and works in partnership with the National Malaria Control Program (NMCP) and other local partners to train sprayers, sensitize the public and spray homes to reduce mosquitoes in the region.

This thesis presents qualitative analysis which examines community perceptions about IRS undertaken in one district of Mwanza, one of the Lake zone regions. The data informing this study on community perspectives was obtained from the IMAPCT 2 project. IMPACT 2 was a qualitative study conducted by the Malaria branch of the United States Centers for Disease Control and Prevention (CDC). The primary aim of IMPACT 2 was to evaluate the national roll out of two interventions to improve access and targeting of Artemisinin-based Combined Therapy (ACT) to confirmed cases of malaria. This was done in three regions of Tanzania. Mwanza, was one of the IMPACT 2 project regions but had also undergone IRS activities. Therefore, the qualitative component of IMPACT 2 was designed to incorporate questions to explore community

perspectives on IRS. The data presented in this thesis, is thus derived from two focus communities in the Mwanza region where both IRS activities and the IMPACT 2 project were undertaken.

Specifically, my study assessed IRS recipients' local knowledge of malaria, malaria prevention methods and perceptions about community sensitization prior to IRS. We sought to explore the participants' reaction to logistics of IRS and the benefits of spraying on malaria transmission and mosquito reduction. My study also explored factors that contributed to local acceptance of IRS activities and aimed to identify key factors that are essential for the development of successful IRS messaging. Participants were asked about their current knowledge about IRS benefits, whether they had participated in the fumigation activities and were given an opportunity to offer suggestions for improving future IRS activities.

Using the data collected from these responses, my research will provide community's perspectives for IRS program improvement.

CHAPTER 2: LITERATURE REVIEW

Background

In 2010 an estimated 219 million cases of malaria occurred worldwide causing a death toll of about 660,000; 91% of which occurred in Africa [3]. Malaria can be categorized as uncomplicated and complicated or severe with the latter resulting in higher morbidity. Without treatment, severe complications develop with death frequently occurring[2]. For this reason, malaria remains one of the largest threats to child survival and maternal health in Tanzania and warrants long-term investment for disease control in-country [3].

IRS is one of the recommended malaria control mechanisms, which has helped reduce disease burden in Tanzania. In 2006, the World Health Organization lent it support to Indoor Residual Spraying, as a recommended means for malaria control [4]. IRS involves spraying indoor walls with insecticides to kill mosquitoes. Targeting mosquitoes by with this approach is effective because mosquitoes rest on walls while digesting a blood meal after biting a human. Mosquitoes are therefore killed before they can bite another individual to perpetuate the transmission of the malaria parasite [3].

IRS use in Tanzania dates back to the late 1950s and continues to be implemented in the lake regions of Mwanza, Kagera and Mara [5]. The President's Malaria Initiative (PMI) supports IRS activities in these regions. PMI is a United States Government (USG) initiative, mandated to reduce malaria deaths in half in target

countries.[2] PMI is jointly implemented by the U.S. Agency for International Development (USAID) and the Centers for Disease Control and Prevention (CDC).

Although IRS coverage rates are high (85% - 97%) in Tanzania and there is an abundance of quantitative data about IRS in the three lake regions[3], PMI was interested in a qualitative evaluation of the IRS activities in Mwanza, one of the implementation regions. To gather the needed information for the proposed IRS evaluation, PMI partnered with the IMPACT 2 project, which was a separate multi-disciplinary evaluation of the national rollout of two malaria interventions.

The main focus of the IMPACT 2 project was to evaluate the implementation of two malaria control interventions designed to improve the access and targeting of Artemisinin combination therapy (ACT) in the Mwanza, Mtwara, and Mbeya regions of Tanzania. The IMPACT 2 study initially had no connection to IRS, however, since it was set to occur in one of the districts where IRS had also been implemented, the IMPACT 2 principal investigators from CDC decided to add IRS-related questions to the IMPACT 2 qualitative topic guides in 2012, to examine community perceptions about IRS. Hence, the qualitative IRS data obtained from the IMPACT 2 project was analyzed and discussed for this thesis.

Statement of Objectives

For the purpose of this thesis, 5 key objectives were identified, namely to:

- Examine perceptions about community sensitization prior to IRS activities.

- Explore participants' reaction to logistics of IRS
- Examine the local perceived benefits of spraying on malaria transmission and mosquito reduction
- Recognize factors that contribute to local acceptance of IRS activities
- Make recommendations for key factors that are essential to improve IRS implementation and acceptance in Mwanza.

A better understanding of the outlined study objectives will inform recommendations to improve delivery of IRS in the study region and inform implementation of future IRS activities. Below, I present additional background information necessary to set the context of my study.

Malaria in Tanzania

The United Republic of Tanzania is located in East Africa.[6] With a population of approximately 49 million, the country is divided into 30 administrative regions, 5 of which are located on the islands of Zanzibar with the remaining 25 on the mainland.

Malaria is common in tropical and subtropical regions such as Tanzania as high rainfall and warm temperatures provide the ideal environment for breeding mosquito larvae [7]. The disease is contracted

following an infective bite by the anopheles mosquito and the introduction of the plasmodium parasite into the circulatory system. Malaria often manifests in the form of fever, chills and flu-like illness but can progress to cause coma and eventually death [2].

In Tanzania, the entire population of 41 million residents on mainland are at risk for malaria [3]. Information from Tanzania's National Malaria Control Program (NMCP) indicate there are 14-18 million clinical malarial cases annually on Tanzania's mainland [3] , which account for approximately 40% of attendees which constitutes the largest disease burden on government resources. Estimates of malaria deaths across various age groups on the mainland are between 60,000-80,000 annually[3].

Tanzania is also characterized by different malaria transmission rates and patterns evidenced by an unstable seasonal transmission in 20% of the population, and by stable but seasonal transmission patterns in another 20% of the country[3]. The remainder of the country experiences stable perennial transmission. In both areas, *Plasmodium falciparum* accounts for 96% of malaria infection, by the principal vector, the *Anopheles Gambiae [3]*. However, recent entomologic data reveals that the *Anopheles arabiensis* accounts for more than 90% of the mosquito population in Zanzibar [3].

Malaria in pregnant women and children under 5 define the highest risk group in Tanzania and accounts for more than half the deaths in children under 5 [5]. Women are at increased risk of contracting malaria during their first pregnancy[3]. The associated risk of malaria in pregnancy involve stillbirths, spontaneous abortions, infant mortality

and low birth weight as parasites interfere with delivery of essential substances through the fetal placenta [8] [9]

As with most infectious disease dynamics, poor and rural areas in Tanzania account for the majority of grave malaria statistics [5]. However, a recent Roll Back Malaria review reported a greater decline in death rates in rural areas of Tanzania as compared to urban settings. This phenomenon is described as perhaps an indication of increased program reach to poor and vulnerable populations who have been particularly targeted for a reduction in malaria burden [3].

President's Malaria Initiative (PMI)

The PMI was launched in 2005, with the goal of reducing malaria deaths by half initially by 2010, in designated sub-Saharan African countries.

This $1.2 Billion initiative seeks to expand coverage of four highly effective evidence-based preventive and therapeutic interventions, namely, case management with Artemisinin-based combination therapies (ACTs), Insecticide-treated nets (ITN), intermittent preventive treatment during pregnancy (IPTp), and indoor residual spraying (IRS). Additionally, PMI seeks to support NMCP in the areas of monitoring and evaluation, health systems strengthening and integration and epidemic surveillance and response [3]. In 2008 the Lantos-Hyde Act extended PMI funding from FY 2009 to FY 2014 with the revised goal of halving the burden of malaria in 70% of at-risk populations in sub-Saharan Africa by 2015, thus reaching 450 million people [3].

PMI in Tanzania

PMI-supported activities in Tanzania were launched in June 2005. Following its introduction into the country, PMI has supplemented malaria control efforts with both mainland Tanzania's National Malaria Control Program and Zanzibar's Malaria Control Program (ZMCP). The NMCP and ZMCP undertake decisions concerning malaria intervention programs for mainland and Zanzibar respectively. PMI's collaboration with the NMCP and ZMCP, has tremendously increased access to malaria prevention and treatment interventions in Tanzania [3]. The presence of the PMI program has successfully established a relative contribution of diagnostically confirmed malaria among patients presenting to first-line health facilities and drug stores in rural Tanzania. Malaria prevention milestones achieved also include launching the impact of Artemisinin-based Combined Therapy, ITNs, and nearly eliminating malaria transmission in the Zanzibar Archipelago. The program has also provided detailed implementation evidence for the rollout of rapid diagnostic tests for malaria in rural Africa [3].

In collaboration with the NMCP, ZMCP, Global Fund and other malaria control programs, the PMI Malaria Operational Plan (MOP) was reviewed and approved to support four key malaria control strategies in Tanzania: Indoor residual spraying, the use of Insecticide Treated Nets, Artemisinin–based Combination Therapy and Intermittent Preventive Treatment during pregnancy [3].

Malaria Control Strategies in Tanzania

Insecticide Treated Nets (ITN)

The primary aim of Insecticide treated nets, commonly referred to as mosquito nets, is to serve as a physical barrier to prevent mosquitoes from reaching the human skin are the most popular prevention methods used [3]. Nets are made more efficient as a malaria control strategy by treatment with insecticide. Thus in recent years most nets have been impregnated with pyrethroids, a low toxicity chemical [2]. The insecticide serves the purpose of killing mosquitoes upon contact with the treated net thus contributing to the double-prong approach of bite prevention and mosquito elimination. A study by Raghavendra suggests that ITNs are twice more effective than untreated nets and offer 70% greater protection from mosquitos compared to no net use [10]. ITNs have been shown to as highly effective malaria control strategies particularly for children in where malaria is endemic. [10].

As of 2010 63% of households on mainland and 76% of households in Zanzibar had at least one net. By 2011, under a Universal Coverage Campaign (UCC) and the under-five campaign, 26.4 million free ITNs were distributed on mainland Tanzania and an estimated 660,000 nets in Zanzibar. PMI also implemented the Tanzania National Voucher Scheme, which supports pregnant women and caregivers of infants in obtaining highly subsidized ITNs with the use of vouchers at local ITN retailers [3].

Case Management with Artemisinin-Based Therapy (ACTs)

Although prevention strategies are essential and continue to form an integral part of malaria control, treatment regimes are necessary for the management of malaria once the symptoms arise. The use of ACTs was officially launched in mainland Tanzania in December 2006 [3]. Artemether-lumefantrine (AL) was chosen as the first–line of treatment and artesunate-amodiaquine as the second line of treatment for uncomplicated malaria by the NMCP [3]. Artemether-lumefantrine (AL) is currently being used in all public health facilities as the key treatment. For severe malaria however, Quinine is currently the recommended treatment, but my soon be substituted for injectable artesunate [3].

The NMCP's aim to improve the accessibility and use of safe, effective, quality and affordable malarial drugs [3]. In addition to ACT use, PMI continues to support microscopy training and implementation of quality assurance/control for Rapid Diagnostic Tests (RDTs) to efficiently test and diagnose malaria [3].

Intermittent Preventive Treatment in Pregnancy (IPTp)

Intermittent Preventive Treatment in Pregnancy (IPTp) is a malaria control mechanism particularly targeted towards pregnant women, who are at high risk [3]. The recommended policy for IPTp is two doses of sulfadoxine-pyrimethamine (SP) administered as directly observed therapy[3]. The first dose is given during the first visit following quickening (from 20 weeks) with the second dose administered within the third trimester, four weeks or more after the first dose.

IRS in the Lake Zone

The Lake Zone regions in Tanzania (Kagera, Mwanza and Mara) are characterized by high malaria prevalence (41% testing positive for Malaria) and unstable transmission. Consequently, these regions have the highest burden of malaria in all of the mainland[3].

IRS activities were launched in Muleba and Kagera districts of Kagera Region in 2007, where frequent malaria outbreaks occurred. In 2009, IRS activities were expended to all districts of Kagera. By 2011, IRS had been expanded to the Mwanza and Mara Regions [3]. In late 2011 and early 2012, 6.5 million people were protected from malaria transmission following an intense spraying exercise involving over 1 million households in 18 districts of Mwanza, Mara and Kagera in Tanzania [11]. This exercise illuminated issues of increasing insecticide resistance and prompted a shift from pyrethroids to carbamate as the primary insecticide of choice for spraying activities in the Karagwe and Muleba districts [3].

Following the achievement of ITN universal coverage in mainland Tanzania, the IRS activities in the lake region were reduced, with continued spraying activities in 11 districts in the Mara and Mwanza regions[12]. As a control mechanism against development of pyrethroid resistance, carbamate insecticides were used instead as spray insecticides [12]. No additional spraying was done in the Kagera region as four rounds of spraying had already been conducted.

Currently, the NMCP together with the PMI, aim to achieve 85% coverage of households with IRS in order to achieve the community target capable of disrupting malaria transmission [13]. However, with program expansion, some community refusals in Mwanza, pose threats to community coverage, which could eventually, impact overall effectiveness of IRS [13]. This occurrence consequently sparked the need to evaluate IRS knowledge levels, misconceptions, particularly pertaining to their effectiveness as malaria control mechanisms and the community perceptions, which shape intervention reception.

Relevant studies on IRS community perspectives

An understanding of prevailing thoughts about IRS is necessary to frame the context within which the current study results are viewed. A similar qualitative study in Tanzania's Lake Zone regions assessed factors that obstruct or enable the uptake of IRS in a community setting [5]. The study was done to elicit information that would influence the design and focus of Behavior Change Communication (BCC) interventions to increase uptake of spraying activities [5].

In study findings by Kaufman, people were aware of the preparatory measures to be taken prior to the arrival of the spray team to prepare their homes for IRS [5]. Further discussion in the Kaufman study indicated good community buy-in into the IRS activities even though people were uncertain about how the insecticide worked, what the effects would be, or the potential ramifications for continued spraying[5].

Different forms of community sensitization were conducted in the townships where spraying activities were to be implemented and people who attended educational village meetings were more knowledgeable and receptive to IRS activities. Additionally, participants of the first round of spraying expressed a higher demand for subsequent IRS activities as they were less skeptical about the procedure and had witnessed the benefits of the spraying activity[5].

According to Kaufman's study, high participation and IRS reception was a reflection of communal perception that active measures were being undertaken by the government to reduce a disease that so burdened the population. Additionally, there seemed to be awareness about the necessary preparatory steps required prior to the IRS activity[5].

Inquiry into the reasons for suboptimal IRS uptake in the lake regions revealed local dissatisfaction with increased quantity of bed bugs in sprayed homes. While most people, particularly mothers, admitted the reduction in febrile symptoms of children since IRS was undertaken and a similar reduction in mosquito density, a higher presence of bugs influenced feelings of skepticism about IRS [5].

Gender dynamics also played an important role with regards to the acceptance of IRS in Tanzanian homes, according to a study also conducted in Mwanza according to the Kaufman study. The decision to participate in spraying usually did not rest solely on the male figure of the home but drew on the mother's opinion as to whether she

considered it a worthy cause to patronize. Women were often in favor of the spray activities however and thus positively influenced the actual implementation in homes [5].

An IRS study conducted in Mozambique by Munguambe, attributed the communal acceptance of IRS to a general desire to comply with governmental policies and authority [14]. Since the government was considered a superior entity and noncompliance with its policies was often punishable by law, most locals accepted IRS whether they liked it or not. Therefore community members' frequently conformed to most community based interventions simply to avoid potential ramifications [14].

Rather unlike the outcomes of the Kaufman study respondents' perceptions of the IRS activities in Mozambique were positive despite perceptions of minimal reduction of mosquito population and malaria illness [14]. The positive responses obtained about IRS were from health professionals and homeowners who felt a sense of gratitude for the implementation of IRS as a health initiative by the government and disregarded the fact that IRS has shown positive outcomes. Out of a sense of patriotism and a moral–political obligation very few people disagreed to participate in IRS [14]. Refusal of IRS was considered as an act of ingratitude and disregard for local and national leadership.

Munguambe's study highlights socio- political influences as a reason for IRS acceptance[14]. A salient application of the Health Belief Model is applied here whereby

adherence to a health intervention stems from the notion of positive expectations following the obedience to a particular stipulation to prevent illness. In the rural Mozambique context, however, this point was disputed with regards to IRS [14]. Here anecdotal data suggested that despite the community perceptions of IRS as an ineffective tool, communal acceptance of IRS remained high [14]. Thus from the public health promotion standpoint, it is imperative to pose questions that reveal information concerning the factors that determine adherence to interventions despite widespread belief of ineffectivity. Factors that could potentially trigger intervention rejections are duly examined prior to the onset of communal fatigue from an ineffective intervention [14].

IRS Knowledge Gap

Although IRS coverage rates remain high in Mwanza, our study district, the benefits and relevance of IRS was not fully comprehended by the communities involved and in turn influenced negative reactions of IRS in communities [15]. Recognizing this gap in IRS implementation, PMI suggested further research to explore community perceptions about IRS in general. My thesis, hence intended to understand and present information on various aspects of IRS in order to make evidenced-based recommendations for future improvement. This is the premise for the study I subsequently conducted concerning IRS uptake in Mwanza, Tanzania.

CHAPTER 3. MANUSCRIPT

Title Page

A Qualitative Assessment of the Community Perceptions of Indoor Residual Spraying (IRS) as a malaria prevention mechanism in Mwanza, Tanzania

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For Publication in: Malaria Journal

Contribution of Student

I coded the IRS data from the transcripts of the IMPACT 2 project. I performed the qualitative data analysis from results obtained from the data using the Nvivi8 software. I subsequently wrote up the findings and prepared the manuscript for publication.

Abstract

Background: The WHO estimated that in 2010, 219 million clinical cases of malaria occurred with an associated death toll of 627, 000 worldwide. Currently in Tanzania, malaria causes 60,000- 80,000 death annually, mainly in children and pregnant women. The successful elimination of malaria transmission in Tanzania is critical for the reduction of child and maternal mortality and reduction of strain on health facilities. To reduce malaria disease burden, the President's Malaria Initiative (PMI) implemented Indoor Residual Spraying (IRS) in Tanzania as a control strategy.

Objective: The main objective of this study was to examine perceptions about IRS as a malaria control mechanism for one particular district in Tanzania. Reasons for IRS refusal and acceptance and suggestions for improving IRS in the district were explored.

Methods: Qualitative methods were used to explore IRS perceptions, popular malaria prevention methods, issues stifling efficiency of IRS and suggestions for IRS improvement. Four focus group discussions and sixteen illness narrative interviews were conducted. All discussions and interviews were digitally recorded and, transcribed in Kiswahili and translated into English. Data was analyzed using Nvivo8.

Results: Participants were knowledgeable about the general causes of malaria. Two broad categories of people were identified: individuals whose homes had been sprayed and others whose homes had not been sprayed. Overall most homes had been sprayed but perceptions about IRS were mainly negative. This was due to inadequate community sensitization about IRS, increased prevalence of bed bugs and other insects, rumors, logistical hurdles and an unabated malaria and mosquitoes prevalence.

Discussion: To increase IRS acceptance and effectiveness, timely and detail-oriented community sensitization for subsequent IRS activities is stressed. Broader measures for malaria reduction in the environment and measures to counteract the rampant insect infestation following IRS are necessary. Improvement of sprayers utility in assisting women especially with the logistical hurdles is emphasized. Addressing the negative perceptions about IRS will improve communal experiences with IRS and enhance its delivery.

Keywords: Malaria, Indoor Residual Spraying (IRS), Mosquito, Malaria prevention, Community sensitization

1. INTRODUCTION

Malaria is one of the deadliest infectious diseases worldwide causing an estimated 627,000 deaths annually. [1, 2]. Tanzania, like many African nations, continues to experience an up hill battle in attempts to rid the nation of malaria. Currently in Tanzania, malaria causes 60,000- 80,000 death annually, mainly in children and pregnant women. The successful elimination of malaria transmission in Tanzania is critical for the reduction of child and maternal mortality and reduction of strain on health facilities.[3] The high morbidity and mortality rates rampant in Tanzania has influenced the implementation of malaria control strategies both on the mainland and in Zanzibar where an estimated 41 million people are at risk [3].

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Combination Therapy (ACT), and Intermittent preventative treatment during Pregnancy (IPTp) [3].

IRS is one of the main components of the PMI malaria control efforts in Tanzania. It was launched in Tanzania in 2007, and by 2012, had been implemented at least twice in the Lake zone regions, where our study was conducted. In 2010, during the first round of spraying, an 84% coverage rate was achieved, while the second round conducted in 2011, reported a 97% coverage rate [3]. PMI funds all IRS activities in the lake zone and works in partnership with the National Malaria Control Program (NMCP) and other local partners to train sprayers, sensitize the public and spray homes to reduce mosquitoes in the region.

This thesis presents qualitative analysis which examines community perceptions about IRS undertaken in one district of Mwanza, one of the Lake zone regions. The data informing this study on community perspectives was obtained from the IMAPCT 2 project. IMPACT 2 was a qualitative study conducted by the Malaria branch of the United States Centers for Disease Control and Prevention (CDC). The primary aim of IMPACT 2 was to evaluate the national roll out of two interventions to improve access and targeting of Artemisinin-based Combined Therapy (ACT) to confirmed cases of malaria. This was done in three regions of Tanzania. Mwanza, was one of the IMPACT 2 project regions but had also undergone IRS activities. Therefore, the qualitative component of IMPACT 2 was designed to incorporate questions to explore community

perspectives on IRS. The data presented in this thesis, is thus derived from two focus communities in the Mwanza region where both IRS activities and the IMPACT 2 project were undertaken.

Specifically, my study assessed IRS recipients' local knowledge of malaria, malaria prevention methods and perceptions about community sensitization prior to IRS. We sought to explore the participants' reaction to logistics of IRS and the benefits of spraying on malaria transmission and mosquito reduction. My study also explored factors that contributed to local acceptance of IRS activities and aimed to identify key factors that are essential for the development of successful IRS messaging. Participants were asked about their current knowledge about IRS benefits, whether they had participated in the fumigation activities and were given an opportunity to offer suggestions for improving future IRS activities.

Using the data collected from these responses, my research will provide community's perspectives for IRS program improvement.

2. METHODS

The broader IMPACT 2 study utilized focus group discussions (FGDs), illness narrative interviews (INIs) and in depth interviews (IDIs) with health care providers and drug shop vendors to investigate issues related to malaria care management. However since my study is focused on community perspectives of IRS, I am only examining the IMPACT qualitative data about IRS obtained from FGDs and INIs.

Study design

This study employed a qualitative study design. The FGDs utilized the interactive approach of group dynamics to explore people's understanding of IRS and malaria prevention mechanisms and the influences behind their perceptions. INIs were conducted with persons who had experienced a suspected malaria fever in the previous two weeks to elicit information about similar themes discussed in the FGDs. Per the original study design, baseline data were collected in Mwanza district (July 2010). Endline qualitative data was subsequently collected during July-August 2012. Because the IRS-related questions were asked at endline only, this analysis is based on the endline qualitative dataset.

Site Selection

Study districts and communities were purposively selected based on features related to the intervention roll out being assessed and in consultation with regional and district health authorities. At the suggestion of the Mwanza Regional Health Management Team (RHMT), two districts in close proximity to Lake Victoria were suggested as possible study districts because malaria prevalence was high in both areas, yet neither had been heavily researched. Of these two districts, the one furthest from Mwanza town, approximately an hour's drive away was chosen. The study communities were selected based on their 1) proximity to a health facility (approximately 20 kms away) as access to health care was substantially limited in the rainy season and, 2) proximity to a government health dispensary to ensure some sort

of access to malaria care. Two rounds of IRS activities had been conducted in the study district. The first phase was implemented in August – September 2010. The second phase of the IRS exercise occurred from March – December 2011.

Data Collection Methods and Participant Recruitment

A six-member field team consisting of a field supervisor, a research assistant, and four interviewers collected the qualitative data. Two primary qualitative data collection methods were used per study community: 1) focus group discussions with community members and, 2) illness narrative interviews with persons who experienced a recent suspected malaria episode. At the start of each data collection round, the field team conducted a 1-2 day rapid assessment visit to meet with village leaders, collect community descriptors, develop community seasonal calendars, and finalize study logistics and participant recruitment. The structure of village leadership, similar across all study communities, included a village executive officer who was appointed by the government, a village chairman who was elected by community members, and a village council made up of hamlet leaders elected by community members. Each village was divided geographically into 5-7 hamlets, resulting in 5-7 hamlets leaders per village council. Data collection lasted 7-10 days per community, including the initial rapid assessment visits and alternating interview and transcription days.

Focus Group Discussions (FGD)

Two FGDs were conducted per study community: one with adult males and one with adult females (A total of 48 participants). The format of the FGD was used to explore general knowledge about and experiences with malaria in the community. This included seasonal patterns and perceived vulnerable groups, care-seeking behaviors, biomedical and non-biomedical sources of treatment and their costs, knowledge and perceptions of antimalarial drugs, and knowledge and use of malaria prevention measures, including IRS. Particular inquiry about community perspectives on IRS involved coverage, the actual spraying procedure, community sensitization, communal acceptance and perceptions. At the end of discussions, participants were asked to share any additional concerns or suggestions that might have for IRS campaigns. A number of suggestions about improving malaria control and IRS in particular were obtained.

Participant recruitment occurred through a mix of random and convenience sampling. First, names of all village hamlets were written on separate pieces of paper and folded. The village executive officer and village chairman were then asked to select one folded paper each (with replacement) to determine the hamlets from which men and women would be recruited. The leaders of the selected hamlets were then asked to invite 8-12 men and women within their hamlet to participate in an FGD. Stipulations covering recruitment were that only one person per household be selected and that participants should come from different family groups when possible.

Illness Narrative Interviews (INI)

Eight INI were conducted per study community, totaling 16 for both study sites. The main purpose of the INI was to document actual treatment-seeking behaviors among persons who experienced a suspected malaria episode within the previous two weeks. Specific to IRS, questions were then discussed concerning the participants' knowledge about IRS as a malaria prevention tool, coverage, the actual spraying procedure, community sensitization, communal acceptance and perceptions, and also the barriers restricting community acceptance of the intervention. An opportunity was provided at the end of the discussion for respondents to provide additional information and suggestions about malaria control and IRS activities.

Eligible INI participants included adult men, adult women, pregnant women, and caretakers of children less than five years of age (under-fives) who had experienced a suspected malaria episode in the previous two weeks. Participants were recruited through household visits in a multi-step process whereby a hamlet was randomly selected first and then recruitment-starting point (a house within the selected hamlet) was selected by the spin of a bottle in the center of the hamlet. Consecutive houses to the right of the index house were visited until 8 INI participants (2 men, 2 women, 2 pregnant women, and 2 caretakers of under-fives) were interviewed or interview appointments made. Only one INI was conducted per house visited. Once a potential participant was identified, they were asked about their symptoms. If the participant had been told they had malaria or their symptoms were consistent with malaria, they

were invited to participate in the interview. Participants whose symptoms did not indicate malaria or had been diagnosed with something else were not interviewed. If more than one person in the home had experienced a fever in the past 2 weeks, the INI participant was selected through a ballot according to the following order: adult male, adult female, or caretaker of an under-five child. Due to their low numbers in the community, pregnant women who had experienced a recent malaria episode were often difficult to find through household recruitment. As a result, pregnant women were actively recruited through discussions with community leaders or other community members.

If field team members reached the boundary of another hamlet before finishing recruitment, they crossed over into the new hamlet and continued visiting consecutive households in a rightward direction. In cases where the boundary of another village was reached before recruitment was complete, field team members returned to the index house and continued in a leftward direction until 2 adult men, 2 adult women, 2 pregnant women, and 2 caretakers of under-fives have been interviewed. In cases where the target numbers were not achieved after a reasonable amount of recruitment effort (usually 1 or 2 days), the recall period was expanded in increments of up to three months. If recruitment targets were still not achieved, additional INI with adult men, adult women, caretakers of under-fives, or pregnant women were substituted, with preference given to caretakers of under-fives or pregnant women.

Table 1 Diagrammatic presentation of the sample size for FGDs and INIs in study area

Qualitative Data Collection Method	***Mwanza*** ***Jul-Aug 2012***		**Endline Interview Totals**
	Village 1	***Village 2***	
Focus Group Discussions	2	2	**4**
Illness Narrative Interviews	8	8	**16**

Table 2 Diagrammatic presentation of participants in each qualitative data collection method

Villages	**Focus Group Discussions (FGD) participants**	**Illness Narrative Interviews (INI) participants**
Village 1	1 female group (12 participants) 1 male group (13 participants)	2 pregnant mothers 2 female caretakers 2 adult men 2 adult women
Village 2	1 female group (12 participants) 1 male group (11 participants)	2 pregnant mothers 2 caretakers 2 adult men 2 adult women
Total participants	**48**	**16**

Data Analysis

All FGD and INI were digitally recorded, transcribed in Kiswahili and then translated into English. Field supervisor oversaw transcriptions from tapes and translations into English. Interview transcripts were read line by line and codes were applied to portions of the transcript. The principal investigator did initial coding for broad themes on IRS data after which I applied more detailed coding. I did content analysis of the malaria prevention and IRS portions of transcripts using Nvivi8

software. I then analyzed the data by the codes applied. Dominant themes from the data analysis were then identified and presented in the results section.

Overall, more information about IRS was derived from FGDs with men and women. The interactive nature of the FGD settings allowed for participants to either bolster points put forth by fellow community members or offer differing opinions. The INIs were useful in finding individual perspectives, though the participants regularly made distinctions between their personal views and that of the community.

3. RESULTS

The results obtained from the FGDs and INIs revolved around 8 major themes, namely: 1) perception of malaria burden, 2) overall causes of Malaria, 3) preferred malaria prevention methods 4) general knowledge about IRS and perceptions of effectiveness 5) negative results and perceptions about IRS 6) positive results and perceptions of IRS 7) community sensitization on IRS and 8) recommendations from the community. Sub themes were discussed under these major themes.

Perception of Malaria Burden

Many respondents both men and women stated that malaria was a major health concern in their community. They expressed concern that malaria caused illness and death in the community and therefore the disease needed to be adequately controlled. Participants in the FGD followed up discussing how children and women, particularly

pregnant women, were at highest risk for malaria infection and that it possessed significant threats to their health.

Especially for me I just…add on to who talked about malaria it disturbs a lot, especially for small children. I mean every time it is a threat

Female FGD

It is the pregnant woman [who] is the one who is in danger and children.

Female FGD

In attempts to explain why children were one of the most vulnerable groups, reference was made to the fact that they were unable to ward off mosquitoes while they slept at night. Especially while sleeping, children were less likely to wake up and expel mosquitoes which resulted in them getting bitten more often than adults. Additionally, it was perceived that, in general, children had lower immunity and were unable to fight the disease which then resulted in morbidity and mortality.

Myself I see that the uncle who has said that on the part of the child is the victim is right because this mosquito who is spreading often bites in that time when it is completely calm. Now this child can't wake up from sleep to expel that mosquito; therefore that mosquito directly puts that blood collected from another area but this adult person has the ability to expel that mosquito.

Male FGD

Now when you say for the children maybe because they themselves, it happens often maybe their immunity is still low that is probably we have got what with him when he gets malaria that is why in the researches they are showing like it is the children who are affected mostly.

Male FGD

Overall Causes of Malaria

A number of responses were obtained from participants about the possible causes of malaria. Almost all participants indicated mosquitoes as the main cause of malaria in the community. The community understood that infection with malaria occurred after one had been bitten by a mosquito, usually at night. A few respondents

even specified the particular species of mosquito, the female anopheles, as the primary vector for the disease. Participants realized that since their community was located close to the lake, there were more breeding grounds to facilitate the reproduction of the mosquitoes that caused malaria.

I think here in our place, [community name deleted] near to the lake there are many mosquitoes and that is why we get malaria from time to time both children and adults.

Female FGD

They regard that other fever which is transmitted by a mosquito known as Anopheles, also continues to harass in our area due to the multiplication of mosquitoes

Male FGD

Preferred Malaria Prevention Methods

A spectrum of responses was obtained about malaria prevention methods with many participants showing an awareness of the origins of mosquitoes and the need to prevent mosquito bites. However, during discussions about malaria prevention, net use and environmental cleanliness were mentioned as the best methods against malaria. Many respondents cited net use first but then followed up with environmental cleanliness as another means of preventing malaria. Respondents indicated an understanding that preventing malaria began by reducing breeding sites for mosquitoes and then following closely with net use which would provide protection from pre-existing mosquitoes in the environment.

Because mosquitoes bite at night, if you don't prevent yourself with a net at night, ok but you must do cleanliness but now you don't have mosquito nets what will you do? we are sleeping under mosquito nets.

Caretaker INI

The use of mosquito nets as a means for malaria prevention was mentioned in almost every FGD or INI. Participants often explained that mosquito nets served as barrier against mosquitoes during the nighttime. Participants mentioned that net use was an important strategy for protecting not only themselves but their entire family from mosquitoes. They elaborated on the fact that nets should be used regularly at night, throughout the year in order to obtain maximum protection from malaria. According to participants, the fidelity with which net use is practiced stems from the advice health professionals provide to the community. Respondents often cited that healthcare providers informed them of the chemicals on nets, which kills mosquitoes upon contact with nets. Thus, provided one used the nets as advised, sufficient protection is provided against mosquito bites and malaria.

Participants mentioned that net use was essential for children because once children slept under nets, parents did not have to worry about them being bitten. Participants considered this as a source of relief because they understood that there were many mosquitoes at night and that small children particularly were less likely to ward them off.

Yes, that of using mosquito net is the best because it can help even small children. It can help a lot because when a child is asleep under a mosquito net it is of great relief because many mosquitoes spread at night when people are asleep. Therefore, at the least the family can be at rest, people are sleeping under then net and are not disturbed by mosquitoes

Male INI

Because that mosquito for advice we are advised, there are mosquitoes and those malaria mosquitoes appear from midnight. Now if you don't have a net those mosquitoes will get in, but if the net is treated there is no getting through.

Male INI

Regarding environmental cleanliness as the best method for malaria control, participants' highlighted stagnant water and unclean environments as the main breeding sites for mosquitoes. Often reference was made to filthy ditches, tall grass and keeping the environment tidy and empty of dirty water, to reduce the chances of mosquito breeding. Thus, people mentioned varying methods for environmental cleanliness as malaria prevention strategies. These forms of environmental cleanliness included drainage of stagnant water especially around the home, in ditches and receptacles around the environment. Cutting tall grass, was also considered important for curtailing mosquito breeding, as participants' viewed it as one the habitats for mosquitoes. This was the understanding upon which people based their recommendations for ensuring that the environment was kept in a manner to prevent malaria.

Eeh the best technique I see, the best means is to keep the environment in good condition. I see this is the best because if you keep the environment in a good condition it means even those insects find nowhere to stay.

Male INI

Interestingly, IRS however, was rarely mentioned as a malaria control mechanism in the initial stages of the discussions about malaria prevention. Most participants did not immediately consider it as a mechanism to prevent mosquitoes or to control malaria. The few times it was mentioned however, respondents expressed mixed knowledge of its ability to reduce malaria and mosquitoes.

General Knowledge about IRS and perceptions of effectiveness.

A mixture of responses was obtained about IRS knowledge. Once the topic of IRS was introduced for discussion, most participants associated those activities with malaria and the need for mosquito reduction. In both study villages, information from FGDs and INI indicated that most houses had been sprayed. All types of houses were reported to have been sprayed including those made of grass, thatch, corrugated iron, and mud. Considering that a person's home was comprised of a number of different structures, participants recalled that only the sleeping quarters were considered necessary for spraying and therefore, they were sprayed. Most respondents recalled participating in two rounds of IRS. However, recalling when exactly fumigation had occurred was a challenge for many.

Eeh it didn't matter whether grasses thatch house, iron sheets, mud, I don't know or tree, they were spraying in all houses but you must be sleeping in that house.

Female FGD

I don't remember the day. Eeh, my brain has already become tired, I lose memory for short periods, but I remember they came here at my home and they put their notices there.

Male INI

Most participants had a fair knowledge on what the spraying activities entailed such as removing household belongings outside, expecting to remain outdoors for an extended period of time following spraying and the need to avoid contact with the insecticide. There was, however, a mixture of knowledge levels with regard to the exact function of the insecticide and its long-term effects. But in terms of the immediate effects of IRS, most people expected to observe a reduction in mosquitoes indoors.

Residents who were poorly sensitized tended to know little or had inaccurate perceptions about spraying and did not know the benefits of IRS. However, people who reported having been properly informed about IRS seemed better prepared for the activities.

They just announced that tomorrow do not remain at home, they are coming to spray. We did not have a meeting to say that now get prepared in such day they people will come to do this and this; no. They just announced that now get prepared, tomorrow each one should take out his utensils and everything else, those who spray will come. People did not know the benefits of that fumigation and its effects [voice of many responding together].

Male FGD

Participants' perceptions about IRS were mixed: some were happy about it while others were not. Most people acknowledged that it simply was implemented for the protection of the community and that something was being done to reduce malaria. Some participants were happy with the intervention especially because they had observed a reduction in mosquitoes in their homes and less malaria episodes among household members.

Also the situation truly since I was sprayed the situation is better. Because here malaria was frequently like my child was the one who were very much disturbed with malaria. But now truly I haven't seen my child getting malaria.

Pregnant INI

A fair number of participants, however, expressed displeasure with IRS as an intervention as they perceived it had not provided the necessary reduction in

mosquitoes or prevented malaria in their households. Consequently, some people refused to participate in the second round of IRS activities.

…..truly I have not understood if this formula of spraying insecticide is correct. For what reason myself I am among the people who in the first phase this was done to me. In the second phase I said no, after I had seen that spraying that insecticide had no good results.

Male FGD

Interestingly, there was a mixture of responses concerning the demand for IRS activities in the study district. Some participants' whose homes had been sprayed indicated their willingness to be included in the future IRS activities. These were mainly people who had not experienced negative effects following IRS and thus were not as skeptical about the intervention. Another group of participants, particularly ones who had experienced undesirable outcomes following IRS implementation, showed reluctance to participate in subsequent rounds of spraying.

In the second phase I said no, after I had seen that spraying that insecticide had no good results

Male FGD

Finally, there were some participants who remained ambivalent about IRS activities. These respondents acknowledged the positive results associated with IRS such as a reduction in mosquitoes and some decline in malaria morbidity. Yet, they still expressed hesitance, especially due to the persistence of some negative outcomes such as bugs.

Reasons for IRS Refusals

Overall, few participants reported that their homes had not been sprayed. Among this group of participants and the information they shared about other locals,

there were two categories of people: 1) people who purposely refused IRS and 2) people who had not refused IRS, but were unable to participate for a number of other reasons. Overall, however, the number of people who purposefully opted out of spraying were more than those who had missed the spraying activities unintentionally. Most participants who intentionally opted out of IRS did so following participation in the previous round and upon observing negative outcomes, refused to partake in the subsequent round.

In the discussions, my self personally truly I have not understood if this formula of spraying insecticide is correct. For what reason myself I am among the people who in the first phase this was done to me, in the second phase I said no, after I had seen that spraying that insecticide had no good results

Male FGD

Some participants simply did not take the IRS activities seriously and assumed a more passive approach to avoiding IRS in their homes by simply closing their doors to decline spraying. Some participants resorted to telling sprayers that they had already been sprayed to escape IRS or stated that they were not the homeowners and thus could not provide permission for spraying. Since spraying was voluntary and required permission from homeowners for implementation, some participants intentionally refused spraying this way.

Now if a person tells you that they have already passed, what you can ask again you continue with your business; some refuse saying that "I do not belong to this place. I do not know where the owner of this place is," then closes the door after seeing you coming

Pregnant INI

He comes and he finds me sitting as I am here, when you say aunt we want to spray outside "Aah uncle I am not from there" he just asks you where is the one who is staying here "Aah we don't know". I am the one staying there but I refused. Can you enter by force?

Pregnant INI

Nonetheless, reports from participants indicated that some community members disliked the intervention so much that they actually ran away to avoid their houses being sprayed. One respondent explained how some people had developed the habit of running away to elude sprayers:

They were running because of the reasons I mentioned, that this medicine which is sprayed is brought. That is how people were running, leaving their houses, they fled…That was really done, people were disappearing in trees.

Male FGD

A few people had not personally suffered consequences of spraying but had heard or witnessed neighbors' or communal dissatisfaction with IRS and therefore refused to be sprayed. This was a sufficient deterrent against IRS participation for some:

Myself concerning this program since they did not reach at my place; because of the cry of my colleagues, Because many were crying [complaining]; and here I have seen the advantage for only one person. Since they started spraying it is now I hear its advantage, for this man who said that at his house there was no inconveniences. But to others it was a cry.

Female FGD

Participants also shared different reasons for unintentionally missing fumigation activities. A few people explained that during times of fumigation, they were simply not around the community to participate in the IRS activities. Other participants mentioned that their work schedules coincided with the spraying schedule. This therefore made it impossible for them to participate in the spraying exercise.

Sometimes when it reaches eleven you find you are at work and a person cannot decide just to spray in the room of that person. I would come to ask you who took [items] out, did I tell you to start taking out my things eeh? Just there I can say I lost my money. A person cannot [do that].

Pregnant INI

Some respondents in whose homes spraying had not occurred mentioned sprayers skipping their household due to negligence on the part of the sprayer. Sprayers were reported to sometimes perform the spraying activities haphazardly and inconsistently. One participant for instance stated that since he resided in a fairly large home, sprayers avoided spraying for him since they did not want to expend the extra effort it took to spray a larger home.

And then another thing to add again if he finds a big house he avoids it. Now like at mine there they avoided it a lot that is a big house to spray the dose…

Male FGD

A few participants however, simply could not give reasons as to why sprayers had missed their houses. In certain instances, they even witnessed their neighbors' homes being sprayed, however, for reasons unknown to them, their homes had been missed.

Myself I can say that in the process of spraying some homes were left. They did not reach; for example, they did not spray at my house; they did not reach. I do not know the time was over, and the second day they did not reach. We do not know why they did not reach in other areas.

Male FGD

Negative Results and Perceptions about IRS

Most IRS participants were unhappy with the outcomes of the spraying exercises. While there were some instances where participants claimed to happy with the intervention, they hinted at some dissatisfactions and negative outcomes associated

with IRS. As described below, several unpleasant outcomes and features of IRS influenced the dissatisfaction with and rejection of spraying activities.

Bed Bugs and other Insects

The most cited reason for dissatisfaction with the IRS activities was that it was perceived to have resulted in an infestation of bed bugs and the proliferation of other insects such as cockroaches, ants and ticks in the homes of respondents. Before the implementation of IRS activities, participants noted that bed bugs were hardly noticed in the community. However, most respondents associated the sudden invasion of their homes by bed bugs with the onset of spraying activities. This finding was consistent with Kaufman's study of IRS in the Mwanza region [5]. The bed bug and insect infestation caused a communal outcry against IRS implementation and eventually led people to the conclusion that IRS had not helped reduce the mosquito prevalence but had rather aggravated the situation with bed bugs and insects.

Mostly people are crying when a person has no bedbugs when that insecticide (IRS) is finished bedbugs become so many, I mean [in] the whole [village] people are just crying with bedbugs

Female FGD

Problems that I hear my fellow citizens crying are bugs. For example, I went to a certain village where I was invited as a guest. I met a cry there and I witnessed, bugs spread all over the house up to the roof. Bugs were creeping down. I asked why? They said these bugs came after we had sprayed. I do not know why, we do not understand.

Male FGD

Generally, people were annoyance that they had agreed to participate in an intervention that would reduce mosquitoes in their homes however, the intervention had aggravated their living conditions with bed bugs. For this reason, people could not reconcile IRS

activities with a positive outcome for malaria control. One mother complained about the bed bug infestation being such a nuisance that her children refused to sleep inside the house due to fear of the bugs:

And again [because of] the bedbugs, the children don't sleep. The children go outside. Others they have moved the beds outside. They sleep.

Female FGD

An interesting point to note was that, even people who supported the fumigation exercise and considered it a useful intervention admitted that bed bugs and other insects had become a nuisance driving local dissatisfaction.

Ehe… that drug has helped but another thing it came like an eruption of a lot bedbugs as mostly now [that] is when the community not me only the whole community complains a lot "Why are the bedbugs too much? How is this drug?" We don't want to be sprayed because bedbugs are increasing alot. …

Male INI

While bed bugs infestation was the major complaint, respondents also reported an increase in tick, cockroaches and ants. Participants believed that these insects stemmed from the insufficient potency of the drug used during the spraying activities:

This medicine is not strong and it brings effects on citizens like these cockroaches, many cockroaches and bugs. Now that is disturbance.

Male FGD

Ants, ticks and bedbugs fill up, then these big ticks, other houses have ticks

Female FGD

In many discussions where bed bugs emerged as a theme of displeasure, people cited the bedbug infestation as the reason some might not be receptive to subsequent rounds of IRS:

And instead indoor residual spray bugs. Now bugs are too much in every family. Where they sprayed, you find bugs. (P6: and cockroaches) And cockroaches are many. Now even that spraying medicine, if you bring it here only few will accept to spray.

Male FGD

Minimal Reduction in Malaria burden and Mosquitoes population

A key negative result of IRS was the discontentment with unmet expectations for a reduction in malaria burden and mosquito population. The inability of IRS to rid homes of mosquitoes and sufficiently reduce malaria episodes was disappointing to participants. Respondents' concern was that malaria was still a health threat despite the implementation of IRS.

No I have said that we have not seen the positive results of spraying. Those who have sprayed we have not got any positive results of any sort, for what reason still malaria is still there and there are people still suffering,

Male FGD

Mainly, information from FGDs revealed that participants did not perceive a positive relationship between IRS and malaria control. There was no change in prevalence according to most respondents. One lady, for instance, shared that her household members continued to experience frequent episodes of malaria, particularly her children even after both rounds of IRS:

They have sprayed an insecticide that one which is for malaria. And till now people are suffering from malaria together with children.

Female FGD

The benefits of IRS with regards to reduction of mosquito population had certainly not been realized according to most FGD respondents. Mosquitoes were reported to have

either increased or at least remained the same despite spraying activities. Participants were not pleased about this observation considering that IRS was supposed to provide evident reductions in mosquito prevalence:

Honestly no relationship is seen because we don't know if mosquitos have been completely vanquished and malaria is becoming worse

Female FGD

There is no change. There is no difference. Before you had sprayed the problem of malaria was there they are spraying the problem is still right there.

Male FGD

Insecticide mixing procedure and application issues

Complaints from respondents indicated minimal confidence in effectiveness of the insecticide used during IRS. This sentiment stemmed from the realization that the intervention per say, may have had the potential to reduce malaria and mosquitoes. However, participants thought certain aspects of the chemical mixing process were inappropriately executed which reduced effectiveness. Several respondents reported suspicions about sprayers failing to properly mix insecticides before spraying. They shared that sometimes, sprayers over diluted the insecticide with water, which affected the potency of the chemical to kill mosquitoes and subsequently its ability to rid homes of mosquitoes. Some respondents even suggested a change in the current pyrethroids being used or the formulation of a new insecticide, one that was capable of eliminating mosquitoes and other insects.

I see probably that medicine was not effective, It was having certain deficiencies of...of mixing. I see it like that.

Male FGD

Others shared that the sprayers do not heed the instructions for insecticide application that experts provided and that was why the desired effects of IRS were not realized. Respondents shared that the sprayers were not diligent in the discharge of their duties. For instance, some sprayers rushed through the spraying activities in order to reach more houses sooner. Apparently sprayers were paid per house sprayed and thus would often spray in a haphazard manner simply to complete more houses in order to receive promised incentives and payment.

Now it becomes [an issue of] quality now… the plan was for every person to spray for one day ten houses and he should bring the names of households which he has been sprayed. But now people started, those sprayers, it became a rush now [he is laughing] that is if you see another there down and him, he is passing this way so that if he completes ten households he sends the report early, he has already got a lot of money now.

Male FGD

Because when they spray…when they spray there inside, mosquitoes remain being outside but normally they spray just this to rush rush I don't know when they spray I don't know they normally put more water.

Female Caretaker

Logistical constraints

Participants noted that a negative aspect of IRS was the logistically demanding nature of the exercise for homeowners. For IRS implementation, home occupants were required to remove personal belongings and household items to the outside. This was to enable the sprayers to achieve maximum coverage of the insecticide in the home and prevent contact of insecticide with household items. Complaints arose from an unwillingness to put belongings outside for the fact that it was a laborious task for many. People expressed reluctance to participate in IRS activities especially when a

household contained heavy items and the responsibility to move items rested on one person. One lady explained how moving water drums outside the home was a laborious task. Sometimes, she had to empty the water in order to move the drums outside the house. She suggested that another strategy be implemented that would spare her the hassles she associated with IRS.

To take in and out eh you can find you have filled drums of water there inside. Again you are forced to take them outside. Sometimes there are not even utensils to fill it so you must pour it outside and start again afresh fetching water. I see they have to bring us another strategy.

Female FGD

Privacy related issues

Another concern about IRS was the communities' reluctance to welcome sprayers into their homes to conduct spraying. The fact that sprayers were not from the community, added to the hesitancy of respondents in allowing them into their homes to conduct the IRS exercise.

They were coming, others we didn't know them even by faces. He comes to tell you "Mother I want you to move so that I start to spray your house."

Female FGD

Residents were also not pleased with the idea of neighbors and by-passers viewing their personal belongings outside, especially if household items were not of high quality. Feelings of embarrassment or fear were expressed in such instances. Some simply felt that certain possessions were personal and preferred not to display them in the public. One participant, for instance, was not happy to remove utensils and sleeping sacks to

the outside. She also mentioned how others who had terrible living conditions would be reluctant to publicly display of possessions and as such refuse IRS.

[Y]ou find those who do not participate feeling shy to take out the things they have inside. I don't know you sleep on sacks you refuse I should take these things outside so that they spray. You find others rent in a room which is terrible you think is this a house that I take out my things in order to spray, I can not let you see… Another one is afraid to take outside the thing he has inside thinking that maybe it is bad "Now I should take my things outside so that they spray, I can not do that" you see.

Pregnant INI

Reported Side effects

Overall experiences of side effects following spraying were only reported among a minority of respondents. These side effects were prevalent in both children and adults, and were a source of concern for community members. Side effects observed involved coughing in adults and children and general body itching upon contact with the insecticide. The reported itching, which occurred all over the body, was often remedied by bathing with soap. There were also reports of children experiencing swollen stomachs after IRS had been conducted in the home. This side effect was common among household residents who had entered the home soon after spraying had occurred, thus coming in contact with the insecticide. One report highlighted the severity of IRS side effects by indicating that a child had actually been rushed to receive medical attention from exposure to the IRS insecticides. Another respondent alleged that one child actually died from exposure to the spraying chemicals.

This year 2010 or 2011 but I remember that problem began in 2010. They started saying children have been sprayed with medicines, that you open after two hours. Then when the

children enter their stomachs swell. In the first village the stomachs of some children swelled, another one died, others were rushed to hospital.

Pregnant INI

Rumors

Overall, only a few participants shared concerns about IRS rumors in the community. In relation to side effects for instance, only a few households actually having such experience. The majority of participants had not personally experienced side effects in their homes. Therefore, most participants only expressed a general fear of side effects from the rumors community members peddled, which then influenced their reluctance to participate in IRS activities.

There were rumors that when they spray their medicines, the children's stomach swell and they die you see.

Pregnant INI

Another rumor community members shared was that IRS was a means for spying on people in the community. Since IRS activities involved entering into the homes and personal spaces of individuals, it seemed to be an appropriate means to gain insight into people's lives, which displeased people. Sentiments were shared that IRS was not truly a malaria control strategy but rather a disguise employed to gain access into peoples' homes for ulterior motives. It was unclear however, who the perpetrators of the spying agenda were. A female respondent said:

They just want to spy on people's lives.

Female FGD

Another rumor recounted by participants was that IRS activities were a means for the devil to reduce the population or destroy humans. Participants explained that the predominance of Christian religion in the locality also enabled some participants' make these religious connections to IRS rumors. A participant of one FGD mentioned that the community actually perceived this rumor to be true especially due to the apparent population reduction in recent times and high death rates. Interestingly, participants associated these particular rumors to the lack of proper sensitization and thought that the provision of seminars would have helped dispel such rumors.

Now many people are Christians who like religion. Now most of the time when this medicine comes without instructing people properly, mm we learn that this is devil's plan to reduce people on earth. This is because you find that most of the time we do not have seminars [health education sessions]. When we see those who have come to spray inside we close our houses, off we go.

Male FGD

So they must bring seminars there so that we can understand. Because we learn that is the devil's system to finish people on earth.

Female FGD

Positive Perceptions about IRS

Positive perceptions about IRS were associated with a reduction in mosquitoes, a reduced frequency of malaria, and the idea that it was been done in the best interest of community health. This perception was observed in a minority of participants, mainly INI respondents. There were a few instances where participants actually encouraged other community members to partake in the IRS activities, as the program had truly produced positive result of decreasing mosquitoes. Participants expressed that the

sprayers were helping the community fight against malaria by implementing IRS and went further to state their unflinching support for IRS if another round was conducted.

Here where I am, that is, even today this day when they start that exercise again, I will be the first person to support it because they are helping us.

Female INI

What I advise my fellow villagers? I advise them to use that medicine and to spray in their houses in order to finish mosquitoes.

Female INI

Respondents seemed irritated at the fact that other community members complained about the IRS activities and refused to participate. They stated that people who refused the spraying exercise did so out of stupidity:

Why are they refusing to do fumigation, now why are they refusing? Whoever rejects let him reject, but when he gets sick he will help himself… it is just stupidity.

Female INI

Some respondents evidently observed the reduction in malaria and mosquitoes and actually attributed the slow increase in malaria cases to the fact that a third round of spraying had not yet occurred. They, therefore, requested that IRS should be implemented again soon. Some respondents were pleased with IRS stating that it has reduced the burden of malaria in their children.

Also the situation truly since I was sprayed the situation is better. Because here malaria was thus, frequently like my child was the one who were very much disturbed with malaria. But now truly I haven't seen my child getting malaria.

Pregnant INI

Interestingly, people who supported IRS also often mentioned that the broader community held views contrary to theirs. They admitted that their positive views

towards IRS were not widely shared by community as most people were complaining about the unpleasant outcomes following spraying. Since participants who had positive perceptions had suffered minimal to no negative effects of IRS, they continued to encourage other community members to respond positively to IRS.

What I am only asking because there are others they have…., they refused to be sprayed those drugs, but what I am advising is that, that the drug is very much helping. Because nowadays malaria has decreased, not like in the past.

Pregnant INI

In fact me, in my opinions, for a number of days I didn't hear neither mosquitoes nor something of that sort (mhmh…) others were complaining ohoooo…mosquitoes aren't dying, I don't know what but at my place I didn't see that problem.

Female INI

Community sensitization on IRS

Information about community sensitization towards IRS activities was mixed. Overall almost every participant had received some sort of sensitization towards IRS. Reports from participants indicated that, when sensitization occurred, it took place prior to the IRS campaign. It is unclear, however, how soon sensitization occurred prior to spraying. A number of different techniques and entities were utilized in the community sensitization activities for IRS. Radio adverts, community leaders, posters and loudspeaker adverts were used to convey varied information about th**e** IRS activities to community members. Due to the variation in methods used for sensitization in the community, participants presented a spectrum of knowledge levels with regards to the implementation and effects of IRS. Some participants knew nothing about the impending exercise until the day of IRS in their homes. Most participants had

heard about imminent spraying activities but discussed the insufficiency of the information provided in preparing them mentally and logistically for IRS. Others reported that their communities had been adequately informed and they had received ample information necessary to prepare for IRS in their homes.

Participants had mixed responses about the core messages discussed during IRS sensitization. Some people said they were educated on the purpose of the spraying exercise and the associated benefits. Thus, most people had ideas about how the insecticide was supposed to work in eliminating mosquitoes.

We were told to spray the mosquitoes. There are mosquitoes I don't know they bite at night in the midnight and that mosquito transmits malaria (yes), so that medicine only kills that mosquito and not any other mosquitoes.

Caretaker INI

Others said they sensitization messages talked about the timely removal of their belongings from the home, stipulating which items should be removed and which items could remain indoors. They said information was provided on appropriate times to re-enter the house and what should be done once the household had been sprayed. One respondent shared:

They were, they were told to...to remove things from inside their houses and now maybe the bed or bed sheets remain in the house while all other things are [moved] out. They spray, now the doors are closed for six hours if I'm not mistaken. After that you open. Then you allow the house to get a circulation of fresh air and after that you enter in the house to do what... cleaning.

Caretaker INI

I mean when they, they were told that to get all things out (mm) leave the bed, when we get other things out, if you have a certain pot you cover it with…with a certain…then they come in, I mean you remove utensils and your flour you put it out.. And also water is being put out, and then they get in to spray

Female FGD

The avenues through which community members were sensitized about IRS varied. Some participants recounted learning about IRS and what was expected of them through village meetings in their communities. They were urged to stay at home during spraying days and to welcome the sprayers in carrying out the IRS intervention. A respondent commented:

We were called to a main village meeting…we were instructed that there are people who will pass in our houses, who will do fumigation. You should be taking things out and you keep the food aside.

Female FGD

A few respondents mentioned hearing on about the spraying activities on the radio. Interestingly, sentiments differed as to whether information dissemination via radio was adequate. Some participants simply mentioned hearing about IRS via radio, without an inclination as to whether it was comprehensive in the scope of information provided. A few respondents however, seemed to consider radio an inadequate means for communicating about IRS and thus felt they were not properly involved in the spraying process.

That we were not involved for the purpose of spraying we were hearing in radios. We were only hearing on the radio.

Female FGD participant

A number of responses were obtained about the designated person to conduct community sensitization. Some respondents reported being educated by their community leaders and village heads. Participants recounted community heads calling

for communal gatherings and providing guidelines as to what was expected of them during the IRS.

Others who were telling us were our leaders. For example in the hamlets, he comes to tell you "A certain day people will come here, those who spray for mosquitoes, so you must welcome them."

Female FGD

Respondents who were of the view that they had received adequate and timely information, had mainly been educated by community leaders in a group setting approach. With proper sensitization provided this way, participants agreed to have their homes sprayed and were also aware about the necessary preparatory steps to be taken prior to the arrival of the spraying team.

Maybe there are other cell leaders maybe they were of, maybe they were negligent by not assembling the people and informing them but for example like us our cell leader we actually called the meetings and not one we went to discuss on that and sensitization was done.

Male FGD

Whistle blowing and the use of loudspeakers in streets were used to bring participants' attention to IRS activities. Respondents explained that these forms of sensitization were used both prior to and on the day of IRS activities. People mentioned that they remembered when spraying would occur exactly by hearing messages over the loud speakers in the streets. Participants also heard announcements on the day of or prior to spraying days and became sensitized about IRS. These announcements involved IRS campaign workers randomly speaking to people in groups at vantage points in the community to share the information about IRS.

Through announcements, they just announced that program. People were just announcing on the roads there, there is mosquito spraying.

Pregnant INI

They were passing by themselves. They called us as a group and informed us and every one of us got prepared then when the day came they did fumigation.

Caretaker INI

While most informants had received some type of education about IRS at some point either prior to or on the day of the IRS activities, some respondents stated that the information they received was either insufficient or ill-timed to be as beneficial as possible. Sometimes, though sensitization had occurred people still did not understand what was required of them. An informant stated knowing nothing about IRS until the day before the IRS campaign in his community. He also narrated that since the announcement had come so late and close to the day of implementation, people were unaware of the benefits and reasons why IRS was even necessary.

They just announced that tomorrow do not remain at home, they are coming to spray. We did not have a meeting to say that now get prepared on such day, they the people will come to do this and this; no. They just announced that now get prepared, tomorrow each one should take out his things and everything else, they will come those who spray. People did not know the benefits of that fumigation and its effects [voice of many responding together].

Male FGD

Here at our place mostly this exercise they were doing people you see, a ten cell leader may come here "People a program of fumigating in the streets is coming you see, but our heads were hard to understand you see.

Pregnant INI

Overall, only a small number of participants mentioned that they received no sensitization about IRS prior to the activities and thus were unprepared for the IRS activities in their homes. In some instances, people were simply home, engaging in

daily activities only to be approached by sprayers and asked to remove possessions from their house to allow for fumigation. Such people were not pleased with this and had expected community education through some sort of gathering, to provide adequate information well in advance of the spraying activities.

We were not given that seminar (to be educated), we were not told this and this. We were only being told as he arrived, he was introducing himself this insecticide helps this and this. And that is why I have said we don't know if mosquitos have been, we don't know whether, or if they are found because malaria is still there constantly, it is not yet finished.

Female FGD

One participant even mentioned that the hamlet leader was unaware of the fact that spraying activities were to be held in the community that day. This called for an impromptu division of the hamlet for spraying followed by a door-to-door explanation to community members to remove household belongings for the spraying activities to be carried out.

We here, they just entered. When they reached to the hamlet leader, they told him "We have come to do this exercise"… so he was walking with them himself by arriving at a house he tells you, also themselves they were telling you, the way they were explaining. Then you have to get things outside in order for them to enter to do their work.

Female FGD

Community members' Recommendations

Participants had some recommendations or suggestions for improving IRS acceptance and delivery. The overriding suggestion was for a better-targeted and timely health education campaign preceding the actual IRS spraying activities. The educational campaigns should stress the importance of spraying and the procedures involved.

Residents explained that the lack of knowledge about the actual benefits of IRS increased hesitance in IRS participation. Additionally, participants expressed that better sensitization efforts, mostly through seminars, would better prepare the community to accept IRS and aid in dispelling myths and rumors about IRS activities. Facilitation of seminars to properly sensitize the public on IRS activities was necessary, instead of simply showing up to the community ready to conduct the activities.

My opinions on this fumigation, they should improve this..this exercise should be improved and citizens must be given good seminars. Rather than just coming to put medicine;

Male FGD

So unless they inform us and give proper seminars, my opinion is that they leave this issue of fumigation. So the important thing is that they should give us a seminar, then those who are concerned with spraying must be educated.

Male FGD

One lady implied that once proper sensitization was done, people would better prepare for the exercise and make the appropriate arrangements to have their homes sprayed. For instance, people who had to be away from home on spraying days could make the appropriate arrangements with neighbors to have their home sprayed.

When I know that there is this service today I leave the door to my house open, I give it to someone to take care saying "Guys, let those people do that service in my house, my clothes I keep in majaba if I don't have a bag." Since there is no one to open someone's property, if I have money I walk with it.

Pregnant INI

Some participants who were frustrated with the IRS process asked that IRS be halted altogether in the community and another strategy for malaria control should be

implemented instead. One participant even thought it was a waste of resources to the government.

My opinions concerning fumigation, if that is the situation they should stop. If that is the situation they spray like that, they should stop completely. For they bring a loss to the government.

Male FGD

Other suggested recommendations included urging the government to conduct further research to improve the insecticide used for spraying. People also proposed that measures be put in place to ensure the potency of the IRS insecticide is not compromised by over dilution with water.

4. DISCUSSION

Examining perceptions about community sensitization prior to IRS activities.

Our study findings showed that IRS community sensitization could be divided into three categories: 1.People who had been adequately educated about IRS in their communities 2. Some who had not been sensitized adequately and 3. A few who had not been sensitized at all. From study findings, we recognize that some efforts were made in the community as a whole to educate people about IRS activities. Yet overall, community sensitization on the benefits and logistics of IRS activities seemed to have been insufficient in our study communities. Most participants asked for better education about the logistics of IRS, its health benefits and needed knowledge to dispel the unfounded rumors about IRS. We realized a need for more organized, timely and adequate sensitization in the community.

In regions of Tanzania where IRS has been evaluated, a demand for better community sensitization was common [5]. Our Study findings are therefore consistent with current literature. One study by Kaufman, evaluating IRS delivery in Mwanza, indicated that locals also requested that detailed information about IRS was shared in a timely manner to improve understanding of IRS and better prepare for its activities [5]. A salient discussion then ensues about what the community considers sufficient sensitization about IRS, who ought to be responsible for IRS sensitization, when and how it should occur.

What the community considers "adequate" information

Predominantly community members wanted to know specific information about the process of spraying. This involved what the chemical was, why the household needed to be evacuated and details about how the spray affected humans and insects overall. This is not an uncommon demand considering that in another study about IRS in the lake region, community members asked to be given more thorough information on the above-mentioned issues of spraying[5].

In Taiwan for instance, one of the main attributes associated with successful IRS was detailed community sensitization that carefully delivered information about aspects of IRS [16]. This study identified that disclosing the date or period when IRS would occur was crucial so people could either be home or make adequate arrangements to have their homes sprayed. People were specifically told which

household items could remain indoors and which ones needed to be removed to the outdoors. Locals were also educated on the functions of the insecticide, once it was applied on walls.

While the Taiwanese study shows that good community sensitization drives communal uptake of IRS uptake another study in Kenya revealed how insufficient sensitization hampered IRS acceptance [14]. The study reported locals being confused about the purpose of spraying, when it would be done and how it could likely affect their health, their children and the environment [14]. Thus it is essential to ensure that useful and relevant information for IRS is provided to the community prior to IRS to facilitate better participation. These messages could also incorporate information to debunk popular myths and rumors in the community.

When the community considers information provided to be "timely"

Some respondents were unhappy about the fact that they only learned about IRS on the day of spraying. These people either refused to have their homes sprayed or experienced difficulty in proper preparation for spraying activities. Others explained that they had been sensitized well in advance of spraying.

According to a Roll back Malaria report (RBM), which discusses IRS communications strategy in Zambia, IRS should be conducted well in advance of spraying. The exact timing should be decided in conjunction with IRS implementation team, community heads and if possible neighborhood health planning committees [17].

Together with community stakeholders the development of a public education timeline is crucial, as implementers would want to avoid giving information far in advance of spraying that community members fail to remember details. Conversely, information should be provided as reasonably close to implementation so people can be logistically and mentally prepared for spraying [17].

Who is the appropriate person to facilitate community sensitization?

Varying responses arose during the study about who had conducted IRS sensitization in the community. Some participants shared that the village leader had educated them and IRS implementation staff had educated others. A few participants mentioned being educated by sprayers on the day of IRS. Information from the RBM communication strategy for IRS, stressed community leaders as one of the best people to educate communities on spraying [17]. Since such leaders signified authority and usually had the confidence of the people, they are considered key players in IRS sensitization. Community members are more likely to accept and heed information by such a trusted source. Community leaders are also more likely to use culturally appropriate approaches that would ensure effective delivery of IRS messaging [17].

Locally recruited staff are also good sensitization agents for the community. A study of IRS interventions in Kenya and Chad highlighted that locally recruited and trained sprayers played an essential role in delivering IRS information to their respective communities prior to, and on the day of spraying[18]. The communal

familiarity of the individuals providing the sensitization was crucial in facilitating a better dialogue among the groups to be educated. Local recruits have been shown to foster better discussions about pending concerns and misconceptions, and to provide a forum for appropriate response, subsequently increasing acceptance of IRS [18].

Means of information delivery is suitable for the community

The means by which community sensitization was done varied. Some people reported hearing information on radio, others reported sensitization by village meetings, with a few others citing one-on-one sensitization by IRS stakeholders. People who had been sensitized in village meeting settings seemed more knowledgeable and were better prepared for IRS. Though, this finding is consistent with recommendations for IRS communication [17] we understand here that the appropriate means chosen to sensitize people, truly lies in proper investigation into the community dynamics and culture to learn what locals perceive to be the suitable means for providing knowledge about IRS [15].

Appropriate means for message delivery should be derived from a comprehensive assessment of the community setting in the beginning stages of designing the community sensitization approach [15]. This is because many different methods for sensitization, are proposed in the RBM communication strategy for IRS, but they may not be suitable for all communities. For instance, The RBM communication strategy mentions the use of radio advertisement as an appropriate

means for sensitization. However in our study findings there were instances where radio use for IRS sensitization was not well received.

In rural Nicaragua, for instance, where community education about malaria was assessed, one community exercised a long-standing tradition embedded in the phrase "only people can educate people" [19]. Therefore one can infer that in such a community radio advertisements, posters and other such impersonal methods for community sensitization may not be well received. This community therefore turned to the use of women and community health workers to assist in the community education through street plays and bonfire meetings.

Exploring reactions to logistics of IRS

The study findings revealed a mixture of opinions on people's reaction to spraying activities on the spraying day. Mainly pertaining to the removal of items from the home, women in particular did not find this feature of IRS to be convenient, especially where the household contained heavy possessions.

Hence although community members may show willingness to participate in IRS activities, frequent spraying activities requiring movement of household belongings, may eventually become troublesome and reduce community acceptance of IRS. This point is buttressed by similar research in the study region, which highlighted that women who were required to suspend usual household activities to accommodate sprayers, eventually reduced their participation in IRS [5]. Also the disruption of

routine chores and domestic duties saw many women refusing to participate in spraying activities. Amid spraying activities where women were still expected to care for children, cook and clean, IRS was noted to be burdensome [5].

Concerns were also expressed about valuable possessions lying outdoors for extended periods of time during spraying. Some community members with low quality possessions felt embarrassed at the poor state of their belongings and preferred not to move such possessions outdoors for spraying. While there is no immediate remedy for this concern in literature, if this aspect of IRS continues to worry locals it could drive subsequent decline in IRS participation.

Individual and communal incentives have also been shown to increase IRS participation, despite the logistical hurdles [16]. These incentives were varied gestures or items considered valuable by locals such as, the distribution of soap to women for complying with IRS. Additionally, community members who complied with the intervention were photographed and showcased in the local newspaper according to another Tanzanian study[16] .

Exploring perceived benefits of spraying to the community

A spectrum of responses was captured about the perceived benefits of spraying activities. A few participants mentioned that they had observed fewer mosquitos and a reduction in malaria burden. These results while specific to our study district were consistent with other studies in Mwanza and Zanzibar, Tanzania [5]. The overriding

finding however, was that for most participants the benefits of IRS had been clouded by the persistence of negative outcomes following spraying activities. As such, IRS was not considered a beneficial activity in reducing neither malaria disease burden nor the population of mosquitoes

Reasons why the community thought IRS was less beneficial and more problematic are likely linked to the persistence of mosquitoes in the home and the outdoor environment as a whole, even after spraying. As recounted by some participants, there was an expectation to observe a substantial mosquito reduction in households, which did not occur for most people. It could be that once community members received spraying, people became more lenient in traditional practices such as shutting windows and doors after dark to prevent entry of mosquitoes. Additionally, general vigilance to the presence of mosquitoes may have increased among household members thus causing a seemingly increase in mosquitoes in the home [16].

Also whether or not IRS actually reduces malaria prevalence however, is rather difficult to assess from a qualitative angle. Especially, that the IRS activities were conducted in conjunction with other malaria control mechanisms, it is challenging to separately determine IRS's contribution on a household level.

Another reasonable explanation for the negative perception that IRS was not an effective control intervention could be that other malaria control interventions infer more tangible benefits than IRS. In our study communities for example, nets were

highly associated with malaria reduction and a reduced contact with mosquitoes at night. The fact that bed nets presented a physical barrier against mosquito contact also enforced the perception that net use was beneficial for malaria reduction and prevention of mosquito bites. Unfortunately, the nature of IRS does not confer such concrete protection from mosquitoes such as nets would.

Importantly, it seems several people in the study district could not truly grasp benefits of the IRS activities as they were clouded by the side effects and the negative outcomes associated with IRS. With mothers complaining about itching and swollen stomachs in children, to coughing reported by community members, the immediate impact of IRS seemed to be the persistence of consequences rather than a reduction in malaria prevalence or mosquitoes. A study in Chiapas, Mexico cited IRS as a probable cause of symptoms such as dizziness, blurred vision, itching, coughing and sneezing in participants[20]. While this study ascertains the occurrence of insecticide side effects, little is known in available literature to inform the physiological and medical reasons behind these side effects [20].

Participants' association of IRS with an increase in bed bugs primarily, cockroaches, ants and ticks also greatly deterred the community from realizing the benefits of the spraying activities. The occurrence of sudden bug infestation after IRS has been noted in other IRS studies in Tanzania, South Africa, Mozambique and India [21], [22]. Similarly community members complained bitterly about the onslaught of

insects. Following these observations, people either refused subsequent rounds of IRS or participated with varying degrees of hesitancy. In the midst of such manifestations, communities and individuals were less cognizant of IRS benefits.

A study by Rafajat discussed the bed bugs infestation in countries undergoing malaria eradication with IRS [23]. It explains that chemicals utilized in IRS increase irritability of insects, thus making bugs more mobile than usual. This falsely creates the impression of an increase in bedbugs and insects, when in fact that may not be true per say. This phenomenon accounts for the sudden visibility of insects following spraying. [23] This finding then accounts for the reported increase in bed bugs and insects that hamper the realization of IRS benefits.

RECOMMENDATIONS

From a public health standpoint, my study results inform some key recommendations that should be considered for improving IRS. The primary recommendation is to enhance community sensitization on IRS. Our study results showed that refusal was not random but instead from a misunderstanding of the process and effects of IRS. This realization highlights the need for good community sensitization.

Ideally, community meetings should be used for sensitization. This approach is recommended because it provides a synchronized method to information dissemination and tackling of misinformation. It is less human and capital resource intensive than

door-to-door sensitization and has greater likelihood to educate more people [15]. Community members witnessing fellow townsfolk's enthusiasm and concern for the intervention during communal information settings will galvanize the entire community towards acceptance.

During these meetings, opportunities should be provided for questions and for the provision of informed responses. The information shared here should be comprehensive, including necessary detail about dates and time for IRS, homes preparation methods and the functions of the insecticide. Community sensitization should involve community leaders in designing messaging for IRS and spray schedules, as they know the community best.

Many concerns that fueled negative perceptions of IRS could be addressed with good sensitization. Timely and detailed information will prepare people logistically, by providing ample time for them to seek assistance from neighbors or make adequate arrangements to be available. People will also better understand the expected benefits of IRS, which will increase acceptance. Issues of IRS refusal or hesitance due to myths, rumors, inadequate perceptions of benefits, insufficient information and inaccurate expectations can also be targeted with sound community sensitization.

Sensitization for IRS needs to be standardized so that all community members receive the same information, though different delivery methods and approaches may be employed. A comprehensive list of salient points that each individual must know

should be developed to facilitate uniform and effective sensitization activities [17]. All the above-mentioned points should be properly incorporated to design a suitable IRS sensitization approach.

2. Provision of logistical support to aid women especially in removing belongings to the outside, would greatly increase their willingness to participate in IRS, since this seemed to be a challenge. Implementation teams should consider incentivizing sprayers to provide logistical support to women. By providing this assistance, the logical burden associated with IRS would be reduced. The reported disruption of daily chores for women during IRS could also be minimized to increase IRS acceptance.

Nonetheless, insecticides cannot be applied without discomforts [20]. In order to realize the full benefits or IRS as a malaria control strategy the community will have to make modifications to communal routines and norms to accommodate IRS exercise and to gain its benefits.

3. Broader mosquito control measures are necessary to curb persistence of mosquitoes in the environment and to prevent further breeding. With less mosquitoes in the environment overall, IRS activities could be more effective as there will be less mosquitoes which enter households. The benefits of mosquito reduction will then be more obvious to community members. This will subsequently reflect in a reduction of malaria disease burden.

Finally, given the variability in malaria seasonality in Tanzania and the fact that IRS does not address all aspects of malaria control, concurrent use with other malaria control strategies is needed to improve malaria prevention overall in Tanzania [5].

As PMI looks to increase the number of districts implementing IRS, creative use of the recommendations provided will lead to increased community acceptance of IRS and improve communal experiences, possibly moving Tanzania towards realizing its vision of a malaria-free nation.

STUDY LIMITATIONS

Due to the fact that the focus of the broader IMPACT 2 was not specifically targeted to investigate IRS, the responses were limited to a narrow scope of inquiry. The interviews did not excessively probe participants to elicit the most comprehensive responses. The small sample size may not have allowed for varying opinions and perspectives to be shared. Overall findings for the study are valid for the study group, however issues of external validity arise due to small sample size and a particular focus the study employed in obtaining specific district data.

CONCLUSION

Overall, the study villages were experiencing a myriad of issues with IRS as a malaria control intervention. A few people were had positive perceptions about IRS as they had observed reductions in malaria and mosquitoes. However, most people had negative experiences due to occurrences such as bed bugs infestations, side effects,

unabated malaria prevalence and persistence of mosquitoes. Relating to the objectives of the study results, key factors were identified to promote better implementation of IRS. To increase IRS acceptance and effectiveness, thorough community sensitization is absolutely necessary. The relevance for timely and detail-oriented community sensitization for subsequent IRS activities is also stressed. Broader measures for malaria reduction in the environment and measures to counteract the rampant insect infestation need to be considered. Improvement of sprayers utility in assisting women especially with the logistical hurdles of IRS at the household level was also emphasized. Through implementation of the proposed recommendations, IRS roll out in Tanzania will continue to observe high coverage but also report higher community satisfaction following participation in IRS activities.

CHAPTER 4. RECOMMENDATIONS AND CONCLUSIONS

PUBLIC HEALTH IMPLICATIONS

The public health implications arising from this study mainly revolve around the need for adequate and well–tailored community education about IRS. Specifically for IRS campaigns where community expectations for tangible reduction in mosquitoes may be not be sufficiently realized, the implementation team needs to properly set the mind frame of the intervention recipients. The definitions of "adequate" information delivered during these sensitization activities may differ by community and thus ought to be altered per the evidenced-based findings for the implementation setting.

Furthermore the findings of this study show that sometimes proposed public health interventions might oppose aspects of local traditions such as in our study, where strangers had to enter homes to spray or participants had to place belongings outside. In these instances, it is important to prioritize community education involving input from community heads who are conversant with the local norms.

It is also important to incorporate the perspective of an epidemiologist, a sociologist and health educator. Together, the technical input of these people can address various components of education and logistical support which is necessary for optimal acceptance.

Occasionally, with public health interventions, unexpected side effects and negative outcomes may arise such as bed bugs, itching and coughing shown by my study results. While this is not the ideal situation, such occurrences must be addressed immediately, to prevent negative community perceptions about the intervention. There may also be undesirable aspects of the intervention that community members may have to endure to reap associated benefits. For instance in our study, it was challenging for a female to remove heavy drums of water or pour it away to empty her house for spraying. Implementers must recognize such inconveniences early, and either provide support or prepare the community mentally to prevent intervention refusal.

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the above-mentioned points should be properly incorporated to design a suitable IRS sensitization approach.

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