Comparing health outcomes and costs of general vaccination with pneumococcal conjugate vaccines in Sweden: a Markov model

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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.

CRD summary
The study was to assess the cost-effectiveness of 10-valent pneumococcal non-typeable *Haemophilus influenzae* protein D conjugate vaccine (PHiD-CV) compared with 13-valent pneumococcal conjugate vaccine (PCV-13) in infants and young children. The authors concluded that PHiD-CV was cost-effective compared with PCV-13. The study methodology and its reporting were adequate. The authors’ conclusions reflect their analysis but uncertainty was not fully characterised and limitations in the study should be considered alongside the conclusions.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
To assess the cost-effectiveness of alternative pneumococcal conjugate vaccines in infants and young children.

Interventions
The interventions evaluated included: 10-valent pneumococcal non-typeable *Haemophilus influenzae* protein D conjugate vaccine (PHiD-CV) (serotypes 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F and 23F) and a 13-valent pneumococcal conjugate vaccine (serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F and 23F). A two plus one vaccination schedule (at three, five and 12 months) was assumed.

Location/setting
Sweden/Primary care.

Methods
Analytical approach:
A Markov cohort model was used to simulate the epidemiological burden of pneumococcal and non-typeable *H. influenzae* (NTHi) related diseases within hypothetical cohorts of infants. The time horizon was the lifetime. The authors stated that the study adopted a societal perspective.

Effectiveness data:
Data used to inform the model were derived from multiple sources that included national statistics databases, data on file, published studies and the authors’ assumptions. Vaccine efficacy data were based primarily on a cost-effectiveness study of PHiD-CV versus PCV7 conducted in the United Kingdom by de Wals et al. (see Other Publications of Related Interest) supplemented with updates for a new vaccine. Epidemiological and demographic data were derived from Swedish sources. Full efficacy phase was assumed from 12 months to two years, after which efficacy waned in a linear manner from two to nine years. Effectiveness was measured using the efficacy of the vaccines against invasive disease, hospitalised and ambulatory pneumonia and acute otitis media caused by *Streptococcus pneumoniae* non-vaccine serotypes or *Haemophilus influenzae* including NTHi. Data were not available for vaccine effectiveness for each of these by serotype so some assumptions were made.

Monetary benefit and utility valuations:
Utility valuations were derived from published studies.

Measure of benefit:
The measures of benefit were the life-years and quality-adjusted life-years (QALYs) discounted using an annual rate of 3%.

Cost data:
The economic analysis considered direct and productivity costs. The direct costs were of vaccination, vaccine administration and disease-related treatment. The productivity costs were of time missed from work for adults with the diseases and for parents caring for their children. Cost data for treatment were derived from Sweden-based studies. Vaccine unit cost was based on pharmacy retail price in Sweden. Other costs were incorporated based on an estimated cost per episode of meningitis, bacteraemia, hospitalised pneumonia, ambulatory pneumonia, GP (general practitioner) visits due to acute otitis media, tube insertions due to acute otitis media and mastoiditis. The authors assumed the price was same for the two vaccines. All costs were reported in Swedish kronor (SEK) and expressed in 2010 prices. Future costs were discounted using an annual rate of 3%.

Analysis of uncertainty:
One-way sensitivity analyses were performed for model inputs that included vaccine efficacy, disutility caused by diseases and PCV-13 reduction in myringotomy. Scenario analyses were performed to determine the variability introduced by assumptions.

Results
Overall outcomes in terms of life-years and total QALYs were reported; both discounted and undiscounted were presented for all three interventions (no vaccination, PCV-13 and PHiD-CV).

Costs results were presented for each of the disease states and vaccine separately. Direct costs, indirect costs and total costs were presented (discounted and undiscounted). Costs and benefits were not combined as PHiD-CV vaccination was more effective in terms of QALYs gained and less costly over PCV-13 vaccination. Base-case results showed that PHiD-CV resulted in improved health outcomes of 45 QALYS at a cost of 62 million SEK less than PCV-13; hence PHiD-CV was the dominate strategy (less costly, more effective) over PCV-13.

The one-way sensitivity analysis found that the results were sensitive to changes in the acute otitis media-related outcome parameters.

Authors' conclusions
The authors concluded that PHiD-CV was cost-effective compared with PCV-13.

CRD commentary
Interventions:
The rationale for selection of the interventions was clear as the authors compared the two available paediatric vaccines.

Effectiveness/benefits:
Some of effectiveness data were derived based on a published economic model and some where taken from other selected publications. How the evidence used as inputs in the modelling were identified and selected was unclear. It did not appear that any form of systematic review had been undertaken and this made it difficult to be sure that the best available evidence was used. It seemed that Swedish sources were utilised which should make the results relevant to the authors' setting. Utility valuations were obtained from studies but the methods using to derive the utility scores were not reported. No details were given for the population from which the valuations were elicited. Life-years and QALYs were appropriate benefit measures for capturing the impact of the disease on patients' health. The applicability of the utilities used to the paediatric population under study was neither clear nor discussed.

Costs:
The cost categories were consistent with the stated perspective it appeared that all relevant costs were included in the analysis. Data sources were reported and were from Sweden-based studies. Most data were reported as total costs. Other details (such as time horizon, currency, price year and discount rate) were reported and appeared appropriate. Resource use was not presented and the use of estimated costs per episode will make the results less generalisable.
Analysis and results:
The analytical approach appeared appropriate. Key features of the Markov model were reported. Model uncertainty was assessed with a series of one-way sensitivity analyses and alternative scenarios were considered. Given the level of uncertainty around input parameters probabilistic sensitivity analyses would have better characterised the uncertainty in the model outcomes. The results of the analyses were fully presented. The authors discussed limitations of their study extensively.

Concluding remarks:
The study methodology and its reporting were adequate. The authors’ conclusions reflect their analysis but uncertainty was not fully characterised and the limitations outlined should be considered alongside the conclusions.

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