Cost-effectiveness and sustainability of lambdacyhalothrin-treated mosquito nets in comparison to DDT spraying for malaria control in western Thailand
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Two approaches for the prevention of malaria were studied. These were residual DDT indoor spraying (2 g active ingredient/m²) and lambdacyhalothrin-treated bed nets (20 mg active ingredient/m² in the form of an emulsifiable concentration containing 2.5% active ingredient).

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study referred to the general population living in highly malaria endemic areas.

Setting
The setting was primary care. The economic study was carried out in six villages in two sub-districts of the Mae-Ramard District, Tak Province, Thailand.

Dates to which data relate
The effectiveness and resource use data were gathered between February 1993 and January 1994. The price year was 1994.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively on the same sample of patients as that used in the effectiveness analysis.

Study sample
Power calculations to determine the sample size were not performed. However, a large sample of patients was included in each study group. Twenty-eight hamlets were selected and divided into three main groups as follows:

10 hamlets, 243 houses and 948 inhabitants in the net group;
12 hamlets, 294 houses and 1,315 inhabitants in the DDT group; and
6 hamlets, 171 houses and 695 inhabitants in the control group.

As different numbers of individuals were enrolled in the three groups, the number of people enrolled for observation was adjusted for the standard population (number of individuals in the DDT spraying group). Therefore, the final samples included 1,034 individuals (202 households) in the net group, 1,423 individuals (265 households) in the DDT spraying group and 757 inhabitants (140 households) in the control group. The mean age was 20.9 (+/-17.7) years in the net group, 21.3 (+/- 17.7) years in the DDT group and 22.3 (+/- 17.5) years in the control group. The male-to-female ratio was 1.01:1.00 in the net group, 1.03:1.00 in the DDT group and 0.96:1.00 in the control group.

Study design
This was a prospective cohort study that was carried out in several areas of the Tak Province. Sites were chosen on the basis of high malaria endemicity. Thick blood smears were obtained from all participants and were examined. Positive individuals received treatment following the policy of the Ministry of Public Health. The length of follow-up was not reported and no loss to follow-up was observed.

Analysis of effectiveness
It appears that all the patients included in the initial study sample were accounted for in the effectiveness study. The health outcomes used in the analysis were:

- the number of individuals with malaria,
- the attack rate,
- the number of malaria episodes,
- the episodes per 1,000 population, and
- the percentage of parasitic species (either Plasmodium falciparum or Plasmodium vivax).

The study groups were shown to have been comparable at baseline in terms of the age, gender and the average number of individuals per household.

Effectiveness results
There were 68 individuals with malaria in the DDT group, 61 in the net group and 97 in the control group, (p<0.0001).

The attack rates were 4.78 in the DDT group, 5.90 in the net group, and 97 in the control group.

There were 136 episodes of malaria in the DDT group, 115 in the net group and 275 in the control group, (p<0.0001). The episodes per 1,000 population were 1.84 (DDT), 2.14 (net) and 6.99 (control), respectively.

In terms of parasitic species, Plasmodium falciparum was observed in 72.1% of malaria episodes in the DDT group, 67% in the net group and 78.2% in the control group, (p<0.0001). Plasmodium vivax was observed in 27.9% (DDT), 33% (net) and 21.8% (control) of episodes, respectively, (p<0.0001).

Clinical conclusions
The effectiveness analysis showed that the two malaria control programmes were more effective than current malaria surveillance in reducing the number of people with malaria.

Measure of benefits used in the economic analysis
The summary benefit measure used in the economic analysis was the expected number of individuals protected from malaria. This was derived from the effectiveness analysis.
Direct costs
Discounting was not relevant since the costs were incurred during less than two years. The unit costs were not reported separately from the quantities of resources used. A detailed breakdown of the costs was not provided. The health services included in the economic evaluation were grouped into three main categories, labour, materials and capital. The cost/resource boundary of the study was that of the public health care provider. In addition, surveillance costs were considered. These covered the costs of blood smear test, treatment and follow-up, organisation, administration, information, education and communication. Resource use was derived from individualised data coming from the patients involved in the effectiveness study. The costs were estimated in the fiscal year 1994.

Statistical analysis of costs
The costs were not treated stochastically.

Indirect Costs
The indirect costs were not included in the economic analysis.

Currency
US dollars ($).

Sensitivity analysis
Sensitivity analyses were not carried out.

Estimated benefits used in the economic analysis
The expected number of individuals protected from malaria was 1,355 in the DDT group, 1,339 in the net group and 1,241 in the control group.

Cost results
The total costs for the standard population were $1,199.18 in the DDT group and $492.71 in the net group.

The costs of malaria surveillance (passive case detection) for the standard population were $1,337.56 in the DDT group, $1,567.65 in the net group and $3,108.32 in the control group.

The total costs for the malaria control programmes were $2,536.74 in the DDT group, $2,060.36 in the net group and $3,108.32 in the control group.

Synthesis of costs and benefits
Average cost-effectiveness ratios were calculated to combine the costs and benefits of the prevention programmes. No incremental analysis was performed. The cost per single case of prevented malaria was $1.87 in the DDT group, $1.54 in the net group and $2.50 in the control group.

Authors' conclusions
The use of insecticide-impregnated bed nets for a programme of malaria control in Thailand was cost-effective in comparison with both DDT spraying and a surveillance programme. Bed nets were also well accepted in a population of migrant workers such as that considered in the study.

CRD COMMENTARY - Selection of comparators
The authors stated that DDT spraying represented a widely used intervention for malaria control in Thailand, while bed nets were an alternative method that had been considered to be highly effective in prior studies. Finally, malaria surveillance represented the alternative of do nothing, as no explicit intervention was considered in this group. You should decide whether they represent valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**

The analysis of effectiveness used a cohort study. This was appropriate for the study question given that, as the authors stated, it was not feasible to conduct a randomised double-blind trial. Randomisation was not possible due to operational difficulties. However, the authors stressed that the study groups were comparable at baseline. The length of follow-up was not explicitly reported and the assessment methods were not accurately described. The study sample was unselected and is likely to have been representative of the study population of individuals at risk of malaria. Sample selection was carried out in several communities. The authors did not state whether some individuals were excluded from the initial study sample for any reason, or if some of the individuals eligible for enrolment refused to participate. Power calculations were not carried out but the sample size was quite large.

**Validity of estimate of measure of benefit**

The summary benefit measure was derived from the effectiveness study. However, the benefit measure was disease-specific, which means that it is difficult to make comparisons with the benefits of other health care interventions.

**Validity of estimate of costs**

The authors explicitly reported the perspective adopted in the study. It appears that all the relevant categories of costs have been included in the analysis. However, the costs were reported as gross categories and a detailed breakdown of the costs was not reported. Also, the unit costs and the quantities of resources used were not reported separately. These factors will hinder the possibility of replicating the cost analysis in other settings. The price year was provided, as were the sources of the data.

**Other issues**

The authors did not compare their findings with those from other studies. They also did not address the issue of the generalisability of the study results to other settings. Sensitivity analyses were not carried out and the external validity of the analysis was low. An average cost-effectiveness ratio was calculated to combine the costs and benefits of the prevention programmes, but the use of an incremental analysis would have been more appropriate. The authors discussed the reasons why DDT spraying should be terminated in Thailand, although it was clear that better results are obtained with a combination of methods.

**Implications of the study**

The study results suggested that residual house spraying for vector control in high-risk areas should be replaced with personal protection measures, such as insecticide-impregnated mosquito nets.

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