

Short Communications

Households with Insufficient Bednets in a Village with Sufficient Bednets: Evaluation of Household Bednet Coverage Using Bednet Distribution Index in Xepon District, Lao PDR

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Abstract: In Lao PDR, the National Malaria Control Program (NMCP) evaluates bednet coverage, often at the village level, using a coverage target of one net per 2.5 (or fewer) persons in a given population. However, in villages that meet the target, not all households necessarily meet the target or utilize all available bednets. This study explored households that fell short of the target and household utilization of bednets in villages that met the target of bednet coverage set by the NMCP. The person per net ratio (PPNR), which is defined as the population divided by the number of available bednets in a household/village, was used to determine whether a household/village met the NMCP target. Using a household survey, we collected and analyzed the data of 635 households in 17 villages in Xepon district in 2012. Households that fell short of the target (households with a PPNR of > 2.5 or no bednet) existed in every village. The proportion of these households differed greatly among the villages, ranging from 3.4–50%, with some households falling far short. Of the 635 households, 275 (43.5%) had at least one bednet that was not being used on the night preceding the survey and 131 (20.6%) had at least two. In conclusion, in villages that met the NMCP target, a considerable number of households fell short of the target, and the available bednets were not fully utilized in many of the surveyed households.

Key words: insecticide-treated bednets, malaria, Laos, community-based distribution, community health workers

INTRODUCTION

The use of insecticide-treated bednets is effective in reducing morbidity and mortality due to malaria [1] and has been adopted as a principal malaria control strategy in malaria endemic countries, including Lao PDR [2, 3]. This type of bednet provides protection by killing mosquitoes on contact. When high community bednet coverage is achieved, all members of the community (regardless of bednet usage) are protected via the community effect [4–6].

Falciparum malaria is endemic in remote communities in the forested areas of Lao PDR in Southeast Asia [7]. The National Malaria Control Program (NMCP) has con-

ducted the nationwide distribution of insecticide-treated bednets on a yearly basis since the early 1990s. The distribution system is as follows. First, with help from village executives, trained village health volunteers (VHVs) survey the existing bednets of each household and report their findings to a local malaria control officer. Second, the reported data are summarized at district and provincial levels and then reach a central level. Third, on the basis of the data, the NMCP allocates and delivers bednets to each village. Fourth, working together with community organizations and village executives, VHVs educate villagers on the importance of bednets and their proper usage at village meetings, and then distribute bednets to each

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household. Finally, VHVs report the results of the distribution campaign to the local malaria control officer.

The NMCP evaluates bednet coverage, often using a coverage target of one bednet per 2.5 or fewer persons in a given population. When evaluating bednet coverage, the NMCP often uses the village as a basic unit and determines whether a target is achieved at the village level [3, 7]. However, in villages that meet the NMCP target, not all households necessarily meet the target [8], as the household unit is not considered in the village level evaluation. Furthermore, in households that meet the target, if bednets are not utilized, then not all household members can benefit directly from their effects. Non-bednet users in a household that falls short of the target may be protected by the indirect, community effect of bednets used by neighbors [4–6]. However, according to a number of studies emphasizing the importance of high bednet coverage at the household level [9–11], non-bednet users may not enjoy the same level of protection as bednet users, even in households that meet the NMCP target.

The present study explored two points: 1) households that fall short of the NMCP target, and 2) household utilization of bednets in villages that met the NMCP target.

METHODS

Study site and population

We collected data in Xepon district, Savannakhet province, in Lao PDR, between July and August 2012. Xepon district is a remote rural district on the Vietnamese border, approximately 500 km from the national capital, Vientiane. The climate of Savannakhet is tropical, with an average temperature of 27°C. Savannakhet experiences wet and dry seasons from April to October and November to March, respectively [12]. Although malaria cases are reported throughout the year, most cases are seen during the wet season [3].

Ethnic minorities comprise 75% of the total district population of approximately 45,000. There are 88 villages in the district, most of which are at risk of malaria. According to the Xepon District Health Office, 218 malaria cases were reported from Xepon District Hospital in 2013. Insecticide-treated bednets have been distributed in the district since 1999. In April and May 2011 (the most recent bednet distribution campaign before our data collection), a total of 7,719 bednets were distributed.

Our study target was households in villages that met the NMCP target of a person per net ratio (PPNR) of < 2.5. We deliberately selected all of the 20 villages where the Health and Demographic Surveillance System is in place, as reliable data on households in these villages are availa-

ble. The system is described elsewhere [13]. From these 20 villages, we excluded 3 villages where PPNR was > 2.5 because they did not achieve the NMCP target. In total, there were 678 registered households within these 17 villages. We succeeded in collecting data from 658 households, and excluded 23 that were missing questionnaire data. Finally, we analyzed the data of 635 households in 17 villages.

Data collection

We collected data using a household survey that was conducted during the daytime. Surveyors visited the study households and inspected bednets to determine their type and physical condition. When inspecting bednets, surveyors also conducted interviews with adult household members to collect bednet-related information including the use of bednets by any household member on the night preceding the survey and the time that bednets were obtained. The time that bednets were obtained was asked categorically (categories: within three years, more than three years, and unknown), as respondents may not exactly remember the time. The cutoff point of “three years” was used because the expected lifespan of bednets (long-lasting insecticide-treated bednets) is around three years.

Analysis

The PPNR, which was defined as the population divided by the number of available bednets in a household/village, was used to determine whether a household or village met the NMCP target. This ratio has been widely used in Lao PDR [7, 8, 14]. The proportion of households that fell short of the target (households with a PPNR of > 2.5 or no bednet) and the proportion of households that fell far short of the target (households with a PPNR of > 4.0 or no bednet) were computed for each village. The cutoff point of “4.0” was used because the upper inter-quartile range of household PPNR was around 4.0 in villages with a PPNR of around 2.5.

Households with at least one bednet ($n = 622$) were categorized into three groups: households with PPNRs of < 1.5, 1.5–2.5, and > 2.5. The cutoff point of “1.5” was used because the lower tertile of household PPNR was 1.67. In each category, the proportion of households with one bednet or multiple bednets that were not used the preceding night was calculated by dividing the number of households with one unused bednet or multiple unused bednets by the total number of households (Fig. 1).

Ethical considerations

This study was approved by the National Ethics Committee for Health Research, Ministry of Health, Lao

PDR (No. 172/NECHR). Verbal and written consent was obtained from the heads or other adult members of the study households who understood that their participation would be voluntary and that all data obtained would be confidential.

RESULTS

Characteristics of villages and households

Table 1 shows the characteristics of the 17 study villages and 635 households. The PPNR in the surveyed vil-

lages ranged from 1.07–2.50 (median: 2.21). In the 5 villages, there was at least one household that did not possess any bednet. There were households that fell short of the NMCP target in all villages. The proportion of these households differed greatly among the villages, ranging from 3.4–50% (median: 31.1%). In the 15 villages, there were households that fell far short of the NMCP target. The proportion of these households ranged from 3.4–25% (median: 10.8%).

The median number of members in a household was 6, with an interquartile range of 4–8 (data not shown).

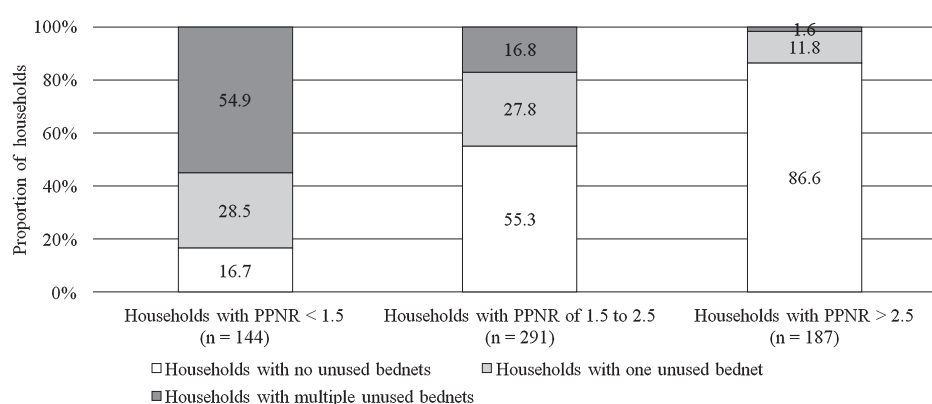


Fig. 1. Proportions of households with unused bednets among three household groups categorized by persons per net ratio (PPNR)

Table 1. Characteristics of study villages and households

Village name	Number of households	Number of residents	Number of bednets	PPNR ^a	Household with no bednets		Household with PPNR ^a > 2.5 or no bednets		Household with PPNR ^a > 4.0 or no bednets	
					n	%	n	%	n	%
1. Adone	31	179	79	2.27	0	0.0	13	41.9	3	9.7
2. Alang-nyai	29	180	168	1.07	0	0.0	1	3.4	1	3.4
3. Alang-noi	15	70	48	1.46	0	0.0	2	13.3	0	0.0
4. Alay-nyai	56	307	123	2.50	4	7.1	28	50.0	13	23.2
5. Dong-nyai	83	543	266	2.04	0	0.0	25	31.1	6	7.2
6. Dong-noi	34	217	98	2.21	5	14.7	13	38.2	6	17.6
7. Kaleng-kang	39	214	107	2.00	0	0.0	14	35.9	4	10.3
8. Kengkhai-nok	24	150	60	2.50	2	8.3	11	45.8	6	25.0
9. Kengkhai-nai	10	77	35	2.20	0	0.0	4	40.0	2	20.0
10. Kengkham-nok	39	228	120	1.90	0	0.0	10	25.6	4	10.3
11. Kengkham-nai	8	50	37	1.35	0	0.0	1	12.5	0	0.0
12. Kenglouang-nai	33	240	140	1.71	0	0.0	5	15.2	2	6.1
13. Kenglouang-nok	37	213	107	1.99	0	0.0	11	29.7	4	10.8
14. Kengpee-nok	38	209	86	2.43	1	2.6	19	50.0	9	23.7
15. Kengpear-nai	14	94	53	1.77	0	0.0	1	7.1	1	7.1
16. Kengthong	111	628	276	2.28	1	0.9	37	33.3	16	14.4
17. Muangseng	34	265	172	1.54	0	0.0	5	14.7	4	11.8

^a: Persons per net ratio

Characteristics of bednets

The 635 households possessed 1,978 bednets (Table 2), including 1,744 (88.2%) long-lasting insecticide-treated bednets, 198 (10.0%) bednets other than long-lasting insecticide-treated bednets, and 36 (1.8%) of unknown type. Approximately 75% of the bednets ($n = 1,464$) were used by a household member the night preceding the survey. The bednets that were used on the preceding night were mostly hung; unused bednets were mostly unhung. Additionally, the bednets that were used were more likely to be damaged than those that were not. According to household respondents, most of the bednets had been obtained within three years, regardless of usage on the preceding night.

Household utilization of bednets

Two hundred and seventy-five (43.5%) of the 635 households had at least one unused bednet on the preceding night and 131 (20.6%) had multiple unused bednets. The proportion of households with one unused bednet or multiple unused bednets decreased with increasing levels of household PPNR (Fig. 1).

DISCUSSION

The present study demonstrated that although bednets

were available at a rate of one bednet per < 2.5 people at the village level, they were not necessarily available at a similar rate at the household level. In villages with moderate bednet coverage, this would suggest the existence of households without enough bednets to cover all members. While most households in villages where bednet coverage is far beyond the NMCP target potentially possess enough bednets, the limitation of village-level evaluations demands consideration.

More importantly, perhaps, was that there were households that fell far short of the NMCP target in most of the study villages. In a household with a PPNR of > 4 , five or more people apparently use the same bednet. Using one bednet with five or more people quite obviously exceeds its capacity. A study conducted in Lao PDR reported that using one bednet with five or more people significantly increased the risk of malaria infection [15]. Thus, the households that fell far short of the target are of great concern.

Although VHVs are supposed to assess the number of bednets in each household and report the assessment results to a local malaria control officer before a bednet distribution campaign, this study found a household that fell far short of the NMCP target in most of the study villages. If it is assumed that VHVs perform their function well, then there are three possible explanations for the existence

Table 2. Characteristics of bednets in the study households

Characteristics	Bednets that were used ($n = 1464$)		Bednets that were not used ^a ($n = 514$)		Total ($n = 1978$)	
	n	%	n	%	n	%
Type						
Long-lasting insecticide-treated bednet	1271	86.8	473	92.0	1744	88.2
Other	164	11.2	34	6.6	198	10.0
Unknown	29	2.0	7	1.4	36	1.8
Placement						
Hung	1417	96.8	52	10.1	1469	74.3
Not hung	11	0.8	461	89.7	472	23.9
Unknown	36	2.5	1	0.2	37	1.9
Condition of bednet						
Intact	915	62.5	456	88.7	1371	69.3
Slightly physically damaged	458	31.3	37	7.2	495	25.0
Heavily physically damaged	53	3.6	19	3.7	72	3.6
Unknown	38	2.6	2	0.4	40	2.0
Time the bednet was obtained						
Within three years	1076	73.5	394	76.7	1470	74.3
More than three years earlier	238	16.3	39	7.6	277	14.0
Unknown	150	10.2	81	15.8	231	11.7

^a: Including four bednets that were used for other purposes such as fishing and farming

of such households: 1) households were not present in the village when bednet assessment and/or distribution took place and were thus unable to benefit; 2) households received a bednet but discarded it when its condition became poor [16]; or 3) the bednet was taken elsewhere (several households of our survey reported that they had taken a bednet for use while fishing or farming). Further study is necessary to explore the bednet use behavior and service access-related resources of the households that fell far short of the target.

The present study also demonstrated that many households did not fully utilize available bednets on the night preceding the survey. As Table 2 shows, most of these unused bednets were unhung, suggesting that they were not usually used [17]. Regarding the non-use of available bednets, a number of reasons have been reported from Lao PDR and neighboring countries: discomfort due to heat [18, 19]; limited perceived benefit of bednets [18, 20]; limited perceived risk of malaria [18]; availability of other preventive measures [18]; and problems with using bednets [18, 21]. In this study site, however, these did not appear to be the main reasons. As Fig 1 shows, households that were saturated with bednets tended to leave some bednets unused; a household's utilization of all available bednets appeared to depend on the abundance of bednets. Another possible reason could be bednet preferences [22, 23]. According to anecdotal reports from local malaria control staff and VHVs in Savannakhet, the villagers disliked some types of bednets, especially bednets made of Nylon material.

This study has two major limitations. One is that household bednet coverage might have been misestimated because it is based on the number of household members, which is difficult to accurately ascertain in this area. Another is the possibility that the findings did not reflect the situation of all malaria-prone villages in Xepon district or Savannakhet province because data collection was confined to the villages of Xepon that met the NMCP target. However, the fact that the bednet distribution system is the same throughout Lao PDR suggests that the findings of the present study can be useful when planning and evaluating bednet distribution in Xepon and elsewhere.

In conclusion, in villages that met the NMCP bednet coverage target, a considerable number of households fell short of the target. Some households fell far short of the target. Therefore, attention should be paid to the limitation of bednet coverage evaluations at the village level and to leakage in the present system of bednet distribution. Additionally, many households did not fully utilize available bednets. The fact that most of these households possessed sufficient bednets indicates that the main reason for non-

usage is household saturation. In the planning of bednet distribution, both households that are in most need of bednets and those saturated with bednets need to be considered. The strengthening of the bednet assessment survey prior to distribution would help to identify such households.

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