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Willingness to pay for the retreatment of mosquito nets with insecticide in four communities of south-eastern Nigeria

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Summary

OBJECTIVES To determine the willingness to pay (WTP) for the retreatment of insecticide-treated nets (ITN) in four malaria holoendemic communities of Nigeria.

METHODS Contingent valuation method. The study tool was a pretested interviewer-administered questionnaire. Randomly selected households were the study units and household heads or their representatives were interviewed by locally trained interviewers.

RESULTS Most households were willing to pay for annual ITN retreatment in all four communities. The proportion of those willing to pay ranged from 79% to 91%. WTP amounts ranged from \$0.05 to \$5.26. The median from the aggregated data from the four communities was \$0.21. Multivariate analysis showed that many explanatory variables were statistically significantly related to WTP for ITN retreatment.

CONCLUSION WTP for ITN retreatment exists. The difficulty lies in implementing this. One possibility would be a community-based ITN retreatment programme.

keywords insecticide-treated nets, retreatment, mosquito, malaria, willingness to pay

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Introduction

Insecticide-treated nets (ITNs) are one of the most attractive malaria control measures that are gradually being introduced in Africa. Mosquito nets are not new to Nigeria; they have been in use for decades as door, window or bednets. What is new is the use of mosquito nets treated with pyrethroid insecticides (ITNs). ITNs could become a cost-effective method for preventing malaria in Nigeria, where the disease is the number one public health problem. Trials have shown the advantages of insecticide-treated nets over untreated nets (Sexton 1994; Lengeler *et al.* 1996; Nevill *et al.* 1996). ITNs have been proved to be cost-effective especially against childhood malaria in Ghana, Kenya and in The Gambia (D'Alessandro *et al.* 1995a; Binka *et al.* 1996; Nevill *et al.* 1996). Though the first task in communities may be to increase net coverage, the Gambian trials with ITNs have amply demonstrated the additional benefits of treating nets (D'Alessandro *et al.* 1995a,b), and users are already very sensitive to the difference.

A critical issue with ITNs is that depending on the type of pyrethroid used, they must be re-treated once or twice a year to retain optimal effectiveness. The budgetary constraints of governments and absence of donor efforts preclude the availability of free net treatment or retreatment services in Nigeria. Thus net owners must be ready to procure the insecticide at least once yearly and either retreat them themselves or pay somebody to do it. If there is no willingness to regularly retreat the ITNs, they will gradually lose all insecticide and become ordinary mosquito nets with all their antecedent disadvantages. Thus, it is vital to determine the willingness to pay for retreatment of households living in communities where ITN programmes are to be introduced, as this will shed light on their probable sustainability.

We used the contingent valuation method to determine the willingness to pay (WTP) for yearly retreatment of ITN in four malaria holoendemic communities of Nigeria. Respondents were presented with a hypothetical market through a scenario and then asked to make their maximum WTP bids. Contingent valuation has mostly been used in

environmental and agricultural economics within the framework of cost-benefit analysis. However, the literature on its use in healthcare is growing (Diener *et al.* 1998). Logsdon *et al.* (1983) used the technique to determine patients' WTP for extra preventive care insurance coverage, and Mills *et al.* (1994) employed it to ascertain WTP for the insecticides in The Gambia. Weaver *et al.* (1996), Walraven (1996), Asenso-Okyere *et al.* (1997), Onwujekwe *et al.* (1998) and Mathiyazhagan (1998) used the technique to determine the WTP for a variety of healthcare goods and services. Golan and Schecter (1993) found that the WTP method is adaptable to the special nature of healthcare commodities while adhering to the conditions of reliability and validity in contingent valuation study, and is therefore acceptable for determining the WTP for ITN re-impregnation (Mills *et al.* 1994). The information from this study should assist policy makers and programme managers in developing and implementing effective and sustainable ITN retreatment programmes where needed.

Materials and methods

The study was conducted in four communities of Enugu State, Nigeria: Alor-uno and Ibagwa ani in Nsukka Local Government Area (LGA); Mbano in Enugu-East LGA; and Orba in Udenu LGA. All are Ibo tribal communities. Each community is subdivided into villages, comprising a collection of households called *Umunna*, which sometimes live together in a compound. In Ibo culture, each household formulates its own decisions and this may be at variance with the collective decisions of a compound. All have traditional rulers called *Igwe*, who are supported by a traditional cabinet, and all have town unions which can be seen as the legislative arm of the traditional government.

Study design

The study design was cross-sectional. The study team in conjunction with local field workers drew up a comprehensive household list in the communities, using the existing primary health care (PHC) house numbering system for guidance. With the household list as the sampling frame, 400 households were selected using systematic sampling from each of the four communities, except in Mbano where 440 were selected due to the larger size of that community. The household heads or their representatives (if the household head was not available) were interviewed. A household is in this case defined as a man, his wife or wives, their unmarried sons and daughters, live-in-relatives, servants and aged/senile parents. Ethical clearance for the study was given by the University of Nigeria Teaching Hospital, Enugu. Additional consent was obtained from the traditional ruler of each community and respondents were given the option to decline.

Willingness to pay determination

The study tool was a pretested interviewer-administered questionnaire. A bidding game was used to elicit the WTP bids in three communities while the *close-ended method with follow-up* was used in Orba. In the close-ended method with follow-up, the respondent is offered a price and asked to simply accept or reject it. Then, the answer is followed by an open-ended question asking the maximum amount the respondent is willing to pay. Trained local interviewers administered the questionnaire. This reassured the respondents that the exercise was not for levy or tax purposes. However, they were told that the provision of the service was dependent on what they said and that they will be expected to pay what they volunteer they are willing to pay. The questionnaire was pilot-tested with 200 residents in a rural suburb of Enugu and the wording, content, and coding of responses were modified accordingly. A simple scenario on the use and mode of delivery of the retreatment was presented to respondents before asking them to make their WTP bids. Our survey was part of a bigger scheme to determine WTP for insecticide-treated nets (ITN). Therefore, the overall scenario presented in determining WTP for ITN already had comprehensive information as to mode of action, benefits and adverse effects of the insecticides. The scenario shown in Appendix 1 was presented in addition to the scenario for ITNs, and was used to facilitate the bidding game for net retreatment. Respondents were allowed three bids, with the last bid representing their maximum WTP. In Orba, no more than one follow-up question was used to elicit maximum WTP. The questionnaire also contained questions on personal data and socio-economic status of the households.

Theoretical validity

One test of validity in a contingent valuation study is to assess whether the hypothesized theoretical relationships are supported by the data (Mitchell & Carson 1989). We used ordinary-least squares multiple regression analysis of WTP *vs.* independent variables. WTP for the retreatment of ITN was the dependent variable. A respondent's or household's willingness to pay is assumed to be a function of economic characteristics and malaria-specific variables. Malaria specific-variables were the households' priority ranking of malaria and the average monthly household expenditure to treat it. The respondents' WTP for ITN was included as an independent variable. Economic variables were the average monthly expenditure for food and annual expenditure on gifts. Dummy variables for residence were also included. All these variables were chosen based on the assumption that they will best explain WTP for ITN retreatment, and are described in Appendix 2.

The theoretical relationships between these variables and WTP are varied. Perception of malaria risk will naturally increase the WTP for its prevention. Also, current presence of

Table 1 WTP for ITN reimpregnation in four communities

	Ibagwa-ani	Alor-uno	Mbano	Orba
Willing to pay	312/395 (79%)	287/324 (89%)	359/430 (84%)	335/370 (91%)
Mean	23.80Naira($0.25)	25.14Naira($0.27)	35.91Naira($0.38)	35.71Naira($0.38)(S.D)
(S.D.)	(17.22)	(33.12)	(15.27)	(40.55)
Median	$0.21	$0.21	$0.32	$0.21
Minimum & maximum	$0.05 – $2.11	$1.05 – $5.26	$0.11 – $1.05	$0.11 – $2.11

malaria and expenditures on curative care could deplete households' income, making them unwilling to pay for preventive interventions in the short term. However, since ITN retreatment will occur at least 6 months from the time of the interview, they are expected to be WTP in the future to avoid further malaria attacks at that time due to the depleted income. The higher the priority ranking of malaria, the higher the WTP should be for its retreatment. In the same vein, the more willing they are to pay for ITNs, the more willing they should be to pay for its retreatment. Also, the more a household spends on the expenditure items named above, the more they will be WTP for ITN.

Data analysis

Using tabulations and ordinary-least squares multiple regression, the data from three of the communities where the bidding game was played were pooled and a multiple regression model specified. Each community was entered as a dummy variable in the model to allow for community differences to be determined. WTP for ITN retreatment was the dependent variable. The explanatory variables were socio-economic data which included respondents' age, expenditure to treat malaria during previous month, type of savings scheme embarked upon, yearly expenditures on clothing and celebrations, and the communities which were entered as dummy variables.

Results

Respondents' characteristics

Usable questionnaires for analysis from the communities numbered 395, 430, 324 and 370 for Ibagwa-ani, Mbano, Alor-uno and Orba, respectively. Males formed the majority of respondents in all communities, and most of the respondents were household heads (Appendix 3). In Ibagwa-ani and Mbano, most were aged 41–60 years, while in Alor-uno and Orba the majority were 20–40. Most had either no or primary education. Subsistence farming was the commonest primary occupation in Ibagwa-ani and Mbano while it was small-time business/skilled labour in Aloruno and Orba. Most respondents in all communities were married.

Table 2 Mean and median WTP from a pooled data from four communities

Mean	30.54 Naira ($0.32)
(S.D)	(28.92)
Median	$0.21
Minimum – maximum	$0.05 – $5.26

Willingness to pay for ITN re-impregnation

The proportion of respondents willing to pay for ITN retreatment ranged from 79% to 91% in the four communities (Table 1). The WTP amounts ranged from $0.05 to $5.26. The mean WTP was $0.25 in Ibagwa-ani, $0.27 in Alor-uno, $0.38 in Mbano and $0.38 in Orba. The median WTP was $0.21 in three communities except in Mbano where it was $0.32. The combined data from the four communities showed a mean of $0.32 and a median of $0.21 (Table 2).

Ordinary-least squares multiple regression analysis

The result is summarized in Table 3. Adjusted r^2 was 0.217 and the regression was statistically significant ($P < 0.0001$). The residences were positively associated with WTP for reimpregnation though only Mbano was statistically significant at $P < 0.05$. The maximum amount respondents stated they were willing to pay for ITNs themselves was positively associated with WTP for re-impregnation ($P < 0.0001$). Household savings was also positively associated with WTP for re-impregnation ($P < 0.05$). The other variables had the expected signs but were statistically insignificant.

Discussion

The result showed that most households in the four study communities were willing to pay for annual ITN retreatment. The aggregated data from the five communities showed a median WTP of $0.21. Whether this will be adequate to cover the cost of net retreatment will depend on the current prices and market situation. This is an issue that needs further evaluation. In a study in The Gambia by Mills *et al.* (1994),

Table 3 OLS-multiple regression analysis of WTP for reimpregnation *vs.* independent variables

Variables	Coefficient	Standard error	Significance level
Constant	1.458	12.165	0.905
Ibagwa-ani	9.428	8.918	0.292
Mbano-Nike	21.642	8.964	0.017
Priority ranking	2.155	3.203	0.502
Willingness to pay for ITN	0.0052	0.014	0.001
Expenditure to treat malaria	0.0002	0.003	0.482
Household savings	3.417	1.418	0.017
Expenditure on food	0.0001	0.000	0.074
Expenditure on celebrations	0.0001	0.000	0.155

Adjusted $R^2 = 0.217$; Standard error = 20.16; F-test = 9.004; Significance level < 0.0001

respondents were asked how much compounds might be willing to pay for insecticide impregnation: the most frequently cited maximum amounts were D5 and 10, and minimum D1 and 5 (D15 = £1). The test of theoretical validity of the results using ordinary-least squares multiple regression showed the regression to be statistically significant. Willingness to pay for ITNs themselves was the most statistically significant variable that explained the willingness to pay for the retreatment. Thus the more willing people are to pay for ITN, the more willing they are to pay for the retreatment since they will want the ITN to continue being effective. This aspect of the result strengthens the expectation that once households start buying ITNs, they will continue to ensure they retain their effectiveness by continually retreating them.

Generally, considerations of the costs of ITN retreatment may influence the willingness of people to pay. Besides this general consideration, other factors such as reduction in number of malaria episodes, the mosquito nuisance factor, reduction in work and school days lost could explain why households that had current episodes of malaria and that incurred malaria treatment costs either during or in the month prior to the field survey were more willing to pay for the retreatment of ITNS. It is possible that the low opening bid amount signalled to them that the cost was not high. The positive and significant association of current household expenditure to treat malaria and WTP showed that malaria episodes in a household motivate people to seek protection especially if the anticipated costs are minimal in comparison with what they paid or are paying for malaria treatment.

The ability of the households to pay for net retreatment is another important issue. If it is low, the sustainability of the intervention will be jeopardised, especially since the commonest reason for unwillingness to pay for ITN retreatment was lack of money. The second most important reason was doubt about long-term availability and effectiveness of the insecticide. However, the unit cost of re-treating an ITN annually will consume only 0.03% of total annual household expenditure on basic items (Onwujekwe 1999). Thus, ITN retreatment would be affordable to most households.

How can the results obtained from the survey be used for the design and widespread community implementation of an ITN retreatment programme? If this is not done properly, those not included in the survey may feel alienated and unconcerned about the scheme for two reasons: since they did not have the benefit of being presented with the scenario and other associated information, they may not understand the scheme and therefore may not patronize it when implemented, and in extreme cases they may even carry false propaganda against it. Secondly, because they may not understand the scientific process of random sampling, they may believe that they were purposely by-passed in the survey because of perceived lack of importance in the community. This may catalyse them into resisting participating in the programme.

An approach towards surmounting these hindrances is through broad-based community mobilization through advocacy visits to key community leaders, talks at village assemblies, churches and animist worship areas. A key mobilization tool will be the survey results and explanations of the scientific process of random sampling and generalisability of the results. Talks in secondary and primary schools and enlisting pupils to educate their households in particular and their villages as a whole could help mobilize and educate the community households on the benefits of the programme. The particular community town union subcommittee that will manage the ITN retreatment needs to be involved in all these processes. Thus, through this broad-based community outreach approach, the results will become meaningful to all and be translated into positive action by the communities. However, comprehensive factors associated with regular retreatment of nets should be elucidated, understood and incorporated into either any marketing activity for ITN or any other programmes for mass introduction of ITN in the communities.

The schedule of programme implementation as given in the scenario should be adhered to in implementing ITN retreat-

ment in these communities. A critical issue for those initiating community-based ITN programmes is to ensure that the insecticides are there when needed. Again, because many community members may not be financially able to pay and participate when the central retreatment is done, a payment system that will counteract this problem should be implemented. This may entail prepayment before the retreatment, and this means that adequate local managerial framework for the collection and management of the funds has to be set up. Luckily, most if not all communities in south-eastern Nigeria have established community town unions with subcommittees responsible for health matters who have experience in funds and project management since they are responsible for collecting and managing funds meant for community development projects. They also supervise the execution of these projects. Thus, the responsibility for local ITN retreatment could be given to them, and they will be supported with logistic and technical support by the initiating body.

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Appendix I

The Scenario

As already mentioned, the bed nets need retreatment with the special chemicals at least once yearly for them to function effectively as the effect of the insecticide wears out with time. The nets should not be washed until the time of retreatment as washing reduces their effect. This retreatment would be easily done by selected community members at a central place in your community. What is the maximum amount that you are willing to pay (per net) to have the net(s) in your household re-treated once yearly?

Appendix 2

Description of the independent variables

Short name of variables	Description	Measurement
Mbano	Measured the household's residency in Mbano as a dummy variable.	1 = if resident in Mbano 0 = if otherwise
Ibagwa-ani	Measured the household's residency in Ibagwa-ani as a dummy variable.	1 = if resident in Ibagwa-ani 0 = if otherwise
Priority ranking	Measured household's priority ranking of malaria as a dummy variable.	1 = if malaria is a priority problem 0 = if otherwise
Households' expenditure on malaria	Measured the average household's expenditure to treat malaria within the past month.	Continuous monetary measure
WTP for ITN	Measured the respondents willingness to pay for family size ITNs	Continuous monetary measure
Households' savings	Measured the level of savings scheme embarked on by household members.	1. Has no savings 2. Saves in the house 3. Saves with co-operative society 4. Saves in the bank
Expenditure on food	Average monthly household expenditure for food	Continuous monetary measure
Expenditure on celebrations	Average annual household expenditure for various types of celebration	Continuous monetary measure

Appendix 3

Personal data of respondents

	Ibagwa-ani *n* (%)	Mbano *n* (%)	Alor-uno *n* (%)	Orba *n* (%)
Sex				
Male	217 (54.94)	347 (80.70)	166 (51.23)	292 (78.92)
Female	178 (45.06)	83 (19.30)	158 (48.77)	78 (21.08)
Total	395 (100)	430 (100)	324 (100)	370 (100)
Status				
Head	270 (68.30)	365 (84.90)	198 (61.11)	264 (71.35)
Representative	125 (31.67)	65 (15.10)	126 (38.89)	106 (28.65)
Total	395 (100)	430 (100)	324 (100)	370 (100)
Age group				
< 20	64 (16.20)	2 (0.47)	17 (5.25)	7 (1.89)
20–40	136 (34.43)	164 (38.14)	149 (45.99)	190 (51.35)
41–60	141 (35.69)	201 (46.74)	121 (37.35)	131 (35.41)
⩾ 60	54 (13.68)	63 (14.65)	37 (11.41)	42 (11.35)
Total	395 (100)	430 (100)	324 (100)	370 (100)
Education				
None	217 (54.94)	178 (41.40)	128 (39.51)	61 (16.49)
Primary	130 (32.91)	170 (39.54)	130 (40.12)	189 (51.08)
Secondary	39 (9.87)	42 (9.76)	44 (13.58)	85 (22.97)
Tertiary	9 (2.28)	40 (9.30)	22 (6.79)	35 (9.46)
Total	395 (100)	430 (100)	324 (100)	370 (100)
Occupation				
Unemployed	25 (6.33)	28 (6.51)	30 (9.26)	21 (5.68)
Unskilled labourer	–	4 (0.93)	16 (4.94)	14 (3.78)
Farmer	266 (67.34)	321 (74.65)	102 (31.48)	67 (18.11)
Skilled labourer/small business	74 (18.73)	30 (6.98)	139 (42.90)	200 (54.05)
Government worker	26 (6.58)	45 (10.46)	31 (9.56)	35 (9.46)
Private company employee	3 (0.76)	2 (0.47)	3 (0.93)	27 (7.30)

Medium business	1 (0.25)	–	3 (0.93)	2 (0.54)
Professional and big business	–	–	–	1 (0.27)
Professional	–	–	–	3 (0.81)
Total	395 (100)	430 (100)	324 (100)	370 (100)
Marital status				
Single	41 (10.38)	43 (10.00)	50 (15.43)	83 (22.43)
Married	264 (66.83)	321 (74.70)	196 (60.49)	259 (70.00)
Divorced or separated	78 (19.75)	56 (13.00)	65 (20.06)	24 (6.49)
Widowed	12 (3.04)	10 (2.30)	13 (4.01)	4 (1.08)
Total	395 (100)	430 (100)	324 (100)	370 (100)