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.

CRD summary
The study examined the cost-effectiveness of alternative strategies for pneumococcal polysaccharide vaccination to prevent invasive pneumococcal disease in adults. The authors concluded that vaccination at ages 50 and 65 years would be more cost-effective than the current vaccination policy (vaccination at age 65 and younger with co-morbidities). The study methodology was characterised by a lack of information on the sources used to derive the economic data. Nevertheless, the extensive use of sensitivity analysis and the clear presentation of study findings enhance the validity of the authors’ conclusions.

Type of economic evaluation
Cost-utility analysis

Study objective
The objective of the study was to examine the cost-effectiveness of alternative strategies for pneumococcal polysaccharide vaccination (PPV) to prevent invasive pneumococcal disease (IPD) in adults aged 50 years or older.

Interventions
Eight PPV strategies were considered. These were no vaccination, one vaccination (at age 50 or 65), two vaccinations (at ages 50/65 or 65/80), three vaccinations (at ages 50/65/80), four vaccinations (at ages 50/60/70/80), and a strategy depicting present US adult vaccination policy (vaccination at age 65 years unless a co-morbid condition is diagnosed prior to that age).

Location/setting
USA/primary care.

Methods
Analytical approach:
A Markov model was developed in order to simulate the natural history of disease and to determine the clinical and economic impact of the alternative immunisation strategies on the basis of epidemiological and clinical data from the published literature. A lifetime horizon was considered. The authors stated that a societal perspective was adopted.

Effectiveness data:
The clinical data appear to have been derived from a selection of known relevant studies. Details of a review of the literature were not reported. Epidemiological data and transition probabilities to chronic health states were derived from the 2004 National Health Interview Survey, supported by data from Surveillance, Epidemiology and End Results programme and the Framingham Study. Other national databases, such as the CDC Active Bacterial Core surveillance publications, were also used. Vaccine effectiveness was derived using data obtained from a modified Delphi panel, which supplied ranges of values (minimum and maximum estimates). This represented the key clinical input of the model.

Monetary benefit and utility valuations:
Utility valuations were derived from the literature, but no other details were given.

Measure of benefit:
The summary benefit measure was the expected number of quality-adjusted life-years (QALYs). These were estimated using the decision modelling framework. The benefits were discounted at an annual rate of 3%.

Cost data:
The analysis of the costs included the cost of vaccination (acquisition and administration) and the cost of treating IPD (fatal and nonfatal). The costs were presented as macro-categories. The costs and quantities of resources used were obtained from published sources, including the 2003 Healthcare Cost And Utilization Project (HCUP) data. An annual discount rate of 3% was applied to future costs. The price year was 2003 and the costs were in US dollars ($).

Analysis of uncertainty:
A one-way sensitivity analysis was carried out by varying all model inputs using published estimates. Furthermore, model inputs were assigned probabilistic distributions and were varied in a probabilistic sensitivity analysis, in which cost-effectiveness acceptability curves were generated. The types of probabilistic distribution were described. In an alternative scenario, co-morbidity sub-group values were used for each age group rather than modelling serotype coverage as the average for all patients. The age-specific or age- and co-morbidity-specific likelihood of IPD from a PPV serotype was also varied from 90 to 110% of the baseline value.

Results
The expected costs per person ranged from a minimum of $105.95 with no vaccination to a maximum of $138.68 with vaccination at ages 50/60/70/80.

The expected QALYs ranged from a minimum of 13.2604 with no vaccination to a maximum of 13.2626 with vaccination at ages 50/60/70/80.

The incremental analysis excluded some of the vaccination strategies (vaccination at age 50 or 65 only, vaccination at ages 65 and 80, and vaccination at ages 50/65/80) because they were dominated (more costly and less effective) than alternative vaccination programmes.

The incremental cost per QALY gained of the remaining strategies was $3,341 with vaccination at age 65 and younger with co-morbidities (current policy) compared with no vaccination, $23,120 with vaccination at ages 50/65 compared with the current policy, and $66,818 with vaccination at ages 50/60/70/80 compared with vaccination at ages 50/65.

The probabilistic sensitivity analysis showed that, at a willingness-to-pay threshold of $50,000 per QALY, vaccination at ages 50 and 65 only would be considered cost-effective in approximately 77% of simulations, while vaccination at ages 50, 65 and 80 would be favoured in about 17% of simulations, and vaccination at age 50 in 4% of simulations.

At a threshold of $20,000 per QALY, the current policy would be favoured, while for thresholds greater than $80,000 per QALY, vaccination every 10 years from ages 50 to 80 would be the preferred strategy.

Variations in other model inputs did not substantially alter the results of the analysis.

Authors' conclusions
The authors concluded that the current vaccination policy was not cost-effective at present vaccination rates and when using a threshold of $50,000 per QALY. The greatest value for money was obtained with a strategy of PPV at ages 50/65, although the optimal strategy depended on assumptions about vaccine uptake.

CRD commentary
Interventions:
The rationale for the selection of the comparators was clear. Alternative strategies were selected to reflect all possible vaccination strategies in addition to the current pattern of care in the USA, which was the vaccination of all persons aged 65 years or older.

Effectiveness/benefits:
The authors appear to have selectively identified the sources of data used in the analysis. Some of them were national
databases, which are likely to represent the most valid sources of epidemiological data given the large sample of patients involved and the validated approach used to collect primary data. Other estimates were derived using a Delphi approach, which relies on expert opinion to reflect actual treatment patterns and vaccine effectiveness. Given the uncertainty surrounding some estimates, extensive sensitivity analysis was appropriately performed on key clinical inputs.

**Costs:**
The authors acknowledged that the analysis of the costs was restricted to the medical services associated with vaccination and treatment of disease, despite the adoption of a societal perspective. A breakdown of the cost items was not provided, the costs being presented as macro-categories. Thus, the types of health services included in the broad category "treatment of IPD" were not clear. Another potential limitation of the analysis was the fact that, except for the HCUP database, details of the other sources of economic data were not reported. These issues tend to limit the transparency of the economic analysis.

**Analysis and results:**
The results of the base-case and sensitivity analyses were presented clearly, both in tables and by means of graphical representations. The issue of uncertainty appears to have been well addressed in the sensitivity analysis, which covered the most relevant aspects of the study. In fact, both deterministic and probabilistic sensitivity analyses were conducted. Patterns of transition among health states considered in the model were accurately described. A graphical representation of the decision model was provided.

**Concluding remarks:**
The study methodology was characterised by a lack of information on the sources used to populate the decision model, especially with respect to economic data. Nevertheless, the extensive use of sensitivity analysis and the clear presentation of the study findings enhance the validity of the authors’ conclusions.

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**Other publications of related interest**


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