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
Streptococcus pneumoniae (pneumococcus) vaccination of infants at 6, 10 and 14 weeks was compared with a no vaccination programme.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis and cost-utility analysis.

Study population
The study population included 76.9 million babies born annually in the 72 GAVI-eligible countries.

Setting
The setting for the study was primary care. The economic study was carried out for all 72 GAVI-eligible countries (pooled analysis), grouped according to infant mortality rates and separately for individual countries.

Dates to which data relate
The main clinical effectiveness data used to populate the model came from a single study published in 2005. The price year was 2000.

Source of effectiveness data
The clinical and epidemiological parameters in the primary model included vaccine effectiveness against all-cause mortality, vaccination coverage, and the probability of dying. The second analysis considered nonfatal disease, outpatient pneumonia visits, and hospital admissions for pneumonia and meningitis.

Modelling
Two analyses were performed. Both used decision trees and one was an extension of the other. The first only considered the effects of vaccination, while the second also considered the effects of vaccination on outpatient pneumonia, hospital treatment for pneumonia and hospital treatment for meningitis. The time horizon was not explicitly stated in the paper, but it would appear to have been a lifetime analysis. Details of all health states and model probabilities were given in the paper.

Sources searched to identify primary studies
The vaccine efficacy data came from the single trial conducted in the Gambia. Vaccination coverage rates were country
specific, while data on mortality rates came from World Health Organization (WHO) publications.

**Methods used to judge relevance and validity, and for extracting data**
The clinical data came from one study alone because the study setting was said to most closely resemble that of other GAVI-eligible counties. Vaccine efficacy was adjusted for country-specific mortality rates. Clear details were reported in the paper.

**Measure of benefits used in the economic analysis**
The measures of benefit used were the years of life lost and the disability-adjusted life-years (DALYs). The authors reported that they used standard methods and assumptions, including age weighting, to estimate the DALYs. The benefits were discounted at a rate of 3% per year.

**Direct costs**
The direct costs to the health service and patient were included in the analysis. These included direct medical costs (hospitalisations, medical staff time, diagnostic tests and medications) and direct non medical costs (transportation and parental or caregivers time). The unit costs for hospital days and medical staff time were taken from published WHO documents. Resource use and cost for diagnostic tests, medications, transportation and parental time were derived from a study undertaken in India. These costs were applied to other countries by weighting them by per capita gross domestic product, the ratio of public to private health care expenditure, and the ratio of urban to rural population. The cost of the vaccine was unknown, but was assumed to be similar to other pricing schemes. The cost of the vaccination programme was derived from financial sustainability plans provided to GAVI by seven GAVI-eligible countries. The costs appear to have been the average costs. The costs were discounted at a rate of 3% per year. The costs and the resources were not reported separately.

**Statistical analysis of costs**
No statistical analyses of the costs were conducted.

**Indirect Costs**
Productivity losses were considered. However, they were not evaluated because of the age of the study population and the fact that, in the primary analysis, the effectiveness of vaccination was only on mortality.

**Currency**
International dollars (Int$). These were adjusted for purchasing power parities.

**Sensitivity analysis**
Uncertainty was investigated using a one-way sensitivity analysis and Monte Carlo probabilistic sensitivity analysis. The authors’ methods were described in detail in an appendix on the Web.

**Estimated benefits used in the economic analysis**
The total number of lives saved in all countries was 262,000. The DALYs averted in all countries was 8.3 million.

**Cost results**
The total cost of vaccination for all countries was Int$882 million, whilst savings from medical care averted were Int$44.3 million. Thus, the total net cost was Int$838 million.
Synthesis of costs and benefits

The cost per life saved for all countries in the analysis was Int$3,200. This ranged from Int$2,200 in countries with high to very high child mortality (>100 deaths per 1,000 births) to Int$175,000 per life saved in countries with low child mortality (<25 deaths per 1,000 births).

The cost per DALY averted for all countries in the analysis was Int$100. This ranged from Int$69 per DALY averted in countries with high child mortality (100 - 149 deaths per 1,000 births) to Int$5,260 per DALY averted in countries with low child mortality.

For the secondary analysis, which included the effects of vaccination on nonfatal disease, the pooled incremental cost-utility ratio across all countries was Int$101 per DALY averted.

The results were most sensitive to vaccine efficacy against all-cause mortality and vaccine cost.

The probabilistic sensitivity analysis found that the 95% confidence interval for the cost-effectiveness ratio was Int$57 to Int$185 per DALY averted.

Authors' conclusions

Routine pneumococcal conjugate vaccination is highly cost-effective in countries with high mortality rates for children younger than 5 years of age (i.e. >100 deaths per 1,000 births). Note, the World Health Organization (WHO) considers interventions to be highly cost-effective when the cost-effectiveness ratio is below a country's gross domestic product per capita.

CRD COMMENTARY - Selection of comparators

The selection of the comparator (i.e. no vaccination programme) was explicitly justified as experience had shown that there is no vaccine uptake without financial support in these GAVI-eligible countries. You should decide if the comparator represents current practice in your own setting.

Validity of estimate of measure of effectiveness

The authors used a single vaccine trial to populate their model. Other efficacy estimates were available for other trials, but this vaccine trial was regarded as most closely resembling the countries of interest. The effectiveness of vaccination was adjusted for country-specific mortality; this was adequately described.

Validity of estimate of measure of benefit

The authors stated that life-years lost and DALYs averted were estimated from deaths averted using standard methods and assumptions. No further details were reported. The benefits were appropriately discounted. The DALYs averted constitutes an appropriate measure of benefit when evaluating interventions in less developed countries.

Validity of estimate of costs

The authors adopted a societal perspective. All relevant costs to this perspective were considered in the analysis. The sources of the resource use and cost data were reported. Some costs required extrapolation to other countries, while the cost of the vaccine and vaccination programme to GAVI was unknown. These costs were subject to a sensitivity analysis. All costs were discounted at an annual rate of 3%, which appears to have been appropriate. The cost methods were adequately reported.

Other issues

The authors compared their findings with earlier cost-effectiveness studies of pneumococcal vaccination and found their results to be in agreement. The generalisability to other settings was investigated in the analysis, using pooled results and grouping by childhood mortality rates. The authors do not appear to have presented their results selectively, and the appendix on the Web provided additional details of the sensitivity analysis. The authors appropriately
considered the scope of their results, given the breadth of their analysis and the large number of countries included. Several limitations to the study were reported. These arose, in part, from its broad scope and the need for simple assumptions with regard to the decision model and its structure.

**Implications of the study**
This economic evaluation shows that the introduction of a pneumococcal vaccination programme in many developing countries would be a cost-effective option. National or regional analysis may be required to further refine the cost-effectiveness estimates and more fully inform decisions on vaccine introduction.

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**Other publications of related interest**
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**Indexing Status**
Subject indexing assigned by NLM

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