Rebound mortality and the cost-effectiveness of malaria control: potential impact of increased mortality in late childhood following the introduction of insecticide treated nets

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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
Insecticide-treated nets (ITNs) for the control of malaria.

Type of intervention
Primary prevention.

Economic study type
Cost-utility analysis.

Study population
Children from sub-Saharan Africa under 5 years of age at risk of malaria.

Setting
Community setting. The study was carried out at the London School of Hygiene and Tropical Medicine, London, UK.

Dates to which data relate
Effectiveness data were collected from studies previously published between 1993 and 1999. Resource use data were collected from studies previously published between 1993 and 1998. The price year was 1995.

Source of effectiveness data
Effectiveness data were derived from a review of previously published studies.

Modelling
A Monte Carlo simulation was conducted to estimate costs and benefits of ITNs.

Outcomes assessed in the review
The outcomes assessed in the review included all cause mortality, malaria morbidity, rate of compliance, and the retreatment rate.

Study designs and other criteria for inclusion in the review
Not stated.

Sources searched to identify primary studies
Criteria used to ensure the validity of primary studies
Not stated.

Methods used to judge relevance and validity, and for extracting data
Not stated.

Number of primary studies included
Approximately 6 studies were included.

Methods of combining primary studies
Meta-analysis.

Investigation of differences between primary studies
Not stated.

Results of the review
Children aged 1-59 months sleeping under ITNs experienced a significant reduction in all cause mortality of 19% (95% CI: 14 -24%), and a reduction in malaria morbidity of 46% (95% CI: 41 - 51%). The average compliance rate was 65%. The retreatment rates were given between 20% and 80%, while between 50% and 97% of children were assumed to correctly use the net.

Methods used to derive estimates of effectiveness
Estimates of effectiveness were also derived from authors’ assumptions.

Estimates of effectiveness and key assumptions
The population was assumed to have a stable age distribution and to be growing at a constant rate of 2.6% per year. A linear relationship was assumed between compliance and effectiveness. Without ITNs, the annual incidence of clinical episodes of malaria per child aged 0-4 years in a high transmission area was taken to be between 1 and 2.9. It was assumed that between 3% and 7% of cases were severe, and that between 0.41% and 2.24% of severe cases resulted in neurological sequelae. For children aged 5-10 years the annual incidence of clinical episodes was assumed to be between 0.4 and 1.1, with between 0.5% and 1.5% of cases being severe, and between 0.25% and 0.75% of severe cases resulting in neurological sequelae. The prevalence of malaria-associated anaemia was taken to be 9% in children aged 0-4 years and 4% in children aged 5-10 years.

Measure of benefits used in the economic analysis
The measure of benefit was disability adjusted life years (DALYs). The calculation of DALYs used a discount rate of 3% and no age weighting. The life expectancy at the age of death was taken from a standard life table. To calculate the morbidity component of the DALY, the disability weights and duration of condition for each type of malaria morbidity were taken from a previously published study. The authors defined the criterion for being reasonably certain that the intervention was cost-effective as a minimum of 95% of all iterations with a cost-utility ratio (CUR) under $150/DALY.

Direct costs
Costs were discounted at an annual rate of 3%. Quantities and costs were not reported separately. Direct costs included costs per child for the purchase, distribution and annual treatment of ITNs. The quantity/cost boundary adopted was that of society. The estimation of quantities and costs was based on actual data. Cost data were derived from previously published studies and expert consultation. The costing was based on a low income sub-Saharan African country with a per capita GNP less than $315. The price year was 1995.

**Statistical analysis of costs**
Not reported.

**Indirect Costs**
Indirect costs falling on households were included.

**Currency**
US dollars ($).

**Sensitivity analysis**
Due to the variability and uncertainty surrounding many of the parameters, the input variables were described as ranges rather than point estimates and a Monte Carlo simulation was performed.

**Estimated benefits used in the economic analysis**
On average 0.1 DALYs were averted per child under 10 by the intervention without rebound.

**Cost results**
The mean cost of the intervention per child aged 1-119 months was $3.79 with 90% of the iterations falling between $1.99 and $6.26.

**Synthesis of costs and benefits**
For children aged 1-59 months, the mean cost per DALY averted without any rebound was $44, with the cost-utility ratio (CUR) in 90% of the iterations falling between $18 and $85. For children aged 5-9 years, the threshold rebound rate at which the intervention is no longer cost-effective is 39% for all children in that age class (equivalent to an additional 1.8 deaths per 1,000 children) and 111% for compliers only in that age class (equivalent to an additional 5 deaths per 1,000 children). For children aged 3-6 years, the threshold rebound rate at which the intervention is no longer cost-effective is 2.5% for all children in that age class, equivalent to an additional 0.7 deaths per 1,000 children, and 6.8% for compliers only in that age class, equivalent to an additional 1.9 deaths per 1,000 children.

**Authors’ conclusions**
With no rebound ITNs would be considered an attractive policy intervention in a low-income country. It is essential that long-term surveillance is included as part of ITN interventions, with particular attention to the age range over which rebound may occur.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparator was clear.

**Validity of estimate of measure of benefit**
The relevant benefit measure was examined. More details about the literature search could have been provided. The model represented an average situation for a low-income country with high transmission in SSA. Hence, the parameter...
estimates will not be appropriate to all areas in Africa. The authors did not allow for the possibility that the rebound effect will be greater in the first year in which it is experienced and will gradually decline as immunity increases. The possibility of rebound in people over 10 years of age has not been included. The minimum age of rebound effects was set at 3 years, although it is possible that these effects may occur even earlier in childhood. The model does not consider health benefits to other household members which, if included, would increase the overall effectiveness of the intervention. Effectiveness may be expected to increase in a non-linear fashion, with disproportionately greater effects with higher compliance levels.

**Validity of estimate of costs**
Costs falling on providers and households were included. Costs of treating malaria were not included. Given the lack of detail on the source of the cost data, it is difficult to assess the generalisability of the cost results to other settings/countries.

**Implications of the study**
It is essential that long-term surveillance is included as a component of any ITN intervention. The possibility of increased incidence of severe malaria in older children highlights the importance of a co-ordinated approach to malaria control, which encompasses both prevention and strategies to improve the accessibility of effective treatment.

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**Bibliographic details**

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10223212

**Other publications of related interest**


**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Africa South of the Sahara /epidemiology; Bedding and Linens; Child; Child, Preschool; Cost-Benefit Analysis; Humans; Incidence; Infant; Malaria /classification /mortality /prevention & control /transmission; Mosquito Control /economics /methods; Quality-Adjusted Life Years; Severity of Illness Index

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