Community trial of insecticide-treated bed net use promotion in southern Ghana: the Net Use Intervention study

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ABSTRACT

Insecticide-treated nets (ITNs) reduce malaria transmission and related morbidity and child mortality; however, incorrect and inconsistent use limits their protective factors. This community trial titled the Net Use Intervention study sought to bridge the gap between ITN ownership and use in southern (coastal) Ghana and to determine the best mix of communication tools to affect behavior of ITN owners to consistent use while maintaining optimal internal and external validity. This two-group, non-randomized experiment evaluated a multichannel, multisector intervention process over the course of 8 weeks. A longitudinal cohort was scientifically sampled from six intervention and six control communities for both baseline and posttest surveys. The posttest survey showed no change in knowledge of ITNs in the intervention or control. In terms of use the previous night, there was a strong and statistically significant intervention effect ($OR=1.67$; $p<.05$) within the intervention communities. The overall increase in ITN coverage was approximately one person per night per every two households. The promotion efforts succeeded well beyond the planners' expectations, not only promoting usage but also dramatically increasing demand for new ITNs.

KEYWORDS

Malaria, Insecticide-treated nets, Bed nets, Vector-borne disease control, Sub-Saharan Africa

Viewed as part of the medical and public health domains, the control of malaria and other vector-borne diseases has largely implied vertical interventions with relatively passive participation of individuals and communities. In contrast, behavioral medicine, which has developed as a largely “Western” discipline with roots in operant psychology and behavior therapy, emphasizes active human behavior change. Chronic diseases and behavioral risk factors have been the primary subject matter for the initial decades of research in behavioral medicine, while family planning, child survival, and other initiatives launched in developing countries have relied largely on the fields of health communication and (later) social

Implications

Practice: Promoting protection from malaria must not only distribute adequate numbers of malaria bed nets but also insure that they are being used as intended with sufficient sustainability to protect a population through at least high-risk seasons.

Policy: Policymakers must support these efforts by insuring that sufficient resources are allotted for communication to target groups including forms of mass as well as interpersonal communication.

Research: It is imperative to continue to validate self-report measures of bed net utilization with some form of visual verification.

marketing when human behavior was targeted. Even though large scale and successful global health initiatives, such as Operation Smallpox Zero [1], utilized interventions clearly interpretable within a behavior modification framework [2, 3], with the primary exception being the Academy for Educational Development's worldwide HealthCom Project launched in the mid-1980s [4], behaviorists themselves had little to do with the design of these programs. Corresponding to the advent of the AIDS epidemic [5] and the globalization of other health problems, however, researchers in behavioral medicine (e.g., health psychology, etc.) began to have a higher profile in addressing problems affecting poorer nations and tropical regions, especially the broad array of infectious diseases transmitted not only from person-to-person but also through water and vectors. This evolution represents the convergence of the realization that behavioral medicine needs to be translated beyond its traditional target areas and the awareness that neither chronic nor infectious diseases respect international boundaries.

The most prominent among these infectious diseases is malaria, which represents the greatest vector-borne disease threat in the world [1]. Transmitted by the *Anopheles* mosquito, malaria is a significant public health issue facing Ghana, as well as the rest of Sub-Saharan Africa (SSA), with an annual estimate of 3.5 million cases reported to the

Ghana Ministry of Health and more than one million deaths in SSA. Approximately one fourth of these cases comprise children under the age of 5 years old. In 2005, the World Health Organization estimated that 22% of deaths in children under the age of 5 and 9% of maternal deaths in Ghana were due to malaria [6].

The two primary approaches to malaria control are transmission reduction and chemotherapy [1]. Based on strong evidence that they reduce malaria transmission and related morbidity and child mortality [7–10], local and international organizations in Africa have been promoting and distributing insecticide-treated nets (ITNs) for more than 10 years. Although this has resulted in greater ITN availability in SSA countries, getting people to use ITNs correctly and consistently is difficult [11–16]. Given the recognized gap between ITN ownership and use, designing effective strategies to promote use is critical, especially among the more vulnerable children under five and pregnant women [17, 18] (even though adult males may be even less likely to use them [18]). In a recent attempt to inform the development of such strategies, Eisele and Root conducted an extensive review of the literature to document the factors associated with ITN use among these vulnerable groups [17]. They concluded that there is currently insufficient empirical evidence to determine the most effective strategies to increase ITN use within ITN-owning households. Nevertheless, there is increasing support for utilizing community health advisors to go house to house to provide accurate information on malaria transmission, to explain how ITNs protect against malaria, and to help households hang their nets properly.

As Eisele and Root noted, not only is additional research needed to develop effective strategies for promoting ITN use, but such research should have sufficient internal and external validity for policy-makers and consumers to make appropriate and informed decisions [17]. The purpose of the Net Use Intervention (NUI) community trial therefore was (a) to identify how to bridge the gap between ITN ownership and use, (b) to identify the best mix of communication tools to affect behavior of ITN owners to become consistent ITN users, and (c) to do so with optimal internal and external validity. This report presents the results of this multichannel, multisector intervention process conducted between June and August 2009 in southern Ghana and the impact of the interventions on the communities and the target groups.

METHODS

Setting

Gomoa East in Ghana's Central Region (which is located on the southern coast) has an estimated population of 123,000 with 81 communities grouped under six sub-districts. Malaria is the greatest cause

of mortality in Gomoa East, accounting for 25.7% of deaths. In spite of this health threat, results from the district Multiple Indicator Survey in 2007 indicate that only about 40% of children under the age of 5 slept under an ITN the previous night [6].

Research design and timeline

The outcome evaluation was derived from a two-group experiment with six communities in Gomoa East in the intervention arm and six equivalent communities in Asikuma Odobeng Brakwah, another district in the Central region, in the control. Communities were not randomized in order to avoid potential contamination by having two communities located in proximity to one another in different conditions. Nevertheless, all communities in the study area had comparable population sizes and prevalence of malaria, as well as similarities in climate and baseline ownership and usage of ITNs. A longitudinal cohort of households and residents was scientifically sampled from each of the 12 communities for both baseline and posttest surveys, thus optimizing internal validity and allowing both characterizations of the entire communities and analysis of behavior change over the course of the 8 weeks. The net use communication intervention was designed specifically to increase the use of ITNs in the intervention district. The impact of the interventions on the communities and people of the intervention district (Gomoa East) was then evaluated by comparing indicators of net ownership, net use, and knowledge of malaria transmission with the control district (Asikuma Odobeng Brakwah) both before and after the 8-week intervention.

Formative and qualitative research¹

Extensive qualitative research was conducted to determine specific perceptions of malaria and its causes, reason for or against net use, and types of messages that could have the most impact on promoting ITN use. Formative and qualitative research was conducted in areas similar to study communities. Focus *groups* in five different communities with five to ten participants per focus group were conducted among pregnant women, mothers of under 5 year olds, grandmothers, and fathers of young children. Examples of specific questions addressing the following issues (tailored to each of these groups) include:

Household issues—Who makes the decisions regarding net use and care? Can mothers make such decisions themselves even if in disagreement with their husbands? Do grandmothers or other relatives influence the decision? How should segmentation occur?; in other words, how would the messages developed through this process be tailored to different gender/generational groups?

¹ The full protocol for the formative and qualitative research effort is available from the first author.

What are the best messages to promote net utilization? Should they be disease-oriented (e.g., “prevent malaria”) or gain-oriented (e.g., “protect your children”)? What are the key benefits to be mentioned in messages (“prevent malaria among children, protect them from pain; protect entire family; positive value association”)? What balance of factual and emotional content should there be?

The perception that heat/lack of ventilation is an aversive by-product of net use. Would it be best to ignore this perception in the messages, contend with it (“it really isn’t that much hotter”) or present the tradeoff (“it’s a lot worse to have malaria than to be hot”)?

What is the best channel of communication (e.g., loud speakers, town criers; face-to-face communication, FM radio stations, teachers and religious leaders, commercial sector)?

What is the household sense of community responsibility for and pride in malaria control and health in general? Would the concept of their community as a “malaria free zone” be of interest? What format of feedback (e.g., awards given to their mayors, a community billboard showing goal attainment) would be effective?

How does the pre-existing prevalence of net utilization impact the type of message and channel selected for the NUC? For example, would we use the same approach in a community in which everyone uses a net as we do in one where no one does?

Health workers and volunteers—Would health workers be able to make monthly visits to pregnant mothers or houses with under 5 year olds to observe and promote ITN use? What should they say to users and to non-users?

Stakeholders—What level of health care personnel (volunteers, extension worker, midwife, nurse, physician) is critical to promoting and sustaining ITN use? Who are other stakeholders (e.g., teachers, elected officials, religious leaders, shopkeepers, neighbors)? Would they be receptive to making their community a “fully net-protected zone” and to receiving recognition for this?

Skill building and reinforcement regarding net hanging and care—Would it be useful to have different print/pictorial instructions with the net packaging or with separate brochures? Would demonstrations about how best to use the materials be of value? Have radio listening groups and maybe combine these with demonstration projects/model houses?

Intervention

The intervention consisted of three main components: community dramas, mobile information vans, and community health volunteers. These three modes were used to communicate net use messages to the communities in the intervention district.

Community theater and video development—Community theater has been identified as a powerful tool for behavior change communication under the Presi-

dent’s Malaria Initiative. The strategic advantage of drama lies in its ability to deliver multi-sensory, entertaining, and interactive messages to a captive audience. The community theater used in this intervention made use of drama, quizzes, games, and question and answer sessions.

As part of the NUI, the Ghana Sustainable Change Project (GSCP) collaborated with NetMark to hire a local drama net group to stage ten performances on appropriate net use in ten selected communities in the Gomoe East District. A community theater was staged in each of the six sub-district capitals, and four additional communities were selected based on high-density population. Performances ran from June 23, 2009 to July 3, 2009.

GSCP and NetMark carefully developed a theater script to highlight the benefits of appropriate ITN use and the consequences of non-use. GSCP and NetMark staff closely monitored the drama group’s rehearsals to ensure that the messages were delivered accurately. The theater group also worked very closely with the District Health Management Team (DHMT) of the Ghana Health Service (GHS) and Ministry of Information staff at the district level to facilitate community entry and social mobilization of the program.

Performances were held late in the afternoon in all communities to ensure maximum attendance, as community members are predominantly farmers who return from the farms around this time. A spectacular dance theater preceded each drama performance to attract people to the *durbar* (the community’s main plaza) grounds. After each drama performance, health workers facilitated a quiz session during which they assessed the community members’ understanding and recall of the key messages delivered in the performance. Correct answers were rewarded with branded t-shirts produced for the intervention. Health workers also handed out posters and flyers on appropriate net use produced for the intervention by GSCP. The community members were also given the opportunity to ask the health workers questions.

Attendance at each performance ranged from 200 to 681 members from each community. A total attendance of 4,243 persons was recorded for the performances in the ten communities, with 2,909 female and 1,334 male attendants. Though this relatively intensive presentation appeared efficacious, there was concern that logistics, expense, and quality control would limit its replicability and ultimate reach in the intervention area and subsequent scalability. Thus, the dramatic presentation function evolved into a video entitled, “Now I Know,” developed by the Ghana National Theatre Group and conceptualized and edited by project staff.

Mobile information vans and the “Now I Know” video—Mobile vans (i.e., pickup trucks) with loud-speakers have been a useful mode of information dissemination in the rural communities in Ghana

and elsewhere and have been used extensively by governmental and non-governmental organizations. NetMark worked in collaboration with the Information Service Department of the Ghana Ministry of Information and the DHMT to develop a strategy and plan to disseminate the message of appropriate net use to the people of Gomoa East District. Two modes of information dissemination were used: the mobile van video show and mobile van announcements. All 98 communities in the district were visited by the mobile vans three times during the vans' period of operation, and each community had at least one chance to see the video show.

A 3-day residential workshop was organized for the mobile van operators, which included the district and regional information officers. The focus and themes of the intervention campaign were discussed and worded into a campaign message that complemented other components of the intervention. The video clip, "Now I Know," to be shown on the vans was previewed and discussed with all workshop participants to enable operators to answer questions posed to them during their rounds in the community. The mobile van team worked with the DHMT and the assembly members to facilitate smooth operation in the communities.

Mobile vans operated during the day disseminating the message of appropriate net use by moving through the streets of communities, making announcements, and answering questions at markets and in other populated areas. Mobile van operators also distributed posters and flyers on appropriate net use to community members at each stop. At night, the mobile van operators showed the video clip at central sites, including community *durbar* (central plaza) grounds. The video clip was preceded by viewings of African films to attract the attention of community members. A question and answer session on appropriate net use followed the viewing of the video.

Community health volunteers—Community health volunteers were identified and selected in all six sub-districts of Gomoa East District. Training manuals and other materials were developed for the dissemination of appropriate net use messages by community health volunteers. A 2-day training was organized for 30 community health volunteers in each of the six intervention sub-districts, for an ultimate total of 181 volunteers. Volunteers visited households in the communities in which they lived to spread the message of appropriate net use and also assisted community residents with the procurement and hanging of ITNs. They gave regular updates about their work to supervisors at the zonal health posts.

Preparatory activities

Community entry—Once Gomoa East District was chosen for the intervention, personnel from NetMark and GSCP met with the Gomoa East DHMT

to introduce the intervention study, to discuss in detail the implementation of the net use intervention, and to consider input from the DHMT and other stakeholders. In doing so, the NUI planners sought to foster the district's ownership of the intervention to ensure the full cooperation of all stakeholders. Familiarization visits were also made to all zonal health posts to health workers who would play the roles of field supervisors for volunteers in communities.

To officially inform the community of the intervention study, an advocacy meeting *durbar* was organized with the DHMT for traditional leaders, political leaders, and other opinion leaders. This was to ensure the smooth implementation and cooperation of all members of the community during the intervention period. Ninety-five participants attended, including chiefs, assemblymen, school health coordinators, traditional birth attendants, and heads of relevant associations. The message of appropriate net use was disseminated using live stage theater performed by the National Theatre Group, lectures by NetMark personnel, and Information, Education, and Communication materials. There were opportunities for discussion and interactions to clarify issues on appropriate net use.

Selection of themes and messages—Initially, NetMark staff and consultants generated an extensive list of intervention themes from which to develop potential messages. Then, several consultative meetings with the NMCP, GHS, and health providers in the target region reduced this list to five themes. Focus group discussions were organized with district health workers and community health volunteers to test these messages. Three of the five messages were selected as the most appropriate for the intervention. GSCP produced the final messages below:

- "If you care, you cover"
- "Malaria kills, Nets save"
- Protect your future today, tomorrow and always"

After further testing, the message "If you care, you cover" was chosen as the most effective message for the net use intervention for its ability to tap into the emotional elements of net use, which is essential to understanding why individuals are motivated to change their behaviors.

Print and other materials—NetMark adapted three different versions of print materials previously developed by UNICEF for each target group: fathers, mothers, and pregnant women. T-shirts and polo shirts inscribed with the primary message, "If you care, you cover," were designed and produced by GSCP for the intervention with a creative, yet emotional image to correspond with the message. These t-shirts were distributed to the community health volunteers, mobile van operators, and the community drama group members. T-shirts were

also given as prizes during the community quiz sessions, and polo shirts were distributed to all participants of the advocacy meeting durbar.

Monitoring—The NUI program implementation via the community health volunteers, mobile vans, and community theater was closely monitored by the health zonal supervisors, the Regional Information Officer and District Information Officer, and Net-Mark project staff (respectively). These various personnel in turn were in frequent contact with one another throughout the preparation and implementation phases.

RESULTS

Quantitative outcomes

Participants—All participants were informed of the purpose of the study and provided informed consent to the survey team before any data were collected. Sixty-eight percent of the participants in Asikuma Odobeng Brakwah lived in households headed by males, as did 60% of the Gomoa East sample. The household locations were primarily rural, with 62% and 85.5% of Asikuma Odobeng Brakwah and Gomoa East (respectively) in this category. In terms of age, about half were under 30 (43% in Asikuma Odobeng Brakwah and 50% in Gomoa East).

Demand creation—During the last 2 weeks of the intervention, field staff determined that the demand for nets far exceeded the prevalence of ownership. This determination was in part due to consistent and increasing pressure from assemblymen, volunteers, and community residents themselves, indicating that the multichannel communication was more than sufficient to convince them that they needed nets, but that there was nowhere to obtain them. It was therefore decided to distribute more than 13,000 nets in the intervention district during the last week of the NUI. By the final day of this multifaceted net promotion, approximately 10,000 of these nets had been distributed and then purchased at subsidized rates by the target population. This distribution occurred concurrently with the posttest survey.

Net ownership and use—The posttest survey showed no change in knowledge of ITNs in either Gomoa East or Asikuma Odobeng Brakwah as almost all residents had already heard of ITNs (Table 1). Ownership of older, non-treated nets actually decreased from baseline to posttest in both districts, while ITN ownership did not change (Tables 1 and 2). Examining changes in longitudinal data, there were 102 households in Asikuma Odobeng Brakwah and 134 in Gomoa East without any nets at baseline, but that acquired them by posttest. Conversely, 31 Asikuma Odobeng Brakwah and 39 Gomoa East households went from ownership to non-ownership status. While the total number of ITNs owned decreased by 15% and 4% in Asikuma Odobeng Brakwah and Gomoa East, respectively (Table 1), the number of nets actually being used decreased by 7% in

the control district while increasing by this same amount in Gomoa East (Table 1).

In terms of ITN use the previous night (Table 1), 73.6% of the households in Asikuma Odobeng Brakwah reported using a net at baseline, increasing to 79.9% at posttest. The corresponding figures for Gomoa East were 63.9% at baseline and 84.4% at posttest, demonstrating a strong and statistically significant intervention effect ($OR=1.67$; $p<.05$; see Table 2) for this variable, even though there was no change in interviewee's personal use (Table 1).

Equally telling was the cumulative number of people covered by a net the previous night in the households interviewed. For calculation purposes, an interviewer code of "3+" was computed as 3. Though this number at times could represent more than three, there is no reason to believe it differentially did so in Asikuma Odobeng Brakwah versus Gomoa East. This number decreased by 15% in Asikuma Odobeng Brakwah (920 to 776; -144 person/night) from baseline to posttest while increasing a nearly equal amount (779 to 910; $+131$ person/night) in Gomoa East. The overall increase in ITN coverage was therefore approximately one person/night per every two households.² The decrease in Asikuma Odobeng Brakwah was even more pronounced among children under 5 years of age ("under 5s"), dropping by over 30%, while in Gomoa East under-5 coverage was virtually unchanged. Therefore, this increase in coverage was largely due to the fact that greater numbers of older children and/or adults (but not necessarily pregnant women; Table 1) were being covered.

Costs—The NUI budget included both the variable costs (i.e., those specific to this special intervention and evaluation study and not necessarily pertinent to other regions who simply want to implement the NUI) and fixed (or "recurrent") costs of the project; the latter figure being the more important in terms of its implications for scalability. The fixed costs for this effort amounted to approximately 71,000 Ghana cedis, which by the time the NUI ended was exchanged at 1.44/US\$1. One fourth of this expenditure (18,000 cedis) was for perhaps the project's most controversial aspect: the payment of the 181 volunteers. One health officer who criticized this element feared that volunteers' willingness to contribute to future efforts would be diminished by having had this history of payment. Given that the NUI program required far more work than they had been accustomed to, however, NetMark decided that monetary compensation was in order. In an effort to lessen the concerns that others had about this feature, the incentives were distributed only after the project was over.

² Adding the absolute values of the decrease in control households and the increase in the intervention households, and dividing by the number of intervention households ($[144+131]/519$ households), yields a proportion of 0.522.

Table 1 | Baseline and postresults for mosquito net and ITN use stratified by district

Variable	Control district				Intervention district			
	Baseline		Post		Baseline		Post	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Have you heard about ITNs?								
Yes	644	97.9	472	97.3	659	98.2	515	99.2
No	14	2.0	13	2.7	12	1.8	4	0.8
Total	658		485		671		519	
Does your household currently have a[n older] mosquito net that can be used while sleeping?								
Yes	489	75.9	281	57.9	476	72.2	277	53.4
No	155	24.1	204	42.1	183	27.8	242	46.6
Total	644		485		659		519	
Does your household currently have any ITNs that can be used while sleeping?								
Yes	473	73.4	337	71.2	460	69.8	368	71.5
No	171	26.6	136	28.8	199	30.2	147	28.5
Total	644		473		659		515	
How many ITNs do you have? ^a								
1	209	44.2	153	45.5	240	52.2	205	55.3
2	179	37.8	0	0	167	36.3	0	0
3	59	12.5	163	48.4	41	8.9	152	41.0
4+	26	5.5	21	6.2	12	2.6	14	3.8
Total	473		337		460		371	
How many ITNs are being used? ^b								
0	0	0	42	12.4	0	0.0	30	8.1
1	294	62.2	208	61.4	294	63.9	0	0
2	94	19.9	0	0	70	15.2	251	67.5
3+	85	18.0	89	26.3	96	20.9	91	24.5
Total	473		339		460		372	
Did you or any member of your household sleep under an ITN last night?								
Yes	348	73.6	271	79.9	304	66.1	314	84.4
No	125	26.4	68	20.1	156	33.9	58	15.6
Total	473		339		460		372	
Did you sleep under a[n older] mosquito net last night?								
Yes	4	3.2	6	8.0	10	6.4	0	0
No	121	96.8	69	92.0	146	93.6	58	100.0
Total	125		75		156		58	
How many people in the household slept under ITNs last night?								
1	17	4.8	15	5.5	17	5.4	16	5.1
2	99	28.2	0	0	123	39.4	0	0
3+	235	67.0	257	94.5	172	55.1	298	94.9
Total	351		272		312		314	
How many of those who were under ITNs were children under 5?								
0	0	0	11	4.0	0	0	12	3.8
1	214	60.6	168	61.8	216	68.6	203	64.6
2	97	27.5	77	28.3	75	23.8	82	26.1
3+	42	11.9	16	5.9	24	7.6	17	5.4
Total	353		272		315		314	
How many pregnant women slept under a net [ITN or mosquito]?								
0	27	5.7	15	20.3	41	9.0	6	10.3
1	39	8.3	1	1.4	20	4.4	0	0
N/A	405	86.0	58	78.4	397	86.7	52	89.7
Total	471		74		458		58	

Response patterns were generally but not fully internally consistent, yielding sample sizes for some of the subset questions that are higher than expected.

Control district Ghana's Asikuma Odobeng Brakwa District, *Intervention district* Ghana's Gomaa East District

^a For calculation purposes, "4+" is treated as 4. Though these numbers could be larger, there should be no intervention/control group differences

^b For calculation purposes "3+" is treated as 3. Though these numbers could be larger, there should be no intervention/control group differences

Table 2 | Binary logistic regressions for prediction of district on select net use variables at posttest

Variable	OR	95% CI	p value
Does your household currently have a mosquito net that can be used while sleeping?			
Control	1		
Intervention	0.83	[0.63, 1.09]	.17
Does your household currently have an ITN that can be used while sleeping?			
Control	1		
Intervention	1.05	[0.76, 1.46]	.75
Did you or any member of your household sleep under an ITN last night?			
Control	1		
Intervention	1.67	[1.05, 2.65]	.03

Analyses were adjusted for baseline values of each dependent variable
Control Ghana's Asikuma Odobeng Brakwah District, *Intervention* Ghana's Gomaa East District

In summary, the entire NUI intervention cost approximately US\$48,000, of which \$12,000 was for volunteers. This amounted to about US\$4.80/net distributed.

Qualitative outcomes

By the end of the intervention, substantial numbers (apparently a large majority) of households owned ITNs, and children and their mothers slept under them. Some fathers actively promoted ITN use though they themselves slept without them.

Before the intervention, the formal sources of health knowledge through which participants received information about ITNs were the health facility, radio, television, video, and cocoa-buying agents. In most of the communities, ITNs could only be obtained through the health facilities. They were normally given out free of charge or at subsidized prices to expectant mothers and those with children under 5 years, who paid an average price of two Ghana cedis. However, after the intervention, participants reported that they received the majority of their information from the community volunteers and from the information vans, a direct product of the NUI activity.

The perceived benefits of ITN usage included the prevention of mosquito bites and subsequent contraction of malaria, as well as the ability to drive away all kinds of insects. Representative quotes in these categories included:

- “The net once prevented a strange insect from our ceiling from falling directly on us to disturb our sleep. I had to call for help from the neighbourhood and it was killed before we got out of the net.”
- “It helps me to sleep well and therefore find myself very alert the next morning.”
- “It has helped to reduce my expenditure on medication.”
- “My children have never fallen sick since we started using it about 4 years ago.”

- “One of my children who does not sleep under ITN from infancy is always getting ill, the nurses in the community can testify to this.”

These responses are consistent with both the campaign messages and the intended purpose of the ITNs.

DISCUSSION

In the present study, the qualitative and quantitative results show that the promotion of net utilization succeeded well beyond the NUI planners' expectations. Initially, we deemed the 8-week intervention to be the minimum necessary to have an impact; however, as time went on, it was clear the communities had become convinced that ITNs were necessary, and instead of just promoting usage, the NUI dramatically increased demand for new ITNs. In the final 2 to 3 weeks of the campaign, health professionals and volunteers alike were being bombarded with requests from the community to increase the supply of new ITNs, an intervention feature that had not been part of the original plan. A typical response to face-to-face communication during this phase was “I already know I need a net. Please tell me how to get one!” Some residents and volunteers even offered money to program staff if they could somehow locate extra nets.

When the commercial sector made more ITNs available in the intervention areas, more than 8,000 new ITNs were sold at subsidized rates to the community members during the last week of the NUI. Overall, previous night ITN use increased substantially and statistically significantly in the intervention communities. Examining intervention and control areas concurrently, there was a net change of approximately one additional person being covered by an ITN per every two households in the intervention communities. Measures of specific coverage in the two primary target groups (under-5s and pregnant women) did not evidence change, however. This is perhaps due to a high

number of under-5s already being covered during baseline and in the control communities, and conversely, a low number of pregnant women being represented in the sample. Additional research is needed to determine whether these two groups are indeed being adequately protected.

This intervention was multifaceted, and thus, it was not possible to determine exactly which components were the most effective. Mobile vans and health workers' efforts were clearly endorsed in the quantitative survey. In the qualitative interviews, community residents noted that they felt the volunteers' efforts to remind them continually of the importance of using ITNs were perhaps the single most critical feature of the overall effort, complemented by the mobile vans and their video presentations of the National Theatre drama skit. Although the community members and health officials both agreed that live messages delivered via community theater may have been even more salient, there was broad agreement at all levels that live drama would not be scalable for a multiregional or nationwide effort. Even when conceivably affordable, it is not clear whether all components of the intervention would be feasible for other regions. For example, the mobile "vans" (small pickup trucks) crisscrossed the target region on roads that are relatively better than those encountered elsewhere in Ghana. Further, volunteers needed transportation to attend their trainings, which entailed both cost and available transportation. All of these resource and feasibility realities will dictate the parameters of future efforts of this nature. Finally, there was concurrence among message recipients, health professionals, and officials alike that the volunteers' efforts were perhaps only effective in terms of the broader health communication and community mobilization efforts that were underway. Community trials are by their nature multifaceted, and it is often impossible to determine what individual and combination of components contribute to any given response. Nevertheless, additional research is warranted to determine the minimal effort and resources needed to produce a broad reduction in malaria morbidity and mortality through ITN use. This research should emphasize not only the reach of the communication effort but also to what degree the behavior change it produces needs to be boosted over time.

Evaluation efforts of net use promotion campaigns should also be refined. The timing of any evaluation approach must be coordinated with the malarial season as it was in the present intervention, which began and ended at the onset and end of the season. However, it is possible that individuals are relatively more motivated to use bed nets at the end of the season (or when cooler weather sets in, etc.), which limits the ability to determine what the true intervention/control differences might have been had other factors not figured in. Related to this,

future evaluations should address how long the effects of the promotion last. Ideally, follow-up surveys would occur in future seasons and not at a point when infection rates were relatively low.

Also, though we believe that the NUI was effective overall, our data relied on self-report of householders, subject to demand and other biases one might encounter in any measurement effort of this nature. Observation of conditions in which individuals sleep would clearly be prohibitively intrusive; nevertheless, approaches such as day-time positioning of nets for probable night use might be of some use in validating self-report. Should we be able to establish the validity of our measures, it would be of interest to know whether the impact of an intervention was just among a certain segment of the target population (e.g., people with disposable income or in relatively rural settings) in order for future interventions to be tailored to the hard-to-reach.

As noted, future efforts to promote ITN use should emphasize whether ITN use is sustained beyond a specific focused intervention effort or whether such efforts need to be reinvigorated over time. NetMark's NUI evaluation demonstrated efficacy in that it showed that, at a minimum, ITN use in targeted groups could be substantially improved through a multifaceted, community-based intervention. The broader effectiveness of this approach and its scalability still need to be examined by determining the minimum number of intervention components needed and the minimum time required for implementation. Consistent with previous research as summarized by Eisele and Root [17], it appears that much of the success of the NUI was based on the interpersonal communication and persistence of the volunteers supported by the wider communication power of the mobile vans. Funders and program partners in Ghana and other countries should consider the employment of a similar strategy and investment if they wish to increase appropriate use and build demand for ITNs. Given the internally and externally valid results from this community trial, operations research can now be used to identify the best means of adapting these and other empirically proven interventions to other settings and contexts [17].

Previously, the field of behavioral medicine has primarily emphasized behavioral aspects of chronic diseases and other health priorities of developed countries. The Ghana Net Use Intervention study applies principles of behavior change to malaria, a vector-borne infectious disease threatening the health of hundreds of millions living in tropical and poorer regions of the world.

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