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Cost-effectiveness of social marketing of insecticide-treated nets for malaria control in the United Republic of Tanzania

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Objective To assess the costs and consequences of a social marketing approach to malaria control in children by means of insecticide-treated nets in two rural districts of the United Republic of Tanzania, compared with no net use.

Methods Project cost data were collected prospectively from accounting records. Community effectiveness was estimated on the basis of a nested case–control study and a cross-sectional cluster sample survey.

Findings The social marketing approach to the distribution of insecticide-treated nets was estimated to cost US$ 1560 per death averted and US$ 57 per disability-adjusted life year averted. These figures fell to US$ 1018 and US$ 37, respectively, when the costs and consequences of untreated nets were taken into account.

Conclusion The social marketing of insecticide-treated nets is an attractive intervention for preventing childhood deaths from malaria.

Keywords Bedding and linens; Insecticides; Social marketing; Cost-benefit analysis; Malaria, Falciparum/prevention and control; Case-control studies; Cross-sectional studies; United Republic of Tanzania (*source: MeSH, NLM*).

Mots clés Literie et linge; Insecticides; Marketing social; Analyse coût bénéfice; Paludisme plasmodium falciparum/prévention et contrôle; Etude cas-témoins; Etude section efficace; République-Unie de Tanzanie (*source: MeSH, INSERM)*.

Palabras clave Ropa de cama y ropa blanca; Insecticidas; Mercadeo social; Análisis de costo-beneficio; Paludismo falciparum/ prevención y control; Estudios de casos y controles; Estudios transversales; República Unida de Tanzanía (*fuente: DeCS, BIREME*).

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Voir page 275 le résumé en français. En la página 275 figura un resumen en español.

يمكن الاطلاع على الملخص بالعربية على الصفحة ٢٧٥.

Introduction

The efficacy and cost-effectiveness of insecticide-treated nets in reducing malaria-related morbidity and mortality have been amply demonstrated (*1*, *2*). Economic evaluations have indicated that such nets represent a sound investment from the cost-effectiveness standpoint, with an estimated cost per disability-adjusted life year (DALY) averted of US$ 48 (*2*) at 2000 prices. However, most studies have used tightly controlled and managed systems for distributing mosquito nets, and, strictly speaking, have therefore produced cost-efficacy estimates. As efforts continue to expand the use of insecticide-treated nets in sub-Saharan Africa so as to reach the Abuja target of 60% coverage of target groups by 2005, approaches are needed to delivering and financing the nets on a large scale. The only study to have looked at the cost-effectiveness of net treatment with insecticide under programme conditions examined the delivery of free insecticide in the Gambia for use on bednets already owned by members of the population (*3*). The cost per death averted of this intervention was three times higher than that reported in an earlier study that took place under trial conditions (*4*). Divergences between efficacy and effectiveness can arise because of operational difficulties in ensuring adequate and regular supplies, inadequate training of providers, inappropriate or ineffective promotional campaigns, leakage of supplies, and a range of other problems (*5*). More evidence is necessary on the cost-effectiveness of the large-scale promotion and provision of insecticide-treated nets.

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Social marketing has emerged as a promising way of combining public and private resources to expand the use of insecticide-treated nets. It involves the application of commercial marketing techniques to behavioural change and the provision of public health goods. Countries such as Malawi, Uganda, and the United Republic of Tanzania have introduced social marketing of insecticide-treated nets on a national scale but economic evaluations of the approach have not previously been attempted. It is clearly important to obtain information on the cost-effectiveness of a delivery model for insecticide-treated nets which can be scaled up.

KINET (Kilombero Valley Insecticide-Treated Net Project) used social marketing to distribute insecticide-treated nets in two rural districts of southern Tanzania from July 1996 to June 2000 (*6*). The project involved extensive promotional activities and nets were sold through both public and private channels. From May 1997 to June 1999 the social marketing activities were expanded to reach all 112 villages in the Kilombero and Ulanga districts, inhabited by some 480 000 people.

This paper assesses the costs and consequences of the KINET social marketing approach to the distribution of insecticide-treated nets. The perspective taken in the evaluation was the project (i.e. the donor in this case; alternatively a national government) and the community. The community participated by contributing cash (for nets and insecticide), time, and resources to the implementation model. The economic costs were calculated so that the optimal allocation of resources for malaria control could be assessed. The financial costs were calculated in order to consider the costs of replication.

Study area and description of project

Kilombero and Ulanga districts are in southern Tanzania, mainly in the flood plain of the Kilombero river (*6*, *7*). As reported by the health services and perceived by the local people, malaria is the most common health problem affecting both adults and children (*8*). The transmission of *Plasmodium falciparum* malaria is intense and perennial. The main vectors are *Anopheles gambiae* and *Anopheles funestus* and it has been estimated that these species of mosquito are responsible for 200–300 infective bites per person per year in two villages in the area (*9*). Children, particularly those aged under 1 year, are at the highest risk of life-threatening malaria (*10*).

The social marketing activities were phased in from May 1997 to June 1999, following sensitization meetings and research on householders' perceptions of the causes of child deaths, mosquito nets, net treatment and malaria (*11*). Nets and insecticide for their treatment were packaged, branded, and sold by sales agents who included health workers, shopkeepers, religious leaders and members of village governments. The nets, pretreated with deltamethrin at 20 mg/m^2, were purchased from the following companies: Siamdutch, Bangkok, Thailand; A to Z, Arusha, United Republic of Tanzania; and TMTL, Dar es Salaam, United Republic of Tanzania. The insecticide for net treatment, lambdacyhalothrin, was produced by Zeneca, Haslemere, England. There was a wholesale agent in each division. A comprehensive information, education and communication campaign was implemented. Retail prices were set at TSh 3000 (approximately US$ 5) for a treated net and TSh 250 (US$ 0.42) for an insecticide retreatment kit. These prices were held constant throughout the study period. Higher-dose net treatment kits were sold at US$ 0.50 as from February 2000. In 1997, ex-factory prices were subsidized by approximately 25% for nets and 83% for treatment kits (*6*). By 2000, when commodity prices had fallen substantially, nets were sold without subsidy and treatment kits received a 40% subsidy.

Methods

Calculation of costs

Details of the financial costs were obtained prospectively from the project's accounting system. All research costs associated with the project were excluded. Included were project implementation costs (donor/provider perspective), user contributions (payments for nets and insecticide), travel and time costs incurred by users in connection with the purchasing of nets, and in-kind community contributions to the running of the distribution system. The cost calculations apply to the districts of Kilombero and Ulanga over the whole implementation period of 1996–2000.

Cost identification

Two main categories of activities were defined: those associated with the initial set-up activities with the development of the project brand and logo together with the initial sensitization of village leaders; and those associated with the supply of nets, including the establishment of distribution channels, product promotion and publicity, training, and distribution.

Cost classification

The initial set-up activities were treated as capital costs because it was assumed that their effect would continue for as long as the brand continued to be sold. The costs associated with the supply of nets were classified as capital costs if the items in question lasted longer than a year, and as recurrent costs if they lasted less than a year or if payment for them was made more than once a year.

Cost valuation

Financial costs were measured in local currency at the time the expenditure was incurred and the consumer price index was used to inflate each year's costs to 2000 values. Foreign exchange transactions were expressed in the local currency by applying the average market exchange rate for the year concerned. Economic costs were calculated by annualizing capital costs on the basis of a discount rate of 3%, a value that has commonly been used in recent economic evaluations of health interventions (*12*, *13*), and by valuing donated inputs, such as community leaders' time and office space for village meetings, at their market rates. The local minimum wage was applied for time and local rental prices were applied for office space.

The total overhead costs of the project (office equipment, rent, furniture, electricity and water) were apportioned between the social marketing component and the research/evaluation component by applying the ratio of the cost of personnel involved in social marketing activities to the total KINET personnel cost. The overhead costs of the project included those incurred by the Ifakara Health Research and Development Centre and the Swiss Tropical Institute. Table 1 summarizes the approaches to cost identification.

Table 1. **Contributions of different sectors and valuation of donated inputs, KINET activities, United Republic of Tanzania**

	KINET	Community	Users
Start-up			
Village leaders' time		X	
Office space	X	X	
Others			
Supply of nets and insecticide			
Nets and insecticide	X		X
Agents' commission			X
Users' costs of travelling to purchase insecticide-treated nets			X
All other costs	X		

Treatment of revolving fund revenue

In order to avoid double counting and to reflect accurately the degree of cost-sharing between the project and users, the cost to the project excluding users' contributions was calculated. Because of the delay between expenditure on supplies and receipt of revenue from sales, average cost-recovery ratios for the four-year period were calculated and applied to each year. The cost-recovery ratios for nets and insecticide were 79% and 20%, respectively. The amount given as a cost to the project was calculated as follows: (1– cost-recovery ratio) x expenditure on commodities in the year concerned.

Treatment of unused resources

Project resources that were unspent by 30 June 2000 were deducted from the total cost. They included stocks of nets and insecticide and advance payments to suppliers. Cash balances held in the bank were also deducted as they reflected revenue from the revolving fund.

Estimation of consequences

A demographic surveillance system was established in 25 villages with over 60 000 inhabitants and was maintained over the whole study period (*7*). A nested case–control study was undertaken in the area covered by the system in order to estimate the effect of the social marketing of treated nets on child survival. The reported use of nets and insecticide treatment was compared between children who died of any cause between the ages of 1 month and 4 years (cases) and children who were alive on the same days (controls), in a ratio of 1 case to 4 controls. A questionnaire was administered in order to collect information about use of insecticide-treated nets and other risk and protective factors (*14*). The results of the case–control study provided separate estimates of the individual effectiveness of treated nets and of untreated nets. The outcomes were limited to mortality averted through the use of treated nets. Other effects of insecticide-treated nets measured in the same area, e.g. reduction in anaemia (*15*) and consequences for pregnant women (*16*), were excluded.

Community effectiveness (*5*) was assessed by estimating population coverage over the whole project area using a cluster sample survey undertaken in July–August 1999. Thirty clusters of 20 households were selected in Ulanga district, and 35 clusters of 20 households in Kilombero district. Villages were chosen with probability proportional to estimated population. Mothers of children aged under 5 years were asked whether each child had slept under a net the previous night, whether it had been treated and when it was last treated.

Estimates of deaths averted among children aged under 5 years were converted into DALYs averted by using life expectancies of 54.2 years at birth and 58.6 years at the age of 3 years, both derived from life tables calculated for the area covered by the demographic surveillance system (*7*). Health effects were discounted at 3%. Only the effects of mortality, i.e. years of life lost, were considered, as other studies have shown that years of life lost account for most of the burden of malaria (*17*). Age-weights were not included. The number of treated-net years was calculated using project records of total sales of nets and insecticide. It was assumed that protection for 6 months was provided by each pretreated net that was sold, and that each sachet of insecticide gave 6 additional months of protection. Because these were probably conservative estimates, the results were also calculated on the assumption that each treatment gave protection for 12 months (*18*).

Sensitivity analysis

Sensitivity analysis was undertaken by recalculating the cost-effectiveness ratios under alternative assumptions about project consequences, including the following: the effects of protection conferred by untreated nets; the level of coverage achieved by the end of the project; and the duration of the effect of insecticide treatment.

Results

Cost

The total financial cost of KINET social marketing was TSh 622 154 347 (US$ 774 787) (Table 2), with start-up, capital, and recurrent costs accounting for 1%, 44%, and 55%, respectively. The largest individual cost item was that of nets and packaging, which amounted to 39% of the total project cost. At 21%, personnel were the second largest item. Staff time was spent on promotion, distribution and project management. The overhead charges for the Ifakara Health Research and Development Centre and the Swiss Tropical Institute amounted to 11% of the total financial cost.

Users and the community contributed 30% of the total financial cost (data not shown). Approximately three-quarters of this contribution was made up by direct payments for nets and insecticide. The remaining 25% represents the share of the purchase price which was retained by sales agents as commission and thus reflects users' contributions to the cost of the distribution system.

The economic cost of KINET was calculated by making adjustments to the financial cost (annualizing capital costs, valuing donated inputs at market rates, and including users' costs for the purchase of nets) (data not shown), summing over the 4 years to arrive at the total economic cost, and dividing this by four in order to calculate the average annual economic cost, which amounted to TSh 120 194 906 (US$ 149 682) (Table 3). The value of donated inputs and users' travel and time costs together amounted to less than 1% of the total economic cost. Start-up costs amounted to 1%, other capital costs to 28%, and the balance comprised recurrent costs.

The user and community share of the total economic costs fell to 22%, the provider contributing 78% (data not shown). The users' contribution was lower in the case of economic costs because of the annualizing of net costs beyond the life of the project (assuming a useful life of 5 years).

Table 2. **Total financial cost (2000 prices) of KINET social marketing activities**

	Cost (x10^6 Tanzanian shillings)[a]					Profile (%)
	1996–97	1997–98	1998–99	1999–2000	Total	
Capital costs						
Start-up costs						
Brand creation and market research	7.45	0	0	0	7.45	
Subtotal	7.45	0	0	0	7.45	1.2
Other capital costs						
Nets and packaging	68.0	42.78	74.45	60.03	245.25	
Equipment[b]	4.59	2.92	0.44	0	7.96	
Vehicle	21.13	0	0	0	21.13	
Subtotal	93.72	45.70	74.89	60.03	274.34	44.1
Recurrent costs						
Insecticide	6.19	10.67	1.23	8.44	26.53	
Personnel	42.10	36.10	30.05	24.78	133.04	
Promotional materials and activities	15.73	0.88	5.69	4.73	27.03	
Other recurrent[c]	36.69	38.01	38.50	40.59	153.78	
Subtotal	100.70	85.65	75.47	78.55	340.37	54.7
Total	**201.87**	**131.36**	**150.36**	**138.57**	**622.15**	**100.0**

[a] US $1 = TSh 803.
[b] Includes containers for storage, computers, buckets and basins, bicycles, megaphones and roadside billboards.
[c] Includes communications, stationery, photocopying, travel, vehicle running costs, bicycle repairs, training, rent, bank charges and overheads.

Consequences

KINET sold 65 111 nets and 24 393 insecticide retreatments by June 2000, yielding 44 752 treated-net years. Insecticide-treated net coverage, measured as the proportion of children that slept under a treated net the previous night, was 14% in Ulanga and 23% in Kilombero in July and August 1999. This rather low estimate reflects the slow geographical spread of the programme after less than two years of implementation. Given the estimate of 27% for protective efficacy from the case–control study, this indicates 96 deaths averted (Table 4) or 2588 DALYs averted (Table 5) in 1999.

Cost-effectiveness ratios

On the basis of economic cost estimates, the cost per treated-net year in the baseline scenario was found to be US$ 13.38. The cost per death averted associated with treated nets was US$ 1559 and the corresponding cost per DALY averted was US$ 57 (Table 6).

Sensitivity analysis

The sensitivity of the cost-effectiveness ratios to alternative assumptions about project consequences was examined in various ways (Table 6). First, we included the health benefits of untreated nets in the calculations of costs and consequences, because even insecticide-treated nets that were not retreated offered some protection and the promotional activities undertaken by the project probably increased the demand for untreated nets sold in the commercial sector. The protective efficacy of untreated nets was estimated to be 19% (95% confidence interval: –9 to 40) (*14*). With 1999 coverage figures this leads to 107 more deaths averted in the two districts (57 infants, 50 children aged 1–5 years) or 2906 more DALYs averted. The cost of the untreated nets was estimated from district population estimates, assuming that population coverage was the same as that of children aged under 5 years and using an estimate of 1.93 people per net (*19*). The cost of a privately purchased untreated net was estimated to be TSh 3000 (US$ 3.75) (*19*), and the value of these nets was annualized in accordance with a discount rate of 3% and a useful life of 5 years. Adding the costs and consequences of these nets to the treated nets gives a cost per death averted of US$ 1018 and a cost per DALY averted of US$ 37.

Second, we examined the effect of estimating consequences by using the estimate of insecticide-treated net coverage attained by June 2000 in the demographic surveillance system area where implementation began (54% coverage, adjusted to 50%). Extrapolation of this coverage to the two districts and the use of the estimated protective efficacy conferred by treated nets resulted in an increase to 249 in the number of deaths averted (6734 DALYs averted) and in decreases in the costs per death averted and per DALY averted to US$ 601 and US$ 22, respectively.

Third, we combined these two scenarios to include both the effects of untreated nets and the extrapolated net coverage of the surveillance area to the two districts (treated-net coverage 50%, untreated-net coverage 19%). The cost of untreated nets that were privately purchased was estimated as above. The number of deaths averted rose to 315 (8526 DALYs). The costs per death averted and per DALY averted fell to US$ 587 and just under US$ 22, respectively.

Finally, in calculating treated-net years we assumed that both pretreatment and retreatment conferred 12 months of protection, thus increasing the number of treated-net years to 89 504 and reducing the cost per treated-net year to US$ 6.70.

Discussion

This paper presents the results of the first economic evaluation of large-scale social marketing of insecticide-

Table 3. **Annual economic cost (2000 prices) of KINET[a]**

	Average annual cost over 1996–2000		
	Tanzanian shillings	**US$**	**Profile (%)**
Capital costs			
Start-up costs			
Brand creation and market research	1 036 648		
Village leaders' time	149 344		
Subtotal	185 992	1 477	1.0
Other capital costs[b]			
Nets and packaging	30 495 057		
Equipment	1 224 614		
Vehicle	2 148 564		
Subtotal	33 868 235	42 177	28.2
Recurrent costs			
Insecticide	6 631 330		
Personnel	33 259 140		
Promotional materials and activities	6 756 904		
Users' costs of purchasing	44 497		
Other recurrent	38 448 808		
Subtotal	85 140 679	106 028	70.8
Total	**120 194 906**	**149 682**	**100.0**

[a] Some items were assumed to last longer than the lifetime of the project, giving an economic cost less than their financial cost.
[b] The following assumptions about the lifespan of capital items were used in annualizing their costs: Zuia Mbu brand – 7 years; roadside billboards – 8 years; storage containers, vehicles, car megaphones – 10 years; computers, bednets, bicycles – 5 years; buckets and basins – 2 years.

treated nets under programme conditions. The results indicate that, even under operational conditions, insecticide-treated nets are an attractive health investment if generally accepted criteria are applied (*2*).

Methodological challenges of evaluation under programme conditions

The economic evaluation of projects of this type is fraught with difficulties. First, there is no typical year in which to measure costs and consequences. The cost structure, with a considerable fixed-cost component in the form of promotion and branding, means that average and marginal costs are likely to fall as coverage expands, at least until the market is saturated. Larger programmes are therefore likely to have even lower distribution costs. Second, costs are likely to fall as local expertise in marketing develops and the need for expatriate personnel diminishes. Third, the share of costs financed by users is likely to rise as project costs diminish. A dynamic approach is therefore necessary in order to interpret cost-effectiveness data and understand how the costs are financed.

Every project has a specific context. For the KINET project the context was that of a research institution with expatriate involvement in project management. This undoubtedly influenced the costs and may have affected the outcomes. For instance, it is possible that more regular feedback to project management from research staff helped to influence the sales effort. We prefer not to speculate on the effect of the context on effectiveness. For illustrative purposes we recalculated the costs and resulting cost-effectiveness ratios with the expatriate personnel excluded, and found that the cost per DALY averted fell in the baseline case from US$ 56.80 to US$ 47.10 (approximately 17%) and in the most favourable scenario (with 50% coverage and including the costs and effects of untreated nets) from US$ 21.70 to US$ 18.69 (approximately 14%).

Despite the considerable subsidy on insecticide in the KINET project, retreatment rates were disappointing (*20*). Retreatment continues to be a challenge for insecticide-treated net projects. Funding for the insecticide treatment of nets should remain a priority for donors. Public funds will probably be necessary to cover the incremental costs of nets with long-lasting insecticide treatment when they become available.

Models for the distribution of insecticide-treated nets should also take account of equity and affordability to poor people. Even with subsidies for promotion, distribution, and insecticide costs, charging for insecticide-treated nets creates barriers for very poor people. KINET used health facilities to distribute vouchers to pregnant women and to children aged under 5 years in order to keep the price as low as possible for the people who were most vulnerable to malaria. Social marketing achieved substantial coverage in the lowest socio-economic group (*21*) even though the vouchers were not targeted at economically vulnerable households. Additional measures, targeted specifically at the poorest people, will be needed to ensure that these households benefit from the protection afforded by insecticide-treated nets.

Comparison with other studies and distribution models

The cost-effectiveness of insecticide-treated nets delivered through social marketing compares favourably with the

Table 4. **Estimates of deaths averted in 1999 as a results of KINET activities**

	Population in 1999	Age group		ITN[a] coverage	Death rate (per 1000) in 1997 (no ITNs) (infant/child)	Estimated death rate (per 1000) if protected (1999) (infant/child)	No. of deaths averted
		1–11 months	1–4 years				
Ulanga	180 000	5479	23 256	14%	73/15	53/11	28
Kilombero	260 000	7914	35 048	23%	73/15	53/11	68
Total	**440 000**	**13 393**	**58 304**				**96**

[a] ITN = insecticide-treated net.

Table 5. **Estimate of disability-adjusted life years (DALYs) averted in 1999 as a result of KINET activities**

Age group	Average age in interval	No. of deaths averted	YLLs[a] per death	Total DALYs (YLLs) averted
1–11 months	0.5	52	25.9	1347.1
1–4 years	3	45	27.6	1241.2
Total				**2588.3**

[a] YLLs = years of life lost.

Table 6. **Cost-effectiveness ratios of KINET activities with alternative scenarios for consequences**

Baseline scenario (costs and consequences of treated nets)	**US$**
Cost per death averted	1559.00
Costs per DALY[a] averted	56.80
Cost per treated-net year	13.38
Including costs and effects of untreated nets[b]	
Cost per death averted	1018.00
Cost per DALY averted	37.00
Assuming ITN[c] coverage of 50%[d]	
Cost per death averted	601.00
Cost per DALY averted	22.60
Assuming ITN coverage of 50% and costs and effects of untreated nets[e]	
Cost per death averted	587.00
Cost per DALY averted	21.70
Cost per treated-net year assuming insecticide lasts for 12 months	6.70

[a] DALY = disability-adjusted life year.
[b] Protective efficacy of untreated nets estimated at 19%. Coverage estimated at 17% (Ulanga) and 40% (Kilombero).
[c] ITN = insecticide-treated net.
[d] Coverage in area of demographic surveillance system in 2000 was 54%.
[e] Coverage of untreated nets in area of demographic surveillance system in 2000 was 19%.

results of randomized control trials that indicated a cost of US$ 2304 per death averted in Ghana (*22*) and US$ 3228 per death averted in Kenya (*23*) (at 2000 prices). The results are in the same range as an estimate of US$ 48 per DALY averted (at 2000 prices) which was based on a modelling approach (*2*). Under less conservative and more realistic assumptions, insecticide-treated nets are even more cost-effective.

The cost per net delivered by KINET is comparable to that of another social marketing project in the United Republic of Tanzania that operated in four districts (*24*). The generalizability of these results to other settings will depend on the comparability of cost structures and output levels. Nets and insecticide, making up about 30% of costs, are tradable goods, and prices are likely to be similar in different countries if markets are relatively competitive, although transport costs and differential tax and tariff treatment of nets can contribute to divergences in prices. Personnel costs, the second largest item, are more likely to vary between settings and also depend on the share of expenditure on expatriate personnel. We would expect social marketing projects in other settings to be able to achieve levels of coverage similar to those in the present study.

Despite the substantial investment in the branding and promotion of insecticide-treated net products, the costs of this social marketing project are considerably lower than those of many other distribution models that have been used for such nets. The comparisons of costs between projects and delivery models is difficult. Without an objective basis for apportioning the share of costs spent on promotion and distribution between nets and insecticide, differences in project outputs can distort comparisons. Moreover, many community-based projects produce benefits that extend beyond the distribution and promotion of insecticide-treated nets. Nonetheless, crude calculations comparing project costs with the number of nets delivered give some indication of the costs of other approaches. A community-based project in Zambia, for instance, was estimated to cost US$ 17–22 per net distributed (Malaria Consortium, unpublished data), and a clinic-based revolving fund approach in Mozambique cost US$ 10 per net delivered (*25*). For the purposes of comparison the same calculation for KINET gives a project financial cost of US$ 8.30 per net delivered (at 2000 prices). However, because they exclude the contributions of users, such measures do not reflect the true value of the resources consumed in delivering nets. Guidelines are necessary for the transparent and valid comparison of the true value of resources consumed by projects.

Scaling up delivery of insecticide-treated nets

Debate continues on ways of delivering insecticide-treated nets on a large scale with efficiency, sustainability and equity. The scale of the donor contribution to the KINET model has implications for the sustainability of social marketing and other project approaches to the distribution of nets. The alternatives have been proposed of distributing free nets, e.g. by using the existing health infrastructure, and of relying on the commercial sector supported by substantial public sector promotion. The first of these approaches clearly requires a substantial continuing commitment by donors and/or governments and is unlikely to be sustainable. Even free public sector interventions often fail to reach the poor and there are few data on the costs of working through the public sector. Making greater use of the commercial sector for the distribution of nets could conceivably prove more sustainable and less expensive. In the United Republic of Tanzania the cost of an untreated net has fallen to TSh 3000 (US$ 3.75) (*19*), demonstrating that the commercial sector provides a highly efficient delivery model in the areas it reaches. However, the commercial sector is unlikely to undertake the massive promotional effort required to create demand for insecticide-treated nets on a large scale. Moreover, it has been reluctant to enter the market for insecticide retreatment. A partnership between the public and private sectors, in which the commercial sector is used for distribution and public funds are used for promotion by means of social marketing techniques, for insecticide provision and for the targeting of subsidies to people who cannot afford commercial prices, may offer opportunities for achieving greater efficiency and sustainability. This approach has been proposed in the United Republic of Tanzania for scaling up the use of insecticide-treated nets (Tanzanian National Malaria Control Programme, unpublished document). An evaluation of the effectiveness and cost-effectiveness of this model in increasing coverage will be essential as part of the evidence base on which to make decisions about scaling up usage and preventing childhood deaths from malaria.

Social marketing has been important in helping to build a base on which the Tanzanian market for insecticide-treated nets can expand. It offers the prospect of increased efficiency and sustainability in their distribution and is clearly a feasible method for saving lives. It undoubtedly has a significant role to play in national strategies for scaling up the use of these nets. ■

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Résumé

Coût-efficacité du marketing social en faveur des moustiquaires traitées par insecticide dans le cadre de la lutte antipaludique en République-Unie de Tanzanie

Objectif Evaluer le coût et les conséquences d'une approche par marketing social de la lutte antipaludique axée sur les enfants au moyen de moustiquaires traitées par insecticide dans deux districts ruraux de République-Unie de Tanzanie, par comparaison avec la non-utilisation de moustiquaires.

Méthodes Les données sur le coût du projet ont été recueillies de manière prospective d'après les registres comptables. L'efficacité au niveau de la communauté a été estimée au moyen d'une étude cas-témoins nichée et d'une enquête transversale par sondage en grappes.

Résultats Le coût de l'approche par marketing social de la distribution de moustiquaires traitées par insecticide a été évalué à US $1560 par décès évité et US $57 par année de vie ajustée sur l'incapacité (DALY) évitée. Ces chiffres tombaient à US $1018 et US $37 respectivement lorsqu'il était tenu compte des coûts et conséquences de l'utilisation de moustiquaires non traitées.

Conclusion Le marketing social en faveur des moustiquaires traitées par insecticide est une intervention avantageuse pour éviter les décès dus au paludisme chez l'enfant.

Resumen

Relación costo-eficacia de la mercadotecnia social de mosquiteros tratados con insecticida para controlar el paludismo en la República Unida de Tanzanía

Objetivo Evaluar los costos y las consecuencias de un sistema de mercadotecnia social para el control del paludismo infantil mediante mosquiteros tratados con insecticida en dos distritos rurales de la República Unida de Tanzanía, comparando los resultados con los obtenidos sin mosquiteros.

Métodos Se reunieron prospectivamente datos sobre los costos de proyecto a partir de los comprobantes de cuentas. La eficacia comunitaria se calculó sobre la base de un estudio anidado de casos y controles y de una encuesta transversal de muestras por conglomerados.

Resultados Según las estimaciones realizadas, el sistema de mercadotecnia social aplicado a la distribución de mosquiteros tratados con insecticida costó US$ 1560 por defunción evitada, y US$ 57 por AVAD (año de vida ajustado en función de la discapacidad) evitado. Estas cifras disminuyeron a US$ 1018 y US$ 37, respectivamente, cuando se tuvieron en cuenta los costos y las consecuencias de los mosquiteros no tratados.

Conclusión La mercadotecnia social de mosquiteros tratados con insecticida es una intervención valiosa para prevenir las defunciones infantiles por paludismo.

ملخص

مردودية التسويق الاجتماعي للناموسيات المعالجة بمبيدات الحشرات في مكافحة الملاريا في جمهورية تنزانيا المتحدة

الغرض: تقييم تكاليف أسلوب التسويق الاجتماعي للناموسيات المعالجة بمبيدات الحشرات في مكافحة الملاريا ونتائجه في منطقتين ريفيتين من جمهورية تنزانيا المتحدة ومقارنة ذلك بعدم استعمال تلك الناموسيات.

الطريقة: تم جمع معطيات الدراسة بالطريق الراجع من سجلات المحاسبة. وتم تقدير المردودية الاجتماعية على أساس دراسة مكافحة مجموعات الحالات ومسح لعينة من مجموعات مستعرضة من الحالات.

الموجودات: قدرت تكاليف أسلوب التسويق الاجتماعي لتوزيع الناموسيات المعالجة بمبيدات الحشرات في مكافحة الملاريا في جمهورية تنزانيا المتحدة بـ ١٥٦٠ دولاراً أمريكياً لكل حالة وفاة يمكن تجنُّبها و٥١ دولاراً أمريكياً لكل سنة من سنوات العجز المصحَّحة باحتساب مدد العجز التي يمكن تجنُّبها؛ ثم تهبط هاتان القيمتان إلى ١٠١٨ و٣٧ دولاراً أمريكياً بالتتابع عندما لا يؤخذ بالحسبان تكاليف ونتائج الناموسيات غير المعالجة بالمبيدات الحشرية.

الاستنتاج: إن التسويق الاجتماعي للناموسيات المعالجة بمبيدات الحشرات من التدُّخلات الجذابة للوقاية من وفيات الأطفال بسب الملاريا.

References

1. Lengeler C. *Insecticide-treated bednets and curtains for malaria control (Cochrane Review).* Oxford: The Cochrane Library; 2000.
2. Goodman CA, Coleman PG, Mills AJ. Cost-effectiveness of malaria control in sub-Saharan Africa. *Lancet* 1999;354:378-85.
3. Aikins MK, Fox-Rushby J, D'Alessandro U, Langerock P, Cham K, New L, et al. The Gambian National Impregnated Bednet Programme: Costs, consequences and net cost-effectiveness. *Social Science and Medicine* 1998;46:181-91.
4. Picard J, Aikins M, Alonso PL, Armstrong Schellenberg JR, Greenwood BM, Mills A. A malaria control trial using insecticide-treated bed nets and targeted chemoprophylaxis in a rural area of the Gambia, West Africa. 8. Cost-effectiveness of bed net impregnation alone or combined with chemoprophylaxis in preventing mortality and morbidity from malaria in Gambian children. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 1993; 2:53-7.
5. Lengeler C, Snow RW. From efficacy to effectiveness: insecticide-treated bednets in Africa. *Bulletin of the World Health Organization* 1996;74:325-32.
6. Schellenberg JR, Abdulla S, Minja H, Nathan R, Mukasa O, Marchant T, et al. KINET: a social marketing programme of treated nets and net retreatment for malaria control in Tanzania, with evaluation of child health and long-term survival. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 1999;93:225-31.
7. Armstrong Schellenberg JRM, Mukasa O, Abdulla S, Marchant T, Lengeler C, Kikumbih N, et al. Ifakara demographic surveillance system (Ifakara DSS). In: *Population and health in developing countries. Volume 1 (INDEPTH Network)*. Ottawa: IDRC Books; 2002. p. 159-64.
8. Tanner M, de Savigny D, Mayombana C, Hatz C, Burnier E, Tayari S, et al. Morbidity and mortality at Kilombero, Tanzania, 1982-88. In: Feachem R, Jamison D, editors. *Disease and mortality in sub-Saharan Africa*. Oxford: Oxford University Press; 1991. p. 286-305.
9. Smith T, Charlwood JD, Kihona J, Mwankusye S, Billingsley P, Meuwissen J, et al. Absence of seasonal variation in malaria parasitaemia in an area of intense seasonal transmission. *Acta Tropica* 1993;54:55-72.
10. Schellenberg D, Menendez C, Kahigwa E, Font F, Galindo C, Acosta C, et al. African children with malaria in an area of intense *Plasmodium falciparum* transmission: features on admission to the hospital and risk factors for death. *American Journal of Tropical Medicine and Hygiene* 1999;61:431-8.
11. Minja H, Schellenberg JA, Mukasa O, Nathan R, Abdulla S, Mponda H, et al. Introducing insecticide-treated nets in the Kilombero Valley, Tanzania: the relevance of local knowledge and practice for an information, education and communication (IEC) campaign. *Tropical Medicine and International Health* 2001;6:614-23.
12. Gold MR, Siegel JE, Russell LB, Weinstein MC. *Cost effectiveness in health and medicine*. New York: Oxford University Press; 1996.
13. Jamison DT, Mosley WH, Measham AR, Bobadilla JL. *Disease control priorities in developing countries*. New York: Oxford University Press on behalf of the World Bank; 1993.
14. Schellenberg JR, Abdulla S, Nathan R, Mukasa O, Marchant TJ, Kikumbih N, et al. Effect of large-scale social marketing of insecticide-treated nets on child survival in rural Tanzania. *Lancet* 2001;357:1241-7.
15. Abdulla S, Schellenberg JA, Nathan R, Mukasa O, Marchant T, Smith T, et al. Impact on malaria morbidity of a programme supplying insecticide-treated nets in children aged under 2 years in Tanzania: community cross-sectional study. *BMJ* 2001;322:270-3.
16. Marchant T, Schellenberg JA, Edgar T, Nathan R, Abdulla S, Mukasa O, et al. Socially-marketed insecticide-treated nets improve malaria and anaemia in pregnancy in southern Tanzania. *Tropical Medicine and International Health* 2002;7:149-58.
17. Goodman C, Coleman P, Mills A. *Economic analysis of malaria control in sub-Saharan Africa*. Geneva: Global Forum for Health Research; 2000 (Strategic Research Series). p. 1-185.
18. Lines JD. The technical issues. In: Lengeler C, Cattani J, de Savigny D, editors. *Net gain: a new method for preventing malaria deaths.* Ottawa: International Development Research Centre/WHO; 1996. p. 17-53.
19. Kikumbih N. Economic analysis of social marketing and commercial sector insecticide treated net delivery models in rural communities of Tanzania. [PhD thesis.] University of London; 2002.
20. Armstrong Schellenberg JRM, Minja H, Mponda H, Kikumbih N, Mushi A, Nathan R, et al. Re-treatment of mosquito nets with insecticide. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 2002;96:368-9.
21. Abdulla S, et al. *Mosquito nets, poverty and equity in rural southern Tanzania*. 2001. Available from: URL: http://www.mimcom.org.uk/ifakara/poverty
22. Binka FN, Mensah OA, Mills A. The cost-effectiveness of permethrin impregnated bednets in preventing child mortality in Kassena-Nankana district of Northern Ghana. *Health Policy* 1997;41:229-39.
23. Some ES. Optimizing the community effectiveness of insecticide-impregnated bednets used for malaria control in coastal Kenya: Implications of perceptions, programme organization, compliance, and costs. [PhD Thesis.] University of London; 1999.
24. Hanson K, Jones C. *Social marketing of insecticide treated mosquito nets, Tanzania: end of project social and economic analysis*. London: Malaria Consortium, London School of Hygiene and Tropical Medicine; 2000.
25. Dgedge M, Kumaranayake L, Cossa H, Hogh B, Lines J. Can the expansion of a subsidised ITN project become self-sufficient? The experience from an ITN project in Mozambique.Second International Conference on Insecticide Treated Nets; 1999; Dar es Salaam.