Cost-effectiveness analysis of pneumococcal conjugate vaccine in Taiwan: a transmission dynamic modeling approach

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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 examined the cost-effectiveness of a 13-valent pneumococcal conjugate vaccine (PCV-13) programme using a transmission dynamic model. The authors concluded that a national infant PCV-13 immunisation programme was cost-effective from the perspectives of both the health care payer and the society in Taiwan. The analysis appears to have been performed and described well. The authors’ conclusions are robust.

Type of economic evaluation
Cost-effectiveness analysis

Study objective
The study examined the cost-effectiveness of a 13-valent pneumococcal conjugate vaccine (PCV-13) programme using a transmission dynamic model.

Interventions
The intervention was a mass infant vaccination programme of four doses PCV-13. The comparator was no vaccination.

Location/setting
Taiwan/primary care.

Methods
Analytical approach:
The analysis was based on an age-stratified transmission dynamic model that considered the impact of herd immunity. The time horizon of the analysis was 10 years. The perspectives of the health care payer and society were adopted in the study.

Effectiveness data:
It appeared that clinical inputs for the model were selectively identified from sources that might have been known to the authors. Most epidemiological inputs were taken from national surveillance databases supplemented by data found in the published international literature. Vaccine efficacy was a key input and was derived from a USA-based pivotal clinical trial. This was adjusted using the local serotype coverage. Most data on vaccine efficacy were based on the results of trials on PCV-7. Assumptions were made on similar efficacy for PCV-13.

Monetary benefit and utility valuations:
Not included.

Measure of benefit:
Life-years were the summary benefit measure and were discounted at an annual rate of 3%.

Cost data:
The economic analysis from the payer’s perspective included costs of vaccination (acquisition and administration) and direct medical costs of treating pneumococcal disease (which included hospitalisations, health care professional consultations, intensive care unit admissions, medications and diagnostic tests). Costs of vaccination were based on USA recommended prices because of the unavailability of a market price of PCV-13. The cost of pneumococcal
disease was based on data from the Taiwanese National Health Insurance Research Database (NHIRD) that covered 2002 to 2004. The societal analysis included additional costs associated with work lost due to non-fatal pneumococcal disease, caregiver time and work lost due to premature pneumococcal death. These indirect costs were estimated using the human capital approach and average earnings for the corresponding age group. Costs were in USA dollars ($). The price year was 2009. Costs were discounted at an annual rate of 3%.

Analysis of uncertainty:
One-way and multivariate deterministic sensitivity analyses were carried out to examine the robustness of base case findings. A Monte Carlo simulation was performed to generate confidence intervals (CIs) around model outcomes and cost-effectiveness acceptability curves. A three-dose schedule of vaccination was considered in an alternative scenario.

Results
Life-years lost were 24,867 with no vaccination and 15,128 with PCV-13 vaccination. Total pneumococcal disease direct medical costs were $512,479,479 with no vaccination and $259,870,832 with PCV-13 vaccination. Indirect costs were $446,720,173 with no vaccination and $254,406,795 with PCV-13 vaccination. The cost of the vaccination programme was $623,145,301. The incremental cost of vaccination was partly offset by reductions in other direct medical costs and indirect costs.

The incremental cost per life-year gained with vaccination over no vaccination was $38,045 from the payer perspective and $18,299 from the societal perspective. When considering a three-dose schedule, the corresponding figures were $22,050 and $2,304. All ratios were below the World Health Organization (WHO) cost-effectiveness criterion of three times the gross domestic product (GDP) per capita in Taiwan ($14,453).

Vaccine price was the most influential input. Base case findings were generally stable.

The probability of vaccination being cost-effective was 100% at a cost-effectiveness threshold of $37,634 (below the WHO benchmark) from the societal perspective and $57,311 (above the WHO benchmark) from the payer perspective.

Authors' conclusions
The authors concluded that a national infant PCV-13 immunisation programme was cost effective from the perspectives of both the health care payer and of society in Taiwan.

CRD commentary
Interventions:
The selection of the comparators was appropriate as the proposed immunisation schedule was compared against the patterns of care in the authors' setting (no vaccination). Both three- and four-dose schedules were considered appropriately.

Effectiveness/benefits:
It appeared that although clinical inputs were not based on a systematic review of the literature but taken from appropriate sources known to the authors. Vaccine efficacy was obtained from a pivotal clinical trial that should have ensured high internal validity. Epidemiological data were mostly taken from large local databases that reflected the authors' setting. Some assumptions were made on the efficacy of PCV-13 on the basis of results from PCV-7. Extensive sensitivity analysis was conducted on clinical parameters. Life-years were a valid benefit measure that enabled comparisons with other disease areas. Disease specific outcomes were reported. The authors stated that quality of life was not estimated given the lack of utility weights.

Costs:
The economic analysis was conducted from two different perspectives that were appropriate to assessing the economic impact of the two strategies from the point of the view of different payers. Data sources were described clearly and appeared to reflect the country-specific setting. Little information on unit costs and resource quantities was reported and this limited the transparency of the economic side of the study. More details may have been available in an online appendix. Variations in key cost inputs were taken into account in the sensitivity analyses. Reflation exercises in other time periods were possible as the price year was stated.
Analysis and results:
The study results were clearly presented. Costs and benefits were synthesised using an incremental approach and the commonly used WHO criterion was adopted to identify the optimal strategy. Both deterministic and probabilistic sensitivity analyses were carried out to deal with the issue of uncertainty. The results of these analyses were clearly discussed. Use of a dynamic model and the inclusion of herd immunity and changes over time of disease epidemics strengthened the analysis. The model algorithms were fully described. The authors stated that the model results might have overestimated the cost-effectiveness of vaccination as some vaccine benefits (such as nasopharyngeal carriage of non-vaccine serotypes) were not included. The model results appeared specific to the Taiwanese setting and might not be valid elsewhere.

Concluding remarks:
The analysis appears to have been performed and described well and based on a sophisticated dynamic model. The authors' conclusions are robust.

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