

# Free Distribution or Cost-Sharing?: Evidence from a Randomized Malaria Prevention Experiment

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## How should we price public health products?

- Generally accepted that products with social/community benefits (e.g. vaccines) should be publicly-funded
  - Uptake at unregulated price too low
- But how much should they be subsidized?
- Figuring out the “optimal” price, if even possible, is time-consuming and expensive
- So with most public health products, **there is no “correct answer”** and we use rules of thumb and trial/error for pricing...

## Free Distribution vs. Cost-Sharing

- Two common models for public health programs in Africa are full-subsidization (zero financial price) and moderate cost-sharing (user fees)
- Arguments for and against both of these models have been advanced

## Example: ITNs

- ITNs great example of the type of product where appropriate pricing is contestable
- Why?
  - **Strong social benefits** (for non-users) + High cost relative to income  
→ITNs should be subsidized
- However:
  - **Strong private benefits** in terms of health (e.g. child mortality, anemia, etc.) & lost income (for treatment + lost wages)  
→People should be willing to pay

## Arguments for Cost-Sharing: Sustainability + Targeting

- Cost-recovery allows tight budgets to stretch further and allows sustainable retail sector to emerge/persist
  - What if donor money dries up or government initiative goes elsewhere?
- Higher prices imply that those who get ITNs are the ones who need them (i.e. the sickest/most vulnerable) and will use them
  - Valuable resources wasted on some people getting free ITNs who don't need or value them

## Arguments for Full Subsidization: Demand, Cost-Effectiveness & Ability to Pay

- Coverage may be much lower under cost-sharing (even moderate prices) than free distribution
- Even if use increases at higher prices, “effective coverage” may be much lower
- Particularly important w/ ITNs because of the form of the community effect: at least 50% coverage needed for big social benefits to emerge
  - High C/E of ITNs is partly due to social benefits
- In extreme poverty (& gender inequality), those who value ITN most may be the *least* able to pay & screened *out* by higher prices

## What are the Tradeoffs between Free Distribution & Cost-Sharing?

Arguments on both sides make sense, however:

- Very limited empirical evidence to support them
- How do different effects of prices interact to determine ITN coverage and health outcomes?

In the end, optimal pricing will depend on:

- 1) How **uptake** responds to price
- 2) How **usage** responds to price
- 3) How “**neediness**” responds to price
- 4) How (1) – (3) combine to yield **effective coverage**, determining level of **social benefits**

## Our Approach: Randomized Trial of ITNs

- Randomize price prenatal clinics in Western Kenya can sell LL ITNs to pregnant women from zero to just below prevailing cost-sharing (PSI) price
- 4 **control** clinics, 5 clinics **0Ksh**, 5 clinics **10Ksh** (\$.15), 3 clinics **20Ksh**, 3 clinics **40Ksh** (90% subsidy)
  - Highest price is \$0.15 below prevailing cost-sharing price in this region (PSI)
- Clinics chosen from about 70 in the area (all public) based on size, services offered, and distance
- Program lasted at least 3 months



## Outcomes Measured

Want to know how variation in price affects:

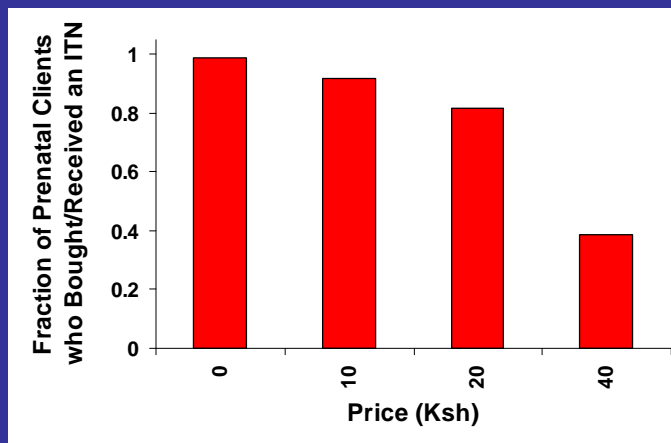
- (1) **Demand/Uptake** (measured with clinic surveys on random days)
- (2) **Need** (measured with hemoglobin at visit)
- (3) **Usage** (measured with home visits 1- 2 months after purchase)

Combine these estimates in a model of cost-effectiveness of ITNs on child mortality that incorporates the private and social benefits of ITN use (i.e. effect on users and non-users)

## Results: Uptake

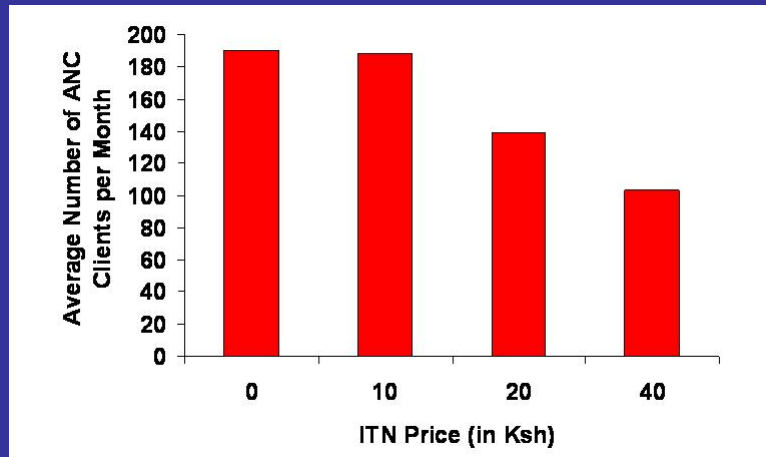
- Uptake drops significantly at modest prices (10Ksh increase in price implies 20% decrease)
- No big fall in uptake with small increase from 0
- Uptake drops increasingly rapidly with price
- Incentive effect of lower prices on ANC attendance
- Sensitivity to price slightly higher for women in first visit and lower for women in first pregnancy
- If 100 women take net for free, 25 of them will buy it at PSI cost-sharing price

## Demand for ITNs: Share of Prenatal Clients Buying/Receiving ITN by Price



- Estimates imply that of 100 women who take free ITN, 40 would pay 40Ksh and 25 would pay PSI price (50Ksh)

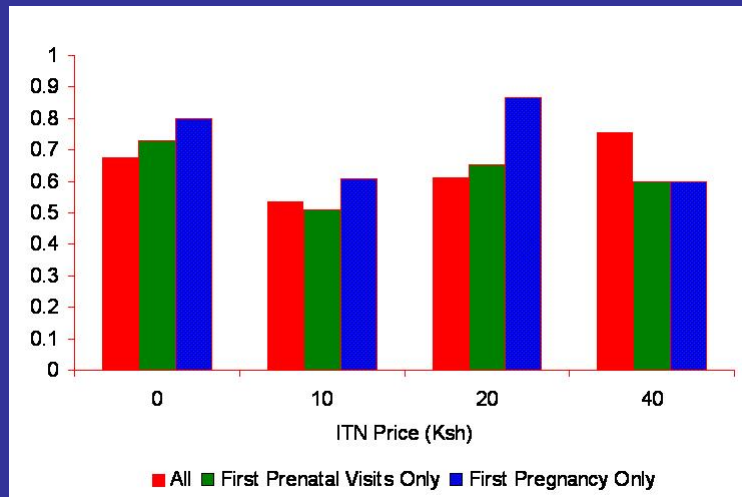
## Demand for ITNs: Monthly Prenatal Visits by ITN Price



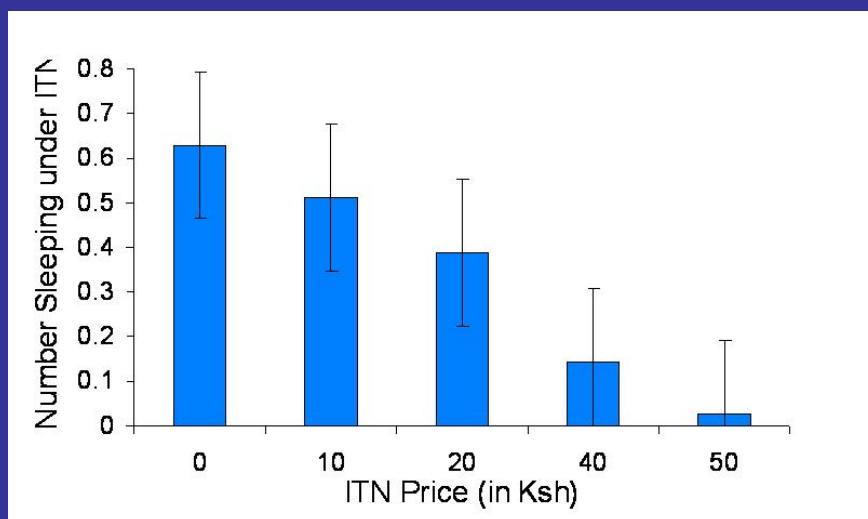
## Results: Usage

- 60 – 70% usage rates
- No evidence that usage is increasing with price
- Use increasing with time since purchase, birth of child & for first pregnancy
  - Most important reasons for non-use were waiting for birth of child or possession of another ITN
- None of women re-sold net & 95% of those claiming to be using net had it hanging
- Similar to uptake results, no big difference between zero & positive prices
- Combining uptake and usage: 63% of women covered by ITN under free distribution, versus 14% at 40Ksh

## ITN Usage Rates by Price: Share of “Takers” who Report Using ITN at Home



## Effective Coverage: Share of Prenatal Clients Sleeping Under ITN, by Price



## Targeting Effects of Price on Health

- Want to know if higher prices encourage purchase by vulnerable women (i.e. sickest)
- Ability of prices to target neediest depends on relative effect of "willingness" vs. "ability" to pay
  - Sicker women probably willing to pay more
  - Sicker women probably able to pay less
- Use hemoglobin at clinic visit to measure need
  - Hb is morbidity measure sensitive to presence of malaria in pregnant women
  - Anemic women likely to be those with most exposure & least resistance to malaria

## Results on Selection

- Compare hemoglobin of women buying/receiving net at each price to that of control group
  - Buyers at 10 & 20Ksh: **same as control**
  - Buyers at 40Ksh: **somewhat healthier than control**
  - Takers of free net: **significantly healthier than control**
- Women taking free ITN 20% less likely to be anemic
- Higher prices do not select sicker women, but free net selects healthier women. Why?
  - Strong incentive of low price ITNs on prenatal attendance
  - Women coming for free net came back for revisit sooner, and walk further/paid more for visit than control

## Cost-Effectiveness Analysis

- Combine uptake and usage estimates in C/E model of ITNs at each price in **reducing child mortality**
- Relative C/E of each price depends on 2 key factors:
  - (1) Protection to user from **physical barrier of net**
  - (2) # of users necessary for **strong community effects**
- Due to high uptake, **number of child lives saved highest under free distribution**
- At most commonly-cited values of (1) and (2), **free distribution is more cost-effective than cost-sharing**
  - Cost-sharing can be more cost-effective if threshold for mass effects is low
- Impact of these distribution schemes depend heavily on **prenatal attendance** and **fertility rate**

## Program Context

- Conducted in area w/ **high baseline valuation of ITNs**
  - Vulnerable population, incurred costs to come to clinic
  - ITNs socially-marketed/sold in shops: value is known
- **Existing cost-sharing** for pregnant women
  - => Are new consumers of ITNs the most price-sensitive?  
If so, how can we understand results on usage?
- ITN distribution through **Measles Initiative** (2006)
  - Results on sample with first pregnancy are similar
  - Our results can be interpreted in context of “keep up”
- **Big clinic incentives**: we don't find much leakage
  - => Would c/e results change under normal conditions?

## Conclusions

- This evaluation seeks to fill two gaps in debate over pricing of ITNs:
  - (1) Is conventional wisdom about price targeting and selection correct in this case?
  - (2) How do benefits from price targeting combine with demand response to yield effective coverage rates?
- We find that cost-sharing for ITNs cannot offset what is lost in demand by improved targeting toward those who value it most
- Results suggest that in this context, free distribution is more effective, and possibly more cost-effective than cost-sharing

Extra Tables and Figures

**Table 3. Demand for ITNs Across Prices**

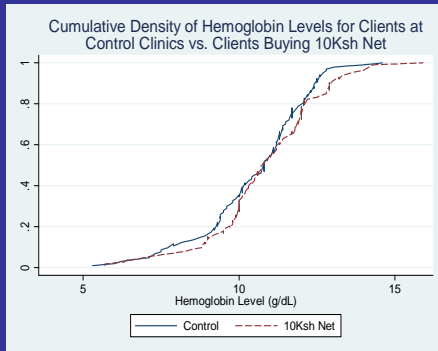
	<i>Dependent Variable is:</i>			
	<b>Indicator for Bought/Received an ITN</b>			
	(1)	(2)	(3)	(4)
ITN Price in Kenyan Shillings	-0.015 (.002)		-0.018 (.003)	-0.011 (.002)
Constant (ITN Price = 0)		.989 (.010)		
ITN Price = 10 Ksh (\$0.15)		-.073 (.018)		
ITN Price = 20 Ksh (\$0.30)		-.172 (.010)		
ITN Price = 40 Ksh (\$0.60)		-.605 (.035)		
First Visit Only			X	
First Pregnancy Only				X
Observations	424	424	201	134
Sample Mean of Dep. Var	0.98	0.98	1.00	0.97

**Table 4. ITN Usage Rates Across Prices**

	<i>Dependent Variable is:</i>					
	<b>Using ITN acquired through program</b>				<b>ITN is Visibly Hanging</b>	
	(1)	(2)	(3)	(4)	(5)	(6)
Constant (ITN Price = 0)	.564 (.069)	.656 (.093)	.604 (.083)	.744 (.058)	.524 (.074)	.637 (.109)
ITN Price	.004 (.004)		.000 (.004)	-.002 (.004)	.003 (.003)	
ITN Price = 10ksh		-.126 (.119)				-.155 (.128)
ITN Price = 20ksh		-.020 (.105)				-.093 (.122)
ITN Price = 40ksh		.106 (.134)				.081 (.127)
First Visits Only			X			
First Pregnancy Only				X		
Obs	224	224	125	58	220	220
Mean of Dep. Var	0.62	0.62	0.61	0.72	0.57	0.57

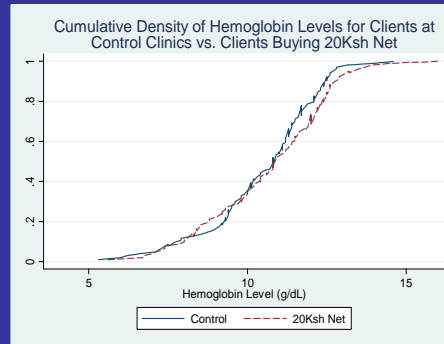
## No Difference between Control Group and Buyers of 10 and 20Ksh ITNs

### Control vs. 10Ksh Buyers



P-value = .47

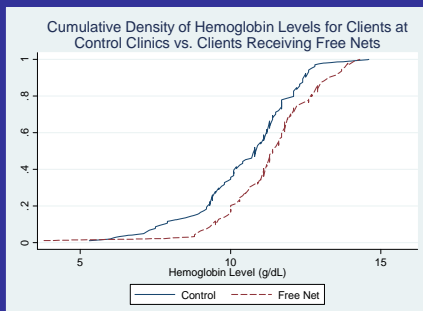
### Control vs. 20Ksh Buyers



P-value = .30

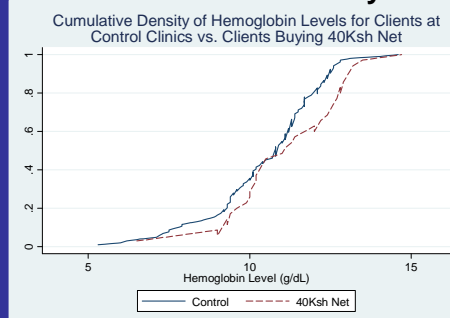
## Takers of Free Nets and 40Ksh appear Healthier than Control Group

### Control vs. 0Ksh Takers



P-value = .02

### Control vs. 40Ksh Buyers

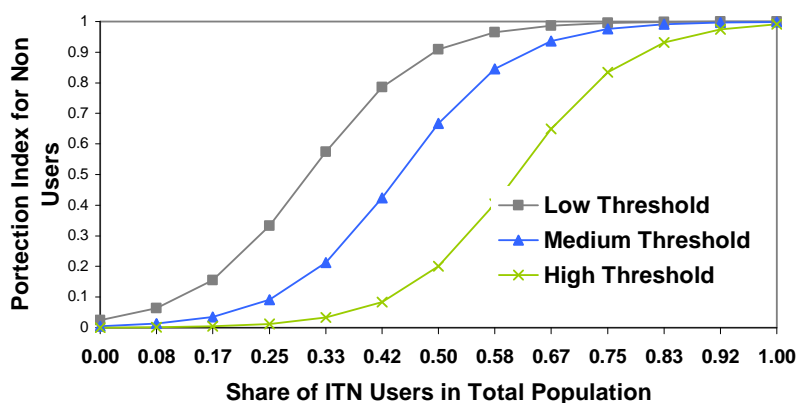


P-value = .17

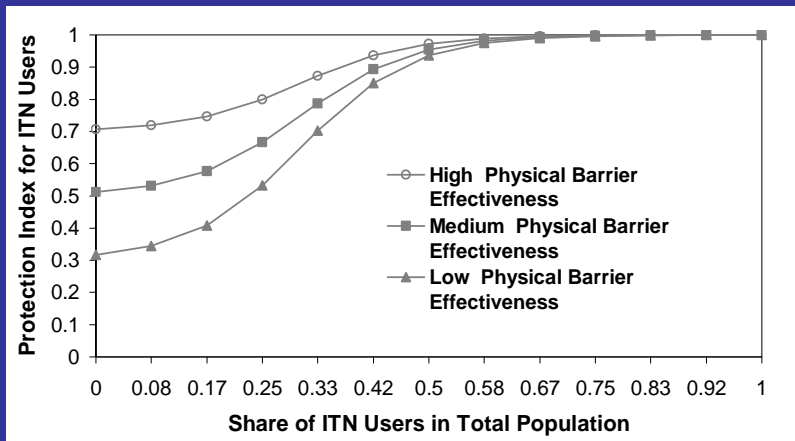
**Characteristics of Prenatal Clients Buying/Receiving Nets Relative to Control**

	Control Mean (1)	<i>Differences with Control Clinics</i>			
		0 Ksh (2)	10 Ksh (3)	20 Ksh (4)	40 Ksh (5)
<b>Health Status</b>					
Hemoglobin Level (Hb)	10.49 1.76	<b>0.86</b> (0.35)	0.39 (0.48)	0.13 (0.47)	0.50 (0.72)
Moderate Anemia	0.55 0.50	-0.20 <b>(0.07)</b>	-0.03 (0.11)	-0.01 (0.11)	-0.01 (0.15)
Severe Anemia	0.16 0.37	-0.10 (0.06)	-0.01 (0.07)	0.07 (0.09)	-0.06 (0.15)
<b>Characteristics of Visit to Prenatal Clinic</b>					
First Prenatal Visit	0.48 0.50	<b>-0.12</b> (0.06)	-0.02 (0.04)	0.03 (0.06)	0.02 (0.04)
First Pregnancy	0.21 0.41	<b>0.09</b> (0.04)	<b>0.15</b> (0.04)	<b>0.08</b> (0.04)	0.14 (0.15)
Paid for transport to Clinic	0.17 0.37	0.14 (0.14)	0.04 (0.06)	-0.07 (0.06)	<b>0.16</b> (0.06)
Price paid for transport	4.58 10.83	3.52 (3.29)	0.79 (1.78)	-1.17 (1.37)	<b>4.27</b> (1.94)
Obs	108	38	120	99	28

**6a. Three hypothetical Scenarios on the “Externality Threshold”:  
How the Protection Index for Non-Users Varies with  
the Proportion of ITN Users in the Population**



**6b. For a Given Hypothesis on the Externality Threshold:  
How the Protection Index for Users Varies with  
Assumptions on Effectiveness of ITNs as “Physical Barriers” for Users**



**Table 1. Characteristics of Prenatal Clinics in the Sample, by Treatment Group**

	Control Group	Treatment Groups			
		ITN Price:			
		0 Ksh (FREE)	10 Ksh (\$0.15)	20 Ksh (\$0.30)	40 Ksh (\$0.60)
	(1)	(2)	(3)	(4)	(5)
Average monthly attendance in 2006 (First visits ONLY)	75 (53)	63 (41)	61 (41)	54 (20)	62 (31)
Average monthly attendance in 2006 (First + Subsequent Visits)	124 (80)	117 (66)	123 (92)	106 (48)	122 (68)
Prenatal Enrollment Fee (in Ksh)	10 (12)	12 (8)	14 (9)	20 (20)	13 (11)
Fraction of clinics with HIV testing services	.75 (.50)	.40 (.55)	.75 (.45)	.66 (.58)	.33 (.58)
Total other prenatal clinics within 10 kilometers (km)	2.75 (2.5)	3 (1.22)	3.6 (.54)	4.3 (2.5)	4.3 (1.15)
Distance (in km) to closest prenatal clinic in the sample	12.69 (2.28)	13.45 (1.2)	13.32 (1.3)	12.05 (1.0)	12.92 (2.5)
Number of Clinics	4	5	5	3	3

**Table 2. Weekly ITN Sales Across Prices**

	<i>Dependent Variable is:</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<b>ITN Price in Kenyan Shillings (Ksh)</b>	-0.797 (.396)		-0.680 (.189)	-0.756 (.096)		
<b>ITN Price = 10 Ksh (\$0.15)</b>		-0.330 (16.617)			-1.645 (5.640)	6.346 (1.816)
<b>ITN Price = 20 Ksh (\$0.30)</b>		-9.502 (15.855)			-4.870 (13.089)	-8.737 (1.521)
<b>ITN Price = 40 Ksh (\$.60)</b>		-32.420 (15.199)			-29.051 (7.397)	-33.081 (.419)
<b>Control for Clinic Attendance in 2006</b>			X	X	X	X
<b>Other Clinic Controls</b>				X		X
<b>Mean of Dep. Var in Clinics with Free ITNs</b>	41	41	41	41	41	41
<b>Intracluster Correlation</b>	0.57					

**Table 5. ITN Usage Rates Across Prices, Holding Willingness to Pay Constant**

	<i>Dependent Variable is:</i>							
	Respondent is currently using the ITN acquired through the program						ITN is Visibly Hanging	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Transaction Price</b>	-0.003 (.006)	-0.006 (.006)	-0.006 (.006)					
<b>Transaction Price &gt; 0</b>				-0.008 (.100)	-0.072 (.101)	-0.065 (.100)	0.010 (.101)	-0.047 (.103)
<b><i>Individual Controls</i></b>								
<b>Got a Free ITN the Previous Year</b>			-0.192 (.100)			-0.191 (.101)		-0.147 (.103)
<b>Has not yet delivered</b>		-0.198 (.121)	-0.234 (.121)		-0.195 (.122)	-0.231 (.122)		-0.216 (.124)
<b>Bought ITN at First Prenatal Visit</b>		0.199 (.102)	0.202 (.102)		0.199 (.103)	0.202 (.104)		0.131 (.107)
<b>First Pregnancy</b>		0.180 (.100)	0.148 (.104)		0.184 (.100)	0.153 (.104)		0.120 (.107)
<b>Time to clinic</b>		0.001 (.001)	0.000 (.001)		0.000 (.001)	0.000 (.001)		0.000 (.001)
<b>Time Elapsed since ITN Purchase</b>		0.014 (.006)	0.015 (.006)		0.014 (.006)	0.015 (.006)		0.017 (.006)
<b>Constant</b>	0.591 (.052)	0.152 (.200)	0.248 (.200)	0.579 (.054)	0.147 (.201)	0.242 (.201)	0.537 (.055)	0.165 (.207)
<b>Observations</b>	130	124	123	130	124	123	128	121
<b>Sample Mean of Dep. Var</b>	0.58	0.58	0.58	0.58	0.58	0.58	0.52	0.52
<b>F Stat</b>		2.64	3.23		2.99	3.6		1.97
<b>Prob &gt; F</b>		0.02	0.00		0.01	0.00		0.07

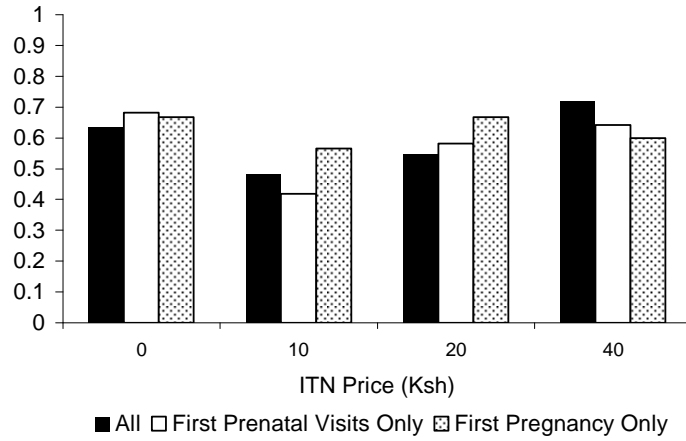
**Table 7. Share of Households Using an ITN in Total Population**

ITN Price (Ksh)	Subsidy per ITN Sold (Ksh)	Share of Prenatal Clients Who get an ITN (Table 3, Col. 2)	Actual Cost (Ksh)	% of ITN owners that are using it (Table 4, Col. 4)	Share of Users among Households With Prenatal Client	Subsidy Cost per Household (Ksh)	Share of Net Users in Total		
							If 65% of HH experience a pregnancy within 5 years	If 75% of HH experience a pregnancy within 5 years	If 85% of HH experience a pregnancy within 5 years
0	455	0.98	446	0.66	0.64	694	0.42	0.48	0.55
10	445	0.93	414	0.53	0.49	840	0.32	0.37	0.42
20	435	0.83	361	0.64	0.53	684	0.34	0.40	0.45
40	415	0.40	166	0.76	0.30	545	0.20	0.23	0.26

**Table 8. Cost-Effectiveness Comparisons**

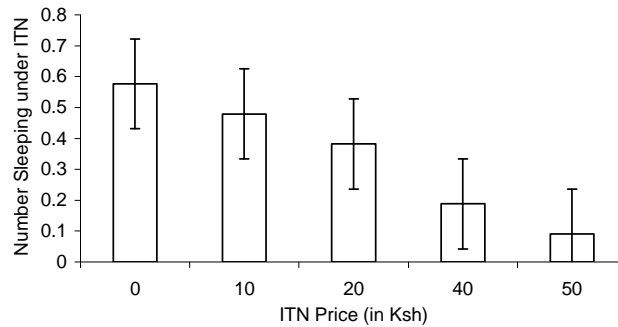
Subsidy Level	ITN Price (Ksh)	Hypothesis on Externality Threshold:								
		Low			Medium			High		
		Hypothesis on Physical Barrier effectiveness:			Hypothesis on Physical Barrier effectiveness:			Hypothesis on Physical Barrier effectiveness:		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
		1	2	3	4	5	6	7	8	9
<b>A. Protection Index for Non-Users</b>										
100.0%	0	0.80	0.80	0.80	0.45	0.45	0.45	0.09	0.09	0.09
97.5%	10	0.53	0.53	0.53	0.19	0.19	0.19	0.03	0.03	0.03
95.0%	20	0.60	0.60	0.60	0.23	0.23	0.23	0.04	0.04	0.04
90.0%	40	0.21	0.21	0.21	0.05	0.05	0.05	0.01	0.01	0.01
<b>B. Protection Index for Users</b>										
100.0%	0	0.94	0.90	0.86	0.83	0.72	0.61	0.73	0.55	0.36
97.5%	10	0.86	0.77	0.67	0.76	0.59	0.43	0.71	0.51	0.32
95.0%	20	0.88	0.80	0.72	0.77	0.62	0.46	0.71	0.52	0.33
90.0%	40	0.76	0.60	0.44	0.71	0.52	0.33	0.70	0.50	0.30
<b>C. Children Lives Saved Per 1000 Prenatal Client</b>										
100.0%	0	38	37	36	30	27	24	22	17	11
97.5%	10	29	28	26	20	16	13	15	11	7
95.0%	20	32	30	28	22	19	15	17	12	8
90.0%	40	16	14	12	11	8	6	9	7	4
<b>D. Cost per Child Life Saved (USD)</b>										
100.0%	0	\$200	\$206	\$212	\$255	\$284	\$321	\$352	\$460	\$662
97.5%	10	\$234	\$251	\$270	\$348	\$421	\$531	\$448	\$609	\$949
95.0%	20	\$189	\$200	\$213	\$274	\$325	\$399	\$361	\$487	\$748
90.0%	40	\$175	\$201	\$235	\$261	\$339	\$483	\$302	\$418	\$678

2b. Share of "Takers" who have the ITN visibly hanging at home visit, by ITN



Notes: Observations: All: 226, First visit: 175, First Pregnancy: 122

Figure 5. Share of Anemic Prenatal Clients Sleeping under an ITN, by ITN Price



Notes: Figure shows coefficients estimated with a Linear Probability Model. Error bars represent +/- 2.14 standard error (5% confidence interval with 14 degrees of freedom).