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Community cooperatives and insecticide-treated materials for malaria control: a new experience in Latin America

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Abstract

Background and objectives: Insecticide-treated materials (ITMs) are effective in substantially reducing the burden of malaria and other vector-borne diseases; but how can high coverage rates of ITMs be achieved and maintained? In south Mexico and on the Pacific and Atlantic coasts of Colombia 14 community-based cooperatives offering three different kinds of ITM services (sale of impregnation services; sale of impregnated nets; production of nets and sale of impregnated nets) were formed and supervised by a national health service (IMSS-SOLIDARIDAD, Mexico) and by an academic institution (the Colombian Institute of Tropical Medicine) along with local district health services. The objectives of this research were to analyse the processes and results of this approach and to identify the favourable and limiting factors.

Methods: The methods used for data collection and analysis were group discussions, individual and semi-structured interviews with users and non-users of ITMs, individual in-depth interviews with cooperative members and supervisors, checks of sales book and observation of impregnation services.

Results: Coverage with unimpregnated nets was above 50% in all study areas. The fastest increase of ITM coverage was achieved through the exclusive sale of impregnation services. Low-cost social marketing techniques were used to increase demand. The large-scale production of nets in two cooperatives was only possible with the aid of an international NGO which ordered impregnated bednets for their target group. A number of favourable and limiting factors relating to the success of ITM cooperatives were identified. Of particular importance for the more successful Mexican cooperatives were: a) support by health services, b) smaller size, c) lesser desire for quick returns and d) lower ITM unit costs.

Conclusions: ITM community cooperatives supported and supervised by the health services have good potential in the Latin American context for achieving and maintaining high impregnation rates.

Background

Insecticide-treated materials (ITMs) have a mean protective efficacy against malaria episodes of roughly 50% in

highly endemic areas of Africa [1] and of 40% in lower endemicity areas of Latin America where either *P. vivax* or *P. falciparum* are predominant [2,3]. Other trials have shown

that ITMs are also protective against the transmission of Chagas' disease [4] and of cutaneous leishmaniasis [5] making them one of the most powerful weapons against disease-transmitting vectors.

The uptake of the new strategy by vector control services in Colombia and other Latin American countries has been slow [6] although ITMs have generally been shown to be cheaper than residual house spraying and are mentioned in national guidelines as an alternative, or complementary, to residual house spraying [7].

The provision of continuous impregnation and re-impregnation services has been identified as a major concern [8–11]. The solutions proposed so far have been mainly developed in the African context, where vector control services are frequently weak and people's ability to pay for ITM services are limited [12,13]. The main focus in Africa is on enhancing the commercial distribution of impregnated nets by social marketing techniques which are subsidised or carried out by international donors and NGOs [14,15].

In Latin America, vector-borne diseases mainly affect the rural and, less frequently, the urban poor. Malaria eradication services are struggling to adapt to their transformation from centralised vertical programmes to integrated district health services and they are frequently overstretched by staff reductions and the need for dealing not only with malaria but also with all other vector-borne diseases [16,6]. The proposed answer to these challenges is to involve the private sector and local communities more actively in vector control activities and to look for partners within and outside the health sector who can play an important role in vector-borne disease control [13]. This was the starting point for the research into community-centred ITM services in Mexico and Colombia presented here.

The main objectives of the research were:

- 1) to analyse the process and results of different kinds of community-based ITM services;
- 2) to identify the favourable and the limiting factors of this approach.

Methods

Study areas and counterparts

Mexico and Colombia (with 95 and 38 million inhabitants) belong to the middle-income countries in Latin America (GNP per capita in 1997 was 3680 USD and 2280 USD respectively) [17]. Malaria transmission in Mexico is mainly restricted to the Southern parts of the country and *P. vivax* is the main parasite, in Colombia the disease is widespread particularly on the Pacific and At-

lantic coast and in the Amazon and both *P. falciparum* and *P. vivax* are widespread.

The research team was involved in training programmes for health managers at district and state levels in Mexico (70 persons) and Colombia (52 persons) which emphasised vector-borne disease control.

The counterpart in Mexico was the solidarity branch of the social security system (IMSS-SOLIDARIDAD) which operates in 18 of the 32 states of the country covering mainly the rural poor and providing them with preventive and curative services. The malaria-endemic areas of Chiapas and Oaxaca, both at the lowest end of socio-economic development of the country, were included in the study.

In Colombia the Ministry of Health and the National Institute of Health were the main counterparts and the staff to be trained were vector-borne disease control (VBDC) managers at state (*departamento*) level. The areas for the intervention study suggested by the MoH were the poor Pacific coast (Chocó state) and the better-off Atlantic coast (Urabá; Turbo district). At local level the counterparts were: the state head office of the MoH in Chocó and an international NGO (*Plan Internacional*); and the local social security company and a national NGO in Urabá (Turbo) as well as the VBDC staff of the MoH.

The methodology of bednet impregnation, choice of insecticides and fabrics, cost aspects and the legal aspects of cooperatives were taught in the training courses. The idea of establishing community cooperatives for the purpose of providing sustainable ITM services and creating local income was welcomed by the participants of the training programme. The research team offered, at the start, provision of free insecticides (donated by industry) for roughly 1000 bednets and promotional materials. The income obtained for the purchase of each impregnated net would be paid into a revolving fund; this would be used for buying insecticides and other supplies. The surplus was for cooperative members themselves.

Following this training, the Mexican health managers from IMSS-SOLIDARIDAD began a process of creating community awareness about the possibility of community-based vector control activities. As a result, eight cooperatives were set up by community assemblies. The members of the cooperatives (usually four people) learned the technical and administrative aspects of the programme and received the basic supplies to start (insecticides, bednets, dipping materials and promotional materials).

In Colombia, the procedures were different as the local health services in the suggested areas were unable to estab-

lish cooperatives on their own. This meant that an academic institution (the Colombian Institute of Tropical Medicine) together with the research team and the district health team had to provide the necessary inputs at the beginning. These included local training workshops on the topics above mentioned and supplying necessary materials for the start of the programme.

Process and impact analysis

The eight cooperatives in Mexico were visited three times between their setting up (from May 2000 to June 2001) and January 2002. During these visits, impregnation activities were observed and sales books for ITMs were checked. Twenty-four group discussions with cooperative members and in-depth interviews with 12 IMSS-SOLIDARIDAD supervisors in Mexico were also carried out as well as 36 individual semi-structured interviews with ITM users; and the same number of non-users of ITMs using a checklist of questions.

The six cooperatives in Colombia (established in the same time period as the Mexican ones) were visited every two or three months in order to correct errors and to support the promotional and impregnation services. On these occasions the same evaluation procedures were carried out as described above including 18 group discussions with cooperative members, 30 semi-structured interviews with ITM users and the same number with non-users and 8 in-depth interviews with MoH staff.

Most in depth interviews and group discussions were taped and later transcribed. A written report was produced after each visit supplemented by the transcribed discussions.

Results

Background information

The general characteristics of the eight Mexican and six Colombian cooperatives, as well as the malariometric indices, are presented in Table 1. It can be seen that malaria endemicity was lower in Mexico and *P. vivax* prevailed, as compared to the Colombian areas where the annual parasite index was higher and *P. falciparum* was more prevalent. More than 50% of beds were covered with bednets. These had been purchased from local retailers at an average price between US\$ 4.50 and 7 in Mexico and US\$ 6 to 9 in Colombia.

All cooperatives had an elected president, secretary and treasurer, and occasionally a vice-president. In most places the office-holders were women and they had their own building for ITM services. They had an average target population of 5,000–15,000 inhabitants; through several of them (particularly the cooperatives on the Pacific coast in Oaxaca, Mexico, and Chocó, Colombia) had far higher

potential target communities. The Mexican cooperatives were located in rural areas (with communities of less than 2,500 inhabitants) and the Colombian cooperatives in urban areas (with roughly 5,000–15,000 inhabitants).

Services offered by ITM community cooperatives

In Table 2, the three basic types of ITM services offered by community cooperatives are presented:

- 1) impregnation/re-impregnation services for existing nets only
- 2) sale of bednets which have been bought on the market and then impregnated by the cooperative
- 3) production of bednets and impregnation services.

The cooperatives of the second and third type additionally offer re-impregnation services in the community. In Colombia, selling impregnation kits to the public through two cooperatives and four pharmacies for self-dipping was also tested. It had, however, to be abandoned due to low sales probably related to insufficient promotion. One cooperative, formed by health workers from the social security system, offered impregnation kits during their house-to-house visits; however, people who bought such kits asked the health workers to do the impregnation for them on the spot.

The services were offered in three ways:

- 1) ITMs are produced and sold from the cooperative's building or by cooperative members in their communities;
- 2) through community outreach, with impregnation and/or sale of impregnated nets from a building (usually a school) in an outreach community;
- 3) house-to-house impregnation in the community as a complementary measure for people who did not attend central-point dipping.

In Mexico, monthly sales rates of impregnation services were highest for the exclusive sale of impregnation/re-impregnation services while in Colombia they were highest for the production of nets plus impregnation (Table 2). This was largely due to an international NGO which bought impregnated nets from the cooperative. The factors related to these differences will be analysed in a later section.

Promotional activities

Promotion of ITMs by word-of-mouth was the most frequently used form of propaganda. This was particularly

Table 1: Background information on study districts in pre-intervention phase

	MEXICO		COLOMBIA	
	CHIAPAS	OAXACA	CHOCO	URABA (ANTIOQUIA)
MALARIA				
Median Annual Parasite Index* (1998 to 2000)	14	20	123	98
% <i>P. falciparum</i> of all cases	10%	1%	55%	50%
BEDNETS				
% coverage of beds with nets	68%	57%	53%	51%
Average size and fabric of nets	14 m ² cotton, synthetic	14 m ² cotton, synthetic	13 m ² synthetic	13 m ² synthetic
COOPERATIVES & TARGET POPULATION				
Number of cooperatives	5	3	3	3
No. of target health districts per cooperative	5	2	3	3
Type of target population	rural	rural	urban	urban
Average target population per cooperative	8000 inh.	5000 inh.	9000 inh.	5000 inh.
Gender of cooperative members	Mixed	Female	Female	Mixed
Whether cooperative has own building	yes	yes	yes	no

* API = number of positive blood smears per 1000 inhabitants

Table 2: ITM services offered by community cooperatives in Mexico and Colombia and monthly sales

ITM services sold	MEXICO		COLOMBIA	
	No. of cooperatives	Monthly sale per cooperative	No. of cooperatives	Monthly sale per cooperative
1. Impregnation/re-impregnation of existing nets	1	25	4	53 ²
2. Impregnation of industrially produced nets or existing nets	7	91	0	-
3. Local production of nets and impregnation	0 ¹	-	2	108
All ITM services together	8	83	6	71

¹ One Mexican cooperative is starting to produce nets for hammocks which are not available on the market ² One cooperative has just started to sell impregnation services ³ 90% of these impregnated nets were sold to an international NGO; occasional re-impregnation of existing nets (n = 6 per month per cooperative)

successful when cooperative members were used to going from house-to-house selling bread and other food or goods. A positive marketing effect was achieved when cooperatives had their own building in the centre of town with a visible logo in front.

The Mexican cooperative members in rural areas promoted ITMs in community meetings while the urban cooperative members in Colombia used a loud speaker (*perifoneo*) for promoting their products in the neighbourhood.

Low-cost marketing materials were provided by the research team which were reproduced by the counterpart institutions and handed over to the cooperatives. These included flyers, stickers, visors and – in Colombia – radio spots (six per day).

Facilitating impregnation services

In each group two people, using protective clothing, were trained to re-pack liquid insecticide from 1 litre bottles into smaller plastic bottles which could be easily closed with a screw-top. The advantages of this system were cost-reduction, management of small doses by the dippers, and the ease of changing the product according to availability. For instance, for one 14 m² area either 7 ml of lambda-cyhalothrin 2.5% CS or 14 ml of deltamethrin 2.5% SC were put into a bottle using either a pipette or a syringe; the cost of the re-packed unit for the impregnation of one net with lambda-cyhalothrin was 0.6 US \$ and with a deltamethrin tablet 2.3 dollar in 2001 in Colombia [7]. The price of the deltamethrin tablets dropped later in 2001 to 1.6 US \$.

Impregnation was generally done using the "closed-bag system": Each net was placed in a plastic bag, water and insecticide were added, and the bag was closed and shaken for 10 minutes. Then it was dried either in the cooperative building or by users at home.

In this way, skin contact with insecticides was avoided and side-effects were minimised. Each cooperative had written instructions about procedures and the impregnation materials and supplies needed.

Control of sales; exemption mechanisms and forms of payment

Generally, the treasurer of each cooperative was responsible for administrative and financial control. This was based on the sales book. In this ledger the following information was registered for each sale: the name of the purchaser, the amount of money received and the date due for re-impregnation. Only in two Colombian cooperatives were the books inadequately kept at first. This was

because members of the cooperative, which was too large, had started to sell ITMs on their own.

The income from ITM sales was meant to feed a revolving fund (60% to 70%) while the rest generated income for the cooperative members (see later "unit costs of impregnation"). The revolving fund was to be used for travel expenses and purchase of ITM materials. Indeed, most of the Mexican cooperatives after six to 12 months used their income exclusively for the revolving fund surplus was put in a bank account. In Colombia, in the initial phase an excessive use of funds was registered for personal purposes in two cooperatives so that only little money was left for purchasing the supplies ("sunset fund"). A second donation of insecticides and bednet fabrics had, therefore, to be provided in order to re-vitalise the cooperative. The next batch of supplies could be purchased with the revolving fund due to improved supervision and financial control.

In one cooperative in Colombia, composed of social security system health workers, the impregnation was offered for free as the insurance company considered malaria vector control to be part of the basic health plan. However, they claimed the insecticide from the district health team and the promotional materials from the research group.

Six of the eight Mexican cooperatives had informally established exemption mechanisms for the very poor (mainly widows with several children) who received ITMs for free. The costs were covered by the profit they had made by their sales and did not affect the price. The other cooperatives had not yet thought about this.

In most small businesses in Latin America, consumers tend to pay by instalments. This was also the case in the Mexican and Colombian cooperatives which – according to the interviews – did not cause problems.

Factors relating to the strengths and weaknesses of the cooperatives

In Fig 1 factors which favour or limit the success of ITM cooperatives are presented. "Internal factors" are directly linked to particular cooperatives and "external factors" are those beyond the control of cooperatives. Examples will be shown and analysed.

Favourable factors

Support and supervision

Continuous support and supervision turned out to be essential for the cooperatives. In Mexico this work was done by IMSS-SOLIDARIDAD, a government organisation with a strong component of community health work and a sophisticated system of supervision. This led to the rapid development of the infrastructure and corporate identity of the cooperatives. Well-organised communities in the

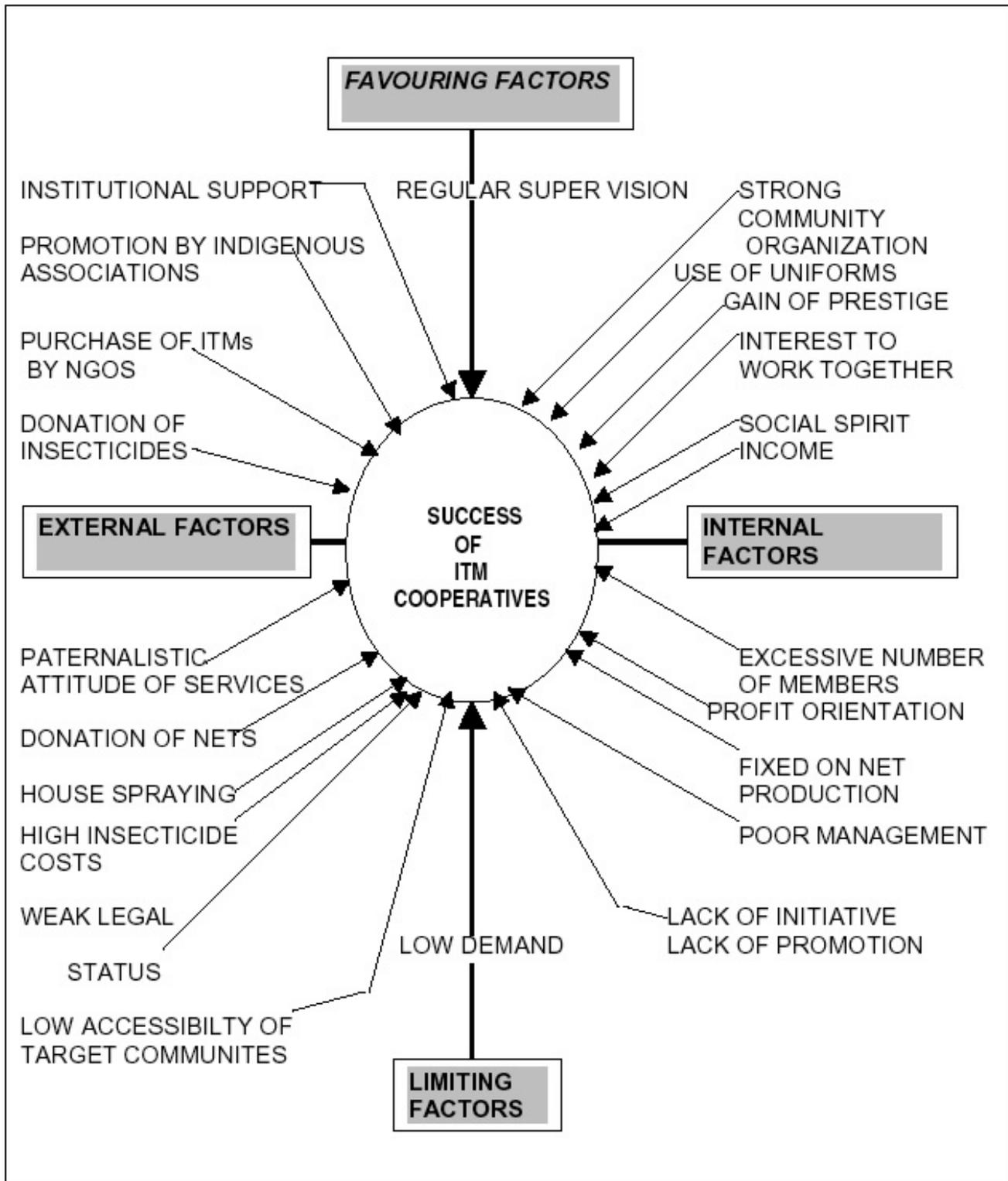


Figure 1
External and internal factors which favour or limit the success of cooperative-based ITM services.

Mexican situation were essential for following up the activities of the cooperatives. In some cases community leaders were also involved – this was perceived by cooperative members to be a strengthening factor.

In the Colombian study areas, the MoH support was much less concrete so that most of the work had to be done by an academic institution, the Colombian Institute of Tropical Medicine, together with the research team. Furthermore, for security reasons, direct supervision of the cooperatives' work outside larger towns could be done only irregularly. This caused significant delays in their work and less stringent control of their activities.

Support by NGOs and health services

In Mexico, the National Institute for Amerindians (*Instituto Nacional Indigenista*) promoted the ITM cooperative for free on their local radio station thereby augmenting sales substantially among the target population. In Colombia, UNICEF donated net fabrics; an international NGO bought 3,700 impregnated bednets from two cooperatives and the local health service purchased 200 ITMs for free distribution among the poor.

Donation of materials and gain of prestige

Initial donations to the cooperatives of insecticides by the pharmaceutical industry and, to a small extent, by the MoH was an essential starting mechanism for impregnation activities – they helped to feed the revolving fund. The donation of promotional materials by the research team and of protective clothing by IMSS-SOLIDARIDAD in Mexico and by the research team in Colombia was important for creating a sense of corporate identity among cooperative members and a sentiment of not operating alone. It contributed also to a gain of prestige in the community.

Motivation of cooperative members

When asked about their motivation for working in the cooperatives, members in Mexico most frequently said it was "to contribute to the development of our communities", "to protect our children" and "to do something for our people". This was reconfirmed by the fact that in most Mexican cooperatives no personal income has not yet been taken from sales. In both Mexico and Colombia women mentioned also that they liked to work together and that the income generated by the sales would help to support their families. This was particularly stressed by the Colombian cooperatives which produced bednets themselves and were keen on selling them as quickly as possible.

Limiting factors

Paternalistic attitudes of health services; donation of nets

Health services and particularly vector-borne disease control programmes have accustomed populations to receiving services for free or to not receiving services at all. This was reflected in the occasional indiscriminate donation of impregnated or unimpregnated mosquito nets by VBDC staff without prioritising specific risk groups and, even worse, without indicating that nets have to be re-impregnated. Indiscriminate donations of bednets by the MoH occurred in all our study areas leading community members to ask: "Why does the cooperative sell the nets which we eventually get from the MoH for free"?

Continuation of residual house spraying

Malaria workers trained in residual house spraying are confused by the new strategy of bednet impregnation and some of them (both in Mexico and Colombia) expressed their concern at losing influence and control. "What do we have to do when people start to use insecticides?" was a question recorded in the interviews. Residual house spraying was done in all study areas at irregular intervals of from 6 months to 4 years. In two study areas in Mexico bednet users asked: "Do we need to impregnate our nets when the malaria [team] comes to spray our houses?"

High unit costs of impregnation

In Fig 2 the components of the direct financial costs of an impregnation service are presented. These include the insecticide, the dipping equipment (plastic bags, jars, gloves, mouth-protectors, aprons), repacking materials (plastic bottles with screw-tops, labels, syringes) and promotional materials (flyers, posters, stickers, visors) but exclude the costs of protective uniforms which were provided by the health services. The radio spots in Colombia have been excluded because at the time of the study these had been broadcast for two months only; this would have added a further US\$2.0 per impregnation service sold.

The higher the insecticide costs, the stronger the dependence on external support. Insecticide costs are particularly high in Colombia, due to import taxes and VAT. The cost of 1 litre lambda-cyhalothrin 2.5% CS at the end of 2001 was US\$105 to the public and US\$84 to the MoH in Colombia. In Guatemala it was US\$40 and in Ecuador US\$27). Even when re-packing the insecticide into small one-treatment units, the price in Colombia was still high (US\$0.87 for lambda-cyhalothrin). The other cost components (Fig 2) and the small surplus for the cooperative (US\$ 0.28) increased the price of one impregnation to US\$1.50 which was, according to our discussions with cooperative members difficult to recover among the general public. As a result the Colombian cooperatives charged only US\$0.50 per impregnation (which was accepted by

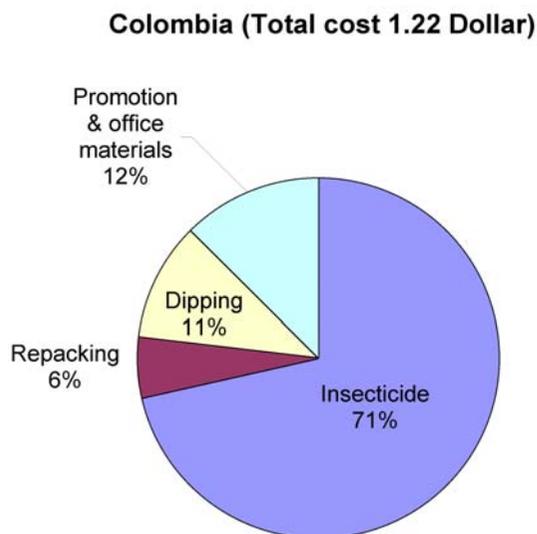


Figure 2
Components of the direct financial costs of an impregnation service (Colombian model)

the general assemblies of the communities involved), relying on donated insecticides by the MoH and the industry.

In 2002, one company started offering insecticide at a lower price (US\$0.60 per impregnation unit) to reduce the dependence on subsidies is less. In Mexico, the insecticide price per impregnated net in January 2002 was only US\$0.35 for deltamethrin SC (market price) and US\$0.23 for lambdacyhalothrin CS (discount price offered by the national retailer to cooperatives) and the total cost of the impregnation service per net was US\$0.7 (Fig 2). A price of US\$ 1.00 was perceived to be reasonable by cooperative members and widely accepted by the community assemblies and the population. This resulted in a surplus of roughly US\$0.30 for the cooperative per impregnated net.

Weak legal status

When cooperatives were involved in business transactions, as in the case of the net-producing cooperatives in Colombia, they experience difficulties when ordering fabrics in large quantities from the capital city or when selling a high number of impregnated nets to an NGO. For such transactions, they needed official status with a company code and VAT registration. The solution was to affiliate the cooperative with a larger organisation which had a defined legal status. However, such affiliations imply charges and weaken the independence of the cooperative.

Excessive numbers of cooperative members and profit orientation

11 out of 14 cooperatives had three to five members. One in Mexico had four active members, but all 26 female spouses in the community insisted on participating in the sale of impregnated nets because no one wanted to be excluded. This was perceived as working well by community leaders and cooperative members, mainly because the cooperative was not profit-oriented and covered only travel expenses and the purchase of new materials and supplies. In contrast, in two Colombian cooperatives in an urban environment, 32 women in one and 11 women in the other produced nets and impregnated them, and they all wanted to get some profit from sales. This worked only because of the external support (see "Support by NGOs"). However, sustainability can only be guaranteed if external donors can be attracted, which is difficult to achieve.

Excessive emphasis on net production or net sales

The two Colombian cooperatives mentioned above paid almost exclusive attention to the production and impregnation of bednets, ignoring the large number of existing nets that needed to be impregnated in the community. Similarly, four Mexican cooperatives, which impregnate and sell pre-fabricated nets, put little emphasis on the impregnation of existing nets (see Table 2).

Poor financial management

All regularly supervised cooperatives kept their books in a satisfactory state with a transparent overview of income and expenditures; this was confirmed by the research team. Only two Colombian cooperatives, in areas of civil unrest, did not appear to correctly register their balance. This led to tensions with the supervisory team and to difficulties in rational budgeting.

A management problem appeared in one generally successful Mexican cooperative when a distant community asked for impregnation services and the cooperative members were fearful about increased transport costs. A simple cost calculation by the research team showed that they would have made a profit and satisfied their consumers if they had travelled.

Lack of initiatives and promotion

As cooperative members were not selected on the grounds of being business people with a talent for promoting and selling goods, this quality was randomly distributed among members. As a result, those cooperatives which had more members with a business spirit developed more initiatives in promoting ITMs than those where members were more shy in promoting their product to the public.

Low demand for ITM services by the population

ITM services paid for and offered through community cooperatives was a new departure for the populations of all

study areas and substantial promotional efforts were needed to increase demand. Some of the factors explaining low demand have been mentioned. For example, donation of impregnated nets for free, dispersed populations in rural areas and lack of initiative by the cooperatives. The cost aspect was less important to the consumers when impregnation was sold at US\$ 1.0 in Mexico and US\$ 0.50 in Colombia. In Mexico there was a certain tendency for people to prefer more expensive bednets of higher quality over the cheaper ones of lower quality (expressed in the group interviews with cooperative members and individual interviews with ITM users).

Other reasons for low demand of ITM services, mentioned in interviews with cooperative members and ITM users and non-users in both countries, included:

- *Fear of side effects*: Many interviewees mentioned residual house spraying, during which housewives have to remove the furniture from their homes and leave for a couple of hours. This made them think that all insecticides are highly toxic, particularly for small children.
- *Low mosquito nuisance*: In areas where mosquito densities are low (although malaria transmission may be high due to potent vectors), interviews mentioned less interest in vector control activities than in areas with high vector densities (although these may have been mainly *Culex* spp).
- *Lack of knowledge*: 80% of the non-users interviewed had little knowledge of the cooperatives and/or of the benefits of impregnation services.
- *Difficult transition from passive to active community participation*: 35% of the interviews among non-users of ITMs showed that people felt that the health services should be responsible for vector control, not the community. Some interviewees mentioned that city councils should be involved.

Discussion

Public and/or private (commercial) ITM services

In the African context, increased involvement by the commercial sector in the sustainable provision of ITMs (including production, promotion, distribution and sale) supported by powerful international donors and NGOs is seen as the best way of responding to the low coverage achieved so far. The public sector, in this case, could be responsible for ensuring coverage for the poor and also for initial promotional activities until the private sector's involvement has sufficiently increased [18,19].

In Latin America, where vector control services are in place, the public sector can play an important role in achieving, maintaining and monitoring high ITM cover-

age. However, public services do not have enough human resources to do this on their own. They would benefit from partnership with communities and extend the conventional model of malaria volunteers (who take blood smears and provide drugs) to community cooperatives (which do vector control through ITMs). This has been shown to be feasible by our research in Mexico and Colombia.

The public sector has a certain control over insecticide prices through central purchasing and by taking advantage of competition between companies [7]. This could be weakened if the profit-oriented commercial sector were to be totally in charge of the distribution and sale of ITMs.

Delivery of impregnation services

On the technical side, ITM services may be delivered: (a) door-to-door, with individual houses visited, (b) using a central dipping point with people bringing their nets to one point, and (c) with do-it yourself kits with impregnation kits sold to the general population and people do the dipping themselves [13].

Country experiences with these strategies were:

a) *Door-to-door impregnation*: According to Snow *et al* [21], the first impregnation round during a bednet trial in Kenya achieved 97% household coverage with free impregnated nets. This dropped to roughly 64% in the second round when the central-dipping strategy was applied (see below).

b) *Central-dipping point*: In Kenya the reasons for the reduced acceptance of re-impregnation were: "unawareness of the impregnation schedule or of the dipping point" and "distance and transport problems to the dipping point". A further decline of re-impregnation coverage occurred when people had to pay for services and financial reasons became the main cause for not buying them [21]. In Tanzania, net dipping and selling at central stations was preceded by house-to-house promotion, work by community net committees and by socio-dramas. However, only about 57% of nets needed were actually acquired by the population. The reasons given for not buying nets were "pre-payment of nets required", "inappropriate size of net", "central point distribution" and "indifference of local leaders" [22]. In Latin America, in two ITM trials the impregnation rates fell in Peru from 80% (first round) to 61% (second round), and in Nicaragua from 77% (in the first round) to 33% (second round) using in both cases the central-dipping point strategy. The main reasons for non-acceptance were: "experience of side effects of insecticides in the first round", "damage caused to cheap nylon nets by insecticide", "division within the community" and

"people's shame to show bednets in a poor state in public" [23].

c) *Do-it-yourself kits*: Intensive ITM promotion with massive donor funding can motivate people to spend money on ITMs and dip nets at home [13,24]. Under trial conditions, the uptake of self-dipping kits in Tanzania was good [25]. However, evidence about the quality and results of self-dipping in routine programmes is still scarce. In places where important external financial inputs cannot be expected, low-cost solutions for establishing ITM services have to be sought because it is doubtful that ITM services will retrieve enough funds to finance commercial marketing (US\$5–10 per net sold [26]).

In our study areas, the central dipping point method was preferred as the most convenient one for cooperative members; it will take some time to introduce alternative strategies.

Financing of ITM services

Possible financing mechanisms for net programmes in Africa include [12]: Net distribution through existing government channels (as with EPI or essential drug programmes); government subsidy of distribution through the private sector or NGO channels; and cost sharing between governments, NGOs and communities with social marketing to encourage people to pay for services. An interesting alternative is employer-based financing of impregnated nets [22]. In Kenya, local industries interested in protecting their workforce were paying for impregnation services against malaria but were struck by an economic crisis in the country (D Wacira, personal communication 2002). Another novel approach used in Tanzania was a voucher system for pregnant women and small children. They received a price reduction for ITMs, but the low use of discount vouchers was seen to be "a reflection of women not being the main ITM purchasers" [24]. In our study areas self-financing through the revolving fund could be achieved in Mexico (where insecticide prices are low) but not in the Colombian study areas where continuous or occasional insecticide donations would be required.

Organising impregnation services: Latin America and Africa compared

The initiatives in Mexico and Colombia described in this paper are the first of their kind in Latin America. They seem to be similar to programmes in Tanzania [22] with similar early problems in the use of revolving funds and in the struggle for acceptance by local people. However, their comparative advantage is close supervision and support by public services and, in exceptional cases, by NGOs interested in VBD control. This has meant that the finan-

cial burden of establishing cooperatives and supervising them only included:

- the cost of insecticides (which were provided for free at the beginning either by the chemical industry or by the vector control services and then bought by the cooperatives)
- protective clothing for re-packing and central-point dipping (which was provided by the health services)
- the development and supply of promotional materials (provided by the research team but which could also be taken up by departments of health promotion in the Ministries of Health).

All other costs for training and supervision of cooperatives were marginal and absorbed in the budgets of the VBDC programmes or the general health services.

Management issues: Mexico and Colombia compared

"Mexico" and "Colombia" are used as labels for our study areas without extrapolating the results to the countries as a whole. The monthly sales per cooperative (Table 2) and our observations and informal interviews show a better performance of the Mexican cooperatives. Explanatory factors are: a) better guidance and support by health services b) smaller size (4 members only) c) less desire for quick returns, d) lower ITM unit cost (favouring the financial independence of the cooperatives).

As an example, regular programme supervision at the Mexican study sites is part of the routine activity of supervisory staff. This is also the case in Colombia, apart from the fact that – in the particular areas studied – programme supervision was weak and had to be complemented by the Colombian research team. The high number of members in two Colombian cooperatives meant that the individual share of the total income was low. This led to disappointment in the group as many women had expected a quick return and a substantial income supplement for their families.

The way forward

The next step in scaling up ITM use is to organise national training courses on the managerial and operational aspects of ITM services for programme managers in malaria-endemic states. This has been initiated in Colombia (by the Ministry of Health and the National Institute of Health) and in Mexico (by the IMSS-SOLIDARIAD programme in coordination with the Ministry of Health). However, just as with market-based approaches, it may take years to achieve high levels of coverage [14] as the shift from house spraying to bednet impregnation and adoption of a new role by health services and communi-

ties requires leadership, technical assistance, the design of appropriate promotional messages [20] and promotion over a long period.

There are indications that the acceptance of ITMs will increase. For instance, many families preferred more expensive nets of a higher quality and also distant villages in Mexico asked for impregnation services, which have to be paid for. Likewise in Venezuela, where impregnated bed-nets and curtains are offered through cooperatives for the control of Chagas' disease and leishmaniasis, people's acceptance and willingness to pay are high (Villegas and Kroeger, unpublished data).

Our study shows the strengths and limitations of a private sector initiative (community cooperatives) supported and monitored by the public sector (MoH) in providing ITM services in malaria endemic areas of Latin America. It was not designed to show an advantage over the model which heavily relies on the commercial sector but it is argued that it makes sense in Latin America to actively involve community organizations and the public sector in this strategy.

Conclusions

ITM services offered by community groups have not yet achieved high coverage. Nevertheless, it is anticipated that, over the coming months and years, the key lessons will be learned by the cooperatives and their supervisors. It can be expected that improved services will be achieved as work routines develop and procedures are established and as more creativity is put into promotional activity. Scaling up to national level in Colombia is envisaged for the next year by the National Institute of Health.

The coming months and years will show the impact of the training of programme managers mentioned above and how efficiently and effectively community groups, under the guidance of the public health services will contribute to VBD control.

Authors' contributions

A.K. designed the project and was involved in the data collection process and analysis. A.A. and J.O. were responsible for the Colombian component and C.E. for the Mexican component and they contributed to the data analysis.

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