The Whole World Will Be Able to See Us: Determining the Characteristics of a Culturally Appropriate Bed Net Among Mestizo Communities of the Peruvian Amazon

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Abstract. The Peruvian Ministry of Health has distributed insecticide-treated nets (ITNs) in the country’s Amazon region since 1999. Net use is nearly universal among mestizo communities in this area, but residents typically use non-impregnated muslin nets. We evaluated the cultural acceptability of Ministry ITNs using qualitative methods. Our results show that nets serve various functions for users: protection against insect bites, warmth, privacy, and a sense of security for young children. Because the Ministry-distributed ITNs could not fulfill these functions as well as traditional nets, many recipients disliked or rejected the ITNs they received. Also, because the ITN fabric stains rapidly, recipients washed their nets frequently rather than waiting 6 months as recommended. We propose a two-pronged approach that balances user and health system expectations of bed nets and that should lead to more widespread and effective ITN use in the study communities.

INTRODUCTION

Insecticide-treated bed nets (ITNs) have been used to reduce malaria morbidity and mortality in Africa and Asia for over a decade.1–3 Although ITN effectiveness for malaria control in the Americas remains controversial,4–6 a recent study in Colombia has demonstrated a significant effect.7 Among mestizo (Spanish-Amerindian) communities in the Peruvian Amazon, bed net use is nearly universal (A. Chan, unpublished data).8,9 Most residents of these communities use non-impregnated nets made of an opaque muslin-like fabric known locally as toquyo.

In response to a 1997 malaria outbreak, the Peruvian Ministry of Health (MOH) began indoor residual spraying and purchased and distributed muslin nets to heavily affected communities. In 1999, the Ministry purchased and distributed 37,000 deltamethrin-impregnated nets, followed by another 45,000 in 2000. These 82,000 ITNs were manufactured of white 156-mesh, 100-denier multifilament polyester, and treated with 25 mg/m² of K-Othrin (deltamethrin) by Siamdutch mosquito netting company (Bangkok, Thailand). These new ITNs were different in size, shape, material, and color from the muslin nets with which area residents were familiar.

The ITN acceptance can depend on a wide variety of social and cultural factors.10–14 The research activities described here were designed to evaluate the cultural acceptability of MOH-distributed nets and to develop recommendations that might improve ITN uptake. The results were part of a larger study on socio-anthropological aspects of malaria control in the Peruvian Amazon.

METHODS

In-depth interviews on bed net use. The study took place in Loreto, the largest department in Peru’s Amazon region from 2000 to 2002. All study villages were located within two hours travel of Iquitos, Loreto’s capital city. To better understand study zone residents’ experience with different nets, we carried out 28 in-depth interviews, 14 with ITN recipients and 14 with community officials, volunteer community health workers (CHWs) and MOH personnel. Interviews with net recipients took place in their home villages; those with health workers and officials took place in these same villages or in the health facilities serving them. The main selection criterion for net recipients was having received an MOH-distributed ITN in the 12 months before the study. The main criterion for health workers was having participated in ITN distribution. The health workers included three doctors, three local officials, four nurses, and five CHWs. Interviewers took detailed notes, which they transcribed immediately after each interview. The first author then used ATLAS.ti, a qualitative data analysis program, to code and analyze interview themes related to positive and negative attributes of traditional and MOH-distributed nets.

Ranking exercises for color and texture preference. After the interviews, we had study participants examine fabric swatches of several different colors and weaves and tell us what they saw as the benefits and drawbacks of each for a bed net. We obtained polyester swatches from Siamdutch. We obtained swatches of the three most commonly used local fabrics from the Belen central market in Iquitos, the place most area residents buy their traditional nets.

At the time of the study, Siamdutch produced polyester nets in five colors (light blue, pink, lime green, olive drab, and white) and fabric of four densities: 156 mesh (12 × 13 holes per square inch), 196 mesh (14 × 14 holes per square inch), triple (about 15 × 15), and jersey cloth (20 × 36). The three most popular local fabrics are single-ply muslin (toquyo simple), double-ply muslin (toquyo doble), and a more finely finished bleached cotton cloth often used for embroidery (tela playa). Bleached cotton cloth is considered the most desirable netting fabric by many because of its brighter white color and its softer feel after washing, but is used much less frequently than muslin (toquyo) because of its higher cost.

We assembled two separate sets of 16 × 20-cm swatches; one for colors, the other for weaves. Color swatches were all of identical 156-mesh, 75-denier multifilament polyester.
Weave swatches were all white or, in the case of muslin, off-white. To make swatches resemble nets in everyday use, we hand washed them with water and a local brand of laundry soap. The interviewer presented different color swatches to each interviewee in random order, asked the interviewee to examine each swatch, and then choose the best, most appropriate color for a mosquito net, then the second best, and so on. Once the interviewee had ranked all colors, the interviewer would point to the first choice and ask what about this color made it the best or most appropriate choice for a mosquito net. After noting the answer, the interviewer would point to the last choice and ask what made it least desirable. The interviewer then put away the color swatches and followed a similar procedure with the weave swatches. Each interviewee would examine and rank the swatches and explain the benefits of his or her first preference in weaves and the liabilities of his or her last preference.

We also asked each interviewee to discuss the advantages and disadvantages of tricot and jersey cloth if these were not chosen as the first or last option. We wanted to identify a polyester fabric that would be as acceptable (or nearly as acceptable) as muslin to the local population, because polyester has two important advantages over cotton for use in ITNs. It requires less insecticide than cotton, and the multifilament polyester used by most ITN manufacturers is designed to retain insecticide between the filaments of each thread. It thus remains effective much longer than when applied to cotton. Interview responses were entered into Microsoft Access (Microsoft Corp., Redmond, WA). Numerical data were entered into Microsoft Excel. Average scores were tabulated for each color and fabric type. Explanations of each interviewee’s choices were analyzed by hand.

This project was approved by the Johns Hopkins Bloomberg School of Public Health Committee on Human Research (CHR#: H.22.00.09.06.A), the Ethics Committee of the Asociación Benéfica PRISMA (CE211.00), and the DISA Loreto.

RESULTS

Advantages and disadvantages of MOH-distributed ITNs. Among interviewees who had received an MOH-distributed ITN, the most frequently mentioned positive characteristic was protection from mosquito bites. Some commented that ITNs were more effective than muslin at keeping mosquitoes out; others noted the numbers of mosquitoes and other insects that died after coming into contact with the net. Some specifically mentioned the net’s efficacy in preventing malaria. In the words of a 69-year-old man, “It’s hard to believe, but I haven’t been sick since I’ve been using this bed net. I think the illness runs away every time it sees the net [laughs].” Some users liked what they reported as the insecticide’s repellant effect: “The remedy [insecticide] keeps mosquitoes from getting too close,” said one respondent, “that’s one advantage of this net over the others.” For others, the main benefit of the insecticide was its ability to kill: “no sooner does an insect touch the net than it dies.”

Other positive characteristics mentioned by ITN users were the net’s size (large enough to cover a double bed), its aesthetic appeal (“better looking than the other net . . . more elegant and prettier”) and even that the insecticide had an agreeable smell. Many expressed appreciation for receiving the net at no cost: “I really do appreciate this gift,” said a woman, “because a lot of times people here don’t get much help, so we can’t even buy a bed net in Belen.” This sense of appreciation made some interviewees reluctant to say anything negative about the net or admit that they were not using it. As one woman put it, “the bad thing is that the material is very thin, but you just have to make do with what they give you, you can’t go complaining about a gift.”

Some net users liked the fact that the MOH ITN kept them cool at night, but many more complained that they felt too cold sleeping in it. Many interviewees observed that the nylon net would be comfortable in very hot weather or in other special circumstances (“when you’re pregnant, you feel hot all the time”), but most maintained that in an open structure like a rural house, it left them uncomfortably cold, especially late at night.

Tocuyo (muslin) is better because not much air gets in, it protects you better, it’s nice and warm. Nylon is good when you have a really well-built house (una casa bien segura), but when it’s made of wood like this, the air gets in, and you know that we’re humble people here and we don’t have a lot of sheets to keep us warm, so the air hits you in the face and you get sick . . . especially the kids, they’re always getting the flu or bronchitis (se enferman de los pulmones). Woman, age 46

One teenage girl admitted that because of the cold, her family had decided not to use the ITN.

“They had put it up, but since so much air came in we got cold. That same day, my mother put it back in the package and there it is, nice and clean, just like when they gave it to us.”

Nine of the 14 net recipients interviewed complained about the net being too cold; this was the most frequent of all complaints raised in the interviews.

Transparency, the fact that one can see through a polyester net, was also a frequently mentioned negative attribute. Many interviewees reported that children who use a transparent net get scared when they wake up in the middle of the night and can see out. Amazon communities have many stories about malevolent spirits, ghosts, and wild animals in the jungle. A real or imagined encounter with such a being can give a child susto, a potentially fatal illness in many Latin American ethnomedical systems. Furthermore, traditional Amazonian cosmology holds that seeing the ghost of a recently deceased relative or neighbor is one potential “cause” of malaria. Another negative aspect of transparency is failure to block out the sun. One interviewee reported that she had started using the MOH net because her 9-year-old daughter was afraid to sleep in it. But the woman found she didn’t like the net either, because it let in too much light, “and I have to sleep during the day because of my baby.” Finally, transparency also relates to privacy. In one interview, a health worker explained that bed net use in study area communities was something that had been passed down through many generations and would continue for many more:

Look, can’t you see that it’s the only way to have any privacy? Since everyone sleeps in the same room, one right
next to the other, if you have a partner, everyone’s going to be watching you. So the bed net becomes your ‘room.’

A net recipient explained that her son-in-law got very upset with the transparent ITN. “He said that the whole world would be able to see them, so my poor daughter had to take down her [new] net and put back up the old worn out tocuyo net.”

The most frequent comment about the MOH-distributed ITNs, with respect to color, was that the white fabric soiled rapidly. Many interviewees explained that smoke from the wood used for cooking quickly discolors the material. Dust, especially in houses with dirt floors, also contributes to dirtying nets, especially since children often go to bed without washing their hands or feet. Another source of stains is the small home-made kerosene lamps (mecheros) that for many are the principal light source in villages with no electricity. Parents with babies and toddlers often leave their mecheros burning throughout the night to make diaper changing easier. Some people read with kerosene lamps alongside or inside their nets. Even without young children, some families sleep with a kerosene lamp lit simply to have light at night. Stains from dust, smoke, or soot are the most commonly mentioned reasons for washing the white ITNs frequently. Muslin nets also require frequent washing; indeed most households in the study area report washing their nets bi-weekly. But muslin nets have not traditionally been treated with insecticide, so there is no drawback to frequent washing. ITN recipients instructed not to wash their nylon nets for as long as six months found this advice nonsensical and impossible to follow.

If interviewees did not mention it in their description of the ITN, we asked about whether the net had any smell. We wanted to determine if the acrid odor from the insecticide was a factor in anyone’s decision about whether to use their net. For most interviewees, odor seemed relatively unimportant. Few mentioned it spontaneously. When asked about it, some said they had not noticed any particular smell. Others de-scribed it as “light,” “agreeable,” or “pleasant.” In the words of one 12-year-old girl, “it just had that smell of new cloth, of something clean, like when someone buys you something new.” One 34-year-old woman reported having a light headache after first using the net, but said she would put up with it again because she was able to sleep much more peacefully after the insecticide had killed all the mosquitoes. Two net recipients described the smell as unpleasant. Three health workers reported hearing complaints about the smell from net recipients. One said he had stored his nets until the odor faded. A 69-year-old woman reported that her net had no smell, adding, “if I had smelled anything, I wouldn’t have used it no matter how good they told me it was.” This opinion, however, was very much in the minority.

**Bed net fabric preferences.** Weave and color rankings appear in Table 1. Bleached cotton (tela playa) was the favorite choice among netting fabrics. Light blue was the first color choice and pink the second for both men and women. Among the synthetic fabrics, jersey cloth was most popular. Least favored were 156- and 196-mesh as can be seen from the large difference in score between tricot (ranked fifth) and the other two.

**Table 1**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Weave</th>
<th>Color</th>
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<tbody>
<tr>
<td>1</td>
<td>Bleached cotton (2.11)</td>
<td>Light blue (1.95)</td>
</tr>
<tr>
<td>2</td>
<td>Single-ply muslin (2.58)</td>
<td>Pink (2.42)</td>
</tr>
<tr>
<td>3</td>
<td>Jersey cloth (3.45)</td>
<td>Lime green (3.11)</td>
</tr>
<tr>
<td>4</td>
<td>Double-ply muslin (3.61)</td>
<td>White (3.66)</td>
</tr>
<tr>
<td>5</td>
<td>Tri Cot (3.92)</td>
<td>Olive drab (3.87)</td>
</tr>
<tr>
<td>6</td>
<td>156-mesh (6.16)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>196-mesh (6.16)</td>
<td></td>
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*Note. Scores indicate interviewee preference order (1 = first preference, etc.), so a lower score indicates a higher preference and vice versa. Score was tied for 156- and 196-mesh.*

Beyond the rankings themselves, participant comments about the different color and weave choices provided much useful information about the necessary attributes of a more culturally appropriate synthetic ITN. Participants described light blue, the top choice in colors, as “beautiful,” “elegant,” “bright,” and “cheerful.” They said it would make the house look more attractive and would look pretty hanging over the bed. The other frequent comment about blue was that it would show dirt less readily and therefore require less frequent washing. By contrast, participants described olive drab, the least popular color, as “tired,” “ugly,” “too dark,” “depressing,” and “lifeless.” For many, it conjured up unpleasant military connotations. “It would make me sad,” said a 52-year-old woman, “it seems like a color for soldiers . . . for them it’s OK, but I don’t like it.” “It’s not an attractive color,” explained a 37-year-old man. “It wouldn’t stand out in your house; it wouldn’t look good in your room.” Some respondents also said it would be difficult to know when a net of this color needed washing: it would seem dirty all the time. Although olive drab was least favorite overall, 12 of the 38 interviewees selected white as their least preferred color. All 12 said the same thing: it shows dirt too quickly and requires frequent washing.

Participants expressed a preference for bleached cotton over other fabric choices because of its tight weave and soft feel. They noted that, like muslin, bleached cotton would protect them against even the small biting sand fleas (manta blanca) common to the area, but that unlike muslin the fabric’s texture was not hard or rough. Bleached cotton allows enough airflow to remain relatively cool during the day without getting too cold at night. Finally, the fabric’s opaqueness provided good privacy and good protection for children. “No one would be able to see you,” commented a 28-year-old man, “I have my kids, but we sleep in the same room, so [with a lighter fabric] they would be able to see their mother and me.” “With this fabric, you wouldn’t be exposing your children’s souls to the night air (no les vas a airear el alma),” said a 30-year-old woman. “Here in the jungle, the souls [of the dead] are wandering about . . . the spirits, what we call here ‘el tunchi,’ loves to come after children and they get frightened.”

The 156- and 196-mesh netting swatches look almost identical, which probably explains their tied ranking for least preferred fabric. Comments about 156-mesh were almost the exact opposite of those about bleached cotton: a net made of this material would provide inadequate protection against insects, would be too cold, and would wear out quickly. “Mosquitoes, flies, biting fleas could all get in at night,” said a 30-year-old woman. “I couldn’t sleep in a bed net like this.”
“The mesh is too big,” explained a 23 year old man. “That might be OK for fancy people (pitucos) in the city, but not for us: with holes this big, the mosquitoes and flies would eat us alive.”

Interviewees had mixed reactions to the jersey cloth. Although it ranked third in terms of fabric preferences after bleached cotton and single-ply muslin, the absolute distance (0.87) between jersey cloth and single-ply muslin was nearly twice that of the distance (0.47) between options one and two (bleached cotton and single-ply muslin). Participant comments reflect this less clear consensus: interviewees described the material as too transparent, but also said its tighter weave would provide good protection against even the smallest insects. Some noted that it would be easier to wash and quicker to dry than muslin, others thought it might be too cold at certain times of the year. Some described the material as much more durable than 156 mesh, others expressed concern that it would melt if it got too close to a kerosene lamp flame or if they tried to kill a mosquito that had slipped inside.*

**DISCUSSION**

Our data demonstrate that, for users, bed nets serve functions beyond protection against disease: they provide warmth, privacy, and a sense of security for children. Table 2 compares user versus health system perspectives on key net attributes. Users may reject ITNs that fail to fulfill their needs. Aesthetic appeal may not be decisive, but for net users it is at least an important secondary concern. Potential users are more likely to use a net if they find it attractive and believe it will make their homes more cheerful or beautiful. Cleanliness and hygiene, on the other hand, carry significant weight. Study area residents stress the importance of keeping their nets clean. If the malaria control program hopes to prolong the residual effect of the insecticide by limiting the number of times users wash their nets, it will need to find a color that does not stain or show dirt quickly. As study participants emphasized repeatedly, white fabric is a poor choice: the pervasive smoke, soot, and dust in the household environment will soil the net and lead to frequent washings. Long-lasting ITNs (LLITNs)—not yet commercially available at the time of this study—might offer a partial solution: under ideal conditions, LLITNs remain 80% effective for up to 20 washings. But with bi-weekly washings, even an LLITN would last slightly less than a year, and field conditions are rarely ideal.17

What would constitute an acceptable compromise between the community’s need for warmth, privacy, security, aesthetic appeal, and protection from small biting insects versus the health system’s need to encourage adoption of ITNs and maximize the residual effect of the insecticide? Our findings suggest two possible answers. The first would be to promote home-based impregnation of muslin nets. Treating muslin nets is not ideal from the perspective of maximizing the residual effect of the insecticide, but it better addresses community priorities not specifically related to disease control, and it probably offers better protection than an untreated muslin net. The second would be to promote use of a more densely woven multifilament polyester net in a color (or choice of colors) that residents find attractive. Such a net would cost slightly more than 156-mesh white polyester, but area residents would also be more likely to use it. It might only partly address the need for privacy, warmth, and security, but it would make insecticide use more efficient, and users would probably feel less need to wash it frequently. Given those options, some households would probably choose one, whereas some would choose the other, but the overall effect would be increased protection.

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* Many people kill insects that get inside a bed net by burning them with a cigarette, a match, or a mechero flame. As one informant explained, “When you want to burn a mosquito that’s landed on the net, you wind up burning the fabric. A cigar would put a hole in the net, melt it.”

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**Table 2**

<table>
<thead>
<tr>
<th>Functions</th>
<th>Health officials</th>
<th>Users</th>
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<tbody>
<tr>
<td>Protection against infective mosquito bites at key times</td>
<td>Protection against 1) all insect bites, 2) cold, 3) malevolent spirits</td>
<td></td>
</tr>
<tr>
<td>Insecticide impregnation</td>
<td>Privacy</td>
<td>Privacy</td>
</tr>
<tr>
<td>Good retention of insecticide</td>
<td>Esthetic appeal</td>
<td>Esthetic appeal</td>
</tr>
<tr>
<td>Stain and odor resistance</td>
<td>Remains clean (unstained, free of unpleasant odors)</td>
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<tr>
<td>Opaque or semi-opaque fabric that reduces air-flow</td>
<td>Adds beauty to the house</td>
<td></td>
</tr>
<tr>
<td>Color other than white</td>
<td>Individual or family use</td>
<td></td>
</tr>
<tr>
<td>Infrequent washing</td>
<td>Frequent washing</td>
<td></td>
</tr>
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REFERENCES


