THE EFFECTIVENESS OF MALARIA CONTROL STRATEGIES AT HOUSEHOLD LEVEL: A SPATIO–TEMPORAL ANALYSIS

Cecilia K Muchepa Muzyamba
Zambian Open University, School of Education
P O Box 31925, Lusaka 10101, ZAMBIA

ABSTRACT

Malaria is a disease of public health concern in many nations of the world. The parasite and the vector have been a nuisance to human populations. It was for this reason that the Government of the Republic of Zambia (GRZ) through the health sector and other cooperating partners introduced various diagnosis and treatment procedures and; malaria prevention strategies. This paper examined the effectiveness of the malaria prevention strategies at household level in Samfya District of Zambia. Random and non-random research designs were used to obtain the sample and data for the study. There were 394 respondents, 3 Focus Group Discussions (FGDs) and 11 key informants.

The results showed that 55.8% of the respondents acknowledged that they had heard about the use of Sulphadoxine-Pyrimethamine (SP – Fansidar) out of which only 9.1% knew that it a prophylactic therapy during pregnancy. Forty-six point two percent (46.2%) pregnant women took the SP as an IPTp. Seventy-two point six percent (72.6%) of the respondents had never had their houses sprayed using the Indoor Residual Spraying (IRS). The 27.4% of the respondents who stated that their houses were sprayed, it was through the use of small domestic insecticide spray cans that were purchased from shops. As a result of this, only 0.8% knew that Dichlorodiphenyl Trichloroethane (DDT) was a chemical used in the IRS strategy. The ownership and utilization of ITNs/LLINs was higher in Mwewa than Lubwe (48.6% and 51.4%; and 22.6% and 42.1% respectively). These results indicate that the strategies were not effectively utilized in the control of malaria.

***Key words**: Control Strategies, Effectiveness, Household, Malaria, Spatial, Temporal.*

INTRODUCTION

Malaria Control and eventual elimination is one of the top priorities for the Government of the Republic of Zambia (GRZ). The Ministry of Health (MOH) and the Ministry of Community Development, Mother and Child Health (MCDMCH), now the Ministry of Community Development (MCD) through the National Malaria Control Center (NMCC) and the support partners had scaled up proven malaria diagnosis, treatment andcontrol These interventions are: Molecular Diagnosis (MD), Microscopic Analysis (MA),Rapid Diagnostic Tests (RDTs);

Artemisinin Combination Therapy (ACT); and Long Lasting Insecticide Nets (LLINs), Intermittent Presumptive Therapy in pregnancy (IPTp), Indoor Residual Spraying (IRS), Insecticide Treated Nets (ITNs),(Karsen et al. 2015). The other anti-malaria interventions are: improved surveillance and reporting at health facilities, mass screening and testing campaigns, and community based malaria surveillance system. All these strategiesare aimed at reducing the malaria and vector populations (GRZ 2014).

This study focused on IPTp, IRS and ITNs/LLINs as the main malaria control strategies whose distributions and coverage had contributed to the unprecedented decrease in the worldwide malaria burden(Heng et al. 2015). According to Sangoro et al. (2014),extensive use of LLINs and IRS had substantially reduced malaria morbidity and mortality in Sub-Saharan Africa. These tools targeted the indoor resting and biting mosquitoes there by reducing the nuisance (Sangoro et al. 2014). This showed that there was a relationship between the increases in the coverage of the intervention strategies and the spatio-temporal distribution of malaria. Others studies too, had shown that, spatially, the number of cases and episodes had declined over time as a result of using various malaria control strategies. This study therefore, was done to establish the effectiveness of the malaria intervention strategies at household levels in Zambia: A case study of Samfya District.

OBJECTIVE

To examine theeffectiveness of the malaria controlinterventionstrategies such as the IPTp, IRS and ITNsathousehold levelof in Samfya district;

STATEMENT OF THE PROBLEM

Zambia, a country in the central southern Africa lies in the malaria endemic region and was overburdened with the disease as Eastern and Luapula Provinces still experienced high transmission levels during the rainy season as they lie in the Malaria epidemiological zone three (3). Despite, the Ministry of Health in partnership with the President's Malaria Initiative (PMI), WHO, UNICEF, Malaria Control and Evaluation Partnership (MACEPA), the Global Fund to Fight AIDS, Tuberculosis (TB) and Malaria (GFATM) putting in place the roll back malaria (RBM) and the Malaria Booster programmes of 2000 and 2005 respectively, malaria related deaths had only declined at national level from 50 000 to 3 871 per year (MoH, 2010: v) through the strategy of 'scaling up' effective interventions (Davies, et al., 2011). The interventions such as the use of insecticide treated nets (ITNs), indoor residual spraying (IRS) Artemisinin Combination therapy (ACT), Intermittent Presumptive Therapy in pregnancy (IPT_p), Molecular Analysis (MA), Microscopy Diagnosis (MD) and Rapid Diagnostic Tests (RDTs) were introduced in order to control, reduce and finally eradicate the disease. With all these efforts, it

was inevitable to find out how effective the utilization of IPTp, IRS and ITNs as malaria control strategies were at household level in Samfya District.

THE STUDY AREA

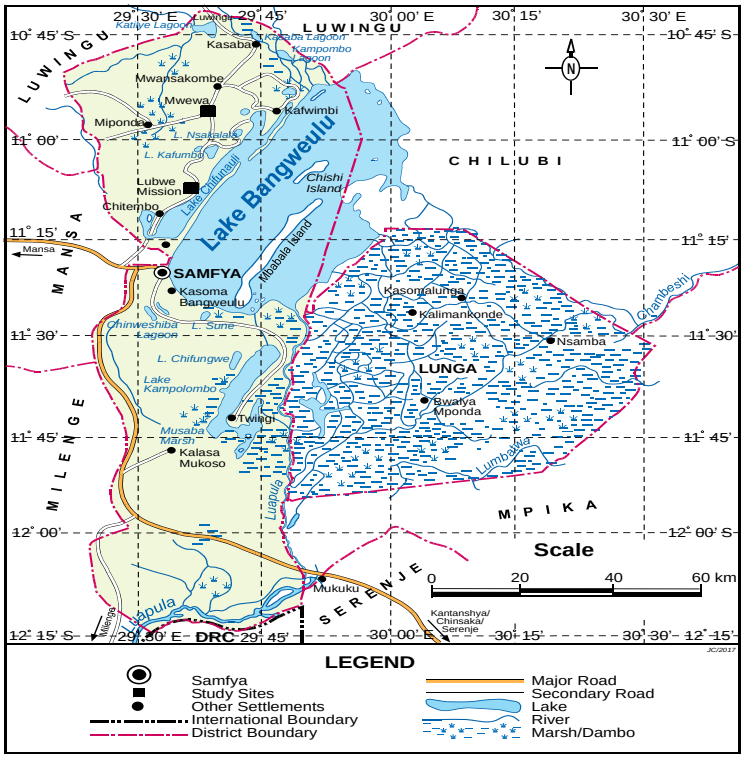

Figure 1: Location of Samfya District

Source: Surveyor General (1979), and Ministry of Local Government and Housing (MLGH 2015).

The study area was Samfya District in the Luapula Province. This area was chosen because other than lying in epidemiological zone 3 of malaria transmission and its ecological nature that provided a geographical gradient, it was also a rural area which experienced various aspects of social developmental inequalities. It was inevitable to assess the levels of knowledge on malaria and malaria control. The study looked at the knowledge levels on the causes, transmission, treatment and prevention on malaria.

STUDY DESIGN AND SAMPLE SIZE

This was a transect study that was aimed at producing results that would show the geographical gradient of the spatio-temporal distribution of malaria in Samfya District. The study employed both qualitative and quantitative techniques in order to ensure more accurate and stronger

outcomes. Questionnaires (394 respondents), Interviews (11key informants), Focus Group Discussions (03), records and observations were used to collect the data.

SAMPLING PROCEDURE

Random and non-random sampling procedures were used to select the respondents and the key informants respectively. The Yamane Formulawas used to determine the sample size, the systematic sampling for the selection of the respondents to the sample,and the purposive sampling for the key informants.

RESULTS AND DISCUSSION

Intermittent Presumptive Therapy in Pregnancy

The Intermittent Presumptive Therapy in pregnancy (IPTp) is a widespread preventive strategy to fight malaria in pregnancy and it involves the administration of curative dose of an effective anti-malaria drug regardless of the presence of plasmodium in the blood. The therapy is a prophylactic measure for malaria in order to protect the mother and the foetus from chances of malaria occurrence. The IPTp measures decrease parasitaemia and consequently influence the immunity response of the infant to plasmodium in utero through maternal IPTp (Borgella, et al., 2013; Brabin, 1983; Moya-Alvarez, et al., 2014; Riley, et al., 2001). The administration of IPTp at different moments, therefore, determine different protection patterns of the infant's birth weight and prematurity and also shows a reduction in placental malaria and parasitaemia.

In Zambia, the drug policy regarding IPTp for pregnant women involves the use of Sulphadoxine- Pyrimethamine (SP – which is popularly known as Fansidar). Fansidar is the brand of SP drug predominantly used in the country. The drug is dispensed as a package through focused antenatal care (FANC). The package include a course of SP, an ITN and iron supplementation (CSO, 2009). Antenatal clinics are used as conduits for malaria prevention among pregnant women. The women with geographical access barriers receive IPTp through the traditional birth attendants (TBAs) or during health centre outreach activities. These activities however, did not reach out to all the pregnant women in Samfya District.

The survey revealed that fifty-five point eight percent (55.8%) had heard about IPTp and Mwewa accounted for 30.7%, while twenty-nine point two percent (29.2%) had never heard about it and, fifteen percent (15.0%) were not sure whether they had heard about it or not, as illustrated in Table 1.

Table 1: ***The respondents' of IPTp***

			Knowledge of IPT			
			Yes	**No**	**Not sure**	**Total**
Research site	Lubwe	Frequency	99	60	42	**201**
		Percentage	25.1	15.2	10.7	**51.0**
	Mwewa	Frequency	121	55	17	**193**
		Percentage	30.7	14.0	4.3	**49.0**
Total		**Frequency**	**220**	**115**	**59**	**394**
		Percentage	**55.8**	**29.2**	**15.0**	**100.0**

Source: Field data, 2015

Despite 55.8% acknowledged that they had heard of IPTp, only 9.1% knew what it meant and the rest of the respondents either did not know or understood it differently as illustrated in Table 6.2. Eighty-nine point nine (89.9 %) did not have any idea as to what IPTp was while 1.0 % of the respondents indicated that it was 'information presumptive treatment' but this was incorrect. This therefore, implied that a total of 90.9 % did not have adequate knowledge of IPTp.

Table 2: ***The Respondents' understanding of IPTp***

			Respondents' understanding of IPT			
			No idea	**Information presumptive treatment**	**Intermittent presumptive treatment**	**Total**
Research site	Lubwe	Frequency	168	2	31	**201**
		Percentage	42.6	.5	7.9	**51.0**
	Mwewa	Frequency	186	2	5	**193**
		Percentage	47.2	.5	1.3	**49.0**
Total		Frequency	354	4	36	**394**
		Percentage	89.9	1.0	9.1	**100.0**

Source: Field data, 2015.

Only 9.1% stated that it was intermittent presumptive treatment and that it was a therapy of anti-malarial drugs administered to pregnant women in doses at intervals during the gestation

period to those that were asymptomatic. This was a malaria prevention strategy that was aimed at safeguarding the health of the mother and the foetus from malaria infection.

The response of 'No Idea' was worrying because the figure was huge (89.9%). This figure could be attributed to the lower levels of formal education. It was, therefore, necessary to conduct health education awareness campaigns both at the health facilities and in the villages. The village scenario, however, was quite a sensitive one as information about conception and pregnancies had huge cultural connotations and as such were secretive. Even the expected date of delivery (EDD) was never shared with anyone for fear of witchcraft as was revealed in the women FDGs. Most women stated that, *awe takwabaukulandaelyowayimitenanguimyeshilyefumopantuingachayishibikwakutibakukakilaif umo nangula wafilwauku papa* (you don't have to disclose when you conceived or the age of the pregnancy for fear of losing the baby or failure to deliver).
Such cultural beliefs and fears made some women not to attend antenatal clinics and if they did it was towards the full-term period because of fear of any anticipated complications. Otherwise, they delivered from their homes either on their own or with the help of TBAs. This meant that the women that excluded themselves from IPTp, exposed their infants and indeed themselves to malaria as no means of personal preventive measure was undertaken.

Deressa, et al., (2014) argued that there was need for social marketing, community education and sensitization of the tools and strategies for a substantial period of time in order to impact on the people's perceptions and attitudes to enhance compliance. According to Mwanje (2013), behavioural change communication (BCC) activities were an effective vehicle to addressing advocacy and social mobilization in the prevention and control of malaria. These communication strategies could help reduce the fears that surrounded pregnancy and the use of IPTp and enhance protection of the mother and the foetus (infant) in Samfya District. Table 6.2 illustrates what the respondents understood about IPTp according to the study sites.
Mwewa had 186 (47.2%) respondents who had 'no idea' about what IPTp meant compared to the 168 (42.6%) of Lubwe, out of a total of 193 and 201 respectively. The majority (31) that knew of IPTp were from Lubwe (7.9%) while Mwewa had only 5 (1.3%) respondents. The 'Information Presumptive Treatment' came from those that had acquired senior secondary education. The minimal variations in the results show no great impact on the respondents' understanding of IPTp despite many respondents having been formally educated as indicated in Table 6.4. The levels of 'No idea' response decreased with increasing levels of education and this did not correlate with the correct knowledge about IPTp. No trend had been developed to show any relationship between the two variables, the level of knowledge and the education levels of the respondents in Samfya District even though the respondents with primary and senior secondary education levels showed more knowledge of what IPTp was.

Table 3: ***The respondents' understanding of IPTp according to education levels***

Highest education level				Understanding of IPT			Total
				No idea	Information presumptive treatment	Intermittent presumptive treatment	
No formal education	Research site	Lubwe	Frequency	22		2	**24**
			Percentage	44.0		4.0	**48.0**
		Mwewa	Frequency	25		1	**26**
			Percentage	50.0		2.0	**52.0**
	Total		Frequency	47		3	**50**
			Percentage	94.0		6.0	**100.0**
Primary	Research site	Lubwe	Frequency	58	1	12	**71**
			Percentage	40.3	.7	8.3	**49.3**
		Mwewa	Frequency	73	0	0	**73**
			Percentage	50.7	.0	0	**50.7**
	Total		Frequency	131	1	12	**144**
			Percentage	91.0	.7	8.3	**100.0**
Junior secondary	Research site	Lubwe	Frequency	35	0	4	**39**
			Percentage	34.7	0	4.0	**38.6**
		Mwewa	Frequency	60	1	1	**62**
			Percentage	59.4	1.0	1.0	**61.4**
	Total		Frequency	95	1	5	**101**
			Percentage	94.1	1.0	5.0	**100.0**
Senior secondary	Research site	Lubwe	Frequency	40	1	9	**50**
			Percentage	50.6	1.3	11.4	**63.3**
		Mwewa	Frequency	27	1	1	**29**
			Percentage	34.2	1.3	1.3	**36.7**
	Total		Frequency	67	2	10	**79**
			Percentage	84.8	2.5	12.7	**100.0**
Certificate /Diploma	Research site	Lubwe	Frequency	13		4	**17**
			Percentage	65.0		20.0	**85.0**
		Mwewa	Frequency	1		2	**3**
			Percentage	5.0		10.0	**15.0**
	Total		Frequency	14		6	**20**

Highest education level				Understanding of IPT			Total
				No idea	Information presumptive treatment	Intermittent presumptive treatment	
No formal education	Research site	Lubwe	Frequency	22		2	**24**
			Percentage	44.0		4.0	**48.0**
		Mwewa	Frequency	25		1	**26**
			Percentage	50.0		2.0	**52.0**
	Total		Frequency	47		3	**50**
			Percentage	94.0		6.0	**100.0**
Primary	Research site	Lubwe	Frequency	58	1	12	**71**
			Percentage	40.3	.7	8.3	**49.3**
		Mwewa	Frequency	73	0	0	**73**
			Percentage	50.7	.0	0	**50.7**
	Total		Frequency	131	1	12	**144**
			Percentage	91.0	.7	8.3	**100.0**
Junior secondary	Research site	Lubwe	Frequency	35	0	4	**39**
			Percentage	34.7	0	4.0	**38.6**
		Mwewa	Frequency	60	1	1	**62**
			Percentage	59.4	1.0	1.0	**61.4**
	Total		Frequency	95	1	5	**101**
			Percentage	94.1	1.0	5.0	**100.0**
Senior secondary	Research site	Lubwe	Frequency	40	1	9	**50**
			Percentage	50.6	1.3	11.4	**63.3**
		Mwewa	Frequency	27	1	1	**29**
			Percentage	34.2	1.3	1.3	**36.7**
	Total		Frequency	67	2	10	**79**
			Percentage	84.8	2.5	12.7	**100.0**
Certificate /Diploma	Research site	Lubwe	Frequency	13		4	**17**
			Percentage	65.0		20.0	**85.0**
		Mwewa	Frequency	1		2	**3**
			Percentage	5.0		10.0	**15.0**
	Total		Frequency	14		6	**20**
			Percentage	70.0		30.0	**100.0**

Source: Field data, 2015.

Table 4: ***The respondents' knowledge levels about IPTp***

Knowledge Levels				Respondents' understanding of IPT			
				No idea	Information presumptive treatment	Intermittent presumptive treatment	Total
Inadequate	Research site	Lubwe	Frequency	127	1	16	**144**
			Percentage	50.4	.4	6.3	**57.1**
		Mwewa	Frequency	102	2	4	**108**
			Percentage	40.5	.8	1.6	**42.9**
	Total		Frequency	229	3	20	**252**
			Percentage	90.9	1.2	7.9	**100.0**
Adequate	Research site	Lubwe	Frequency	41	1	15	**57**
			Percentage	28.9	.7	10.6	**40.1**
		Mwewa	Frequency	84	0	1	**85**
			Percentage	59.2	0	.7	**59.9**
	Total		Frequency	125	1	16	**142**
			Percentage	88.0	.7	11.3	**100.0**

Source: Field data, 2015.

MANIFESTATIONS OF MALARIA IN PREGNANCY AND THEIR CONSEQUENCES

When an infected mosquito bites a pregnant woman, the following happened. The woman and the foetus were both at risk. The foetus was subjected to low birth weight or worse still, to abortion or it was born dead. These, therefore, translated into loss of life of an infant, while the mother either developed an acute illness or/and anaemia that led to long term sequelae or clinical malaria. These threatened the two lives, that of the mother and the infant, and that was the more reason why they were considered to be the most vulnerable. Figure 1 illustrates the pregnancy related manifestations of malaria and their consequences.

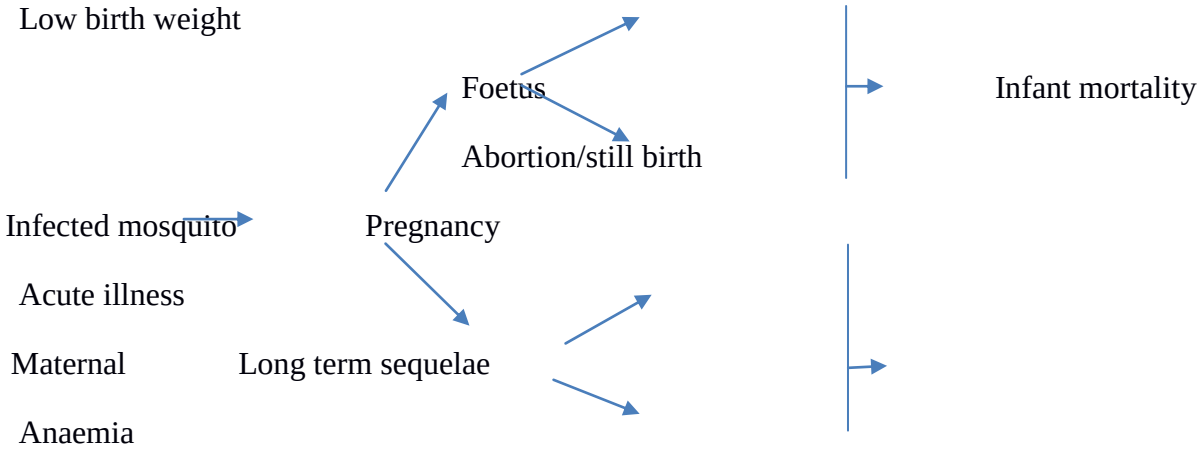

Figure 1: ***Consequences of malaria manifestation in pregnancy***

Source: Adapted from Breman et al. 2004:4.

Nosten and Gready (2015) argued that despite the recent progress, malaria continued to cause devastation during pregnancy especially in areas of intense transmission. Samfya District lay in the national epidemiological zone 3 of the high malaria transmission which was characterized by more than 20% of the transmission rate. The mothers in such areas were subjected to anaemia and, severe and cerebral malaria as Figure 6.1 portrays. The hospital records in this study also showed a lot of clinical malaria cases of which most patients were women and children below 60 months. This was an indication of increases of malaria episodes within a short space of time. Another view postulated by Chico, et al., (2015) was that the low uptake of SP in IPTp in pregnant women put them at high risk of malaria. There was need therefore, to scale up the uptake of the drug during pregnancy for the strategy to be very effective in Samfya District. The IPTp uptake in the survey was low as indicated in Table 6.5 as only 52.3% against 47.7 % of the respondents participated in SP – IPTp strategy.

Table 5: ***The respondent/Spouse ever taken IPTp***

			Spouse/self participation in IPTp			
			Yes	**No**	**Not sure**	**Total**
Research site	Lubwe	Frequency	82	52	51	**185**
		Percentage	23.6	14.9	14.7	**53.2**
	Mwewa	Frequency	100	37	26	**163**
		Percentage	28.7	10.6	7.5	**46.8**
Total		Frequency	182	89	77	**348**
		Percentage	52.3	25.6	22.1	**100.0**

Source: Field data, 2015.

Only fifty-two point three percent (52.3%) of the respondents stated that either themselves or spouses had taken IPTp as it was an important prophylaxis for malaria. The remaining 47.7% had 'No' (25.6%) and 'Not sure' (22.1%) as their responses. This representation did not constitute the whole sample because some respondents were not married at the time of the survey. The 47.7% of the respondents, however, was a big percentage of women that did not take SP for IPTp. This meant that there was a great reservoir for malaria parasites in the community. Other than that, some respondents did not even know the reason why SP in IPT was administered to pregnant women as illustrated in Table6.

Table 6: ***Respondents' reasons for the use SP in IPTp***

			Reasons for IPT in pregnancy			
			Prophylaxis	**Treatment**	**No idea**	**Total**
Research site	Lubwe	Frequency	62	75	64	**201**
		Percentage	15.7	19.0	16.2	**51.0**
	Mwewa	Frequency	51	69	73	**193**
		Percentage	12.9	17.5	18.5	**49.0**
Total		Frequency	113	144	137	**394**
		Percentage	28.7	36.5	34.8	**100.0**

Source: Field data, 2015.

Twenty-eight point seven percent (28.7%) of the respondents knew that IPTp was a malaria prevention therapy or used as a prophylaxis, while thirty-six point five percent (36.5%) and thirty-four point eight percent (34.8%) said that it was for malaria treatment and others did not actually have any idea of what it was respectively. Table 6.6 shows the respondents' knowledge on why IPTp was used on pregnant women.

Lubwe had more responses in the category of 'prophylaxis' and 'treatment' than Mwewa. Those without any idea as to why SP was given to pregnant women were more in Mwewa than Lubwe. This was so because of the availability the health resources (Physical infrastructure and personnel) in Lubwe. On the whole, 65.2% were somewhat correct to state that SP was used as a prophylaxis and for treatment. Those that said it was a treatment therapy could have been right in their own way because SP was initially used as a treatment therapy for malaria worldwide not until its efficacy reduced. The reduction in utilization was a result of parasitaemia resistance as stated by Nosten and Gready, (2015) and other scholars.

Nosten and Gready (2015) and Slater, et al., (2016) argued that SP was an old anti-malaria drug used for the treatment of uncomplicated Pf infections. Its single dose provided a period

of protection against new infection for several weeks after treatment. The resistance however, emerged in South East Asia in 1970 and had since spread to larger parts of Africa, Zambia inclusive, where Coartem (Artemether-Lumefantrine) which is used in ACT as first line treatment therapy for malaria had replaced SP (Battle, et al., 2016; Dellicour, et al., 2015; Nosten and Gready, 2015; Slater, et al., 2016; Ogouyemi-Hounto, et al., 2016 and Yeung, et al., 2004).

Sulphadoxine- pyrimethamine (SP) was said to be a failed drug in large parts of Africa and the more recent studies had shown that it had positive indirect impacts on birth weight and anaemia. In Benin (Riley, et al., 2001); Malawi (Gutman, et al., 2013) and Tanzania (Moya-Alvarez, Abellan and Cot, 2014), studies showed that SP improved the infant's birth weight and the mother's haemoglobin levels. This, therefore, enhanced maternal and child health. In other areas the health was seriously compromised by SP resistance. This caused harm by increasing placenta proliferation of resistant parasites and by gametocyte carriage making the women to be more at risk of the malaria infection as they were reservoirs of the parasitaemia.

There was no claim by Chico, et al., (2015), that IPTp reduced maternal and foetal mortality. It was also unclear whether the dose administered to pregnant women was adequate. There were manifestations that SP was not a real preventive strategy as malaria infection resurged 4-6 months in infants in Cameroon (Chico, et al., 2015). In Gabon, it was found out that there was a significant correlation between placental malaria and the first malaria episode; while in Mozambique, infants born to women who had placental infection had increased risk of clinical malaria and malaria in infants. Similar results were obtained in other studies and that which was done in Benin confirmed the link between placental malaria and malaria in infants (Borgella, et al., 2013; Brabin, 1983; Dellicour, et al., 2010; Moya Alvarez, et al., 2014 and Riley, et al., 2001).

This, therefore, confirmed that SP merely suppressed the parasites and inhibited their multiplicity until the drug efficacy in the body ceased. The rate of infection for children aged between 0 – 59 months in Samfya District was quite high as portrayed in Figure 4.4. During the winter months the levels of infection for the children surpassed those of the adults as revealed by the study.

There were challenges in the administration of IPTp in that not all the pregnant women accessed the health facility either due to fears of the drug causing miscarriage or distance they had to cover to visit the health facility. The fear of miscarriage was reinforced by what came out in the women FGDs. The discussants stated that:

> *banamayobamobalatinaukunwa umuti ngabalipabukulupantuifumokutilyafuma. Ala! ubufyashibwalishupa Kanshi tetichiwameifumoukufuma. Bambi nabonangubesakuchipatala, ulya umuti*

> *batupelaukunwababikapanshiyalulimielyobayaufwisanokuwuposa*(some women did not take the drugs because they feared miscarriage because some women had challenges with their fertility levels, so it was not good to lose a baby. Even though some women went to the hospital, the drugs were put under the tongue and later spat).

According to the medical personnel interviewed at the Mother and Child Health Clinic (MCH), they dispensed the drugs to pregnant women and made sure that they were taken, but least did they know that the drugs were not swallowed. The FDGs further revealed an aspect of compliance in that some of the women did not adhere to IPTp as a strategy for malaria in pregnancy. This therefore, needed more information to both the medical staff and the women. The women required more knowledge on the utilization and benefits on the use of SP in IPTp. The strategy as a preventive measure of malaria was not effective in Samfya District as the majority of women did not access the therapy even those that did were not compliant.

INDOOR RESIDUAL SPRAYING

Another malaria control strategy is Indoor Residual Spraying (IRS). IRS is a vector control strategy that has had a distinguished historical role in the control of malaria on Southern Europe, North America, Japan, Central and South Asia and Latin America (Ngufor, et al., 2014), through the utilization of DDT. This strategy was scaled up significantly in Africa in general and Zambia in particular.

In Zambia, IRS was introduced in 2003 as already alluded to in Chapter two. This was piloted in five districts and by 2011 – 2012 transmission season, IRS was rolled out at varying levels of coverage in all the 72 districts then. The number of districts had since increased to over 100 by 2016 through the implementation of the 2013 decentralization policy. Luapula Province, and indeed Samfya District in particular, had operational challenges associated with the implementation and sustainability of the strategy. This, therefore, did not benefit many households in the survey as indicated in Table 6.7. The respondents that said their houses were sprayed, actually only used the small domestic insecticide sprays.

Table 7: ***House ever been sprayed***

			House ever been sprayed		
			Yes	**No**	**Total**
Research site	Lubwe	Frequency	45	156	**201**
		Percentage	11.4	39.6	**51.0**
	Mwewa	Frequency	63	130	**193**
		Percentage	16.0	33.0	**49.0**

Total	**Frequency**	**108**	**286**	**394**
	Percentage	**27.4**	**73.6**	**100.0**

Source: Field data, 2015.

Seventy-three point six percent (73.6%) of the respondents stated that their houses were never sprayed by massive IRS and there was never such an activity in the community. The response was echoed by hospital administration who confirmed that IRS had never taken place in the area. This meant that the 27.4% of the respondents who acknowledged that their homes had been sprayed, was by the use of small domestic insecticide spray cans such as 'Raids', 'Target', 'Mortein Power Guard' or 'Doom' that were purchased from shops. The prices varied according to the make and size of the can. The prices generally ranged from ZMK 12.00 to ZMK 15.00 (US$ 1.20 to US$ 1.50). This was rather expensive for the community that earned an average income of ZMK 700.00 per month (US$ 70.00). These cans were used between 1 to 3 days depending on the size of the house and the intensity of the spray. The spraying was not consistently done in that when the insecticide finished, it took time to purchase another can. The respondents' knowledge levels on the chemical used for indoor residual spraying supported the revelation that the survey area had never been massively sprayed. Figure 2 shows what the respondents knew about the chemical that was used in IRS.

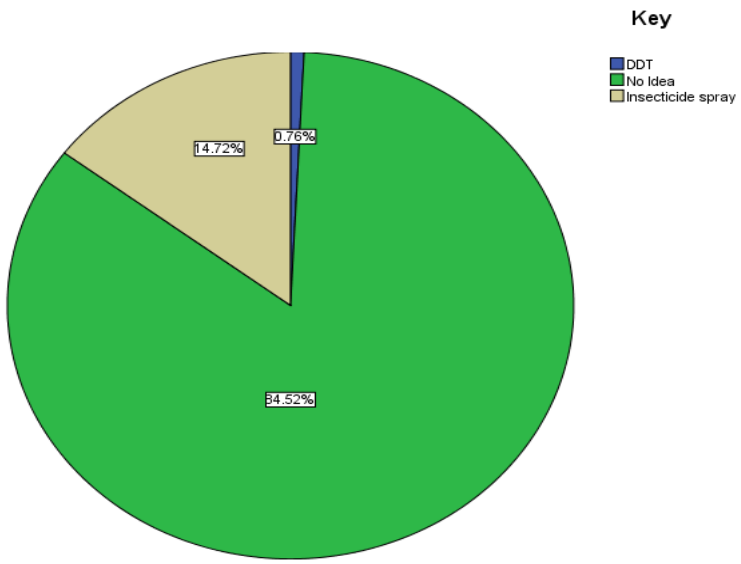

Figure .2: ***Type of chemical used in IRS***

Source: Field data, 2015.

Out of the 27.4% that had earlier said their homes were sprayed only 0.8% knew the chemical that was used in IRS as DDT. Fourteen point seven percent stated that it was insecticide spray

while 11.9 % had no idea. This, therefore, meant that even though 27.4% of the respondents stated that their homes were sprayed, 26.6% of these had a misrepresentation of massive IRS. The 73.6% of the respondents that showed no response were actually those that stated that the area had never had any massive IRS. According to Figure 6.2, the 84.5 % was the sum of the 'No idea' and 'No response' as the people who showed that the area had never been sprayed using the IRS strategy.

There were various reasons that were provided by those respondents that stated that their houses were sprayed as illustrated in Figure 6.3.

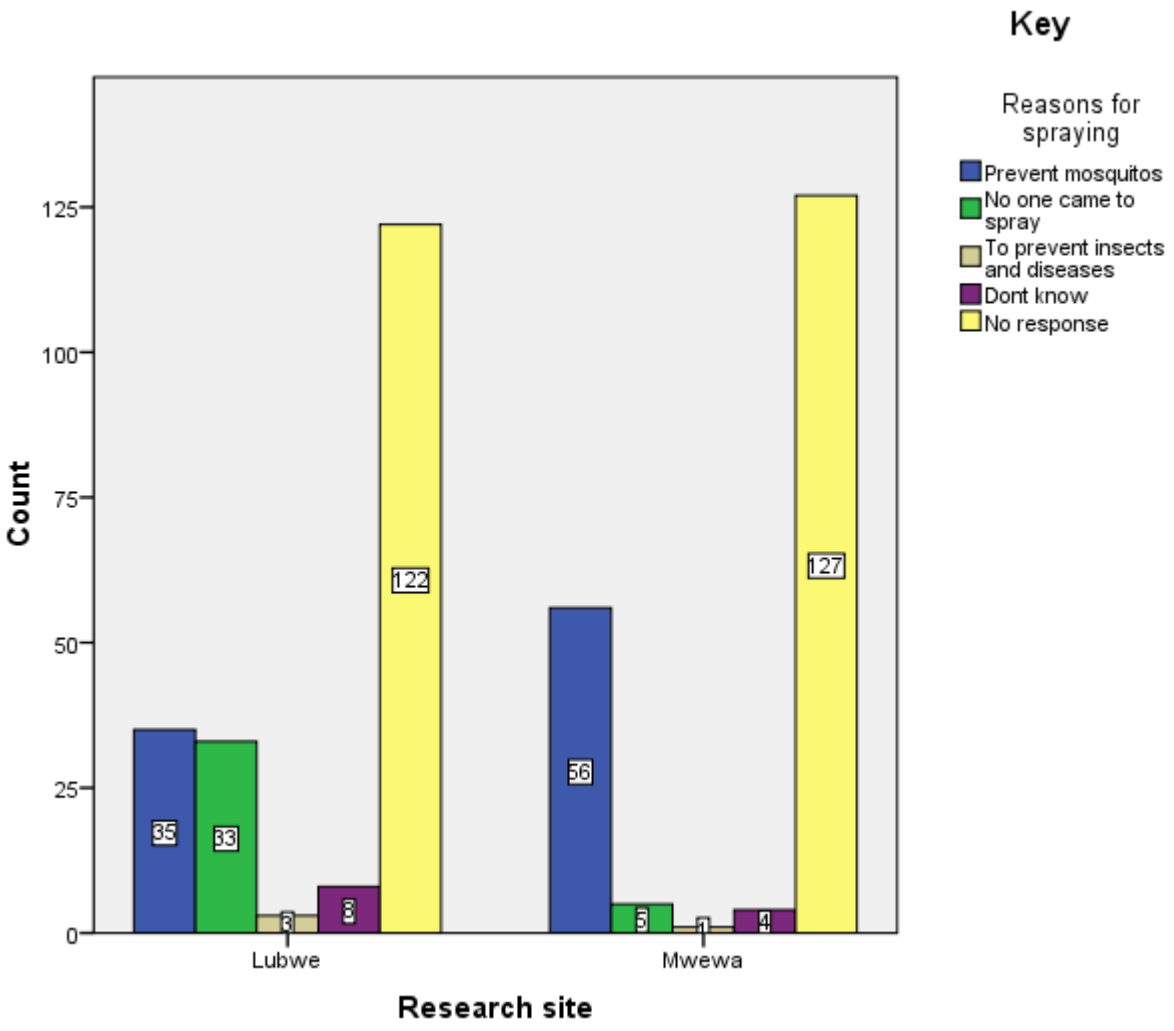

Figure 3: ***The respondents' reasons for house spraying***

Source: Field data, 2015.

Twenty-three point one percent (23.1%) had a better reason for spraying their houses and that it was to prevent mosquitoes from resting on the walls, while 3.0% did not know. The response to 'prevent insects and diseases' had a representation of 1.0 % only. This clearly showed that there were low levels of knowledge and utilization of IRS in Samfya District. The 63.2% of the respondents indicated in the 'no response' category had said that the houses had never been sprayed.

Insecticide residual spraying (IRS) effective coverage depends on the proportion of houses correctly treated and this needs to be repeated every 3-6 months (Heng et al. 2015). The strategy had continued to work in most malaria endemic areas. For instance Madagascar introduced IRS in 1949 using the DDT and then abandoned it in 1979 due to weak health structures and drug stock outs (Nepomichere, Tata and Boyer, 2015). In 1986, there was an epidemic which prompted the re-introduction of a systematic IRS in 1993 which was then replaced by selective operations. This procedure did not help much as there was a resurgence of another epidemic in 2013 (Nepomichene, Tata and Boyer, 2015). This clearly showed that IRS was an effective way of vector control in the fight against malaria. This however, called for systematic and intermittent application as the most effective way of malaria and vector control through the intensification and scaling up of malaria control interventions (MCI) in general (Kestman, et al., 2016). This entailed that, whatever spraying that was done in the study area was not helpful enough in the control of the vector population and malaria infections as a whole.

An alternative to IRS was the use of insecticide treated wall hangings as the principle was the same as that of deterring mosquitoes from settling on the interior house walls. The use of hangings made from different sorts of materials on the interior house walls for the purpose of decorations was a common human practice (Ngufor, et al., 2014). This then was a probable way to go in order to supplement the use of IRS whose sustainability to user compliance and operations had challenges. Wall hangings were suitable for rural dwellings owing to the construction materials used for walls and roofs. These would hang from the poles or fixed on the interior walls, used as curtains or just decorations. This strategy could help control and reduce entrance of vector mosquitoes into the houses.

In the survey sites there were other methods used to repel the mosquitoes from the houses and these were:

- Burning of leaves in order to create smoke that made the mosquitoes to flee the house or just faint. Those that fainted after coming round, they continued their nuisance. The burning of the leaves did not help much;

- The use of mosquito coils. These were not consistently utilized as they were not only expensive but also the pungent smell was unpleasant to some household members. Others attributed its usage to persistent coughs.

Houses in the survey had never been sprayed by massive IRS and therefore, it was difficult to state whether or not the IRS strategy was effective, since IRS was effective wherever it had been used, it could have been effective also in this area on condition that operational and compliance challenges were addressed. Treated wall hangings could be used as a cost effective alternative strategy to IRS.

THE INSECTICIDE TREATED NETS AND THE LONG LASTING INSECTICIDE NETS.

WHO (2014) defines an Insecticide Treated Net (ITN) as a mosquito net that repelled, disabled or/and killed any mosquito that came into contact with the insecticide on the netting material (WHO, 2014). According to Baume and Martin (2008) an ITN was a net that had been treated in the last 12months. The definitions of an ITN given above all focus on the treatment of a net such as the 'Mama Safenite', the ITN that was distributed through the Society for Family Health (SFH), by dipping it into insecticide. The duration of usage before the re-treatment varied according to utilization levels and the insecticide used to treat the net. The LLIN was a net made from polyethylene and much more tough fiber than that which was used for an ITN. An LLIN was made from impregnated netting material with Permethrin and did require re-treatment after a period of 3 years under field conditions or after at least 21 washes. Such type of nets were those distributed through the President's Malaria Initiative (PMI), (WHO, 2014). This, therefore, shows that there are two categories of ITNs: conventionally treated nets (CTNs) and long-lasting insecticide nets (LLINs). This study has used ITNs synonymously to mean CTNs.

An Insecticide Treated Net was an ordinary net made from polyester that was dipped with Deltamethrin, Primiphos or Pyrethroid (Ngufor, et al., 2014) or any WHO recommended treatment Insecticide. In order to ensure insecticide efficacy, the net was re-treated after 3 washes or after one year depending on the type of net. Ngufor, et al., (2014) argued that the net re-treatment was after 21 washes and the insecticide lasted at least 2-3years. The use of ITNs and LLINs was considered the most cost-effective method of malaria prevention in high endemic areas. Between 2003 and 2006 there were 4 million nets that were distributed in Zambia (CSO, 2009) through channels such as malaria in pregnancy (MIP), school health programme (SHP), community based malaria prevention and control programme (CBMPCP) and other malaria control initiatives and programmes (CSO, 2009; MOH, 2008).

Even though both nets were different, their purpose was the same as that of vector barring (Owusu, at al., 2016). These provided personal protection by preventing vector mosquitoes' access to human population (WHO, 2012). The ITNs and LLINs helped to reduce the vector population more so if they were used by the majority of the human population. They also provided protection for all the people in the community including those who did not themselves sleep under the nets (Binka, Indome and Smith, 1998; Hawley, at al., 2003). This meant that the reductions on the vector populations caused by the net users in the community, indirectly benefited the non-users as well.

The study looked at the household level net ownership and utilization in Samfya District in order to determine whether or not there was any effectiveness in the use of these nets as a strategy in the control of malaria. Out of 394 households, 370 (93.9%) had bed nets in their homes while 24 (6.1%) of the households did not have any nets. The nets were distributed as illustrated in Table.8 below:

Table 8: ***Households' ownership of bed nets***

			Research site		
			Lubwe	**Mwewa**	**Total**
Bed net ownership	All the members	Frequency	139	186	**325**
		Percentage	37.6	50.3	**87.8**
	Children under five years	Frequency	4	0	**4**
		Percentage	1.1	.0	**1.1**
	Children over five years	Frequency	2	1	**3**
		Percentage	.5	.3	**.8**
	Mother	Frequency	13	0	**13**
		Percentage	3.5	.0	**3.5**
	Father	Frequency	22	3	**25**
		Percentage	5.9	.8	**6.8**
Total		**Frequency**	**180**	**190**	**370**
		Percentage	**48.6**	**51.4**	**100.0**

Source: Field data, 2015.

Eighty-nine point eight percent (87.8%) of the households had all members owning a bed net, 1.1% of children U/5 years' slept under a net while only 0.8% of the children above 5 years slept under a net. The households where the fathers and mothers slept under a net had a 6.8% and 3.5% representation respectively.

The results further revealed that the children and mothers who were the most vulnerable to malaria and who were also required to own nets, had some of the lowest figures of 1.1% and 3.5% respectively. The children (both under and over 5 years) slept with their mothers and other older members of the households. The ITN malaria intervention strategy focusses on mothers and the children U/5 years, but the results of this survey revealed low figures of net ownership in these two categories as indicated in Table 6.8. These figures are far from reaching the targets set at the Abuja Conference on the Roll Back Malaria, and the WHO recommendation on malaria prevention and eradication of 60% and 80% respectively (Seyoum, et al., 2012 and WHO, 2014).

These results therefore, showed that there was need for all the stakeholders to re-organize and remobilize their resources in order to enhance the bed net ownership numbers by children U/5 years and the women. This called for mass health education and distribution campaigns which could be done at the health facilities and within the communities through either meetings, focus groups or community public addresses in order to scale up and meet the national target of 100% as earlier advocated by Chanda, et al., (2008); and Seyoum, et al., (2012) in their various studies of which one of them was on the use of ITNs in the Luangwa Valley.

Even though the percentage of the households where 'all the household members' owned bed nets, some of these nets were actually shared as was revealed by the men's FDG. Discussants 1, 8, 9 and 12 echoed that:

> *Bonse babili tulala pamo, kanshi inga chandalawa munono kukambantana pakutuila mwisumwa notusu nangula mung'wing'wi* (both of us sleep under one net, so if the net was small we made sure we clung to each other so that no one is bitten by mosquitoes).

Other than the being shared, some had holes that could not be stitched as Plate 1 shows, and facilitated easy entry into the mosquito net. This equally put the household members at risk. This therefore, meant that the households' ownership of nets did not guarantee all the members to sleep under a net as further revealed by this study.

When the discussants were asked as to what they did to the children U/5 years who did not own any nets, they responded that after 2 years the child was considered old enough to share the sleeping arrangements with the other family members. Cots in this area were not common, so the children from very poor families slept on floor beds whilst the children from moderate income earning families who could afford a bed, slept on the beds. The differences in the bed net ownership in this area were due to the distribution strategies that missed the households occupied by the elderly, those without children or no ANC access, this therefore, defeated the achievement of the national 100% coverage.

This study further revealed that there were shifts in the mosquito feeding patterns from the night time to evenings and mornings due to the preventive measures that were mostly occurring in doors and protected the people when they were asleep. These results were similar to those of Russell, et al., (2011) on the use of ITNs and IRS in Tanzania; Reddy, et al., (2011) in Equatorial Guinea and Bugoro, et al., (2011) in the Solomon Islands. Mazigo, et al., (2010) in their findings on knowledge, attitudes and practices about malaria in rural Tanzania demonstrated that the tools being advocated as interventions for malaria control required to address short and long term goals to deal with vector nuisance and parasite populations. The methods employed in Samfya District were short term as these were on household level and some (for example the burning of leaves) were ineffective.

Even though six point one (6.1%) of the respondents did not have bed nets, the 93.9% that owned bed nets did not use them regularly as shown in the table below:

*Table 9**: Frequency of bed net utilization***

			Research site		
			Lubwe	**Mwewa**	**Total**
ITN utilization	Never	Frequency	39	2	**41**
		Percentage	9.9	.5	**10.4**
	Sometimes	Frequency	73	25	**98**
		Percentage	18.5	6.3	**24.9**
	Always	Frequency	89	166	**255**
		Percentage	22.6	42.1	**64.7**
Total		**Frequency**	**201**	**193**	**394**
		Percentage	**51.0**	**49.0**	**100.0**

Source: Field data, 2015.

Table 9 shows that 64.7% ‘always’ used the bed net, 24.9% ‘sometimes’ used the bed net and 10.4% ‘never’ used the net. The households that ‘always’ used the bed nets were more (42.1%) in Mwewa than Lubwe (22.6%). Meanwhile, there were 9.9% and 0.5% of the households that never used the bed net for Lubwe and Mwewa respectively. The ‘sometimes’ category could be ranked to ‘never’ because if they ‘sometimes’ used the net, it meant that other times they ‘never’ used the bed nets at all.

The respondents from households that did not use the bed nets gave different reasons as indicated in Figure 4.

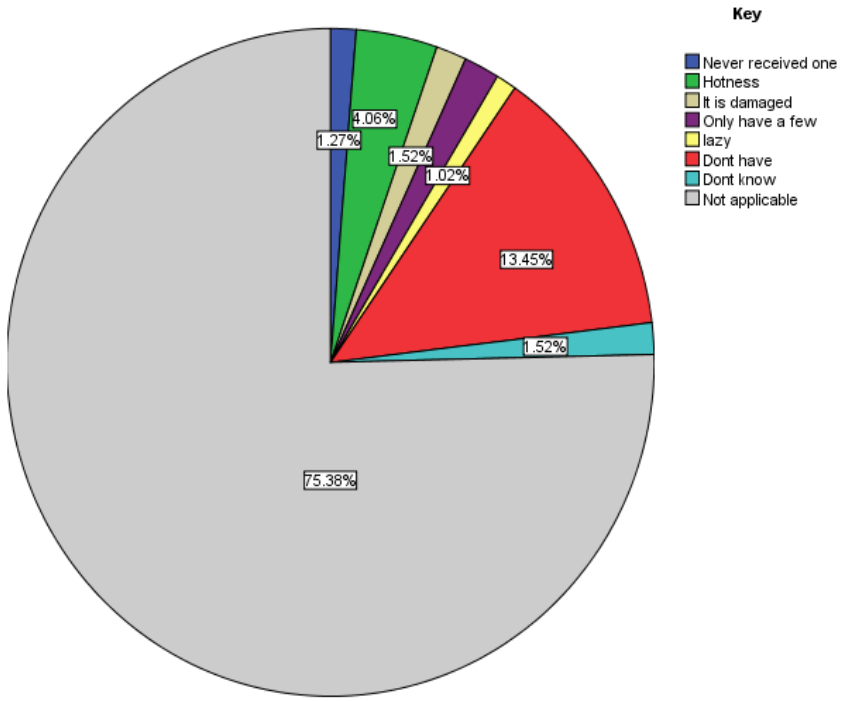

Figure 4: ***Respondents' reasons for non-utilization of bed nets***

Source: Field data, 2015.

The respondents in Lubwe gave more responses on non-net utilization than those of Mwewa. This in itself showed that respondents from Mwewa were more compliant in net utilization than those in Lubwe. The respondents who 'never received one' were more in Lubwe than Mwewa and these constituted 1.27 % of the total, but had at least one bed net in the household. Those that felt 'hot and insufficient air' circulation were more in Mwewa than Lubwe. This response was attributed to the way the respondents perceived the bed nets because there was no way the net could increase the room temperature for someone to feel hot. Those who did not have a bed net were more in Lubwe than in Mwewa and the total number for both the sites was 13.45 % of the respondents. This meant that even though some respondents were purported to own bed nets, they were not actually using one at the time of the survey due to the reasons advanced above. Some of the nets that were used had unstitchable holes that allowed free passage of mosquitoes as Plate 1shows.

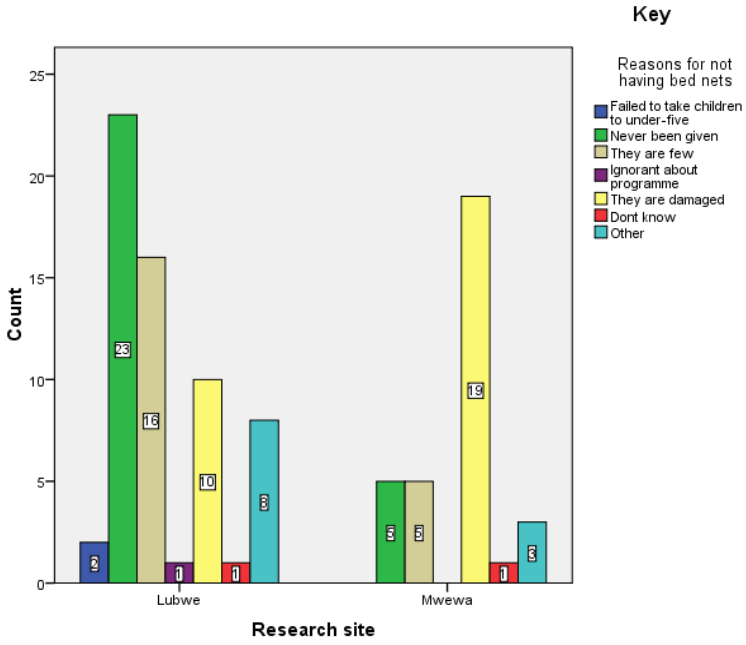

Figure5: ***The reasons for non-availability of bed nets by research site***

Source: Field data, 2015.

Mass distribution strategies could also help enhance the ownership levels. A study by Zegers de Beyl, et al., (2016) on multi country comparison of delivery strategies for mass campaign to achieve universal coverage with ITNs showed that improved strategies helped to increase the net ownership. The distribution strategies were:

- A fixed point strategy,
- The house to house and,
- Specialized clinics such as Diphtheria, Polio and Tetanus (DPT), U/5 and ANC.

These helped capture almost everyone in the community. The house to house could work well in the study area with the help of village communities. This was suggested by Chief Mwewa. The villagers knew one another, therefore monitoring the ownership and the utilization of the mosquito nets would be eased out as compared to the fixed point strategy.

Out of the 370 of the respondents that owned mosquito nets only 255 (64.7%) actually, 'always' used them and 98 (24.9%) 'Sometimes' used the bed nets as broken down in Table 9. There were more households in Mwewa where 'all the members' used the bed nets than in Lubwe (50.3% and 37.6% respectively). On the other categories of household members, however, Lubwe had more than Mwewa, that used the bed nets as illustrated in Table 6.8.

Table 6.9 shows the variations in the utilization of the bed nets between the two study sites. These variations were confirmed with the use of a Chi-Square (X^2) test whose result revealed the differences between the sites as well as amongst the categories that utilized the bed nets. The X^2_{obs} was 22.48 against the X^2_{crit} of 0.84 at df=4. This therefore, confirmed the differences and that these variations were significant.

The total utilization of nets was higher in Mwewa in both ways that is, out of the total number of the households that owned the bed nets and also out of the whole sample population (i.e. in the total number of households in the whole sample population) compared to Lubwe. Out of the whole sample population (394) Mwewa had 46.7% while Lubwe only had 33.5%. These figures accounted for 80.2% of the total number of households in the survey that used the bed nets. Those that owned (370) the nets, 51.4% and 48.6% were in Mwewa and Lubwe respectively, accounting for 100% of all the households that owned the bed nets.

The compliance levels were lower in all categories of users due to the following factors:

- The users felt suffocated even when the meshes were big enough to allow a lot of air circulation,
- It was cumbersome to continue tacking the bed net each time there was need to answer the call of nature,
- It was difficult to hang bed nets over floor beds,
- They were allergic to the insecticide used to treat the nets and,
- Some nets were torn and had big holes (Plate 1),
- The nets were diverted for other uses such as fishing and gardening (Plate 2).

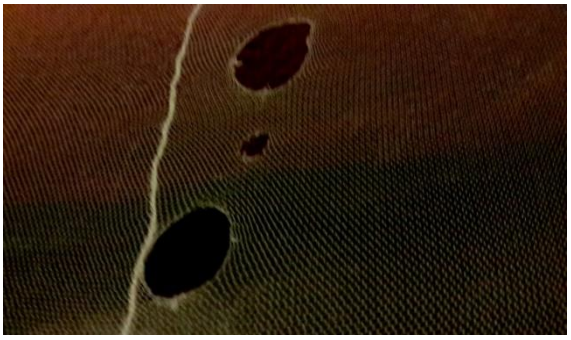

Plate 1: ***Part of the net showing holes***

Source: Field data, 2015.

Plate 2: ***A mosquito net used for garden fencing***

Source: Field data, 2015.

The diversion of the nets was reported by the interviewees and discussants. One such interviewee was Chief Mwewa (interview 07.09.2015) who attested to the nets being used to catch fish while some were sold. He advocated for partnership with other stakeholders so that when the nets were being distributed, the Chief should, for easy monitoring, know which households received them. This was going to help instill discipline into those that abused the nets. One other thing he brought out was that the distribution of the free nets was not appreciated by some people and that was the more reason for reduction in utilization.

Those views were similar to the ones revealed in a study by Baume and Martin (2007). These argued that the nets that were distributed freely were less used than those that were purchased. Asking the beneficiaries in study sites to pay for the nets could be quite challenging as the community was poor. The majority were farmers who got low incomes that were also seasonal in nature.

CONCLUSION

The intervention strategies such as IPTp were not fully utilized. The IPTp strategy did not capture all the pregnant women. Even some of those that accessed the therapy did not comply as mosquito net strategy was far better than the two (IPTP and IRS). Even though more nets were used in the survey area, it is worth noting that not all the nets owned were treated and for some of the treated nets the insecticide had lost its effectiveness. Some respondents and discussants stated that some nets which they were using had since developed holes to an extent that they could not be stitched, and those allowed in mosquitoes. This therefore increased the chances of malaria infection.

The IRS had never been done in this particular area other than households using small domestic insecticide cans that were equally expensive (K12 and more, depending on the size of the spray) to cater for a big house on an everyday spray. This therefore, showed that the household level

malaria intervention strategies were not very effective. There was need for various stakeholders through the different partnerships to re-draw program strategies so that places like Samfya District could have all strategies rolled out and scaled up in order to reach the 100% target in coverage.

REFERENCES

Baume A and Marin M C (2008). 'Gains in awareness, ownership and use of insecticide-treated nets in Nigeria, Senegal, Uganda and Zambia'. *Malaria Journal.* 7: 153.

Borgella S, Fievet N, Huynh B T, Ibitokou S, Hounguevou G, Afedjou J, Sagbo J C et al. (2013). 'Impact of pregnancy-associated malaria infection in Southern Benin'. *PLoS.* 8: e 80624

Brabin B J (1983). 'An analysis of malaria in pregnancy in Africa'. *Bull World Health Organization.* 61: 1005-1016.

Breman J G, Alilio M S and Mills A (2004). Conquering the intolerable burden of malaria: what's new, what's needed: a summary'.*Journal of tropical Medicine and Hygiene.* 71 (suppl 2): 1-15.

Bugoro H, Iroofa C, Mackenzie D O, Aparaino A, Hevalao W et al. (2011). 'Changes in vector species composition and current vector biology and behaviour will favour malaria elimination in Santa Isabel Province, Solomon Islands'. *Malaria Journal.* 10: 287.

Central Statistical Office (CSO, 2009). *Zambia Demographic and Health Survey 2007.* Lusaka: CSO.

Chanda E, Masaninga F, Coleman M, Sikaala C, Katebe C et al. (2008). 'Integrated Vector Management: The Zambian experience'. *Malaria Journal***.** 7:164

Chico R M, Dellicours S, Roman E, Mangiaterra V, Coleman J et al. (2015). Global call of action: maximise the public impact of intermittent preventive treatment of malaria in pregnancy in sub-Saharan Africa. *Malaria Journal.* 144: 207.

Dellicour S, Tatem A J, Guerra C A, Snow R W and terKuile F O (2010). Quantifying the number of pregnancies at risk of malaria in 2007: a demographic study. *PLoS Med.* 7: e 1000221

Deressa W, Some A, Asefa A, Teshome G and Enqusellassie F (2014). 'Effect of combining mosquito repellent and insecticide treated net on malaria prevalence in Southern Ethiopia: a cluster randomized trial'. *Parasite Vectors.* 7: 32.

Government of the Republic of Zambia (GRZ, 2014). *Revised Sixth National Development Plan 2013-2016.* Lusaka: Ministry of Finance.

Gutman J, Mwandama D, Wiegand R E, Ali D, Mathanga D P and Skarbinski J (2013). 'Effectiveness of intermittent preventive treatment with sulfadoxine-pyrimethamine during pregnancy of maternal and birth outcomes in Machinga District in Malawi'. *Journal of Infectious Diseases.* 208: 907-916.

Hawley W A, Phillips-Howard P A, terKuile F O, Terlouw D J et al. (2003). 'Communitywide effects of permethrin-treated nets on child mortality and malaria morbidity in Western Kenya'**.** *American Journal of Tropical Medicine and Hygiene.* 68: 121-127.

Heng S, Dunez L, Gryseels C, Roey K V, Mean V et al. (2015).'Assuring access to tropical mosquito repellents within an intensive distribution scheme: a case study in a remote province of Cambodia'. *Malaria Journal.* 14: 468.

Karsen D A, Chisha Z, Winters B, Mwanza M et al. (2015). 'Malaria surveillance in low-transmission areas of Zambia using reactive case detection'. *Malaria Journal.* 14: 465.

Kesteman T, Randrianarivelojosia m, Raharimanga V, Randrianasolo L, Piola P and Rogier C (2016). 'Effectiveness of malaria control interventions in Madagascar: a nationwide case-control survey'. *Malaria Journal.* 15: 83.

Mazigo et al. 2010 Mazigo, H.D., Obaasy, E., Mauka, W., Manyiri, P., Zinga, M. and Kweka, E. J. (2010). 'Knowledge, attitudes and practices about malaria and its control in rural Northwest Tanzania'. *Malaria Research and Treatment.* 2010: 1-9.

Ministry of Health (MoH, 2008)**.** *National Malaria Control Action Plan.*Lusaka: MoH

Ministry of Local Government and Housing (MLGH, 2015). *Topographical Map Sheets 1029 D and 1129 B- an upgrade.* Lusaka: MLGH.

Moya-Alarez V, Abellana R and Cot M (2014). 'Pregnancy-associated malaria and malaria in infants: an old problem with present consequences'. *Malaria Journal.* 13: 271.

Mwanje L F (2013). 'Knowledge, attitudes and practices on malaria prevention and control in Uganda: A case study of Nsaabwa village, Mukono District'. Post-Doctoral Report. Kampala: Gulu University.

Nepomichere T N J J, Tata E and Boyer S (2015). 'Malaria case in Madagasca, probable implications of a new vector, Anopheles coustain'. *Malaria Journal.* 14: 475.

Ngufor C, Tungu P, Malima R, Kirby M, Kasinza W and Rowland M (2014). 'Insecticide-treated net wall hangings for malaria vector control: an experimental hut study in North-eastern Tanzania'. *Malaria Journal.* 13: 366.

Nosten F and Gready M (2015). 'Intermittent presumptive treatment in pregnancy with Sulphadoxine-pyrimethamine a counter perspective'. *Malaria Journal.* 14:248.

Owusu E D A, Buabeng V, Dadzie S, Brown C A, Grobusch M P and Mens P. (2016). Characteristics of asymptomatic Plasmodium spp. Parastaemia in Kwahu-Mpraeso, a malaria endemic mountainous district in Ghana, West Africa'. *Malaria Journal.* 15: 38.

Reddy M R, Overgaard H J, Abaga S, Reedy V P et al. (2011).Outdoor host seeking behaviour of anophelene gambiae mosquitoes following initiation of vector control on Bioko Island, Equatorial Guinea'. *Malaria Journal.* !0: 184.

Riley E M, Wagner G E, Akanmori B D and Koram K A (2001). Do maternally acquired antibodies protect infants from malaria infection? *Parasite Immunol.* 23: 51-59.

Russell T L, Govella N J, Azizi S, Drakeley C J et al. (2011). 'Increased proportions of outdoor feeding around residual malaria vector populations following increased use of insecticide-treated nets in rural Tanzania'. *Malaria Journal.* 10: 80.

Sangoro O, Kelly H A, Mtali S and Moore S J. (2014). Feasibility of repellent use in the context of increasing transmission: a qualitative in rural Tanzania'. *Malaria Journal.*13: 347.

Seyoum A, Sikaala C H, Chanda J, Chinula D et al. (2012). 'Human exposure to anophelene msquitoes occurs primarily indoors even for users of insecticide-treated nets in Luangwa valley, south-east Zambia'. *Parasites and Vectors.* 5: 101.

Slater H C, Griffin J T, Ghain A C and Okell LC (2016). 'Assessing the potential impact of artemisinin and partner drug resistance in sub-Saharan Africa'. *Malaria Journal.* 15: 10.

Surveyor General (1979). *Topographical Map Sheets 1029 D and 1129 B.*Lusaka: Ministry of Lands.

World Health Organization (WHO 2012*). World Malaria Report-2011*. Geneva: WHO

World Health Organization (WHO, 2014). *World Malaria Report-2014.* Geneva: WHO.

Zegers de Beyl C, Koenker H, Acosta A, Onyefunafoa E O Adegbe E et al. (2016). 'Multi-country comparison of delivery strategies for mass campaigns to achieve universal coverage with insecticide-treated nets: what works best?'.*Malaria Journal*. 15: 58.