Evaluation of the ownership and usage of long lasting insecticidal nets (LLINs) in Madagascar six months after the October 2007 measles and malaria integrated campaign.

Final report

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Final report: Survey on the ownership and usage of LLINs in Madagascar six months after the October 2007 integrated campaign (MCHW).
Survey conducted from 11 April - 1st May 2008. Date: 30 June 2008

* *Report originally prepared in French, and translated into English by Malaria No More with review by HealthBridge*

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Summary

Introduction: An integrated health campaign -"Mother and Child Health Week" (MCHW)- was conducted in Madagascar between 22 and 30 October 2007. The campaign was based on immunization against measles, distribution of vitamin A tablets, mebendazole distribution and the distribution of Long Lasting Insecticidal Nets (LLINs) The main beneficiaries of this campaign were children under 5 years old and pregnant women. An evaluation survey was conducted six months after the campaign, between 11 April and 1st May 2008. This survey collected data on the ownership of LLINs at the household level, the usage of LLINs by target groups (children under the age of 5 and pregnant women), as well as the provision and use of measles immunization services. This document presents the results of the survey at a national level and for the different operational areas of the integrated campaign. This information could aid the Madagascar Ministry of Health and its partners in their efforts to identify strategies to improve malaria prevention and control.

Methodology: A three-stage selection process using probability proportional to size (PPS) sampling of the population was carried out to select 10 districts for each area and 6 fokontany for each district. In each fokontany, 24 households were selected at random. The proportional estimates were adjusted for the probability of unequal selection. In total, the survey targeted 4,320 households.

Results: Four thousand three-hundred and two (4,302) households were surveyed, 56% of which had at least one child under the age of 5. The ownership of LLINs at the household level was 59.2% nationally and 70.5% in the malaria endemic area. In the districts with LLIN integration, 90% of households with a child under the age of 5 had at least one LLIN compared to 58.2% for the districts without LLIN integration. The campaign seems to have reduced the disparity of LLIN integration between the different economic quintiles. The use of LLINs at a national level was 60.4% for children under the age of 5 and 49.2% for pregnant women, or 74.5% for children under the age of 5 and 62.2% for pregnant women in the endemic area. The national estimate of measles immunization coverage during the 2007 integrated campaign was 66.6% amongst targeted children, and there was economic equity amongst those immunized during the campaign.

Conclusion: The free integration of LLINs in an integrated campaign seems to be an efficient means for Madagascar to rapidly increase the ownership of LLINs in order to achieve the international Roll Back Malaria targets. The level of LLIN ownership was higher in the districts with LLIN integration during the campaign than in the districts without LLIN integration, with a higher level of economic equity. The integration of LLIN distribution improved measles immunization cover during the campaign. The integration of LLIN distribution may have encouraged mothers and caregivers to bring their children to the integrated campaign to receive immunization against measles.

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Abbreviations

CDC	Centers for Disease Control and Prevention
CRC	Canadian Red Cross
DHS	Enquête Démographique et de la Santé (Demographic & Health Survey)
GPS	Global Positioning System
ITN	Insecticide-treated Net
LLIN	Long-lasting insecticidal net
MICS	Multiple Indicator Cluster Survey
CRM	Malagasy Red Cross
MS	Ministère de la Santé (Ministry of Health)
DNK	Do not know
WHO	World Health Organization
PDA	Personal Digital Assistant
EPI	Expanded Program on Immunization
PPS	Probability Proportional to Population Size
SIA	Supplemental Immunization Activities

Introduction

The large scale introduction of insecticide-treated nets (ITNs) is a corner stone in the strategies being implemented for malaria control and prevention. Insecticide-treated nets effectively contribute to the reduction of morbidity and mortality in young children (Lengeler, 2004). Indeed, achieving 60% ITN coverage in children less than five years of age and pregnant women is one of the main RBM targets (WHO, 2000).

Until recently, ITN coverage rates have remained low in most of Africa (<5%), particularly amongst the poorest groups (UNICEF, 2003). In contrast, measles vaccination campaigns in sub-Saharan Africa routinely achieve high and equitable coverage (>90%) (Grabowsky et al 2005a).

The success of SIAs as a service delivery vehicle for measles vaccine has led to strategies for integrating other services with SIAs. These strategies of integrated SIAs have included adding Polio vaccine, Vitamin A, albendazole, multi-vitamin sprinkles and long-lasting insecticidal nets (LLINs).

The impact of LLIN integration on the level of measles immunization coverage achieved by an integrated SIA has not yet been fully assessed, but studies show that linking the distribution of ITNs or LLINs to vaccination campaigns is an effective method to increase ITN/LLIN coverage (Grabowsky et al 2005b). This integrated approach has been used successfully in Togo, Niger, Ghana, Zambia, Mozambique, Kenya and Sierra Leone, often achieving >80% coverage of target groups (Grabowsky et al 2005a,b).

Since 2002, many programs have successfully integrated free net distribution into mass measles vaccination campaigns; however they do not always ensure that the nets are properly hung and used (Grabowsky *et al*. 2005a, CDC 2005, CDC 2006). This suggests the need to monitor subsequent net use and assure that nets are properly hung after a mass net distribution and investigating the effect of public awareness programs aimed at increasing the awareness of the population in correct usage of the LLINs.

Malaria prevention by insecticidal mosquito nets

In Madagascar, Malaria is considered a primary cause of morbidity and mortality in children under the age of 5 and pregnant women. Data collected during the MICS (2000) and DHS (2003-4) surveys indicate a moderate level of net ownership at the national level but with a very large disparity between different districts.

The current malaria control strategy divides the country into four main intervention areas. On the East and West coasts (endemic area/stable transmission of malaria) the interventions aimed at malaria consist mainly of LLIN distribution, case management, intermittent preventive treatment during pregnancy (IPTp), home based management of fever (HBM) and community education. Interventions in the Central Highlands (epidemic-prone) are indoor residual spraying (IRS) of insecticides, case management,

the monitoring/detection of epidemics and community education. In the South, prevention and treatment activities include: epidemiological monitoring, case management, HBM, IPTp, community education and also now LLIN distribution.

Recently, several malaria control programs have used LLINs to reduce morbidity and mortality in certain districts of Madagascar. In 2006 and 2007, over 4.5 million LLINs were distributed through routine health care programs such as prenatal care clinics for pregnant women and EPI visits for children under the age of 5 (~1.2 million LLINs), social marketing (~1.8 million LLINs) and the MCHW integrated campaign (~1.5 million LLINs). In 2007, 200,000 additional mosquito nets were distributed as part of a relief program to a population stricken by a major cyclone in the southern part of Madagascar. LLINs for routine distribution and social marketing were financed by the Global Fund for AIDS, TB and Malaria. LLINs for the integrated campaign against measles and malaria were donated by the Canadian Red Cross (~491,800 LLINs), Malaria No More (~110,000 LLINs) and the Global Fund (~936,000 LLINs).

The October 2007 integrated campaign

To reinforce the reduction in morbidity and mortality of children under 5 years of age, in particular those caused by measles and by malaria, the Government of Madagascar, with partners from around the world, implemented a national integrated campaign from October 22-30, 2007. The Mother and Child Health Week campaign provided measles vaccinations, along with vitamin A supplements and de-worming medicine, to more than 2.8 million children under five years of age. In addition, more than 1.5 million insecticide-treated mosquito nets to prevent malaria were distributed in 59 districts in the West and South of the country.

The objectives of the integrated campaign were:

Intervention	**Region**	**Age group**	**Targeted children**
LLINs	West and South (59 districts)	0-59 months	1,398,000
Vitamin A	National (111 districts)	6-59 months	3,027,276
Mebendazole	National (111 districts)	12-59 months	2,648,866
Measles immunization	National (111 districts)	9-59 months	2,835,000

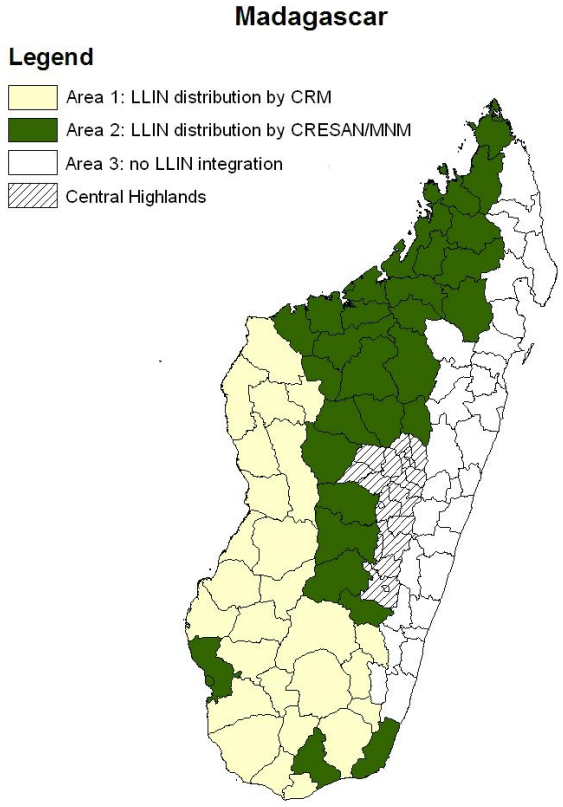
To raise awareness of the campaign activities in the community, a social mobilization campaign was led by the Malagasy Red Cross and the Ministry of Health one week before the campaign. One week after the campaign, the Malagasy Red Cross led a "hang-up" activity in 29 districts in the West and South of the country to sensitize the population about the correct way to hang and use LLINs.

LLIN distribution by the integrated campaign has the potential to significantly increase national levels of LLIN ownership and usage in Madagascar in 2008. Additionally, the distribution of free LLINs with a monetary value of approximately 5USD as an incentive may be introduced for children to receive measles vaccine through the SIA. However, the distribution of LLINs adds a logistical burden which may lead to a negative impact on implementation of measles SIAs.

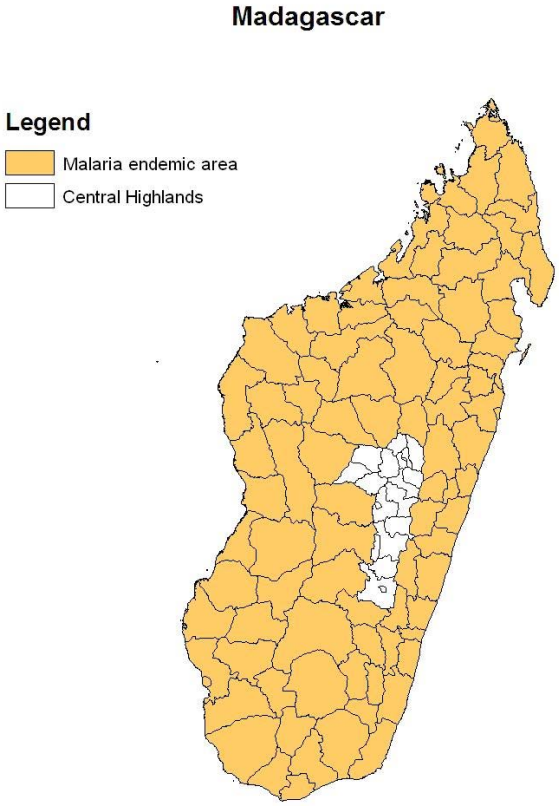
The objective of this evaluation survey
The objective of this survey was to assess the ownership of LLINs and their usage in the districts where distribution took place. To achieve this, we assessed the impact of this distribution on three target groups as described in the WHO/World Bank's Roll Back Malaria program: a) households, b) children under the age of 5, and c) pregnant women. Finally, we also analyzed data on the reference population (cohort) which was targeted during the campaign (children between 6 and 65 months of age).

The main aim was to obtain information representative of the whole population which could demonstrate the potential benefits of this strategy. Estimates on the usage and ownership of mosquito nets were measured on several levels to distinguish between the different sources of LLIN distribution during the integrated campaign and the important geographical divisions of the interventions against malaria in Madagascar. We also compared the measles immunization coverage in districts with and without integrated LLIN distribution in order to assess the success of the integrated campaign strategy.

This report provides estimates at national level as well as for the three operational "areas" for LLIN distribution during the integrated campaign (Map 1): Area 1 comprises 26 districts where the Malagasy Red Cross distributed LLINs during the integrated campaign, Area 2 comprises 33 districts where CRESAN and Malaria No More distributed LLINs during the integrated campaign (out of which 8 districts are part of the fringe area of the Central Highlands) and Area 3 comprises 52 districts where there was no LLIN distribution during the integrated campaign. Furthermore, the 20 districts of the Central Highlands (CHL) where malaria transmission is unstable (epidemic-prone) and where the LLINs do not figure in the national strategy against malaria are excluded from some geographical divisions to give estimates for the malaria endemic area (Map 2) and for the East coast.



Map 1: The operational areas for the evaluation of the October 2007 measles/malaria integrated campaign in Madagascar. The districts of the Central Highlands shown are among the Area 3 districts.



Map 2: The malaria endemic area in Madagascar (orange) and the Central Highlands (white).

The seven geographical divisions and their definitions for this report are:

1) **National**: all 111 districts in the country;
2) **Endemic area**: all districts in the country except the 20 districts of the Central Highlands (CHL);
3) **Districts with LLIN integration** (Areas 1 and 2): the 59 districts where LLIN integration was carried out during the integrated campaign;
4) **Area 1 (CRM)**: the 26 districts where the Malagasy Red Cross distributed LLINs during the integrated campaign;
5) **Area 2 (CRESAN/MNM)**: the 33 districts where CRESAN and Malaria No More distributed LLINs during the integrated campaign;
6) **Districts without LLIN integration** (Area 3): the 52 districts where there was no LLIN integration during the integrated campaign;
7) **East Coast**: the 32 East coast districts where there was no LLIN integration during the integrated campaign (Area 3 minus the 20 CHL districts).

Lists of all the districts in the three operational areas and the Central Highlands are shown in Annex 1 (Tables 9-12).

Specific objectives

1. To measure the ownership of LLINs
    a. The proportion of households having at least one LLIN after the campaign
    b. The proportion of households having at least 2 LLINs after the campaign
2. To measure the level of usage of LLINs
    a. The proportion of households with at least one LLIN hanging the previous night
    b. The proportion of children aged 0 to 59 months old who slept under an LLIN the previous night
    c. The proportion of pregnant women who slept under an LLIN the previous night
3. To measure measles immunization coverage
    a. The proportion of children aged 12 to 23 months who received immunization through the routine health care service
    b. The proportion of children aged 9 months to 5 years who received immunization through the routine health care service
    c. The proportion of children targeted by SIA (aged 9 months to 5 years) who received immunization during the October 2007 integrated campaign
4. To assess the obstacles to immunization and LLIN coverage
    a. To compare the proportions of targeted children who received the measles immunization in the areas where the LLIN were distributed with the proportions of targeted children who received immunization in the area where there was no LLIN integration during the campaign.
5. To assess these objectives depending on the economic status of the households
6. To assess the LLIN campaign targets
    a. The proportion of children aged 6 to 65 months who received an LLIN during the campaign.
    b. The proportion of households having a child aged 6 to 65 months who received an LLIN during the campaign.
    c. The proportion of pregnant women who received an LLIN during the campaign
7. To assess the LLIN ownership and usage by source of supply

Methodology

Survey schedule

The survey was conducted during the peak malaria transmission season, from 11 April to 1 May, 2008, six months after the MCHW integrated campaign.

Sampling

For survey sampling, the country was divided into 3 areas (Map 1): the first area with 26 districts where the Malagasy Red Cross distributed LLINs with the support of the Canadian Red Cross; the second area with 33 districts where CRESAN and Malaria No More distributed LLINs; and the third area with 52 districts where the measles immunization campaign took place, but where LLIN distribution was not integrated.

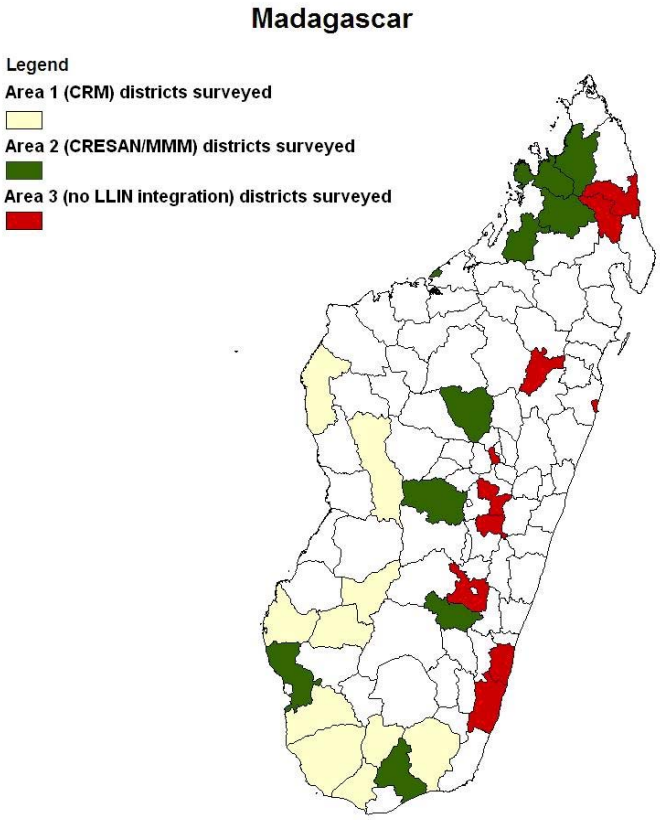
Sampling was carried out on three levels according to the 2007 population projections based on the 1993 National Census (INSTAT 1993). Population data was available for each fokontany and this enabled sampling by probability proportional to population size (PPS). The fokontany were selected so as to ensure a sufficient sample size to produce precise estimates of child LLIN usage (confidence intervals of less than 5% at national and area levels).

In each area 10 districts were selected using the PPS methodology. In each selected district, 6 fokontany were selected on the basis of PPS. Following this, all the households in a fokontany were identified using PDA-GPS technology (Vanden Eng *et al*., 2007). Twenty-four (24) households were surveyed in each fokontany; households were chosen at random from a complete listing of all the households. For this survey, members of a household are defined as "any person sharing the same pot of food". This definition complies with the definition used in previous surveys or studies in Madagascar.

If no-one was available at the time the surveyors called at a specific household, this household was revisited at the end of the day. If there was still no-one available in this household after two attempts, the household was replaced by another household randomly selected as an alternative. No replacement households were selected for households who refused to take part in this study.

In summary, 30 districts (10 in each area) with a selection of 180 fokontany and 4,320 households in total were included in this study. In each area, the determination of the sample is "self-weighting", that is to say each person has the same chance of being selected.

The districts surveyed in each area are shown on Map 3 and in Tables 9-11 in Annex I.



Map 3: Districts surveyed in Madagascar between 11 April and 1 May 2008, during the evaluation survey for the ownership and usage of LLINs six months after the October 2007 MCHW integrated campaign.

Restrictions

Between 27 January and 17 February 2008, Madagascar was hit by two consecutive hurricanes, Fame and Ivan (OCHA 2008). Several districts were affected by flooding and roads that had been cut off. Because of the logistical problems predicted in the affected regions, two selected districts were excluded from the sample and replaced by the next districts to be extracted from the PPS sampling in the respective areas. The districts of Maroantsetra (Area 3) and Port-Berger (Area 2) were replaced by Sambava and Ankazobe respectively. The new fokontanys were selected on the basis of PPS in these districts.

Due to the inaccessibility encountered in the field in five districts in the north and west of the country, the exclusion of additional fokontanys was required. A total of sixteen fokontanys were replaced: seven in Area 2 of which three were in the communes of Marovato and Bemaneviky (Ambanja district), two in the communes of Ambarakara and Ambakirano (Ambilobe district), and two in the commune of Ambodiadabo (Bealanana district); three in Area 3 in the communes of Bevonotra and Antsahavaribe (Sambava

district); and six in Area 1 in the Antsalova district which was replaced by Maintirano. In each case, the next fokontany in another commune extracted by PPS sampling was used as the replacement.

Survey procedures

Mapping / household listing

Fifteen teams, each composed of a supervisor and four surveyors, took on average half a day to create a map/listing of households in one fokontany. Households in a fokontany were mapped using a portable computer (PDA) (Asus MyPal 696) equipped with an internal global positioning system (GPS). The teams were also equipped with electrical chargers and solar backpacks (Voltaic Systems) to enable recharging of the PDAs. Once the surveyors had mapped the households, the GPS Sample software developed by the Centers for Disease Control and Prevention (CDC, Atlanta) was used to randomly select 24 households and 6 replacement households.

The survey

The surveyors asked questions about the household, the mosquito nets in the household, pregnant women, children under the age of 5 and the economic characteristics of the household. The survey was guided by a PDA-based software. At each household, the surveyors requested to see the mosquito nets and they recorded the brand of each LLIN during the survey.

For the children surveyed, whether or not they had had the first routine measles immunization dose was determined by parental recall. The measles immunization status for the 2007 integrated campaign was determined either through inspection of the campaign card if available or by parental recall. All children whose parents did not know the immunization status were considered as not immunized.

Data input

During the survey, data were automatically inputted into a Pocket Access Database in the PDA in the field (software: Visual CE 10.3, Syware Inc, Cambridge, Massachusetts). Each day, the team supervisors saved their GPS and survey data. The data from all the teams were copied and saved to a central database at the end of the survey (Microsoft Access).

Statistical analyses

The final field data were saved in a Microsoft Access file. Because the clusters were chosen from several levels and each region was selected on the basis of proportional probability, several different software packages were used for the analysis of the survey in order to produce estimates and assess the proportional sampling errors, e.g. SAS version 9.2, SAS Institute, Cary, NC. The differences between proportions were statistically assessed with a Pearson's chi-square test.

One section of the questionnaire specifically concerned the house infrastructure. These questions were adapted from the MICS (2000) survey and the Demographic and Health Survey (2003-4). An economic score was allocated to each answer (scores based on those used by the World Bank, DHS) and used to determine the weight of the economic indicators of each household. Households were divided into five equal groups (quintiles) according to their level of wealth, and by definition approximately 20% were in each quintile. Quintile 1 represented the poorest households and quintile 5 the wealthiest households. The economic equity ratio was calculated as the proportional rate of the poorest quintile comparative to the wealthiest quintile. A ratio of 1.0 indicates equality between the quintiles.

Results

The results of the survey are presented here at both national level and for the other geographic divisions. To show the impact of LLIN distribution during the integrated campaign on LLIN ownership and usage, combined estimates are presented for Areas 1 and 2 in comparison with Area 3. Estimates are also presented separately for Area 1 and Area 2 where different organizations were responsible for the social mobilization campaign and LLIN distribution during the integrated campaign. Estimates for all the geographical divisions are shown in the result tables as indicated in the text.

Household characteristics

Among the 4,302 households surveyed there were 18,771 people, including 3,555 children under the age of 5 and 4,300 women of reproductive age (15 to 49 years old); 454 (10.6%) of women were pregnant at the time of the survey; 2,410 (56%) of households had at least one child under the age of 5. At the national level, 446 (10.4%) of households surveyed were urban and 3,856 (89.6%) were rural (Table 1).

LLIN ownership

National and Endemic Area

Six months after the integrated campaign, at the national level 69.9 ± 4.9% of households owned at least one mosquito net of any type and 59.2% ± 5.0% owned at least one LLIN. Almost 99% of all the insecticide-treated nets were LLINs. The ownership rate of any type of mosquito net and of LLINs increased to 82.0 ± 3.2% and 70.5 ± 4.2% respectively in the endemic area (Table 2). The proportion of households owning at least two LLINs (a national objective of the strategy against malaria) was 21.7 ±3.5% at the national level and 27.2 ± 4.1% in the endemic area (Table 2). LLIN ownership in urban and rural areas is shown in Figure 1.

Areas with and without LLIN integration during the campaign

In the districts with LLIN integration (Areas 1 and 2), the proportion of households having at least one LLIN was 76.8 ± 3.1% compared to 48.9 ± 6.8% in the districts without LLIN integration (Area 3) (Table 2, Figure 2). The proportion of households having at least two LLIN was 34.0 ± 3.9% in the districts with LLIN integration and 14.6 ± 3.9% in the districts without LLIN integration (Table 2, Figure 2). If the districts without LLIN integration excluding the CHL are considered (i.e. the East coast) 64.8 ± 6.3% of the households received a LLIN and 28.4 ± 7.1% of households had at least two LLINs.

LLIN ownership was even higher in households having at least one child under the age of 5: 71.4 ± 5.5% at national level, 84.2 ± 3.0% in the endemic area, 89.8 ± 3.5% in the districts with LLIN integration, 57.9 ± 6.2% in the districts without LLIN integration and 77.5 ± 4.8% on the East coast (Table 3a). LLIN ownership rates were similar in households having a child eligible to receive an LLIN during the campaign (i.e. 0 to 59 months old in October 2007 and 6 to 65 months old at the time of the survey) (Tables 3b).

There was a disparity in the equity of the LLIN ownership between the different campaign areas. Equity across the economic quintiles was evident in the districts with LLIN integration (equity ratio of 1.05), however ownership was concentrated in the wealthiest quintiles in the districts without LLIN integration (equity ratio of 0.5) (Table 2, Figure 3). The same trend was evident in households having at least one child under the age of 5: the equity ratio was 1.01 in the districts with LLIN integration and 0.44 in the districts without LLIN integration (Table 3a). On the East coast the equity ratio was 0.65 in all the households and 0.57 in the households having one child under the age of 5.

LLIN ownership was higher in rural areas in the districts with LLIN integration, whereas in the districts without LLIN integration, ownership was higher in urban areas (Figure 1).

At the household level, out of 1,727 households with at least one eligible child in the districts with LLIN integration, 80.1 ± 3.1% received an LLIN during the campaign. Almost all (98-99%) the households which received an LLIN during the campaign still had the LLIN in the household six months later. In the districts with LLIN integration, out of 2,540 eligible children (i.e. aged between 0 and 59 months old in October 2007 and between 6 and 65 months old at the time of the survey) 71.6 ± 3.4% received an LLIN. More children received an LLIN if they were the only eligible child in the household (78.0 ± 4.4%, n=995) than if there were two eligible children (70.9 ± 5.4%, n=1,038) or three eligible children (60.4 ± 8.4%, n=397).

Areas 1 and 2

In general, the ownership of LLINs from any source in households having one child eligible during the campaign was marginally higher in Area 1 than in Area 2 (93.1 ± 2.5% vs. 89.0 ± 3.2%, respectively (Table 3b)). However, ownership at the household level of LLINs received from the campaign was similar between the two Areas. Out of the 836 households surveyed in Area 1 with an eligible child, 684 (81.0 ± 3.2%) received at least one LLIN during the campaign. Out of the 891 households in Area 2 with an eligible child, 732 (80.6 ± 3.7%) received at least one LLIN during the campaign. This difference is not significant ($p<0.05$). A similar level of equity in LLIN ownership was evident in both areas. The equity ratio is 1.05 in Area 1 and 1.04 in Area 2 (Table 2, Figure 3).

Out of the 1,295 eligible children in Area 1, 70.0 ± 3.9% received an LLIN during the campaign. Similarly, 72.2 ± 4.4% of the 1,245 eligible children in Area 2 received an LLIN during the campaign. In the households surveyed, the main reason identified for eligible children who did not receive an LLIN during the campaign was "no more LLINs at the centre" and "not at home", although almost 50% answered "don't know" or "other" (Figure 4). The answers were similar in the two areas.

Out of 183 women in Area 1 who were pregnant at the time of the integrated campaign, 50.0 ± 10.0% received an LLIN during the campaign. Similarly, 48.0 ± 11.4% of the 160 women who were pregnant in Area 2 at the time of the integrated campaign received an LLIN during the campaign.

Hanging of LLINs

National and Endemic Area

The rate of LLIN hanging was marginally lower than the ownership rate, but more than 90% of the households that owned at least one LLIN reported having had an LLIN hanging the previous night. At the national level, 53.5 ± 5.2% of the households had at least one LLIN hanging the previous night, with a hanging rate of 65.1 ± 4.6% in the endemic area (Table 4).

Areas with and without LLIN integration during the campaign

The LLIN hanging rate was higher in the districts with LLIN integration (71.5 ± 3.6%) than in the districts without LLIN integration (42.9 ± 6.9%). On the East coast, 59.3 ± 6.8% of the households had an LLIN hanging (Table 4, Figure 5).

Areas 1 and 2

After adjusting for LLIN ownership at household level[1], the LLIN hanging rate was similarly high in Area 1 (79.0% ownership and 74.4% hanging in all the households, i.e. 94.2% of households which had an LLIN had hung it up) compared to Area 2 (76.1% ownership and 70.5% hanging in all the households, i.e. 92.6% of households having an LLIN had hung it up) (Table 4). This does not necessarily demonstrate an effect of social mobilization which occurred after the campaign. Other factors, such as the climate and cultural behaviours, which differ between the geographical regions of the country, can also affect LLIN hanging.

Use of LLIN by children under the age of 5 years old

National and Endemic Area

At national level, 68.0 ± 6.4% of the 3,355 children under the age of 5 in the households surveyed were reported to have slept under any type of net the previous night, and 60.4 ± 6.1% had slept under an LLIN. In the endemic area, the usage rates of any net and of LLINs were 83.4 ± 3.1% and 74.5 ± 3.7%, respectively (Table 5a).

Areas with and without LLIN integration during the campaign

The proportion of children who had slept under an LLIN was higher in the districts with LLIN integration during the campaign (80.8 ± 3.5%) than in the districts without LLIN integration during the campaign (44.6 ± 8.7%) or on the East coast (66.0 ± 6.4%) (Table 5a). On the basis of households having at least one LLIN, the usage rates by children increased to 94.6 ± 1.6% and 89.7 ± 3.4% respectively for the districts with and without LLIN integration, and 90.0 ± 3.8% on the East coast (Table 5b).

The equity ratio for LLIN use by children under the age of 5 was 1.08 in the districts with LLIN integration during the campaign and 0.41 in the districts without integration during the campaign (0.44 for the East coast) (Table 5a).

Areas 1 and 2

After adjusting for LLIN ownership at household level, the use of LLINs by children under the age of 5 in households having at least one LLIN was similar between Area 1 and 2 (95.2 ± 1.2% and 94.4 ± 2.0% respectively) (Table 5b). The use of LLINs by children under the age of 5 was similar in the poorest and the wealthiest households in the two areas (equity ratio of 0.96 in Area 1 and 1.05 in Area 2) (Table 5a).

[1] It is important to adjust for LLIN ownership in estimates of hanging and usage to avoid confounding the effect of ownership on these measures.

LLIN use by pregnant women

National and Endemic Area

At the national level, 55.7 ± 8.5% of the 454 surveyed pregnant women had slept under any type of net the previous night, and 49.2 ± 8.6% had slept under an LLIN. In the endemic area the rate of usage of any net and of LLINs was 70.6 ± 7.3% and 62.2 ± 8.2% respectively.

Areas with and without LLIN integration during the campaign

The proportion of pregnant women who had slept under an LLIN was higher in the districts with LLIN integration during the campaign (68.5 ± 8.3%) than in the districts without LLIN integration (34.4 ± 11.6%) or the East coast (54.0 ± 14.5%) (Table 6).

On the basis of households having at least one LLIN, the rate of usage by pregnant women increased to 88.7 ± 5.7% and 78.7 ± 3.5% respectively for the districts with and without LLIN integration, or 87.7 ± 12.6% on the East coast (Table 6b).

The sample size (number of pregnant women) was too low to measure the equity of LLIN usage by pregnant women with any confidence.

Areas 1 and 2

After adjusting for LLIN ownership, the use of LLINs by pregnant women in households having at least one LLIN was similar between Area 1 and 2 (91.3 ± 5.9% and 87.9 ± 7.4% respectively) (Table 6b).

Social mobilization before and after the campaign

Out of the 1,421 households surveyed in Area 1, 729 (51%) reported having received a visit from a community worker the week before the October 2007 MCHW integrated campaign. Of the households visited, 190 (26%) indicated that they were visited by a Malagasy Red Cross volunteer and 455 (62%) by a health care worker. In Area 2, of the 1,439 households surveyed, 501 (35%) reported having received a visit from a community worker the week before the October 2007 MCHW integrated campaign. Of the households visited, 81 (16%) indicated that they were visited by a Malagasy Red Cross volunteer and 352 (70%) by a health care worker. In Area 3, out of the 1,442 households surveyed, 474 (33%) reported they were visited before the campaign, 99 (21%) by a Malagasy Red Cross volunteer and 291 (61%) by a health care worker (Table 7a).

Three hundred and twenty-two (322) households surveyed (23%) in Area 1 reported having received a visit from a community worker the week following the October 2007 MCHW integrated campaign. Of the households visited, 112 (35%) indicated that they

were visited by a Malagasy Red Cross volunteer and 196 (61%) by a health care worker. In Areas 2 and 3 where there was no social mobilization organized after the campaign[2], 6-7% of households surveyed reported having received a visit from a community worker the week following the MCHW integrated campaign of October 2007 (Table 7b).

In general, the LLIN ownership was higher in households who received a visit before the campaign compared to those who did not receive a visit (Figure 6a). Similarly, the proportion of households having an LLIN hanging the previous night was higher in households who had received a visit after the campaign compared to those who did not receive a visit (Figure 6b).

LLIN ownership was higher in households who identified "mosquito bites" as the cause of malaria (Figure 7).

Source of LLINs

The contribution of the different sources of LLINs to the total pool of LLINs in Madagascar is shown in Figure 8. The survey collected data on nine sources of LLIN supply: community-based sales agents (CBRW), shops, basic Health Care Centres (BHCC), private Health Care Centres, October 2007 MCHW campaign, kiosks, private doctors, chemists/drug depots, and don't know/other. In Area 1 and Area 2, the "October 2007 MCHW campaign" was the main source of LLINs (65-67%) with the second highest contribution from "shops" (23-26%). In Area 3, "shops" were the primary source (52%) with "BHCC" in second place (19%). Despite there being no LLIN integration in Area 3 during the MCHW campaign, 16% of households in this area reported receiving an LLIN from the "October 2007 MCHW campaign".

The LLIN brands are shown by source of supply in Table 8. The main sources of supply of Super Moustiquaire mosquito net were "shops" and "kiosks". The "October 2007 MCHW campaign" was the main source of supply of Olyset and Permanet.

[2] The three districts where CRESAN distributed LLINs and the Malagasy Red Cross conducted a social mobilization program after the campaign (Ambovombe, Toliary I and Toliary II) are excluded from Area 2 for this analysis.

Measles immunization

Coverage of measles immunization through routine health care services

The national estimate for measles immunization coverage amongst those aged 12 to 23 months at the time of the survey was 56.2 ± 5.6%. This result is similar to that of the 2004 DHS whose estimated measles immunization coverage, determined either by immunization card or parental recall, was of 59.0% (DHS 2004). Amongst the children aged between 9 and 59 months at the time of the survey, measles immunization coverage through routine health care services was 68.9 ± 2.8% nationally. Routine immunization coverage of measles immunization for the two age groups was similar between the districts with LLIN integration during the campaign and those where LLIN distribution was not integrated in the campaign (Figure 9). At the national level, there was a disparity in the routine immunization coverage equity where, more precisely, there was a reduction in coverage rate between the wealthiest and poorest economic quintiles ($p < 0.002$). Of the children living in households in the wealthiest quintile, 75.3 ± 5.4% had received a measles vaccination compared to 64.7 ± 6.6% of children in households in the poorest quintile (Figure 10).

Measles immunization coverage during the 2007 integrated campaign

The national estimate for measles immunization coverage during the 2007 integrated campaign for the targeted children aged 9 to 59 months was 66.6 ± 2.8%. There was equity between the economic quintiles for measles immunization coverage. Of the children living in households in the poorest quintile, 64.9 ± 7.2% had received a measles vaccination compared to 63.3 ± 6.7% of the children living in households in the wealthiest quintile (Figure 11).

Measles immunization coverage during the 2007 integrated campaign in the districts where LLIN distribution was integrated and where it was not

The national estimate for measles immunization coverage during the 2007 campaign in the districts where LLIN distribution was integrated was 71.4 ± 3.1% compared to 63.1 ± 4.3% in districts where LLIN distribution was not integrated (Figure 12). This difference is statistically significant with a Pearson's chi-square test ($p< 0.002$). In the districts where LLIN distribution was integrated during the campaign, there was equity between those immunized where, more precisely, 67.0 ± 9.5% of children from households in the wealthiest quintile were immunized against measles compared to 69.0 ± 7.1% of children from households in the poorest quintile (Figure 11). However, in the districts without LLIN integration, there was a disparity among those immunized such that there was a reduction in immunization coverage during the campaign from the wealthiest quintile to the poorest quintile ($p<0.02$). In the districts without LLIN integration, 61.5 ± 8.9% of children from households in the wealthiest economic quintile had received a measles immunization compared to 51.6 ± 18.8% of children from households in the poorest economic quintile (Figure 11).

Limitations

Due to inaccessibility caused by flooding following hurricanes Fame and Ivan, the sampling was adjusted in some districts. A valid method was used to identify replacements; however, the exclusion of some out-of-reach fokontanys could have reduced the representativeness of the sampling. If a fokontany which was not accessible at the time of the survey was also inaccessible at the time of the October 2007 MCHW campaign LLIN distribution, the results of the survey would show an artificial increase in LLIN ownership. It could be expected that the impact of this on LLIN usage would be less as usage should be less affected by accessibility. Furthermore, as the need to replace fokontanys was similar in all three operational areas, the impact on the differences between the areas is probably minimal.

The analysis of this report concentrates mainly on the evaluation objectives, which were to measure LLIN ownership and usage in Madagascar six months after the October 2007 integrated campaign. Several different LLIN interventions occurred in Madagascar before the integrated campaign, and the results in this report aim to assess the contribution of the campaign to the total LLIN reserve in the country, but not all the LLIN sources of supply are necessarily well represented in the sampling. Further analysis is required in order to better assess the ownership and usage patterns by LLIN source of supply. The results of a further in-depth analysis will be published.

The study on the measles immunization coverage has a few restrictions. The determination of immunization status by parental recall can introduce a bias in the results, particularly for older children. The recall bias in immunization status was possibly limited at the time of the campaign as campaign cards were checked when available. The results on the measles immunization coverage are preliminary; a more in-depth analysis will be completed and the final results will be published.

Discussion

The preliminary results of this survey indicate a high LLIN ownership rate six months after the integrated campaign carried out in Madagascar in October 2007, with an LLIN ownership rate of almost 80% in the districts where LLIN integration occurred during the campaign. If only households with a child under the age of 5 are considered as a denominator, the ownership rate increases to almost 90% in these districts.

The ownership of LLINs received during the campaign was similar in the two areas where CRM and CRESAN/MNM distributed LLINs during the campaign. This comparison demonstrates effective LLIN distribution in the two areas.

In the districts without LLIN integration during the campaign, where the LLINs were distributed through social marketing and routine health care services, the ownership rate remained lower, with an obvious disparity between the poorest and wealthiest economic quintiles. The LLIN ownership rate and equity in the East coast districts was higher, but remained lower than in the districts where LLIN distribution occurred during the campaign.

Over 90% of households who owned at least one LLIN, either in the districts with LLIN integration during the campaign or in the other districts without LLIN integration, had an LLIN hanging the previous night, which suggests a good sensitization of the population as to the use of LLINs. When all the households are considered as a denominator, the proportion of children and pregnant women who had slept under an LLIN the previous night was higher in the districts with LLIN integration during the campaign. This is probably a function of the higher level of ownership in these districts. When households owning at least one LLIN are considered as a denominator, the usage by children is more on a par: 95% and 90% in the districts with and without LLIN integration during the campaign.

The evaluation six months after the campaign on the impact of the social mobilization campaign on LLIN ownership and hanging up demonstrated a positive effect on the households visited, but it seemed to make little difference whether the visit was made by a health care worker or a Red Cross volunteer. It is striking that the identification of the community workers as Red Cross workers or health care workers does not correspond well to the activities occurring in the different areas, particularly for the "hang-up" social mobilization activities led by the Red Cross. This evaluation is limited by a recall bias. The results could be confused by other community visits and/or could indicate a tendency to consider the Red Cross volunteers as health care workers. In some districts, such as in the South of the country, the CRM manages health care centers (Dr. H. Rabeson, CRM, pers. comm.).

The national estimate for measles immunization coverage through routine health care services is 56.2% for children aged between 12 and 23 months. An economic disparity exists for routine measles immunization for the poorest. The national estimate for measles immunization coverage during the 2007 integrated campaign was 66.6% amongst the targeted children, and there was economic equity amongst those immunized during the campaign.

Conclusion

The PDA-GPS methodology used in this survey enabled the acquisition of representative results on LLIN ownership and usage for the Madagascar population. These results indicate that the mass distribution of LLINs during the MCHW integrated campaign in October 2007 had a significant impact on LLIN ownership at the household level. In the districts with LLIN integration during the campaign, the equity of LLIN ownership was evident across the economic quintiles.

The results indicate a disparity in LLIN ownership in the districts with and without LLIN integration during the campaign. The hanging and usage rates in the different geographical divisions appear to be a function of the ownership rate. This suggests that the increase of LLIN ownership at national level, with the continuation of increased population sensitization on correct LLIN usage, should be a priority for the national malaria control strategy in Madagascar.

The integration of LLIN distribution improved measles immunization coverage and improved the economic equity of those who received the measles immunization during the campaign. The integration of LLIN distribution may have encouraged mothers and caregivers to bring their children to the integrated campaign to receive immunization against measles.

Acknowledgements

This survey was an international collaboration with contributions from various different organizations and institutions.
Our thanks to:

- the parents and children's caregivers who took part in the interviews,
- the local administrative authorities who facilitated the realization of the survey,
- Dr. Benjamin Ramarosandratana, Dr. Andriamahefa Rakotoarisoa, Dr. Louise Ranaivo and M. Andry Rakotorahalahy of the Service de Lutte Contre le Paludisme (National Malaria Control Program) of the Ministère de la Santé, Planning Familial et de la Protection Sociale (Ministry of Health, Family Planning and Social Protection), for their assistance and expertise,
- M. Fanja Ratsimbazafy, Dr. Herizaka Rabeson and Dr. Bary of the Malagasy Red Cross for their administrative, technical and logistic assistance during training and in the field,
- M. Victor Rabiaza and M. Tovonirina Razafimiaratsoa of INSTAT for their technical assistance with the databases on administrative structures, sampling and the selection of the fokontanys,
- INSPC who made available to the survey the human resources necessary for its realization,
- the 15 supervisors and 60 surveyors for their professional work in the field under difficult conditions,
- UNICEF Madagascar, the Canadian Red Cross and USAID for their important support,
- WHO, PSI Madagascar, Santénet, and the American Red Cross for their technical contributions,
- Adam Wolkon and Jodi Vanden Eng of the CDC, Atlanta, for their technical support and advice and their contribution to the materials adapted by HealthBridge for the PPS sampling, the surveyor training, the questionnaire and the survey's Visual CE program.

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Figures

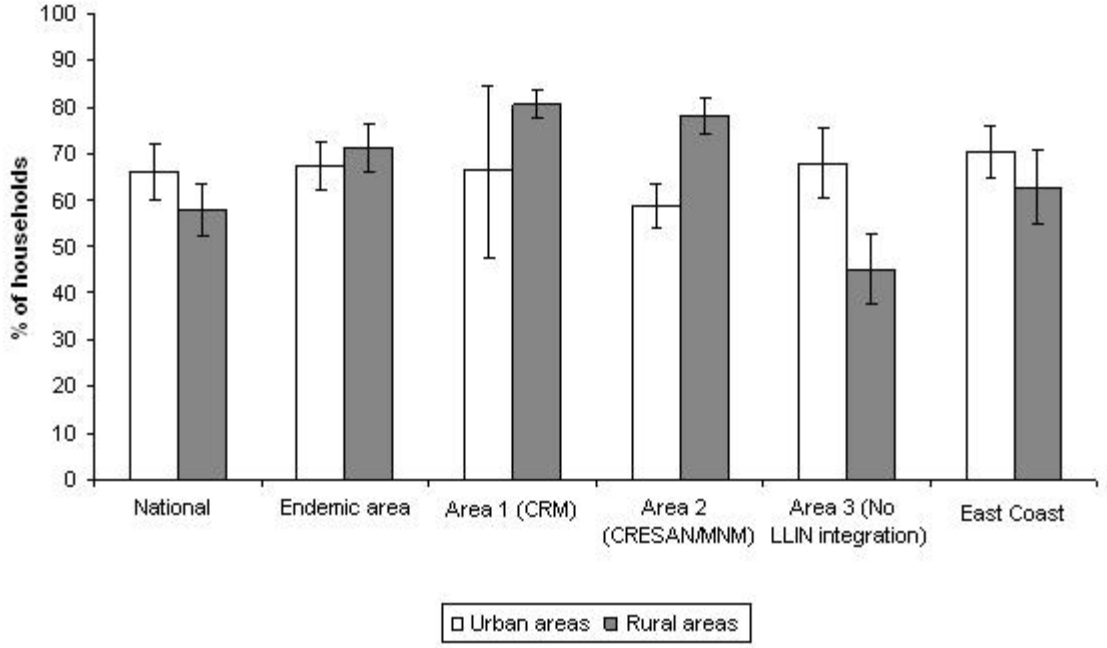

Figure 1. LLIN ownership by urban/rural status. The proportion of households having at least one LLIN in the fokontany classified as urban and rural in (1) the entire island of Madagascar, (2) the endemic area, (3) the 26 districts where the Malagasy Red Cross distributed LLINs, (3) the 33 districts where CRESAN/MNM distributed the LLINs, (4) the 52 districts without LLIN integration (Area 3), and (6) the 32 East coast districts. The error bars indicate 95% confidence intervals.

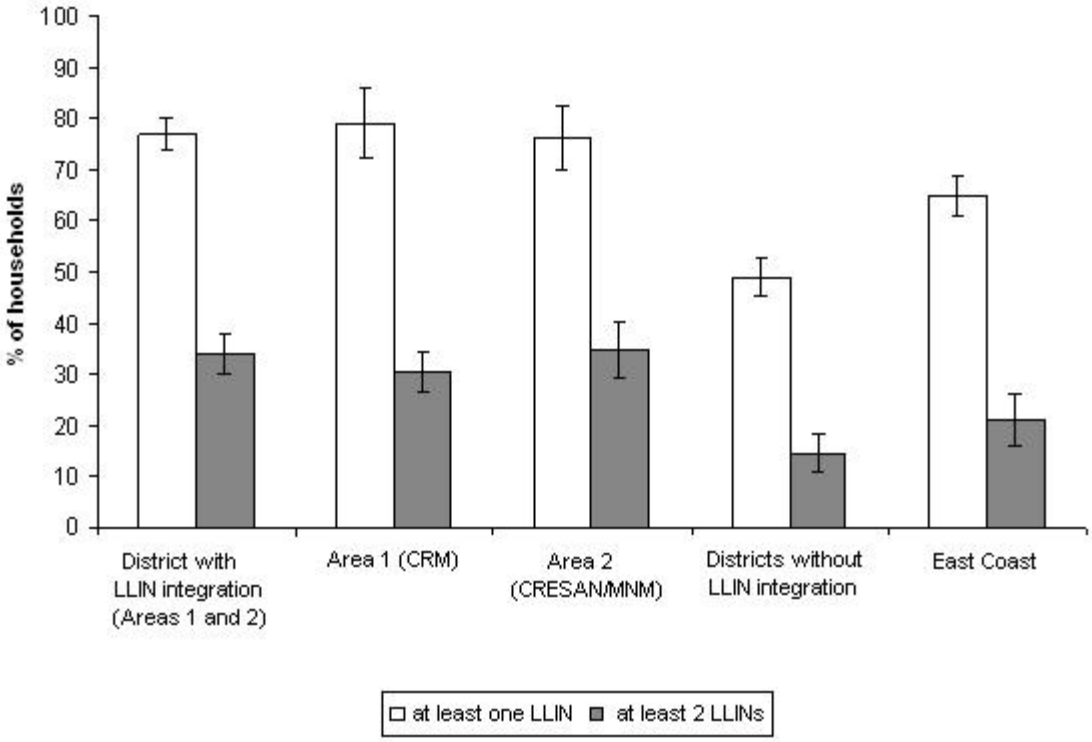

Figure 2. LLIN ownership: The proportion of households in Madagascar having at least 1 LLIN and at least 2 LLINs in (1) the 59 districts where there was LLIN distribution integration during the October 2007 campaign (Areas 1 and 2), (2) the 26 districts where the Malagasy Red Cross distributed the LLINs, (3) the 33 districts where CRESAN/MNM distributed the LLINs, (4) the 52 districts without LLIN integration (Area 3), and (5) the 32 East Coast districts. The error bars indicate 95% confidence intervals.

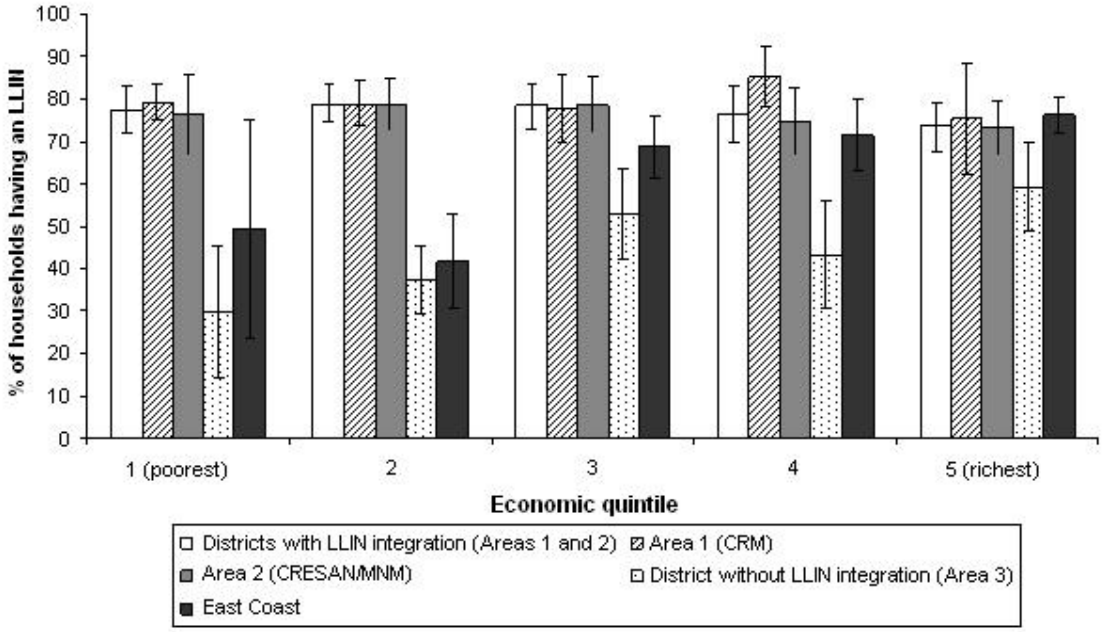

Figure 3. Equity of LLIN ownership: LLIN ownership in households in (1) the 59 districts where integration of LLIN distribution was carried out in the October 2007 integration campaign (Areas 1 and 2), (2) the 26 districts where the Malagasy Red Cross distributed LLINs, (3) the 33 districts where CRESAN/MNM distributed LLINs, (4) the 52 districts without LLIN integration (Area 3), and (5) the 32 East coast districts, organized by economic quintile. Quintiles were calculated on the basis of the 2004 DHS economic indicators in Madagascar. The error bars indicate 95% confidence intervals.

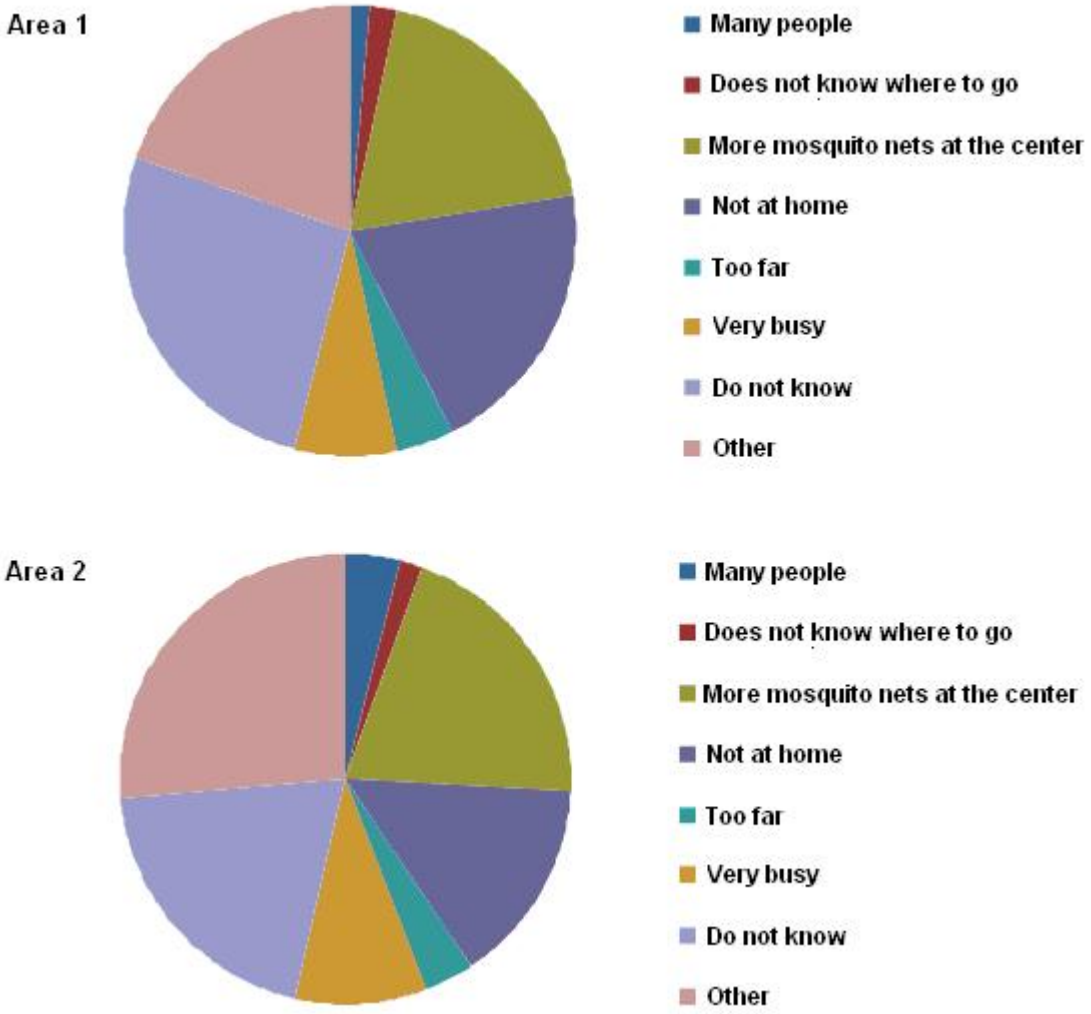

Figure 4. Why did this child not receive a LLIN during the October 2007 Mother and Child Health Week? Answers to that question from households who stated that an eligible child did not receive an LLIN during the campaign in Area 1 (n=363 out of 1,245 eligible children) and Area 2 (n=332 out of 1,295 eligible children).

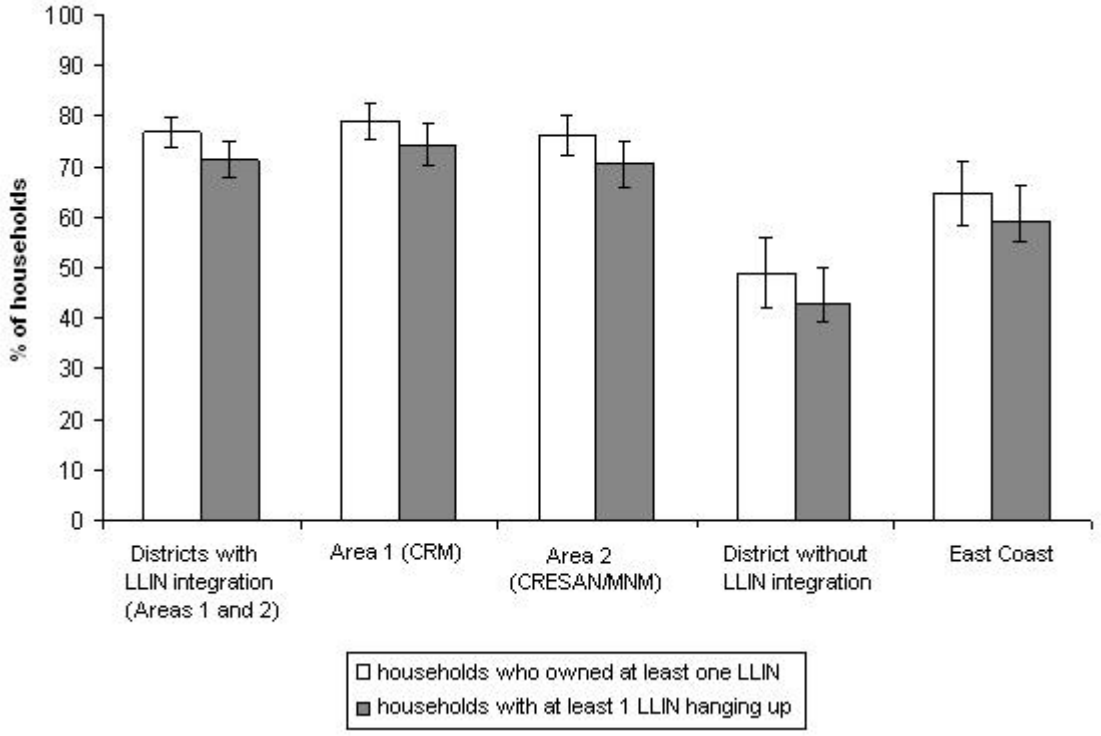

Figure 5. LLIN hanging: The proportion of households in Madagascar who had received at least one LLIN and the proportion of households in Madagascar having at least one LLIN hanging in (1) the 59 districts where there was LLIN distribution integration during the October 2007 campaign (Areas 1 and 2), (2) the 26 districts where the Malagasy Red Cross distributed the LLINs, (3) the 33 districts where CRESAN/MNM distributed the LLINs, (4) the 52 districts without LLIN integration (Area 3), and (5) the 32 East Coast districts. The error bars indicate 95% confidence intervals.

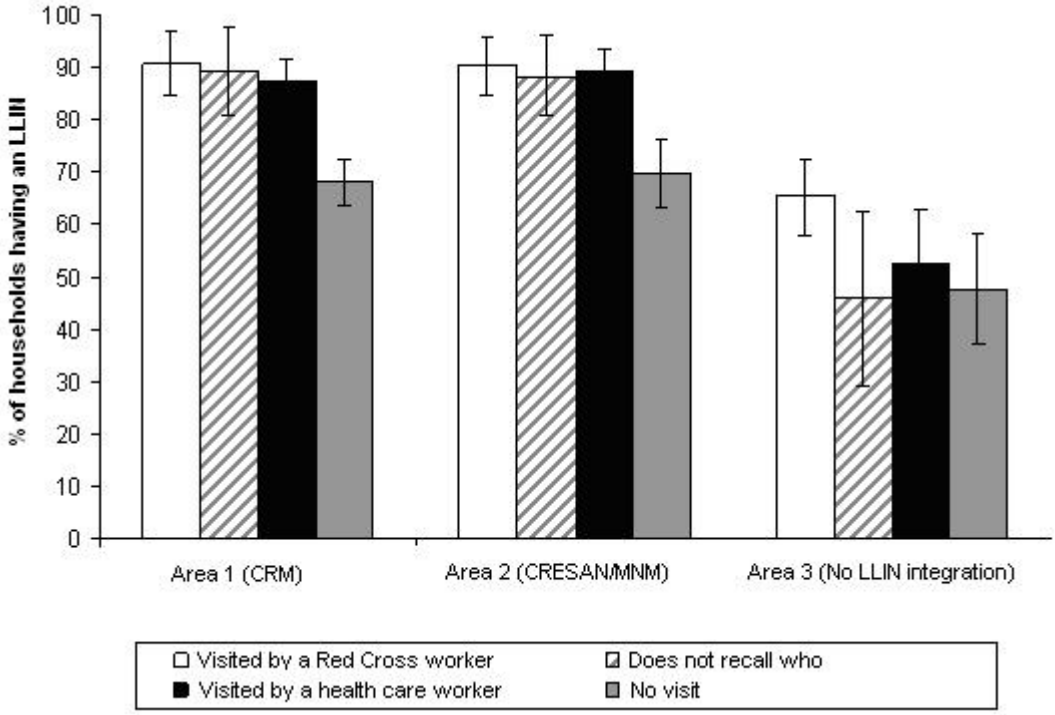

Figure 6a. The ownership of LLINs at household level by visit status of a community worker before the campaign: The proportion of households having at least one LLIN in the three operational areas who reported being visited by a community worker (health care worker or Malagasy Red Cross volunteer) in the week before the October 2007 MCHW integrated campaign.

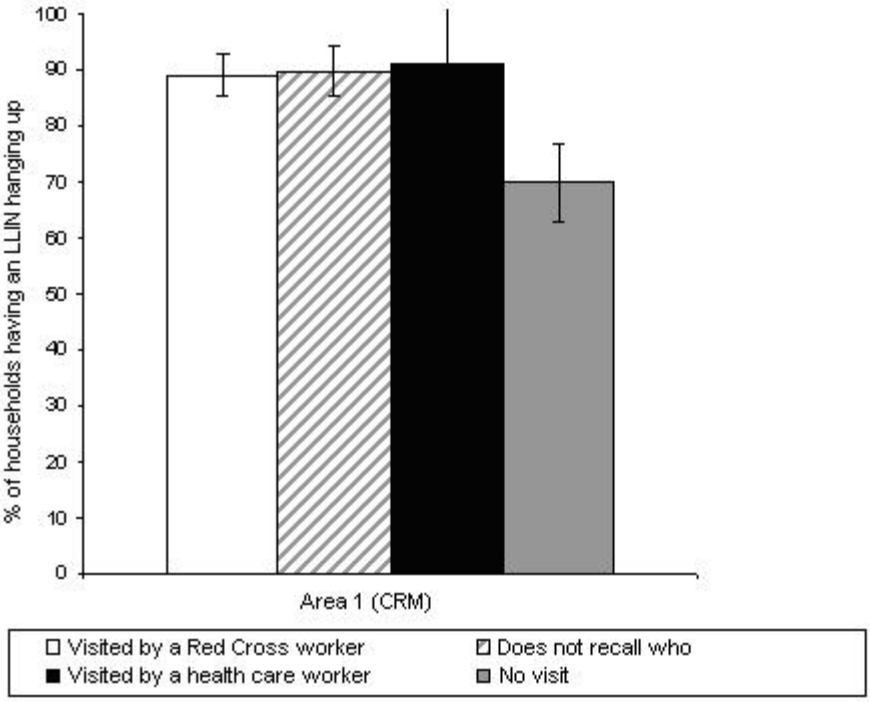

Figure 6b. The rate of LLIN hanging at household level by visit status of a community worker after the campaign: The proportion of households having an LLIN hanging the previous night in Area 1 who reported having received a visit from a community worker (health care worker or Malagasy Red Cross volunteer) in the week after the October 2007 MCHW integrated campaign.

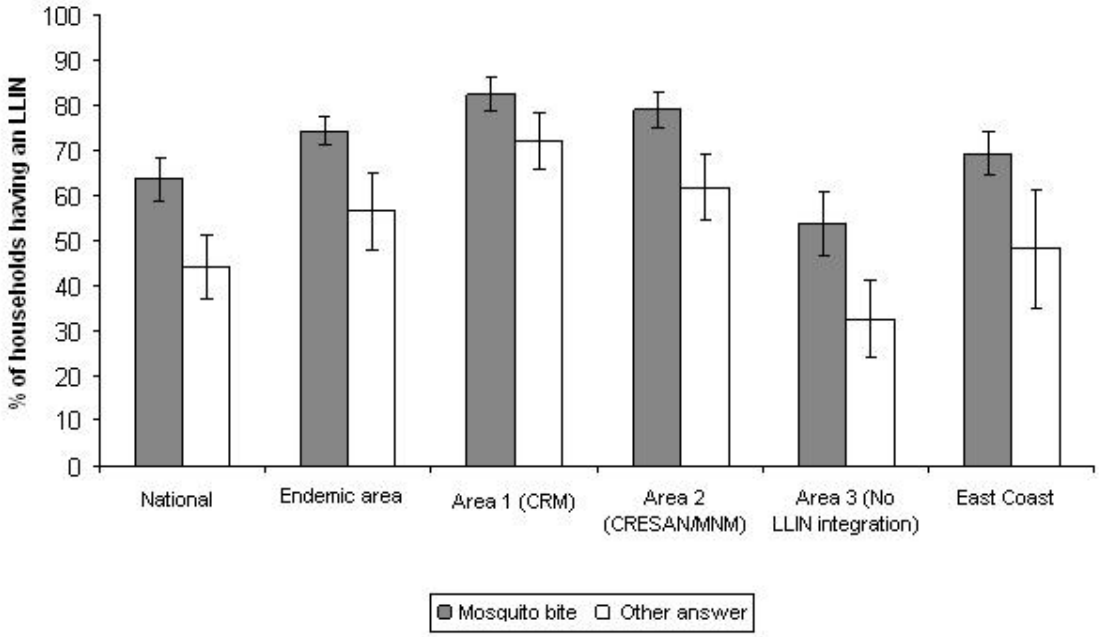

Figure 7. Knowledge of malaria: How can you get malaria? LLIN ownership in the households surveyed who knew the cause of malaria, "mosquito bite". Other possible answers were: By drinking dirty water, by eating certain types of food, by catching a cold, by staying out in the rain, from stagnant water, do not know, and other.

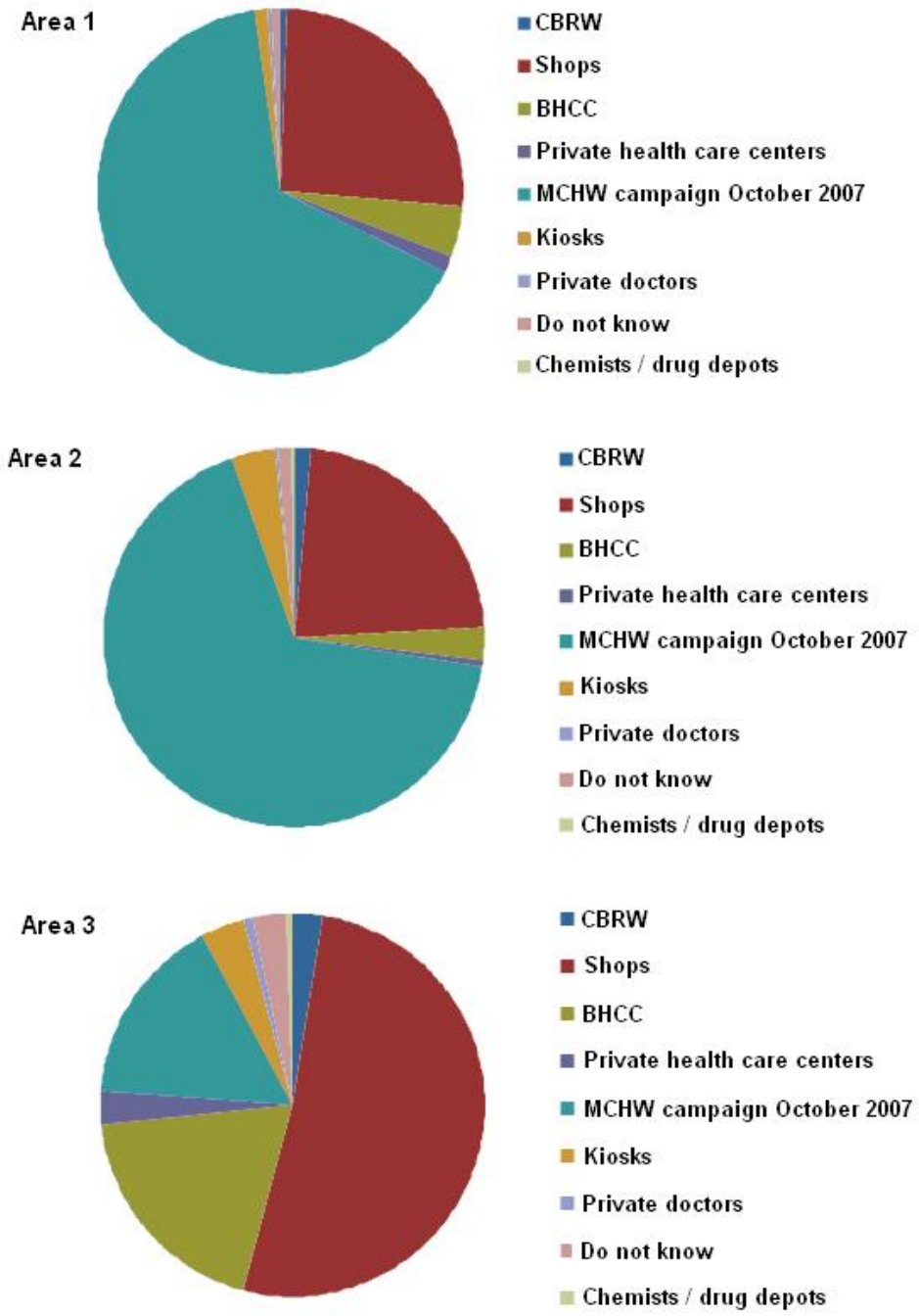

Figure 8. The sources of supply of LLINs in Area 1 (n = 1,752) where the Malagasy Red Cross distributed LLINs, Area 2 (m = 1,730) where CRESAN/MNM distributed LLINs and Area 3 (n = 912) where there was no LLIN integration during the campaign.

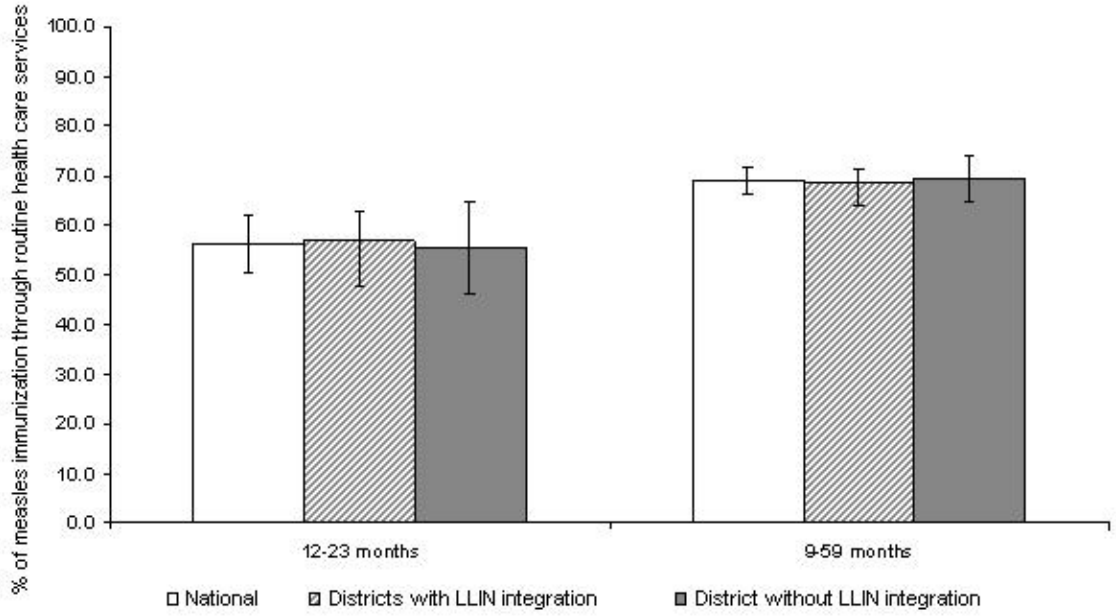

Figure 9. Coverage of routine measles immunization by age range at national level, and for the districts with and without LLIN distribution integration during the 2007 campaign.

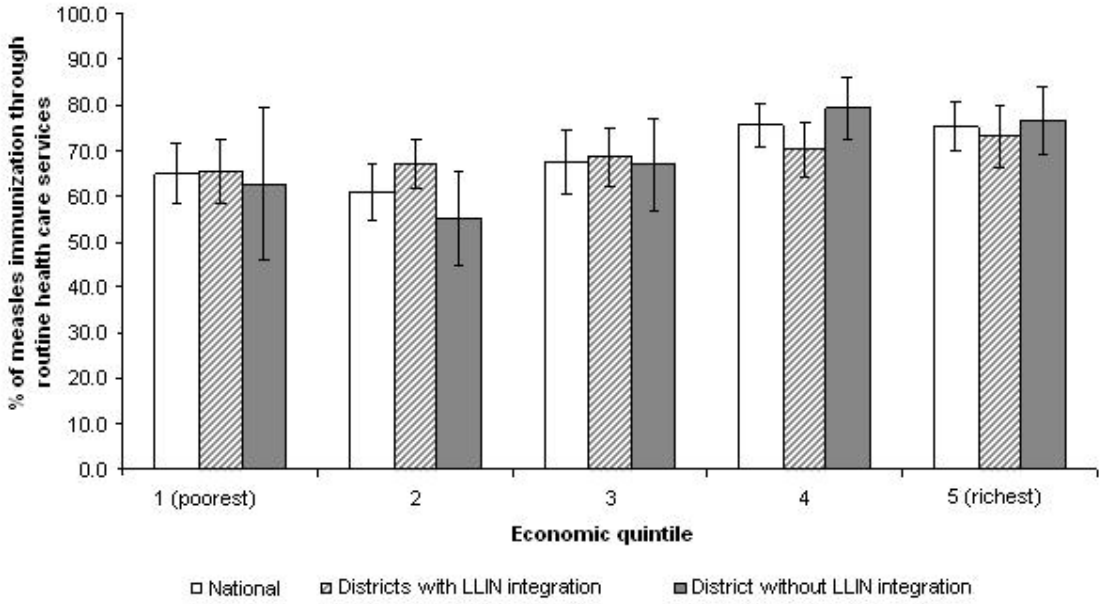

Figure 10. Coverage of routine measles immunization by economic quintile at national level, and for the districts with and without LLIN integration during the 2007 MCHW campaign.

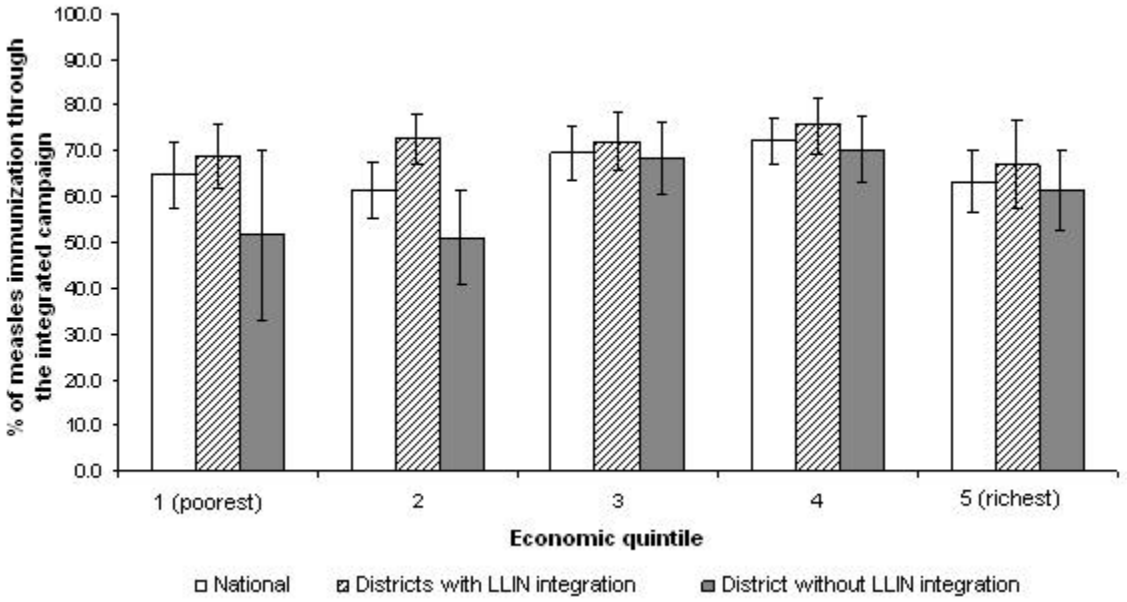

Figure 11. Coverage of measles immunization during the 2007 campaign by economic quintile at national level, and for the districts with and without the 2007 campaign LLIN distribution integration

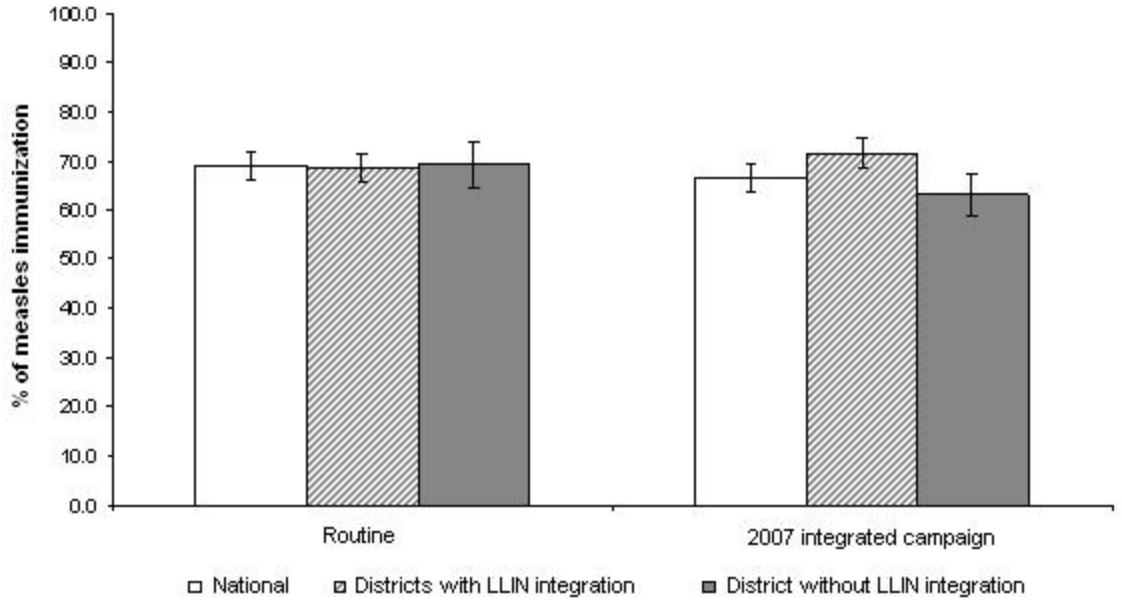

Figure 12. Coverage of routine measles immunization and that of the campaign for those aged 9 to 59 months at national level, and for the districts with and without LLIN distribution integration during the 2007 campaign.

Tables

Table 1. Number of households surveyed in the different geographical areas classified by urban/rural status*.

Level	Urban areas		Rural areas		Total
	n	%	n	%	
National	446	(10.4)	3856	(89.6)	4302
Endemic area	422	(11.3)	3297	(88.7)	3719
Area 1 (CRM)	94	(6.6)	1327	(93.4)	1421
Area 2 (CRESAN/MNM)	143	(9.9)	1296	(90.1)	1439
Area 3 (No LLIN integration)	209	(14.5)	1233	(85.5)	1442
East Coast	185	(21.5)	674	(78.5)	859

* The categorization of urban/rural status of the fokontanys surveyed was carried out by the Madagascar Ministry of Health, Family Planning and Social Protection.

Table 2. LLIN ownership in Madagascar. The proportion of households having at least one LLIN, at least two LLINs, at least one mosquito net of any type (denominator (n): all the households).

Level	n	Adjusted mean	95% CI	
National				
at least one LLIN	4302	59.2	54.2	64.2
at least two LLINs	4302	21.7	18.2	25.1
at least one mosquito net	4302	69.9	65.0	74.8
Endemic area				
at least one LLIN	3719	70.5	66.3	74.7
at least two LLINs	3719	27.2	23.1	31.3
at least one mosquito net	3719	82.0	78.7	85.2
Districts with LLIN integration				
at least one LLIN	2860	76.8	73.8	79.9
at least two LLINs	2860	34.0	30.0	37.9
at least one mosquito net	2860	83.9	81.3	86.5
(>=1 LLIN) quintile 1	637	77.4	71.8	83.1
quintile 2	755	78.9	74.6	83.1
quintile 3	548	78.3	73.0	83.7
quintile 4	453	76.3	69.8	82.9
quintile 5	467	73.5	67.7	79.3
Area 1 (CRM)				
at least one LLIN	1421	79.0	75.3	82.8
at least two LLINs	1421	30.5	27.0	34.1
at least one mosquito net	1421	82.2	79.1	85.4
(>=1 LLIN) quintile 1	456	79.2	75.0	83.5
quintile 2	480	78.9	73.5	84.4
quintile 3	258	77.6	69.6	85.6
quintile 4	118	85.3	78.1	92.5
quintile 5	109	75.3	62.0	88.6
Area 2 (CRESAN/MNM)				
at least one LLIN	1439	76.1	72.1	80.0
at least two LLINs	1439	34.8	29.7	40.0
at least one mosquito net	1439	84.4	81.1	87.7
(>=1 LLIN) quintile 1	181	76.1	66.6	85.5
quintile 2	275	78.7	72.6	84.7
quintile 3	290	78.6	72.0	85.2
quintile 4	335	74.7	67.0	82.4
quintile 5	358	73.2	66.8	79.6
Districts without LLIN integration				
at least one LLIN	1442	48.9	42.1	55.8
at least two LLINs	1442	14.6	10.7	18.5
at least one mosquito net	1442	61.8	54.6	68.9
(>=LLIN) quintile 1	64	29.6	14.0	45.2
quintile 2	266	37.3	29.3	45.2
quintile 3	328	52.9	42.2	63.7
quintile 4	392	43.2	30.6	55.8
quintile 5	392	59.1	48.7	69.4

East coast				
at least one LLIN	859	64.8	58.5	71.0
at least two LLINs	859	21.0	15.5	26.6
at least one mosquito net	859	80.2	74.9	85.6
(>=1 LLIN) quintile 1	20	49.3	23.6	75.0
quintile 2	204	41.6	30.4	52.8
quintile 3	188	68.7	61.4	76.0
quintile 4	200	71.6	63.1	80.0
quintile 5	247	76.1	71.8	80.5

Table 3a. LLIN ownership in Madagascar. The proportion of households having at least one LLIN, at least two LLINs or at least one mosquito net of any type [denominator (n): households having at least one child under the age of 5 (0 to 59 months old)]

Level	n	Adjusted mean	95% CI	
National				
at least one LLIN	2410	71.4	65.9	76.9
at least two LLINs	2410	29.3	25.0	33.6
at least one mosquito net	2410	79.0	73.8	84.2
Endemic area				
at least one LLIN	2094	84.2	81.3	87.2
at least two LLINs	2094	36.8	32.3	41.3
at least one mosquito net	2094	92.1	90.4	93.9
Districts with LLIN integration				
at least one LLIN	1685	89.8	87.2	92.3
at least two LLINs	1685	43.7	38.9	48.4
at least one mosquito net	1685	93.9	92.2	95.7
(>=1 LLIN) quintile 1	388	89.8	85.4	94.1
quintile 2	473	91.1	88.3	94.0
quintile 3	327	90.7	86.0	95.4
quintile 4	283	88.0	81.3	94.7
quintile 5	214	88.7	84.4	93.1
Area 1 (CRM)				
at least one LLIN	801	93.1	90.2	96.1
at least two LLINs	801	46.2	40.8	51.6
at least one mosquito net	801	94.5	92.5	96.6
(>=LLIN) quintile 1	258	93.4	90.1	96.8
quintile 2	282	92.8	88.7	100.0
quintile 3	142	97.9	95.3	98.1
quintile 4	65	91.2	84.3	100.0
quintile 5	54	86.9	67.1	100.0
Area 2 (CRESAN/MNM)				
at least one LLIN	884	88.8	85.6	92.0
at least two LLINs	884	42.9	36.9	48.9
at least one mosquito net	884	93.7	91.5	95.9
(>=1 LLIN) quintile 1	130	87.7	81.1	94.4
quintile 2	191	90.4	86.6	94.2
quintile 3	185	88.9	82.9	94.9
quintile 4	218	87.6	79.8	95.3
quintile 5	160	89.0	85.1	93.0
Districts without LLIN integration				
at least one LLIN	725	57.9	49.6	66.1
at least two LLINs	725	18.8	13.3	24.2
at least one mosquito net	725	68.0	59.6	76.4
(>=1 LLIN) quintile 1	44	32.2	13.8	50.7
quintile 2	151	51.9	41.7	62.3

quintile 3	195	58.2	44.8	71.7
quintile 4	179	50.3	35.0	65.7
quintile 5	156	73.2	61.6	84.9
East Coast				
at least one LLIN	409	77.5	72.7	82.3
at least two LLINs	409	28.4	21.4	35.5
at least one mosquito net	409	89.9	86.9	93.0
(>=1 LLIN) quintile 1	14	51.2	27.2	75.2
quintile 2	108	61.2	50.6	71.8
quintile 3	100	76.9	64.5	89.4
quintile 4	84	86.5	78.9	94.1
quintile 5	103	90.0	84.5	95.4

Table 3b. LLIN ownership in Madagascar. The proportion of households having at least one LLIN, at least two LLINs or at least one mosquito net of another type [denominator (n): households having at least one child aged 6 to 65 months old, i.e. eligible to receive an LLIN during the October 2007 MCHW integrated campaign]

Level	n	Adjusted mean	95% CI	
National				
at least one LLIN	2465	71.6	66.0	77.1
at least two LLINs	2465	29.6	25.2	34.0
at least one mosquito net	2465	78.6	73.5	83.8
Endemic area				
at least one LLIN	2150	84.2	80.8	87.7
at least two LLINs	2150	37.0	32.2	41.6
at least one mosquito net	2150	91.6	89.5	93.7
Districts with LLIN integration				
at least one LLIN	1727	90.0	87.6	92.5
at least two LLINs	1727	44.1	39.4	48.7
at least one mosquito net	1727	93.8	92.0	95.6
(>=1 LLIN) quintile 1	407	89.2	84.8	93.5
quintile 2	475	92.3	89.0	95.5
quintile 3	331	89.8	85.3	94.4
quintile 4	293	88.4	81.9	94.8
quintile 5	221	89.8	86.2	93.3
Area 1 (CRM)				
at least one LLIN	836	93.1	90.6	95.6
at least two LLINs	836	45.7	41.0	50.3
at least one mosquito net	836	94.5	92.9	96.2
(>=1 LLIN) quintile 1	279	91.9	88.4	95.3
quintile 2	286	93.3	88.5	98.2
quintile 3	142	97.9	95.4	100.0
quintile 4	75	89.5	80.9	98.0
quintile 5	54	91.9	80.6	100.0
Area 2 (CRESAN/MNM)				
at least one LLIN	891	89.0	85.9	92.2
at least two LLINs	891	43.6	37.6	50.3
at least one mosquito net	891	93.5	91.3	95.8
(>=1 LLIN) quintile 1	128	87.5	80.7	94.3
quintile 2	189	91.8	87.5	96.1
quintile 3	189	87.8	82.0	93.6
quintile 4	218	88.2	80.5	95.8
quintile 5	167	89.4	85.7	93.1
Districts without LLIN integration				
at least one LLIN	738	58.2	49.9	66.5
at least two LLINs	738	19.1	13.3	24.8
at least one mosquito net	738	67.6	59.4	75.8
(>=1 LLIN) quintile 1	42	35.8	15.7	55.9
quintile 2	158	50.6	40.2	61.1

quintile 3	197	58.7	47.5	69.9
quintile 4	185	51.8	36.6	67.0
quintile 5	156	73.5	61.5	85.5
East Coast				
at least one LLIN	423	77.4	71.7	83.2
at least two LLINs	423	28.5	21.0	36.0
at least one mosquito net	423	89.0	85.3	92.6
(>=1 LLIN) quintile 1	14	51.2	27.2	75.2
quintile 2	114	60.2	49.1	71.4
quintile 3	105	75.1	67.1	83.1
quintile 4	86	89.3	82.7	95.8
quintile 5	104	91.4	86.9	95.9

Table 3c. LLIN ownership in Madagascar. The proportion of households having at least one LLIN, at least two LLINs or at least one mosquito net of another type [denominator (n): households having at least one child aged between 0 and 5 months old, i.e. born after the October 2007 MCHW integrated campaign]

Level	n	Adjusted mean	95% CI	
National				
at least one LLIN	307	66.1	58.2	74.1
at least two LLINs	307	31.7	22.9	40.5
at least one mosquito net	307	77.2	69.9	84.5
Endemic area				
at least one LLIN	259	78.2	70.5	85.8
at least two LLINs	259	40.2	30.4	50.0
at least one mosquito net	259	90.0	85.6	94.5
Districts with LLIN integration				
at least one LLIN	217	86.8	80.7	92.9
at least two LLINs	217	42.7	33.6	51.8
at least one mosquito net	217	92.4	87.9	96.9
(>=1 LLIN) quintile 1	44	95.7	89.1	100.0
quintile 2	66	83.47	71.3	95.5
quintile 3	52	87.9	76.4	99.3
quintile 4	33	90.9	78.6	100.0
quintile 5	22	73.9	50.5	97.3
RC area				
at least one LLIN	120	90.6	82.4	98.7
at least two LLINs	120	41.7	31.7	51.7
at least one mosquito net	120	91.7	83.6	99.9
(>=1 LLIN) quintile 1	34	91.1	78.1	100.0
quintile 2	46	90.8	79.2	100.0
quintile 3	24	100.0	100.0	100.0
quintile 4	7	100.0	100.0	100.0
quintile 5	9	69.1	16.3	100.0
GF area				
at least one LLIN	97	85.2	77.3	93.2
at least two LLINs	97	43.1	31.7	51.7
at least one mosquito net	97	92.6	87.2	98.0
(>=1 LLIN) quintile 1	10	100.0	100.0	100.0
quintile 2	20	78.5	60.0	96.9
quintile 3	28	84.7	70.0	99.3
quintile 4	26	90.1	76.4	100.0
quintile 5	13	75.7	49.2	100.0
Districts without LLIN integration				
at least one LLIN	90	51.1	38.8	63.5
at least two LLINs	90	23.7	9.9	37.5
at least one mosquito net	90	66.1	53.8	78.4
(>=1 LLIN) quintile 1	9	29.1	0.0	63.5
quintile 2	25	56.8	27.3	86.4

quintile 3	21	30.9	7.6	54.2
quintile 4	18	46.8	19.5	74.0
quintile 5	17	69.2	52.6	85.8
East Coast				
at least one LLIN	42	66.2	49.9	82.6
at least two LLINs	42	36.7	16.8	56.7
at least one mosquito net	42	86.8	77.9	95.6
(>=1 LLIN) quintile 1	2	-	-	-
quintile 2	16	65.3	32.4	98.2
quintile 3	9	64.7	42.6	86.9
quintile 4	6	68.9	19.2	100.0
quintile 5	9	73.6	47.4	99.7

Table 4. The LLIN hanging rates in Madagascar. The proportion of households having one LLIN, an insecticide-treated net (ITN) or a mosquito net of any type hanging the previous night [denominator (n): all households]

Level	n	Adjusted mean	95% CI	
National				
LLIN	4302	53.5	48.3	58.7
ITN	4302	54.3	48.9	59.6
Mosquito net (any type)	4302	64.2	58.8	69.5
Endemic area				
LLIN	3719	65.1	60.6	69.7
ITN	3719	66.1	61.5	70.8
Mosquito net (any type)	3719	77.1	73.2	81.1
Districts with LLIN integration				
LLIN	2860	71.5	67.9	75.1
ITN	2860	71.7	68.2	75.3
Mosquito net (any type)	2860	78.4	75.0	81.9
(LLIN) quintile 1	637	73.3	67.4	79.2
quintile 2	755	71.1	66.0	76.1
quintile 3	548	73.3	66.9	79.7
quintile 4	453	70.1	62.7	77.5
quintile 5	467	69.9	63.9	76.0
Area 1 (CRM)				
LLIN	1421	74.4	70.3	78.5
ITN	1421	74.4	70.3	78.5
Mosquito net (any type)	1421	77.6	73.9	81.4
(LLIN) quintile 1	456	73.4	66.7	80.1
quintile 2	480	73.8	67.1	80.5
quintile 3	258	73.9	66.2	81.6
quintile 4	118	83.0	75.5	90.5
quintile 5	109	71.6	60.5	82.8
Area 2 (CRESAN/MNM)				
LLIN	1439	70.5	65.9	75.1
ITN	1439	70.8	66.2	75.4
Mosquito net (any type)	1439	78.7	74.2	83.2
(LLIN) quintile 1	181	73.2	63.9	82.5
quintile 2	275	69.4	62.4	76.5
quintile 3	290	73.1	65.0	81.3
quintile 4	335	67.8	59.2	76.4
quintile 5	358	69.7	62.9	76.5
Districts without LLIN integration				
LLIN	1442	43.0	36.1	49.9
ITN	1442	44.1	37.0	51.2
Mosquito net (any type)	1442	55.9	48.1	63.6
(LLIN) quintile 1	64	25.5	10.2	40.9
quintile 2	266	32.7	23.6	41.9
quintile 3	328	49.9	38.4	61.3
quintile 4	392	38.4	26.1	50.8

quintile 5	392	49.3	38.2	60.3
East Coast				
LLIN	859	59.3	52.5	66.1
ITN	859	61.0	53.9	68.1
Mosquito net (any type)	859	75.9	69.3	82.5
(LLIN) quintile 1	20	42.5	9.1	75.9
quintile 2	204	38.0	24.8	51.2
quintile 3	188	67.8	60.8	74.9
quintile 4	200	65.3	56.1	74.5
quintile 5	247	66.3	59.1	73.6

Table 5a. LLIN usage by children under the age of 5 years in Madagascar.
The proportion of children who had slept under an LLIN the previous night
[denominator (n): children between 0 and 59 months old in all the households]

Level	n	Adjusted mean	95% CI	
National				
LLIN	3355	60.4	54.3	66.5
ITN	3355	61.2	55.1	67.4
Mosquito net (any type)	3355	68.0	61.6	74.3
Endemic area				
LLIN	2892	74.5	70.8	78.2
ITN	2892	75.6	71.9	79.2
Mosquito net (any type)	2892	83.4	80.3	86.5
Districts with LLIN integration				
LLIN	2369	80.8	77.4	84.3
ITN	2369	81.3	78.0	84.7
Mosquito net (any type)	2369	85.1	82.1	88.1
(LLIN) quintile 1	559	82.3	77.2	87.5
quintile 2	650	81.5	77.1	85.8
quintile 3	478	83.0	75.3	90.8
quintile 4	398	77.4	70.0	84.8
quintile 5	284	79.0	74.3	83.7
Area 1 (CRM)				
LLIN	1141	84.7	81.3	88.1
ITN	1141	84.7	81.3	88.1
Mosquito net (any type)	1141	86.2	82.8	89.5
(LLIN) quintile 1	369	82.5	74.6	90.5
quintile 2	386	86.9	82.0	91.9
quintile 3	211	88.9	83.1	94.8
quintile 4	97	76.5	67.3	85.8
quintile 5	78	85.6	71.4	99.8
Area 2 (CRESAN/MNM)				
LLIN	1228	79.6	75.1	84.1
ITN	1228	80.3	75.9	84.6
Mosquito net (any type)	1228	84.7	82.9	89.5
(LLIN) quintile 1	190	82.2	75.4	89.1
quintile 2	264	78.9	73.0	84.9
quintile 3	267	81.5	71.5	91.4
quintile 4	301	77.5	68.9	86.2
quintile 5	206	77.9	73.1	82.8
Districts without LLIN integration				
LLIN	986	44.6	35.9	53.2
ITN	986	45.6	36.8	54.4
Mosquito net (any type)	986	54.7	44.8	64.5
(LLIN) quintile 1	63	23.5	7.3	39.6
quintile 2	224	45.2	33.0	57.3
quintile 3	281	42.6	29.6	55.7
quintile 4	235	38.4	24.1	52.8

quintile 5	183	56.9	43.0	70.7
East Coast				
LLIN	523	66.0	59.6	72.3
ITN	523	67.7	61.3	74.1
Mosquito net (any type)	523	81.2	75.3	87.0
(LLIN) quintile 1	22	33.2	5.0	61.4
quintile 2	154	57.4	44.8	69.9
quintile 3	130	65.7	54.1	77.4
quintile 4	100	73.6	65.5	81.7
quintile 5	117	75.0	64.7	85.3

Table 5b. LLIN usage by children under the age of 5 years in Madagascar. The proportion of children who had slept under an LLIN the previous night [denominator (n): children between 0 and 59 months old in households having at least one LLIN]

Level	n	Adjusted mean	95% CI	
National	2501	92.5	90.7	94.3
Endemic area	2432	92.8	90.9	94.6
Districts with LLIN integration	2054	94.6	92.9	96.2
Area 1 (CRM)	1024	95.2	93.3	96.4
Area 2 (CRESAN/MNM)	1030	94.4	92.3	96.4
Districts without LLIN integration	447	89.7	86.3	93.1
East Coast	378	90.0	86.2	93.7

Table 6. LLIN usage by pregnant women in Madagascar. Proportion of women who were pregnant at the time of the survey and who had slept under an LLIN the previous night [denominator (n): pregnant women in all the households]

Level	n	Adjusted mean	95% CI	
National				
LLIN	454	49.2	40.6	57.8
ITN	454	50.0	41.4	58.4
Mosquito net (any type)	454	55.7	47.0	64.3
Endemic area				
LLIN	396	62.2	54.0	70.4
ITN	396	63.1	55.1	71.2
Mosquito net (any type)	396	70.6	63.3	78.0
Districts with LLIN integration				
LLIN	320	68.5	60.2	76.9
ITN	320	68.5	60.2	76.9
Mosquito net (any type)	320	75.5	68.6	82.4
(LLIN) quintile 1	86	73.8	60.5	87.0
quintile 2	85	72.9	58.3	87.5
quintile 3	63	78.5	64.3	92.7
quintile 4	51	53.4	36.0	70.8
quintile 5	35	50.7	29.0	72.4
Area 1 (CRM)				
LLIN	151	78.0	70.9	85.2
ITN	151	78.0	70.9	85.2
Mosquito net (any type)	151	79.3	72.7	86.0
(LLIN) quintile 1	57	77.5	63.7	91.2
quintile 2	43	83.3	67.0	99.6
quintile 3	30	67.3	56.0	78.6
quintile 4	13	78.6	57.8	100.0
quintile 5	8	92.7	79.9	100.0
Area 2 (CRESAN/MNM)				
LLIN	169	65.8	55.1	76.5
ITN	169	65.8	55.1	76.5
Mosquito net (any type)	169	74.4	65.7	83.1
(LLIN) quintile 1	29	71.9	52.9	90.9
quintile 2	42	70.4	52.4	88.4
quintile 3	33	82.5	64.2	100.0
quintile 4	38	49.1	29.8	68.5
quintile 5	27	44.4	21.7	67.1
Districts without LLIN integration				
LLIN	134	34.4	22.8	46.1
ITN	134	35.8	24.1	47.3
Mosquito net (any type)	134	40.5	28.3	52.6
(LLIN) quintile 1	9	34.7	0.0	76.9
quintile 2	35	24.6	7.9	41.2

quintile 3	35	40.9	19.6	62.2
quintile 4	29	23.2	3.3	43.0
quintile 5	26	50.0	24.2	75.7
East Coast				
LLIN	76	54.0	39.6	68.5
ITN	76	56.1	42.0	70.2
Mosquito net (any type)	76	64.3	50.8	77.8
(LLIN) quintile 1	7	41.1	0.0	89.4
quintile 2	26	32.0	10.9	53.1
quintile 3	14	83.4	64.1	100.0
quintile 4	10	49.6	19.5	79.8
quintile 5	19	69.7	40.4	98.9

Table 6b. LLIN usage by pregnant women in Madagascar. The proportion of pregnant women who had slept under an LLIN the previous night [denominator (n): pregnant women in households having at least one LLIN]

Level	n	Adjusted mean	95% CI	
National	309	84.5	77.8	91.2
Endemic area	300	88.3	82.3	94.3
Districts with LLIN integration	253	88.7	83.0	94.4
Area 1 (CRM)	129	91.3	85.4	97.2
Area 2 (CRESAN/MNM)	124	87.9	80.5	95.3
Districts without LLIN integration	56	78.7	65.2	92.3
East Coast	47	87.7	74.9	100.0

Table 7a. The number of households surveyed who reported having received a visit by a community worker before the October 2007 MCHW integrated campaign.

Level	n
Area 1 (CRM)	
households surveyed	1421
households visited (total)	729
households visited by a CRM volunteer	190
households visited by a health care worker	455
does not recall who	84
no visit	692
Area 2 (CRESAN/MNM)	
households surveyed	1439
households visited (total)	501
households visited by a CRM volunteer	81
households visited by a health care worker	352
does not recall who	68
no visit	938
Area 3 (districts without LLIN integration)	
households surveyed	1442
households visited (total)	474
households visited by a CRM volunteer	99
households visited by a health care worker	291
does not recall who	84
no visit	968

Table 7b. The number of households surveyed who reported having received a visit by a community worker after the October 2007 MCHW integrated campaign.

Level	n
Area 1 (CRM)	
Households surveyed	1421
households visited (total)	323
households visited by a CRM volunteer	112
households visited by a health care worker	196
does not recall who	15
no visit	1098
Area 2 (CRESAN/MNM)*	
households surveyed	1152
households visited (total)	75
households visited by a CRM volunteer	4
households visited by a health care worker	67
does not recall who	4
no visit	1077
Area 3 (districts without LLIN integration)	
households surveyed	1442
households visited (total)	87
households visited by a CRM volunteer	28
households visited by a health care worker	45
does not recall who	14
no visit	1355

*Ambovome, Toliary I and Toliary II are excluded

Table 8. The LLIN brand by source of supply. Number (% for the line) of Olyset, Permanet and Super Moustiquaire LLINs in the households surveyed by reported source of supply.

LLIN source	Olyset	Permanet	Super Moustiquaire	Total
Community based retail worker (CBRW)	4 (6.90)	24 (41.38)	30 (51.72)	58
Shops	32 (2.43)	106 (8.05)	1178 (89.51)	1316
BHCC	136 (44.74)	106 (34.87)	62 (20.39)	304
Private Health Centers	6 (11.11)	11 (20.37)	37 (68.52)	54
The October 2007 MCHW campaign	1163 (47.30)	1253 (50.96)	43 (1.75)	2459
Kiosks	8 (6.96)	10 (8.70)	97 (84.35)	115
Private doctors	3 (20.00)	2 (13.33)	10 (66.67)	15
do not know	24 (36.92)	18 (27.69)	23 (35.38)	65
Chemists / drug depots	1 (12.50)	0 (0.00)	7 (87.50)	8
Total	1377 (31.34)	1530 (34.82)	1487 (33.84)	4394 (100.0)

Annex I: List of districts

Table 9: List of the 26 districts in Area 1 where the Malagasy Red Cross distributed LLINs during the integrated campaign. The districts surveyed are indicated in bold.

Province	Région	District
Mahajanga	Melaki	Ambatomainty
		Antsalova
		Besalampy
		Maintirano
		Morafenobe
Toliara	Menabe	Belo Tsiribihana
		Mahabo
		Miandrivazo
		Morondava
		Manja
	Atsimo Atsinanana	Befotaka
	Atsimo Andrefana	**Ampanihy**
		Ankazoabo
		Benenitra
		Bororoha
		Betioky
		Morombe
		Sakaraha
	Androy	**Bekily**
		Beloha
		Tsiombe
	Anosy	**Amboasary**
		Betroka
Fianarantsoa	Ihorombe	Ihosy
		Ivohibe
		Iakora

Table 10: List of 33 Area 2 districts where CRESAN and Malaria No More distributed LLINs during the integrated campaign. The districts surveyed are indicated in bold.

Province	Région	District
Antsiranana	Diana	Antsiranana I
		Antsiranana II
		Ambilobe
		Nosy Be
		Ambanja
Mahajanga	Sofia	Analalava
		Antsohihy
		Bealanana
		Befandriana Avaratra
		Mandritsara
		Borizini
		Mampikony
	Boeny	Ambatoboeny
		Mahajanga I
		Mahajanga II
		Marovoay
		Mitsinjo
		Soalala
	Betsiboka	Kandreho
		Maevatanàna
		Tsaratanàna
Toliara	Atsimo Andrefana	**Toliara I**
		Toliara II
	Androy	**Ambovombe**
		Taolañaro
Antananarivo	Analamanga	Anjozorobe*
		Ankazobe*
	Bongolava	Fenoarivobe*
		Tsiroanomandidy*
	Vakinankaratra	**Betafo***
Fianarantsoa	Amoron'i Mania	Ambatofinandrahana*
	Matsiatra Amboni	Ikalamavony*
		Ambalavao*

* Central Highland districts

Table 11: List of the 52 districts in Area 3 where there was no LLIN distribution during the integrated campaign. The districts surveyed are indicated in bold.

Province	Region	District
Antsiranana	Sava	Antalaha
		Sambava
		Andapa
		Vohimarina
Toamasina	Aloatra Mangora	Ambatondrazaka
		Amparafaravola
		Andilamena
		Anosibe An'ala
		Moramanga
	Analanjirofo	Fenerive Est
		Mananara Nord
		Maroantsetra
		Nosy-Boraha
		Soanierana Ivongo
		Vavatenina
	Atsinanana	Antanambao Manampotsy
		Vohibinany
		Mahanoro
		Marolambo
		Toamasina
		Toamasina II
		Vatomandry
Fianarantsoa	Amoron'i Mania	Ambositra*
		Fandriana*
		Manandriana*
	Atsimo Atsinanana	**Farafangana**
		Vaingandrano
		Midongy-Atsimo
		Vondrozo
	Haute-Matsiatra	Ambohimahasoa*
		Fianarantsoa*
		Fianarantsoa II*
	Vatovavy-Fitovinany	Manakara
		Ifanadiana
		Ikongo
		Mananjary
		Nosy-Varika
		Vohipeno
Antananarivo	Analamanga	Ambohidratrimo*
		Andramasina*

		Antananarivo-Renivohitra*
		Antananarivo-Atsimondrano*
		Antananarivo-Avaradrano*
		Manjakandriana*
	Itasy	Arivonimamo*
		Miarinarivo*
		Soavinandriana*
	Vakinankaratra	Antsirabe I*
		Antsirabe II*
		Ambatolampy*
		Antanifotsy*
		Faratsiho*

* Central Highland districts

Table 12: List of the 28 districts in the Central Highlands of Madagascar where LLINs were distributed during the October 2007 integrated campaign. The LLINs were distributed by CRESAN and Malaria No More in 8 districts of the marginal section of the Central Highlands indicated below.

Province	Region	District	LLIN	Source
Antananarivo	Analamanga	Andramasina		
		Antananarivo-Renivohitra		
		Antananarivo-Avaradrano		
		Ambohidratrimo		
		Ankazobe	X	CRESAN
		Manjakandriana		
		Anjozorobe	X	CRESAN
		Antananarivo-Atsimondrano		
	Bongolava	Tsiroanomandidy	X	CRESAN
		Fenoarivo-Afovoany	X	CRESAN
	Itasy	Arivonimamo		
		Miarinarivo		
		Soavinandriana		
	Vakinakaratra	Ambatolampy		
		Antsirabe I		
		Antanifotsy		
		Betafo	X	Malaria No More
		Faratsiho		
		Antsirabe II		
	Amoron Mania	Ambatofinandrahana	X	Malaria No More
		Ambositra		
		Fandriana		
		Manandriana		
	Haute Matsiatra	Fianarantsoa I		
		Ambalavao	X	CRESAN
		Ambohimahasoa		
		Ikalamavony	X	CRESAN
		Fianarantsoa II		