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Research Article

Insecticide Treated Net Utilization among Under-Five Children and Household Net Ownership in Adami Tullu District, Oromia Regional State, Ethiopia: a Community Based Cross-sectional study

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ABSTRACT

Background: Children under the age of five years and pregnant women have been identified as the most vulnerable risk group for malaria. In addition to scaling up of net distribution, periodic assessment of the utilization and associated factors among high risk population is important.

Objective: To assess the level of long lasting insecticide treated nets use and associated factors among under-five children and net ownership of the households.

Methods: A community-based cross-sectional study was conducted in Adami Tullu District from February 1-25, 2014. Cluster randomized sampling technique was used to select 748 households. Data were collected using a structured questionnaire and observation checklist. Bivariate and multivariable logistic regressions were applied for the analysis of the independent variables against long lasting insecticide treated nets use among under five children and household net ownership. The results were reported using crude and adjusted odds ratio (OR) with their 95% confidence interval.

Results: Household ownership of at least one long lasting insecticide net was 188 (25.3%). About two third, 101(63.9%) of under-five children slept under net the night preceding the survey among net owning households. Knowledge that sleeping under net every night prevents malaria [Adjusted Odds Ratio, AOR (95%CI) =4.7 (1.1-9.6)], spouse education [AOR (95%CI) =1.74 (1.2-2.6)], and kebeles (small admistrative unit) i.e. Bochessa [AOR (95%CI) =2.2 (1.2-4.1)], Elka Chellemo [AOR (95%CI) =2.3(1.2-4.4)] were associated with net ownership. Net utilization among under-five children was affected by knowledge that LLIN kills malaria mosquitoes [AOR (95%CI) =3.8 (1.15-12.4), knowing fever as a symptom of malaria [AOR (95%CI) =3.2(1.05-9.6)] and male gender of the child [AOR (95%CI) =6.0 (2.5-12.8).

Conclusion: The ownership of long lasting insecticide treated nets and the use among high risk population remained low. Information, Education and Communication (IEC) on the net use need to focus on avoiding gender discrimination among under-five child. Further research is needed to study the decline in household ownership.

Keywords: LLIN; under-five children; ownership and use

Abbreviations

EC-Ethiopian calendar

IEC-Information, Education and Communication

IRS-Indoor Residual Spray

LLINs-Long Lasting Insecticidal Nets

MIS-Malaria Indicator Survey

SNNP-Southern Nations Nationalities and Peoples

WHO-World Health Organization

Background

World Health Organization (WHO) estimates indicate that 212 million cases occurred globally in 2015, leading to 429000 deaths, most of which were in children aged under 5 years in Africa. In 2015, 303000 malaria deaths were estimated to have occurred in children aged under 5 years, equivalent to 70% of the global total. Malaria remains a major killer of children, and is estimated to take the life of a child every 2 minutes [1].

Approximately, 60 percent of Ethiopia's population lives in malarious areas, and 68 percent of the country's landmass is favorable for malaria transmission, with malaria primarily associated with altitude and rainfall [2].

One of the recent study in Tanzania showed that an increase of 10 % ownership of at least one mosquito net at household level is associated with 12 % and 10 % decrease of malaria risk for all age and under-five children per year, respectively [3].

The national strategic plan for malaria prevention and control in Ethiopia aims at scaling up both long lasting insecticide nets (LLINs) and indoor residual spray (IRS) interventions in malaria endemic regions [4]. The malaria indicator surveys (MIS), conducted in 2007, 2011 and 2015 indicated that 65%, 55% and 64% of surveyed households had at least one LLIN, respectively, whereas the use by the children under five years, during the night prior to survey, within households with at least one net was improved from 64% in 2011 to 70% in 2015 [2,5,6].

A wide gap exists between coverage and utilization of LLINS in the country [7]. This shows that, mosquito net ownership in itself is

not synonymous with utilization especially for under-five children. Increase in LLIN access (i.e. household ownership) does not necessarily translate to equal increase in utilization [8]. The success of LLIN utilization depends on several factors: such as, willingness of people to use nets, inconvenience to hang the nets, educational background, place of residence, age, gender differences and colour of nets [5-7]. An increasing number of LLINs have been delivered to sub-Saharan African countries including Ethiopia, but those numbers are still insufficient to achieve universal access [9]. Thus, periodic assessment of the ownership, utilization and associated factors among high risk population is highly recommended [9]. Children under the age of five years and pregnant women have been identified as the most vulnerable risk group for malaria. Thus, this study aimed at identifying potential factors associated with LLINs use in under-five children and ownership of LLINs in the households that live in malaria-prone districts.

Method

Study setting and participation

A community based cross-sectional study was conducted among 748 households in Adami Tullu District of East Shewa Zone, which is located at 160kms from Addis Ababa. The study period was from February 1-25, 2014. The district lies at an altitude between 1,500 and 1,750 m above sea level. Malaria transmission in the District is seasonal and epidemic type, peaking from September to December. Two species of *Plasmodium* are present in the area; *Plasmodium falciparum* (about 70%) and *P. vivax* (about 30%) [11]. All randomly selected households and under five-children living in the households were included in the study.

Sample size and sampling methods

The required sample size was calculated using Epi Info version 3.5.3 assuming that 55% of children had slept under LLIN among net owning households during the previous night and 44.3% of households own one LLIN in Oromia Region [10]. Assuming 5% margin of error at 95% confidence level, 5% non-response rate ,1.5 children per household [11] and design effect of 1.25 [12], the final sample size was estimated to be 748.

Study households were identified by cluster random sampling technique. Out of 62 rural kebeles, four of them were selected randomly (Anano Shisho, Boccessa, Elka Chelemo and Gallo Heraphe and). The 30 Gares (used as clusters in our study) were selected from kebeles based on geographical proximity. The number of households in each cluster varies from 15 to 72. Since our sample size is 748 we used all Gares (village that consists of 30 house holds on average) by selecting 25 households from each Gare using table of random numbers by Excel Computer program. Those clusters with less than 25 households were combined together as one cluster while those clusters with above 50 house holds were divided into two based on their geographical proximity. Finally, 30 clusters and 25 house holds from each cluster were used for data collection

Data collection methods and instruments

Structured and closed ended questionnaires, which addressed the objectives of the study, were adapted from Ethiopia Malaria Indicator Survey (MIS) 2O11 report [6]. Observational check list was additionally used to verify the status of nets in the household. The questionnaire was prepared in English and then translated to Afaan Oromo (local language of the study area).

It included questions about the respondent's socio-demographic characteristics, knowledge and perception about malaria and LLINS, and household possession of LLINS and its use by each child in the household during the night preceding the survey. The observational check list contains variables such as number of LLINS, number of beds available in the household, number of net already hanged for use and the condition of the net. Data were collected by eight trained nurses through house to house visit

In households where there were married couples, the husband or the wife (wife preferred if both available at the same time) responded to the questionnaire. In case when there were no married couples, the head of the household or another adult above 18 years responded to the questionnaire. If the appropriate respondent was not available in the house during the initial visit, revisits were done the next day to contact the appropriate person.

Data processing and analysis

This was the part of thesis which was a mixed type [22] and its qualitative part was published previously [23]. Data was entered in to Epi info version 3.5.3 (Center for Disease Control and Prevention of the United States of America (CDC), 2011, Atlanta-Georgia) and exported to SPSS version 21.0 for analysis. Descriptive analysis was done to determine the prevalence of LLIN ownership, IRS coverage and under five children net use. The knowledge section included one question each assessing the cause, symptoms, prevention of malaria and knowledge that net kills malaria mosquito and net protects against malaria. The questions were like, "does sleeping under net every night prevents malaria, mosquito bite causes malaria? "Is fever a symptom of malaria?" "Knew net kill malaria mosquitoes", "Knew net prevents malaria" four of them with a Yes or No value and one with True, False and Not sure option.

Misconception of the respondents was calculated for both knowledge of cause and prevention of malaria. For example, for cause of malaria there were 7 different options including the correct answer. They are Mosquito bite, eating immature sugarcane, eating maize stalk, hunger (empty stomach), exposure to cold or changing weather, witchcraft and exposure to dirty swampy areas. Those six variables were first recorded in SPSS to give large number for those who didn't have misconception and added up in EXCEL program. The mean was calculated in SPSS and those below the mean were identified as those who had misconception. The same calculation was done to calculate the misconception of prevention of malaria.

Household ownership of LLIN was calculated as a proportion of households having at least one LLIN among the total surveyed households. Data were filtered into a separate file of households with at least one under-five child. LLIN use among under-five

children was calculated as the proportion of children using at least one LLIN in the net owning households. Bivariate logistic regression was used first and those significant variables at 0.2 were entered into multivariable logistic regression to determine independent predictors of household net ownership and net utilization among under-five children. The Hosmer-Lomeshow ($P > 0.05$) test was used to check goodness-of-fit of model. The level of significance was set at $p < 0.05$ for statistical significance in the model. The results were reported using crude and adjusted odds ratio (OR) with their 95% confidence interval.

Ethical consideration

Ethical clearance was obtained from Ethical Review Committee of the School of Public Health, at Addis Ababa University. Formal letter from the School was written for Adami Tullu District Health Office. Households of study kebeles were informed about the objectives and aims of the study. Participants were informed that their participation is purely voluntary and assured of the confidentiality of all information. Data collection was done after getting the verbal consent of the participants.

Results

Socio-demographic characteristics :

Seven hundred forty three households were included in the study with a response rate of 99.3%. The total population of the studied households was 3,900 with an average (± SD) household size of 5.25 (±2.4). Majority of the respondents were Muslims (65.3%) and from Oromo ethnicity (86.3 %). The mean age (± SD) of the respondents was 34.4 ± 12.2 years. Two hundred seventy six (37.1%) of the respondents and one third (33%) of the spouses of the respondents had formal education respectively (Table 1). Five hundred forty nine children were identified from 375 households. The mean age of under- five children in the study was 29.05 ± 15 months.

Table 1: Socio-demographic Characteristics of the respondents, Adami Tullu district, February 2014.

Variables	Frequency (n=743)	Percent
Kebeles		
Bochessa	223	30
Elka Chellemo	222	29.9
Gallo Heraphe	148	19.9
Anano Shisho	150	20.2
Sex of household head		
Male	584	78.6
Female	159	21.4
Sex of respondent		
Male	234	31.5
Female	509	68.5
Age (739)		
18-30	344	46.5
31-44	221	29.9
≥ 45	174	23.6
Education of spouse		
Not educated	498	67
Educated	245	33
Household size		
<4	297	40
>= 4	466	60
Under-five child in household		
Yes	375	50.5
No	368	49.5
Roof of house		
Corrugated Iron Sheet	426	57.3
Thatched and others	317	42.7

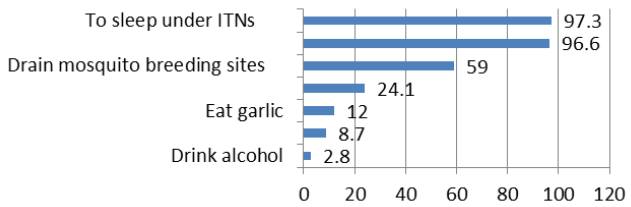

Figure 1: Respondents knowledge of how to prevent malaria, Adami Tullu District, February 2014.

Knowledge of the cause and prevention of malaria:

Majority of the respondents, 694 (93.4%) considered malaria as a major health problem in the community and about 647 (87.1%) stated fever as a symptom of malaria. Six hundred seventy (90.2%) reported mosquito bites as a cause of malaria. While, eating maize stalk (43.7%), exposure to dirty swampy area (36.6%), exposure to cold weather (26.6%) and hunger/ empty stomach (25.7%) were also reported as the causes of malaria.

Sleeping under mosquito net every night prevents malaria was true for 690 (97.3%) of the respondents. Spraying the house and draining mosquito breeding site were also among the main prevention methods for 718 (96.6%) and 438 (59%) of the respondents, respectively (Figure 1). Majority of the respondents knew how to prevent malaria. On the other hand, some of them still had misconception about the prevention (32.2%, n=239) of malaria.

Almost all of the respondents, 740 (99.6%) heard about mosquito nets. Six hundred fifty three, (87.9%) of the respondents mentioned that LLINS are used to kill malaria mosquitoes. More than half (53.8%) of the respondents mentioned that it protect against the bite of nuisance insects.

Slightly less than half (49.1%) and 448 (60.3%) of the respondents reported that malaria is more serious for under five children and pregnant women respectively. However, 67(9.0%) of the respondents said that it is equally serious for all household members.

Household ownership and use of LLINs:

Of the total households (n=743), only 188 households (25.3%) owned at least one LLINS. The household coverage of indoor residual spray was almost universal (97%, n=721). Only 28.8% (108 out of 375) of households with at least one under five children own at least one LLIN. LLINS were observed in 90% (n=169) of those households reported to have LLIN. One hundred three

(58.2%) of the total observed nets were in a good condition, without holes. Among LLIN owning households, the coverage for one and two mosquito nets was (83.5%) and (16.5%) respectively. Only 31 (4.6%) households of the total population purchased LLIN within the past 12 months from any source.

The total number of mosquito nets reported to be owned by households (used and unused) in the sample were 219. Around two third, 144 (65.8%) of them were reported hanged over bed/mat/platform by interview and about 113 of the nets were confirmed hanging during observation. Average number of LLIN per household for all surveyed households and households with at least one LLIN were 0.37 and 1.16 respectively.

Among LLIN owning households, at least one household member had slept under it during the previous night prior to interview (60.6%). LLIN was not clean (39%), not hanged (30%) and absence of mosquito during this time of the year (15.1%) were the main reasons for not using the net by those households who owned LLIN.

LLIN utilization among under-five children

About 51% (n=375) of the 743 households surveyed had an under-five child. There were 549 under-five children living within these 375 households, giving 1.5 children per household. Among the net owning households, a total of 158 (28.8%) children were identified and included in the analysis of LLIN use by children. The number (%) of under-five children who slept under LLIN the previous night was 101 (63.9 %), for households with at least one LLIN.

Factors associated with household ownership of LLIN and use among under-five children

Bivariate analysis showed that, the perceived benefit of sleeping under mosquito nets every night prevents malaria (OR=2.8 [95%CI, 1.2-6.7]), knowing as mosquito bite causes malaria (OR =0.5 [95 %CI, 0.3-0.8], educated spouses [OR (95% CI) =1.7(1.2-2.4), presence of under-five child in the household [OR (95 % CI) =1.5(1.O4-2.03)], Houses with two and above sleeping room [OR (95% CI) =1.6(1.1-2.2), kebeles (Bochessa (OR=2.1[95%CI 1.24-3.44]) and Elka Chelemo (OR=2.7[95%CI 1.55-4.6]), sex of household head [OR (95% CI) =1.9(1.2-2.9) and misconception about the prevention of malaria were associated with household ownership of at least one LLIN [OR (95% CI) =1.6(1.1-2.31].

In the multivariate analysis, those who perceived the benefit of sleeping under net every night prevents malaria were 4.7 times more likely to own LLINS compared to those who had not perceived this way. Those households with educated spouses were 1.74 times more likely to own nets compared to their counterparts. Residence is one of the independent predictor of household net ownership i.e. those households in Bochessa and Elka chellemo were 2.2 and 2.3 times more likely to own LLINS compared to Gallo Heraphe kebele, respectively (Table 2).

Table 2: Factors associated with household net ownership, Adami Tullu District, February, 2014.

Variable	Total	HH ownership		Crude OR	Adjusted OR
		Yes	No	COR(95%CI), P value	AOR(95%CI),P value
Kebele					
Gallo Heraphe	150	26(17.3)	124(82.7)	1	-
Anano Shisho	223	42(18.8)	181(81.2)	1.1(.645-1.9), .71	1.01(.54-1.98), .907
Boccessa	222	67(30.2)	155(69.8)	2.1(1.24-3.44), .005*	2.2(1.2-4.1), .011**
Elka Chellemo	148	53(35.8)	95(64.2)	2.7(1.55-4.6), <.0001*	2.3(1.2-4.4), .017**
Sex of household head					
Female	159	27(17.0)	132(83.0)	1	
Male	584	161(27.6)	423(72.4)	1.9(1.2-2.9) .007*	1.4(.83-2.3), .220
Education of spouse					
No education	498	109(21.9)	389(78.1)	1	
Yes	245	79(32.2)	166(67.8)	1.7(1.2-2.4), .002*	1.74(1.2-2.6) .008**
Total room					
One	362	76(21.0)	286(79.0)	1	
Two & above	381	112(29.4)	269(70.6)	1.6(1.12-2.2), .009*	1.55(.99-2.44) .058
Perceived benefit of sleeping under net every night prevents malaria					
False & N/s	53	6(11.3)	47(88.7)	1	1
True	690	182(26.4)	508(73.6)	2.8(1.2-6.7) .020*	4.7(1.8-12.0) .001**
Is there U5 child in the household					
No	368	80(21.7)	288(78.3)	1	
Yes	375	108(28.8)	267(71.2)	1.5(1.04-2.03), .027*	1.4(.93-2.5) .110
Misconception on prevention of malaria					
yes	239	47(19.7)	197(80.3)	1	
No	504	141(28.0)	363(72.0)	1.6(1.1-2.31), .015*	1.54(.97-2.4) .067

*-significance in bivariate **-significance in multivariate N/s-not sure, O-others, variables like occupation, family size and knew mosquito bite is a cause of malaria were included(data not shown). HH-household U5–under-five COR-Crude odds ratio AOR-Adjusted odds ratio.

A total of 158 (28.8%) children were included in the analysis of LLIN use by children. In bivariate analysis, those who knew fever as a symptom of malaria were more than 3 times more likely to use LLIN than those who had no knowledge. Similarly, knowledge of the fact that LLINS kills malaria mosquitoes [COR =4.0, 95%CI=1.4-10.6] and male gender of the child [COR=7.15, 95%CI= (3.5-14.8) were associated with LLIN use among under-five children during the night preceding the survey. In multivariate analysis, both knowledge of fever is a symptom of malaria [AOR=3.2, 95%CI=1.1-9.6] and LLIN kills malaria mosquitoes [AOR=3.8, 95%CI=1.15-12.4) remained associated with LLIN use among under five children. In addition, male children were 6 times more likely to use LLIN during the night prior to the survey than girls [AOR=6, 95%CI=2.5-12.8] (Table 3).

Discussion

Our study assessed the ownership of nets among households, its utilization among under- five children and their determinants in the rural setting. In the present study only one fourth of total households owned at least one net. Adami Tullu District is one of the malarious areas in East Shewa Zone. The LLIN coverage remained low in our study area though the government is planning

Table 3: Factors associated with LLIN use among under-five children in Adami Tullu District, February, 2014.

Variable	Total(158)	U5 LLIN use (n=101)	Crude OR COR(95% CI),P-value	Adjusted OR AOR(95%CI), P-value
Is your Spouse educated?				
Yes educated	94	66(70.2)	1.7(.82-3.6) .149	1.6(.64-4.2), .305
No spouse	19	9(47.4)	.66(.224-1.9) .446	.57(.15-2.2), .422
Not educated	45	26(57.8)	1	1
Family size				
<4	47	35(74.5)	2.0(.93-4.24) .072	1.7(.65-4.54), .273
>=4	111	66(59.5)	1	
Knew fever is a symptom of malaria				
Yes	135	92(68.1)	3.33(1.34-8.3) .010*	3.2(1.05-9.6), .041**
No	23	9(39.1)		1
Knew mosquitoes cause malaria				
Yes	138	90(18.0)	1.53(.59-3.4) .376	
No	20	11(22.0)	1	
Knew LLIN kills mosquitoes				
Yes	138	94(68.1)	4.0(1.5-10.6) .006*	3.8(1.15-12.4) .028**
No	20	7(35.0)	1	1
Sprayed in the past 12months				
Yes	152	99(65.1)	3.7(.66-21.1), .135	1.95(.27-13.9) .507
No and not sure	6	2(33.3)	1	1
Re-plastering wall makes IRS very effective				
False & not sure	129	86(66.7)	1.9(.83-4.22), .133	1.5(.52-4.3) .464
True	29	15(51.7)	1	
Get LLIN within the past 12 months				
Yes	37	28(75.7)	2.0(1.5-10.6), .093	1.9(.64-5.43) .255
No	121	73(60.3)	1	1
Number of net currently used while sleeping				
Two	15	13(86.7)	4.1(.88-18.7), .072	3.13(.51-19.1) .216
one	143	88(61.5)	1	1
Gender of the child				
Male	93	76(81.7)	7.15(3.5-14.8), .000*	6(2.5-12.8) .0001**
Female	65	25(38.5)	1	
Had misconception of the cause of malaria				
No	64	45(70.3)	1.6(.82-3.2), .169	1.63(.7-3.8) .257
Yes	94	56(59.6)	1	
Age of child				
0-11	24	15(62.5)	.67(.22-2.0), .472	
12-23	28	16(57.1)	.53(.19-1.52), .240	
24-35	32	19(59.4)	.56(.21-1.62), .301	
36-47	39	26(66.7)	.80(.3-2.2), .659	
48-59	35	25(71.4)	1	

universal coverage. Therefore, immediate distribution should be undertaken in order to prevent malaria. The distribution should give priority for those households with under five children

Similar to our finding, the study done in South central Ethiopia reported less than a quarter (23.1%) of LLIN ownership among households [15]. According to MIS 2011, for households living in malaria-endemic areas (i.e.<2,000m), more than half owned at least one LLIN [6]. Similarly, in a study carried out by Deressa et al. about half of households,49.1% owned at least one LLIN in Oromia and Amhara regions of Ethiopia [14]. The much variation between the present study and the above couple of studies could be that these two surveys were conducted shortly after LLIN distribution in Ethiopia [11,19]. The time gap between two surveys is very important because the present study was conducted after 3 years of the net distribution.

In the present study, those who said sleeping under a mosquito net every night prevents malaria were five times more likely to own nets. This result was similar to analysis of Malaria indicator survey in 2007 in which any malaria knowledge including LLINS prevents malaria was strongly associated to LLIN ownership [16]. In addition, this finding was in agreement with the study done in Equatorial Guinea in which the knowledge of prevention of malaria was associated with household LLIN ownership [17].

Spouse education was significantly associated with household ownership of at least one net. Similar findings were reported in Nigerian studies [18,19]. However, it was in contrary to couple of studies in Ethiopia and Nigeria in which those illiterate household heads owned LLIN than those who had an education [15,20]. Both arguments might be possible because the time of distribution matters in addition to literacy status. Those households with educated spouses might have used it wisely and kept it for a longer period of time without damage.

There was a significant difference between Kebeles (small administrative units) in terms of LLINS ownership. This had probable justification since the LLINS were distributed recently (i.e. 2004EC) in Boccessa and Elka Chellemo kebeles relative to the other two kebeles in which the nets were distributed three years earlier.

Among net owning households, less than two third (60.6%) of at least one household member had slept under it during the previous night prior to interview. This was in agreement with the study in SNNPR, in which less than two third of households (60.5%) reported using their nets during previous night [21]. The most common reasons reported for not using LLINS were; too old, too dirty and unavailability due to wash. Similarly, in our study more than one third of the nets (39%) were not used because of dirtiness.

Multivariate analysis among under-five children living in the households owning at least one net showed that, knowing that LLIN kills malaria mosquitoes and fever as symptom of malaria were associated with LLIN use among under-five children. Similar finding was reported in Ethiopia in which any malaria knowledge was significantly associated with under-five LLIN use [15]. The association between the knowledge that LLIN kills malaria mosquitoes and LLIN use was also reported by cross sectional study in Oromia and Amhara regions of Ethiopia though it was not for under-five rather for any household member [12]. Our finding was also in agreement with the study that found an association of increased malaria knowledge and improved net use by individuals and/or members of the household [19].

There was notable finding between gender of the child and LLIN utilization. Male children were more likely to sleep under nets than their female counterpart which was not found in other African countries [18,20,21].The probable reason for this difference could be that, our culture prefers male to female child in the household starting from birth ceremony. Further investigation is needed in order to verify it and address through intensive health education.

The utilization level was based on self-report of the respondents. The study was undertaken during the dry season when the malaria transmission is low and it might underestimate LLIN utilization. Recall bias is also the other limitation for the specific questions. We used the observation checklist to reduce the bias.

Conclusion

Only one fourth of the surveyed households owned at least one net. Education of the spouse and kebeles (small administrative units) were found to be additional predictors of household net ownership. Knowing the symptom of malaria and benefits of LLINS were also found to be independent predictors of household net ownership and under-five use. Utilization of LLIN was not equal in terms of sex among under-five, since male children were more likely to use net. Information, Education and Communication (IEC) on the LLIN utilization need to address misconceptions and focus on avoiding gender discrimination among under-five child. Vulnerable group of the population (i.e. children under-five) should be given priority on the net use in the household. Further research is needed to study the reasons for the low household ownership and barriers of LLIN use among under-five children. Prospective study is also recommended to see effectiveness of the combination of the LLIN and IRS.

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CONFLICTS OF INTERESTS

No conflict to declare

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