The clinical and economic impact of pneumococcal conjugate vaccine associated herd immunity in Canada

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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.

Health technology
The authors assessed a heptavalent pneumococcal conjugate vaccine (PCV-7).

Type of intervention
Primary prevention (using the technology of interest to vaccinate against common pneumococcal serotypes).

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised Canadian adults. No further details were reported.

Setting
The setting was primary care. The economic study was carried out in Canada.

Dates to which data relate
The effectiveness data (cases of pneumococcal disease prevented) were taken from studies published between 1995 and 2003. The dates when the cost data were collected were not reported, although the price year was stated to be 2000.

Source of effectiveness data
The effectiveness data were derived from a review and synthesis of completed studies.

Modelling
A model was used to estimate the cost implications. No further details were provided. The model assumed that a herd immunity effect similar to that observed in the USA would occur in Canada. The time horizon was not stated clearly.

Outcomes assessed in the review
The review assessed the number of adult cases of pneumococcal diseases avoided.

Study designs and other criteria for inclusion in the review
Study designs and other criteria for inclusion in the review were not reported. Estimates were derived on the basis of disease and population information for Canada and the USA.
Sources searched to identify primary studies
Not reported.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
Five studies were included in the review of effectiveness.

Methods of combining primary studies
The results of the primary studies were combined by narrative means.

Investigation of differences between primary studies
Potential differences between the primary studies were not discussed in the analysis.

Results of the review
For meningitis, the number of cases avoided was 35 for adults aged 20 - 39 years, 8 for adults aged 40 - 64 years and 8 for adults aged over 65 years.

For bacteraemia, the number of cases avoided was 176 for adults aged 20 - 39 years, 105 for adults aged 40 - 64 years and 504 for adults aged over 65 years.

For pneumonia, the number of cases avoided was 1,541 for adults aged 20 - 39 years, 1,114 for adults aged 40 - 64 years and 5,040 for adults aged over 65 years.

A total of 8,531 cases related to pneumococcal disease were avoided.

Measure of benefits used in the economic analysis
The authors used the number of cases avoided as their summary measure of benefits. This estimate was taken directly from the effectiveness study.

Direct costs
The costing was carried out from the perspective of the Canadian health care system. It included direct costs only, which was appropriate for the perspective adopted. The direct costs were determined from Health Care Financing and Administration data and the Institute of Medicine data, and also published information that provided age-specific average costs for selected pneumococcal diseases. This information was reported to relate to the USA. Discounting was not required as the authors were interested in a static estimate of costs avoided due to the vaccination programme. The authors reported the cost avoided per case, the total costs avoided per disease (cost avoided per case multiplied by the number of cases avoided), and the total cost avoided for all diseases. The costs were inflated to 2000 dollars (the price year) using an exchange rate of 1.36 and a general consumer price index inflation-adjustment factor of 0.885. Unit costs, to indicate the composition of the total costs, were not reported separately.

Statistical analysis of costs
The costs were treated deterministically.

**Indirect Costs**  
In keeping with the stated perspective of the study, the authors did not include the indirect costs.

**Currency**  
Canadian dollars ($).

**Sensitivity analysis**  
A one-way sensitivity analysis was performed to determine the disease and cost parameters in the model with the greatest influence. The disease burden estimates were varied by 50% and the costs were varied by 30%.

**Estimated benefits used in the economic analysis**  
See the 'Effectiveness Results' section.

**Cost results**  
The authors estimated that the cost to inoculate an entire birth cohort of 340,000 infants, excluding administration costs (i.e. including drug costs only), would be Can$91.8 million.

**Synthesis of costs and benefits**  
For meningitis, the cost per case avoided was Can$11,852 and the total cost avoided annually was Can$604,452.

For bacteraemia, the cost per case avoided was Can$6,696 and the total cost avoided annually was Can$5,256,360.

For pneumonia, the cost per case avoided was Can$4,464 and the total cost avoided annually was Can$34,350,480.

The total cost avoided for all pneumococcal diseases was Can$40,211,292.

The sensitivity analysis was reported to reveal that "both the cost and disease burden of pneumonia have the largest influence on model outcome".

The total cases avoided ranged from 4,264 to 12,793 when disease burden was varied by 50%.

The total costs avoided ranged from Can$28.13 million to Can$52.25 million when the costs were varied by 30%.

**Authors' conclusions**  
There would be a significant reduction in pneumococcal diseases and the associated costs of treatment if a herd immunity effect similar to that observed in the USA were to occur in Canada. The authors argued that a universal, childhood heptavalent pneumococcal conjugate vaccine (PCV-7) programme may be cost-saving from a societal perspective if their own results are combined with those of another author (Lebel et al., see 'Other Publications of Related Interest' for bibliographic details).

**CRD COMMENTARY - Selection of comparators**  
The authors assessed the clinical and economic effectiveness of inoculation with PCV-7 with reference to herd immunity effects. The authors did not report a comparator.

**Validity of estimate of measure of effectiveness**
The authors did not state that a systematic review of the literature had been undertaken. Since the methods used to find and select the primary studies and to extract the data were unclear, it was difficult to assess the validity of the estimates. The authors appear to have used data from the available studies selectively, and did not consider the impact of potential differences between these studies when estimating effectiveness. This, together with the absence of details of the methods or results on the relevance, validity and data extraction of studies, potentially limits the reliability of the findings. The estimates were investigated in sensitivity analyses, but the authors did not provide a justification for the ranges selected and reported.

**Validity of estimate of measure of benefit**
The authors used the number of cases avoided, obtained directly from their effectiveness study, as the summary measure of health benefit. This is a sensible measure to use in terms of comparability with similar vaccination studies, but it does not open the results to broader comparisons.

**Validity of estimate of costs**
The costing was carried out from the perspective of the Canadian health care system. It incorporated cost estimates relevant to this perspective, focusing on the cost of vaccination and the costs avoided because of pneumococcal disease avoided. Further details of the analysis (e.g. the composition of the costs, with unit costs where possible) would enable the reader to better understand and interpret the results presented. A sensitivity analysis of the costs was conducted, but the authors did not justify the ranges selected and reported. Further, US costs rather than Canadian costs were used. The analysis might have been improved if Canadian costs had been sourced. However, the year to which the prices referred was reported, and this improves the reproducibility of the results.

**Other issues**
The authors drew comparisons with the wider available literature, suggesting consistency with other economic evaluations that also reported that the vaccine was a cost-effective intervention for the Canadian population. Several limitations were presented. For example, the relationship between the vaccine and decline in pneumococcal disease is not necessarily causal. The authors acknowledged that the use of an adult vaccine, albeit with low uptake, may well have contributed to the decline in pneumococcal disease. The costs of this latter intervention were not accounted for in this study. A further limitation was the assumption that incidence and costs were similar in Canada and the USA as clinical and costing estimates were reported to be based primarily on US data. This limitation has implications for the generalisability of the study, which the authors did not address. The authors reported that when the results were combined with another study, PCV-7 was cost-effective despite current reports of immunisation exceeding the cost-savings. This may be because other studies relate directly to the inoculated population, whilst the current study related to herd immunity effects. This conclusion requires more explanation and discussion.

**Implications of the study**
The authors did not suggest any specific recommendations resulting from their own study. They did, however, acknowledge that "there needs to be a paradigm shift in decision-making that leads to vaccine funding and coverage". Further research should include pursuing current initiatives such as population-based surveillance of pneumococcal disease.

**Source of funding**
None stated.

**Bibliographic details**

**Other publications of related interest**


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Subject indexing assigned by CRD

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