COMMUNITY REACTIONS TO THE INTRODUCTION OF PERMETHRIN-TREATED BED NETS FOR MALARIA CONTROL DURING A RANDOMIZED CONTROLLED TRIAL IN WESTERN KENYA

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Abstract. Prior to implementation of a randomized controlled trial of insecticide (permethrin)-treated bed nets (ITNs) in western Kenya, ethnographic studies were conducted to understand local perceptions of disease, sleeping patterns, and other factors that might affect use of ITNs. Educational activities took place prior to distribution, but immediately after distribution in Asembo only approximately half of the ITNs were in use. A qualitative study was then conducted to identify the community’s perceptions about ITNs and the ITN project. While participants ranked malaria as important and recognized that malaria prevention could be beneficial, they believed ITNs would be only partly effective due to the perception that malaria has multiple causes. Concerns expressed included fear of the insecticide, thought by some to be a toxic family planning aid, the taking of blood during clinical studies, and the mixing up of family ITNs during net re-treatment, which would violate cultural taboos. Attempts were made to allay fears by improved communication on these subjects and modification of the study design.

INTRODUCTION

Insecticide (permethrin)-treated bed nets (ITNs) have emerged in the last several years as an effective malaria control intervention. Questions remain, however, on how best to promote correct and sustained use of ITNs, particularly in areas without a tradition of bed net use. Two baseline anthropologic studies were conducted before the trial was implemented. An ethnographic study was undertaken to better understand community perceptions of disease, including malaria, and care seeking. Studies of sleeping arrangements and bed net use were conducted separately. Information from these rapid assessments were used to develop a wide-scale awareness campaign designed to 1) stimulate interest in the trial, 2) inform community members that mosquitoes alone transmit malaria, and 3) emphasize the importance of adherence (proper use and deployment of ITNs) for maximal benefits of the intervention. A variety of methods were used to disseminate this information, most relying upon the traditional word of mouth approach: open air meetings called by local political authorities (bazaras), community theater, song, and house-to-house visits by trained local traditional birth attendants (TBAs). Information leaflets were also distributed.

As described elsewhere, the trial in western Kenya distributed pretreated bed nets, twine, and nails free of charge to those residing in intervention households. After receiving ITNs, each participant was given a demonstration on bed net mounting and use. Despite this, a spot check in 1,104 randomly selected households one month after net distribution showed that approximately half of the ITNs were not being used. At the same time, community members reported a variety of concerns about the trial to traditional birth attendants (TBAs). In an effort to systematically document these concerns, we carried out a participatory rural appraisal (PRA), an anthropologic research method used to motivate communities to plan and promote their own health agenda. Reasons for poor initial acceptance of ITN use, as provided by participants of the PRA, are presented along with a discussion of solutions suggested by the community. Results of the pre-intervention ethnographic and sleeping behavior studies are also presented because these provide a useful comparison to the PRA findings.

MATERIALS AND METHODS

Study population. The study population of Asembo, situated on the northeastern shores of Lake Victoria in the Bondo District of western Kenya. It typifies lakeside communities of eastern Africa, and is described elsewhere. The climate is typically tropical with rainfall reaching an annual average of 1,400 mm. The study area is holoendemic for Plasmodium falciparum malaria and transmission occurs throughout the year. Asembo comprises 79 villages with approximately 55,000 people. Ninety-six percent of the population are members of the Luo ethnic group.

Most residents are subsistence farmers who cultivate maize, sorghum, cassava and millet, and a few other vegetables. Some limited animal husbandry of cattle, goats, or poultry is also evident. Off-farm activities include fishing near the shore of Lake Victoria, trading at market centers, and selling of vegetables and grain. Some adult males migrate to towns for employment, and return to their homesteads during holidays and at planting and harvesting time. Women of these homesteads become de facto heads of the household. Most men without regular jobs engage in seasonal farm labor. The most common type of house is the traditional Luo hut, which has a stick framework plastered with mud and cow dung, a grass thatch roof, and one door. Few houses have iron sheet roofs with sealed eaves. Before the trial, the proportion of houses with at least one bed net was approximately 5%.

Baseline ethnographic survey. In 1996, TBAs recruited mothers with children less than five years of age to discuss child health in focus groups of 5–10 mothers each. Discussions in Dholuo, the local language, were held in the home village of the mothers and lasted approximately two hours. A Luo social scientist transcribed discussions by hand, and a tape
recording of the meetings was made to check for errors. In addition, a Luo researcher conducted a series of the informant interviews using a semi-structured questionnaire. Informants were teachers, TBAs, and opinion leaders. Information from focus groups and interviews was used to define ethnomedical terms used by Luo mothers in the diagnosis and treatment of childhood illnesses. The mothers’ perception of the severity of each category of illness was also defined.

**Sleeping behavior survey.** A small-scale baseline survey of sleeping behavior in the study site was conducted in Asembo Bay in 1996. The sampling unit was houses with mothers having at least one child less than five years of age. Houses were selected, with the assistance of TBAs, to include households from large and small compounds, as well as those with and without bed nets. Three different methods were used: 1) separate in-depth interviews of 16 mothers, 2) structured interviews of 38 mothers, and 3) three focus group discussions including a total of 30 women. Interviews were held in the home of the mother while focus group discussions occurred in the homes of TBAs. Questions and discussion centered on family sleeping arrangements, with particular attention to children’s behavior. Experience with bed net use was discussed. Reasons for using or not using nets were elaborated in an attempt to identify factors that might prove relevant in determining ITN use during the subsequent trial.

**Participatory rural appraisal.** The PRA was undertaken in an attempt to diagnose reasons for low ITN usage immediately after net distribution. It uses a variety of techniques to obtain information, including informal interviews with informants, interviews of selected participants using open-ended questionnaires, focus group discussions, community walks and mapping, seasonality drawing, and problem ranking. The basic idea is to stimulate community members to think about problems in a variety of creative ways, not all of which depend upon verbal fluency or literacy, so that all community members may contribute. Traditionally, this method starts with no specified problem, but we adapted the method to target the specific problem of low net usage faced by the ITN trial, to explore how malaria fits into the overall picture of health-related problems affecting the community, and to identify which factors most affected the population’s acceptance of the project.

Six of the 40 intervention villages within Asembo were randomly selected for study, but one village did not participate due to logistical problems. The 323 participants included mothers, village elders, teachers, health workers, village ITN committee members, and members of women’s, youth, and church groups. An effort was made to ensure the participation of mothers with young children. Study staff were assisted by TBAs and members of voluntary village ITN committees. Field work was conducted by a team consisting of a social scientist, six field research assistants, and two community members. Team members were trained in PRA techniques and all training materials were subjected to preliminary field evaluation.

The PRA was conducted during January–February 1997, two months after ITN distribution in Asembo. Assessments in the five villages were conducted separately. Each was carried out for three consecutive days from mid-morning to mid-afternoon. In general, day 1 was devoted to assessment, day 2 to analysis, and day 3 to feedback and recommendations. Responses and information gathered were recorded verbatim by hand; at the end of each day the social scientists summarized the information, and tabulated instances of each category of response.

**Day 1: Situational assessment.** Forty-nine women and 33 men took part in activities on day one. The starting point was an organized walk around the community, which aimed to draw in more participants and stimulate discussion. The research team and participants were divided into four groups to walk in four different directions of the village. Topics addressed were people’s perceptions of common illnesses, problems with using ITNs, seasonality of malaria, mosquitoes, rainfall, farm activities, and labor demand, and accessibility of health facilities, shops, and transportation services. The data generated therefore provided a broad overview of the community’s perception of health and ITNs.

**Day 2: Data synthesis and analysis.** Activities began with a recap of issues arising from the previous day. Participants included 104 women and 30 men. The main goal was to understand in more detail participants’ perceptions of diseases, the relative importance of malaria, and implications for ITNs and their use. Two group discussions, one each for men and women, were conducted at each site.

**Day 3: Feedback and recommendations.** On day three all previous days’ research was pooled together. A total of 110 participants were involved in identifying persistent problems and to suggest solutions. Activities included rank scoring of identified problems with ITN use in order of perceived seriousness and priority. The aim was to examine ways to improve adherence with ITN use. Activities on this day also helped identify misconceptions about malaria, ITNs, and project activities.

**Ethical clearance.** The bed net trial was reviewed and approved by the institutional review boards of the Kenya Medical Research Institute (Nairobi, Kenya) and the Centers for Disease Control and Prevention (Atlanta, GA). Informed consent was obtained from all caregivers after the study was explained in the local language.

**RESULTS**

**Pre-intervention studies. Sleeping behavior.** Two-roomed thatched houses without windows predominated in the study population, with a small proportion of the population living in larger houses. Eaves were open, and some roofs had gaps. Most houses had cross-beams that allowed for tying of string to hold nets in place. Within a family compound, condition of houses varied, with the house of the head of the compound being in best condition and that of houses serving as kitchens the worst.

All rooms in the house are potential sleeping areas. Sleeping places are governed by space and custom. The husband and wife sleep in the bedroom, sometimes in separate beds. Small children less than three years of age sleep with their mothers, but two-thirds of such children among the study houses were displaced from the bed by a newborn child, on account of bed wetting, or as the parents say, the child is ‘old enough to sleep elsewhere.’ A small proportion of displaced children less than five years old slept with another female adult, but most remained alone or slept with older siblings in the sitting room or kitchen. By Luo custom, when a child reaches puberty he or she can no longer sleep under the same roof as the parents. They seek sleeping spaces in the grand-
parents’ upper house, build a bachelors house (simba), or stay with relatives or friends. Visitors are accommodated in the upper house or kitchen depending on age and status. Visitors whose status allows them to sleep in the upper house may displace children or share their sleeping space.

Parents sleep on a bed with a mattress and have priority access to the only bed net in the house, if one exists. The rest of the family sleeps on the floor on shared papyrus reed mats (par). Asked for an explanation for this custom, several mothers said: “There is no money to buy extra beds and bed nets, and furthermore, when they sleep on a hard surface like that they learn to appreciate that the comforts of life are not easy to come by. Children are still young and can endure lack of sleep due to mosquito nuisance. It is the adults who have to struggle to provide for them that need to sleep well.”

Most families go to bed by 9:00 PM. Women wake from 5:00 AM onwards to go to the farm, market centers, or the lakeshore. It is usual for a mother with no child caregiver to carry her baby to the farm or lakeside with her at dawn. Fishermen spend most of their night on Lake Victoria and return home in the early morning hours.

Protection from mosquitoes. A variety of methods for protection from mosquito biting were cited, including burning of traditional products (plant, cow dung, fire), use of commercial products such as nets, mosquito coils, sprays, or Vaseline® repellent, and environmental interventions such as clearing of bushes or draining of ponds. Two-thirds claimed to use commercial means, predominantly mosquito coils. This preference is illustrated by one participant from a focus group discussion: “If you have KShs. (Kenya Shillings) 2.00 (U.S. $0.05) to spare you can get a mosquito coil which affords the whole household protection. It burns the whole night so mosquitoes do not disturb you in the middle of the night unlike the case with traditional plant products.” Participants, nevertheless, recognized the advantage of nets: “With a bed net you do not waste money buying mosquito coils every day or expose your health to the dangers of heat and smoke caused by burning herbs.” Burning herbs were thought to cause a congested chest and cough, and make the house and clothing smell. Participants noted, however: “bed nets are good, yes, but we cannot afford them.”

Of 12 homes selected that had purchased their own bed net pre-intervention, most were used to lessen nuisance mosquitoes. One-fourth of these homes claimed it sometimes prevented malaria; however, only one net was present per house and was invariably used by the parents. If an infant was present, and slept with the parents, then they too slept under the net. Nets were used mainly in the cold/rainy season and stopped when the mosquito population was perceived to be low. Problems experienced with bed nets included heat, nets that were too small for the beds, and nets that were not working because they were old and had holes. Heat was most often cited. Mothers also mentioned problems with washing, the inconvenience of daily opening and deployment of nets, and the problem of nets trapping small children left sleeping in bed.

Willingness to purchase bed nets. Of the 26 homes without bed nets, mothers were asked how they would allocate a large sum of money to household needs. One-fourth included a mosquito net among things to be bought first. None considered buying more than one bed net. Most considered that the purchase of a net may be possible after other needs had been addressed, such as utensils, a sofa set, house renovation, setting up a business, or buying a new blanket. They noted: “Once you have a good blanket, you sleep well because you do not feel cold, and when you cover yourself properly (including the head), mosquitoes do not disturb you.” Thus, respondents implied there was no perceived need for buying bed nets. Participants felt nets were not a popular item in most Asembo homes because they are not affordable and, in homes where there was a net only one or two people, usually the mother and father, or mother and infant, had access to it. When further asked about the cost of bed nets, two-thirds thought one would cost between KShs. 200–500 (U.S. $4–10) depending on size, excluding indirect transport costs. The overall perception was that bed nets are very expensive.

Ethnomedical terms. The main categories of childhood illness were fever and fever-associated illness, diarrhea, skin rash or measles, stomach ache, and a variety of other conditions (Table 1). The English term malaria has been incorporated into the Luo ethnomedical system, with commonly perceived symptoms (in both adults and children) of fever, vomiting, diarrhea, and joint pain. *Fudha* and *midhusi* characterize illnesses clinically diagnosed as malaria, leading to *ndalume* (loss of consciousness or convulsions) if untreated. Severity of illness is not necessarily evaluated on an *a priori* scale or set of indicators, but requires consideration of the social and cultural situation at the time of the illness episode in addition to the mothers’ appraisal of physical symptoms. A number of indigenous illness categories are perceived to be life-threatening and given greater attention. Of these, *ang’iew* (measles) and malaria were considered to be the most severe.

Participatory rural assessment. Community calendar. Seasonality information generated during the community walk was compiled into a seasonal calendar depicting community perceptions of trends in the distribution of illness (malaria), mosquito density, rainfall, and labor demand (Table 2). Overall, participants perceived peak malaria seasons to coincide with the long and short rains of March–May and September–October, respectively. The calendar suggested an association between peak malaria and mosquito seasons, although there was no concept of a time lapse between the rains starting and the onset of acute malaria attacks. The calendar also illustrated higher labor demands on women than on men, with women performing most agricultural activities in the family fields. However, since women are also the traditional household managers, they tend to work around the home, and are easier to contact via door-to-door research activities than are men.

Ranking of diseases. A list of 21 illnesses commonly affecting adults and children was generated during the community walk. Of 64 instances respondents listed a disease, the most frequently mentioned illness was malaria (13 of 64); then, less frequently, diarrhea (9 of 64), measles (7 of 64), coughs (7 of 64), and *wichbar*, a term used interchangeably for headache and malaria fever (7 of 64). When 10 groups were asked specifically to rank the importance of these 21 illnesses, the leading diseases were perceived to be malaria (10 of 10 groups), measles (9 of 10), diarrhea (9 of 10), and coughs (8 of 10). Other childhood diseases in the list included vomiting (3 of 10), scabies (3 of 10), and *wichbar* (3 of 10). Disease ranking showed convergence in perceptions of men and women, except for the cases of diarrhea and coughs. Women’s groups
Fever and rash from measles, ranked diarrhea higher than coughs, and vice versa for men’s groups.

Participants in group discussions recognized malaria and measles to be the most serious of the diseases commonly affecting children. The two diseases were considered troublesome because either could be easily confused for the other, especially early in the course of illness. Confusing the two conditions, it was said, often led caregivers to undertake the wrong treatment. In addition, 9 of 10 focus groups perceived malaria to be the most worrisome of the two diseases. Participants stated that the preferred treatment of measles is traditional. Malaria treatment, on the other hand, requires non-traditional (western) solutions that are sometimes not easily attainable for various reasons including cost (Table 3).

**Perceived causes of malaria.** While participants in all 10 group discussions cited mosquitoes as causing malaria, this co-existed with traditional beliefs that cold weather and rain (3 of 10 groups), some foods (3 of 10), and dirty water (1 of 10) independently cause malaria. This may suggest that bed nets alone are not enough protection against malaria, and has important implications for adherence with ITNs. As one participant stated: “...what use is it to sleep under bed nets daily (every night)? What about mosquitoes that bite when we are eating...” (Excerpt from remarks mostly made by men at public gatherings to discuss the trial). Thus, in addition to using ITNs, cited by all 10 groups, participants also suggested a range of preventive regimens perceived to be equally important such as boiling drinking water (3 of 10) and taking antimalarial drugs (4 of 10).

**Care-seeking for sick children.** Participants in group discussions perceived drugs purchased over the counter (8 of 10 groups) from local retail outlets (duka), and medicines dispensed at local health facilities (7 of 10) as the main forms of health care commonly sought by both adults and children. However, the norm is to seriously seek medical care only when the illness gets to a worrying stage (might cause death). Apparently, duka and health facility drugs are popular choices because 1) the duka is easily accessible and one does not require consultation fees, and 2) drugs from health facilities cost relatively less compared with other care options, as long as the drugs are available at local public health facilities. Discussion sessions indicated that while dispensaries may seem on face value to be a common source of health care, this is usually as a last resort when other more accessible care options, consisting mainly of self medication, have been tried and found ineffective.

**Factors influencing care seeking.** Group discussion participants cited low income levels (5 of 10 groups) coupled with high cost of drugs and medical consultation (2 of 10) as obstacles to care seeking. Other problems include poor roads, some impassable in the rainy season, inadequate vehicles (2 of 10), and distances to health facilities (3 of 10). In view of these problems, more than three-fourths of the participants agreed that ITNs may play an important role in improving the welfare of the community.

**Likes and dislikes for ITNs.** At the time of these studies, participants had little or no experience of the effectiveness of ITNs, and valued them mainly for affording people a good sleep free of mosquito nuisance. Another perceived advantage was the potential of ITNs to reduce and/or kill household pests, including bedbugs, cockroaches, and rats. It is notable that during this study, previously quoted likes for bed nets such as improving the appearance of a bedroom were not listed. Perhaps this could be attributed to the green color of the research nets, though there was no stated conflict about net colors during the PRA. Many problems associated with mounting and using the newly acquired ITNs were listed during the community walk. Four categories of problems were identified: problems associated with insecticide, problems re-
### TABLE 2
Summary of the community seasonal calendar*

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* † = long rains; ‡ = short rains; † † = ploughing; † † † = planting; † † † † = weeding; † † † † † = harvesting; † † † † † † = land clearing; † † † † † † † = peak mosquito season (“mosquitoes sing a lot”); † † † † † † † † = peak malaria season (many people sick); † † = labor (women); † † † = labor (men).
Problems with the nets

Some nets too small
Nets too hot on warm nights
Not everyone was given nets
Nets wear and tear easily on papyrus reed sleeping mats of children
Rats like to eat the netting
Daily hanging and removal of nets in living rooms and kitchens is tiresome
Some people did not get twine for hanging

Problems associated with nets and general concerns about the insecticide-treated bed net project

Problems with insecticide
Nets smell badly when new and retreated
Chemical causes flu-like symptoms: (runny nose), and skin rashes
Chemical may make nets unfit for babies
Chemical may be a secret fertility and/or birth control device

Concerns about ITN trial
Suspicion over blood sampling surveys
Concern that free distribution of nets was a trap to later get money from people
Concern that researchers would repossess nets and reuse for research in control areas
Security worries during night compliance monitoring

Local practices affecting compliance
Mixing nets during treatment is taboo
Night vigils at funerals prevent net use
Influx of people into homes during funerals disrupt sleeping arrangements, and prompts locking away of nets to prevent theft

Concerns about the use of chemical (insecticide) in bed nets.
Participants commonly raised concerns about the use of the chemical in ITNs. Of 10 groups, eight were particularly concerned about the chemical smell evident in newly treated bed nets. Apparently, people were waiting for the smell to wear off before they could start using their nets. Some mothers were washing babies’ nets to reduce the smell in an attempt to prevent suffocation. Three groups perceived the chemical content in nets to be a secret fertility control device imposed by the government, while two groups thought it could cause suffocation. The general perception was that the chemical was the cause of flu-like and runny nose symptoms experienced about the same time ITNs were distributed to study participants. When specifically asked whether they thought ITNs were harmful, all 10 groups said the nets were not the problem per se. The underlying cause for reluctance to use ITNs, related to mounting and using nets, concerns and misconceptions about specific aspects of the research, and, occasionally, local practices that may hinder optimal ITN use (Table 4).

Misconceptions about trial activities. The main concern about proposed trial activities, the groups said, surrounded drawing blood for clinical surveys (5 of 10 groups) and night spot checks to monitor use (2 of 10). Distrust for clinical surveys was traced to Luo beliefs relating to witchcraft, and termed logo remo. It is generally believed that evil persons could use blood to bewitch donors, causing their death. This fear was compounded by rumors that the trial would drain people’s blood in exchange for nets. Not knowing the exact quantities of blood to be drawn made people reluctant to start using ITNs lest the so-called free nets turned out to be a trap to get blood donors. As heard from listening surveys: “...I am waiting to see if they come and say they want blood...and then I will say to them; here is your net...you can have it back...I have no use for it...” (part of a discussion often overheard from gatherings of villagers at the time). Night spot checks caused concern not as an imposition on family privacy, but as a security risk with fears that robbers might pose as staff.

Problems relating to mounting and using ITNs. The two main problems in this category related to sleeping arrangements and perceived heat under nets. Sleeping arrangements were generally perceived as posing a major logistical challenge to good ITN use. Sleeping arrangements for children in living rooms and kitchens require a daily commitment to mount and dismount nets, making this job tedious and difficult to sustain. Five of 10 groups recognized heat under ITNs as a major determinant of when and if people would use nets. Although this was listed only five times during the community walk, participants stated it was common knowledge that few people would use ITNs in the hot dry season. It was encouraging to note, however, that some people thought one could still sleep comfortably under nets in the hot season: “...bed nets do not bring heat! The land (general climatic condition) is hot. Therefore he (participant) can stop covering himself with a blanket and sleep under a net without any covering.” (male participant during open discussion session).

Problems relating to culture and other practices. While we could not define any cultural taboos against ITN use, participants articulated concerns about the ignorance of researchers regarding taboos governing family relations and social networks in terms of sharing or mixing bedding items including ITNs. Fertility beliefs prohibit mixing bedding items of parents and their children who have attained puberty. This was cited as a major reason for rejection and/or exchange of ITNs in the first weeks of ITN distribution. Some study participants were said to be awaiting reassurance that such oversights would not occur during ITN re-treatment periods. Funerals, often involving temporary migrations are a cultural practice that indirectly impact on adherence with ITN use. With so many people sharing sleeping spaces on such occasions, it may not be practical to mount and use nets. In addition, families tend to lock up ITNs during times when many visitors are present to prevent theft.

Ranking exercises showed the effect of family hierarchical systems on members’ access to items such as ITNs and peo-
peolpe’s reasons for using ITNs.\textsuperscript{3} Traditionally, adults, by virtue of their age and position as family income earners, get priority coverage. These exercises also showed the divergence between people’s opinion and scientific evidence about persons most at risk for malaria. The rankings showed that although over three quarters of participants perceived children to be most vulnerable to malaria (perhaps because researchers said so), the general perception was that everyone was equally vulnerable and needed equal protection. This, coupled with the persistent notion that adults needed priority coverage, has implications for child ITN use in households where there may not be enough ITNs to go around.

\textit{Community suggestions for enhanced ITN use.} Participants were encouraged to outline elements of the trial that needed to be reviewed to improve adherence, and how best to achieve such changes. The underlying cause of problems, they said, were gaps in community knowledge and understanding of trial activities and their purpose. The best solution, it was suggested, was to educate community members at various levels, and address their concerns about ITNs and proposed trial activities. Particular emphasis was placed on the need to understand the nature of clinical surveys, detailing their purpose, inclusion and exclusion criteria, and how often they would be conducted, including estimated quantities of blood to be drawn per sample. Other areas of concern related to proposed night spot checks, and their timing. To counter fears about robbers posing as staff, it was recommended that staff be accompanied by a villager held in high esteem during night-time studies. Recognition of family relations and fertility beliefs required that plans to treat ITNs at a central point in the village be reviewed, to which participants proposed door-to-door dipping as the best possible option.

\textit{Improvements to the project following PRA.} Many of the problems with ITN use were related to misconceptions about the bed nets and insecticide, and the purposes of the trial in general. Our findings give a clear indication for the need to revisit general health communication for the trial. The original focus was on awareness creation with the main objective of persuading people that ITNs were a worthwhile disease control tool. These findings showed it was time to shift to more practical issues if people were to start using ITNs; provide correct information designed specifically to address people’s concerns and fears about the intervention. Rogers calls this the innovation decision stage,\textsuperscript{11} during which people require information to reduce uncertainty. We sought to involve community members at all levels including schools. Greater emphasis was placed on more personalized discussions with the community, at both the individual and community level. This involved shifting ITN meetings from the framework of the local community meetings convened by chiefs to existing community networks including women groups, village ITN committees, and church groups where people felt more at ease to discuss their fears. To supplement these group meetings, community theater was used to raise topics of concern to which villagers were welcomed to participate and role-play. ITN drawing and poetry competitions were designed to target primary school children, and winning items went into compiling a project calendar incorporating monthly messages about key trial activities. A workshop was held for the village ITN committees to familiarize them with underlying principles for trial activities to enable them to address people’s concerns at community meetings project staff could not attend. Similarly, all data collection training for trial field staff included understanding the underlying principles for any field activities they may be assigned to carry out so that they might accurately answer questions and allay concerns about trial activities. For the quarterly spot checks, performed to monitor ITN use during the project, interviewers from the local villages were given identification cards to show to householders before entering their homes.\textsuperscript{12}

\textbf{DISCUSSION}

Information from this study was used to design subsequent educational campaigns that aimed to maximize ITN use. We also took into account community taboos in designing an effective method for ITN re-treatment. It is likely, although impossible to verify, that the exercises described herein helped the researchers and community to work together to implement a trial that was successful, at least in the sense that the intervention reduced infant mortality by 23%.\textsuperscript{12} Furthermore, levels of adherence for the overall trial were close to 70% over a two-year period,\textsuperscript{13} which were considerably higher than levels observed immediately after ITN distribution.

Some of the concerns raised by participants in the qualitative surveys were later quantitatively validated. In particular, net use by adults was consistently higher than for children and use during periods of hot weather tended to decrease. However, no association between observed net use and numbers of mosquitoes was observed.\textsuperscript{13}

It is also worth noting that requests for PRA were often made by ITN village committees and TBAs in non-PRA villages as a means of improving people’s perceptions of ITNs. Our study population’s reluctance to use ITNs was quite contrary to previous indications from formative research that people desired nets, but were only mainly barred by financial constraints.\textsuperscript{3} Overall, the results suggest high potential for the acceptance and use of ITNs for malaria control in this area. The apparent absence of any cultural barriers to ITN use\textsuperscript{3,9} is an added advantage.

Our observed community reaction raises questions about programs placing too much emphasis on action to the extent that implementers fail to recognize the processes of behavior change.\textsuperscript{15} Our experience may be typical of attempts to introduce new ideas,\textsuperscript{11} and attests to the common problem of how best to speed the uptake of ITNs as a malaria control tool.\textsuperscript{4,14–16} It is generally assumed that an advantageous innovation, such as ITNs\textsuperscript{1,2} will diffuse rapidly. The uncertainty inherent in innovations is of course a concern, and is a major determinant of people’s evaluation of a new tool against previously existing alternatives:Œ.œwe (our family) are waiting to see how it (insecticide in nets) reacts on those who have started using it…” (Excerpt from informal conversations heard making rounds in the community).

How the uncertainty involved is addressed is of crucial importance. Health communication plays an important role in predisposing people to an intervention. However, the relationship between knowledge and behavior is not linear.\textsuperscript{11} Often, a window period of information processing follows the first knowledge and the decision stages. As in our case, people would first need to acquire a new perception,\textsuperscript{11} that the chemical concentration in nets is not toxic\textsuperscript{17} and that it is,
therefore, safe to sleep under nets treated with insecticide. It is arguable, therefore, that what we observed was not necessarily failure, but rather a stage in the process of adopting the intervention,11 raising questions of how to overcome negative influences while enhancing positive factors. Perhaps, at this stage, health communication would be best used to provide correct information aimed specifically at addressing people’s concerns rather than bombarding people with more scientific evidence. Although it was too early in the program for people to realize any benefits, it has been noted that the absence of direct and immediate benefits often result in limited response to programs relying on consistent, repeated behavior. The transmission of malaria, for instance, is quite complicated, and participants may fail to see the utility of their efforts.18 In our experience, misconceptions about insecticide, lack of congruity between preventing nuisance biting versus disease prevention, and concepts of multiple causation of malaria collectively prevented people from perceiving the potential benefits of ITNs for malaria control: “... it does not make a difference how I use the net...I will still get malaria if I am rained on ...”

If other threats for the transmission of malaria remain equally relevant, over which ITNs have no effect, maintaining ITN use by explicitly talking about reducing mosquito burden throughout the year clearly becomes more problematic. At the onset of this trial, people viewed protection from mosquito biting in terms of avoiding nuisance biting, rather than preventing disease. Consequently, ITNs were the preserve of adults who are perceived to need better sleep to effectively meet their daily obligations as family breadwinners.5 In other studies, the emphasis on good sleep was exacerbated by seasonal changes in temperature, particularly in the hot season, and when mosquitoes are perceived not to be abundant.14,15 It has been suggested that acknowledgment of any factor that motivates people to sleep under ITNs, even when it is not directly related to health, may help in trying to win people over to public health awareness and action.14,19 Sole focus on the reduction of nuisance biting or killing household bugs may backfire, however, because people will stop using ITNs when they do not perceive those benefits.15,16 In our quantitative studies of ITN deployment (adherence), we found no seasonal correlation between high abundance of nuisance biting culicines and malaria-transmitting anophelines, nor did we find that numbers of either culicines or anophelines were associated with ITN use.13 Nonetheless, our entomologic studies showed that proper deployment of ITNs was associated with reduced numbers of indoor-resting Anopheles gambiae.20

Most people at risk of malaria are poor. In Asembo, little variation was found in the distribution of wealth.21 The priority in their daily life is subsistence; they can barely afford to invest in items such as ITNs. As with former trials elsewhere15,22 ITN coverage and adherence rates may decrease considerably once participants have to pay for ITNs and insecticides themselves. Our baseline study illustrated that ITNs were not considered a priority3 and were, thus, valued as a luxury rather than a public health item at distribution. In a former site, ITNs continued to be used although access to insecticides and new nets limited effectiveness.23 Ultimately, however, it remains to be seen whether the population will value ITNs because of perceived health or subsidiary benefits, and whether bed nets and insecticide will be ranked as a household priority. As with questions of affordability,21,24 correct use of ITNs will be largely determined by the perceived need to use a net in the first place.

In summary, findings from our anthropologic studies early in the trial indicated that the study population would accept and use ITNs. After introduction, an array of social and cultural issues associated with the ITN studies became apparent. While the majority of these problems could be addressed during the trial they illustrate the shifting roles of communication, time, and the social system in the diffusion process.13 Individuals seek information at various stages of the diffusion process to decrease uncertainty about its expected consequences.11 The decision leads to either rejection or adoption of the innovation and success or failure of the intervention.

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