Cost-effectiveness of a 3-dose pneumococcal conjugate vaccine program in the province of Quebec, Canada


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
This study examined the cost-effectiveness of a heptavalent pneumococcal conjugate vaccine (PCV7) in children, compared with no vaccination. The authors concluded that the three-dose PCV7 programme reduced the burden of disease and provided value-for-money from both the health care and the societal perspectives. The economic data were not fully described, but the study had a typical cost-effectiveness framework and the authors’ conclusions appear to be robust.

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

Study objective
This study examined the cost-effectiveness of a heptavalent pneumococcal conjugate vaccine (PCV7) in children younger than one year old, compared with no vaccination.

Interventions
The vaccination was delivered in three doses, at two, four, and 12 months, and this was compared against no pneumococcal vaccination.

Location/setting
Canada/primary care.

Methods
Analytical approach:
The analysis was based on the synthesis of data from multiple sources. A lifetime horizon was considered. The authors stated that the perspectives of the health care system, the family, and society were adopted.

Effectiveness data:
The clinical data came from a selection of relevant sources, which were mainly national administrative databases, registries, and Canadian statistics. The impact of the PCV7 on the incidence of invasive pneumococcal disease was the key input for the analysis and was estimated based on the notifications of cases in Quebec province before and after the introduction of the vaccine. The reduction in cases of community-acquired pneumonia, all-cause otitis media, and myringotomy with ventilation tube insertion were from regional statistics. Data from US studies were used where Canadian sources were not available.

Monetary benefit and utility valuations:
The utility values were from a UK study. The disutility associated with disease was assumed to be the same for the patient and one caregiver.

Measure of benefit:
Several benefit measures were considered: quality-adjusted life-years (QALYs), cases averted, deaths averted, and life-years gained. A 3% annual discount rate was applied.

Cost data:
The economic analysis included the costs of vaccination and the family and health care costs associated with: pneumococcal meningitis, hospitalised and non-hospitalised pneumococcal bacteraemia, hospitalised and non-hospitalised community-acquired pneumonia, visits for all-cause otitis media, myringotomy with ventilation tube insertion, and treatment of sequelae in survivors of meningitis. The indirect costs to society were the productivity losses associated with premature death and neurological sequelae and these were estimated using the human capital approach. Other costs were from published studies. The vaccine price was from the Quebec Ministry of Health, while the vaccine administration costs were from a micro-costing study in Quebec. The costs of the PCV7 programme management were from official Quebec sources. The price year was 2007, the costs were in Canadian dollars (CAD), and a 3% annual discount rate was applied.

**Analysis of uncertainty:**
A series of one-way sensitivity analyses was performed to examine the impact of variations in the model inputs, using ranges mainly from expert opinion.

**Results**
Vaccination was associated with 19,283 fewer disease cases, 38 fewer deaths, 1,237 additional (undiscounted) life-years, and 1,337 additional (undiscounted) QALYs, compared with no vaccination. It increased health system costs by CAD 15,245,790 and family costs by CAD 1,362,595. When the indirect costs were included (societal perspective), vaccination saved CAD 9,978,342 without discounting and cost CAD 392,661 with discounting.

From the perspective of the health care system, the incremental cost with vaccination was CAD 791 per case averted, CAD 401,928 per death averted, CAD 22,506 per life-year gained, and CAD 18,095 per QALY gained. From the perspective of society, the incremental cost was CAD 20 per case averted, CAD 10,352 per death averted, CAD 580 per life-year gained, and CAD 466 per QALY gained.

The most influential input was the assumption on herd immunity against invasive pneumococcal disease. When serotype replacement completely erased the benefits of herd protection in adults, the cost-effectiveness of vaccination was reduced. When the assumptions favoured vaccination, it was not only more effective, but also cost-saving.

**Authors' conclusions**
The authors concluded that the three-dose PCV7 programme reduced the burden of disease and provided value-for-money from both the health care and the societal perspectives.

**CRD commentary**

**Interventions:**
The selection of the interventions was appropriate as the immunisation strategy was compared against no vaccination, which was the usual practice in the authors’ context before the introduction of the PCV7.

**Effectiveness/benefits:**
Selected administrative databases were used for the clinical data and these were from a large number of patients before and after the introduction of the immunisation. The use of before-and-after data was a limitation of the analysis as it is possible that factors other than the vaccination could have changed the incidence of invasive pneumococcal disease. As the data were from the whole Canadian population, they allowed the assessment of the indirect impact (herd immunity) of vaccination. Some data were from a US cohort as there were no Canadian data and this raised issues around the transferability of the data. The use of various benefit measures was appropriate, as each was relevant for alternative stakeholders. QALYs were particularly useful as they allow cross-disease comparisons.

**Costs:**
A broad range of costs borne by various stakeholders was considered. Both discounted and undiscounted costs were presented. A list of cost items was not given and costs were presented as category totals for each pneumococcal disease. The data sources were not fully described, but appear to have been relevant to the Canadian context. The price year was appropriately stated, allowing reflation exercises in other time periods.

**Analysis and results:**
The costs and benefits were appropriately combined, using an incremental approach, and the findings were clearly presented. Conventional discounting was applied to the costs and benefits, while the undiscounted results were presented. The uncertainty was investigated, using a deterministic approach, which considered variations in individual assumptions. A multi-dimensional method could have fully assessed the uncertainty, considering alternative scenarios. The authors acknowledged some limitations of their analysis and these mainly related to the design of the clinical data collection.

Concluding remarks:
The economic data were not described in detail, but the study had a typical cost-effectiveness framework and the authors’ conclusions appear to be robust.

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