Economic analysis of the 1992-1993 mass immunization campaign against serogroup C meningococcal disease in Quebec

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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
A mass immunisation campaign against serogroup C meningococcal disease (CMD) was examined.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness and cost-utility analysis.

Study population
The study population comprised the general population aged between 6 months and 20 years, who were living in the province of Quebec.

Setting
The setting was a community. The economic study was carried out in Quebec, Canada.

Dates to which data relate
The effectiveness evidence was derived from studies published between 1995 and 2001. The resource use data were derived from studies published in 1994 and 1996. The price year was 1993.

Source of effectiveness data
The effectiveness data were derived from published studies, augmented by the authors' assumptions.

Outcomes assessed in the review
The primary health outcomes assessed in the review were:

the number of cases directly prevented by vaccination,

the indirect impact of the campaign in decreasing transmission of the bacteria in the population and providing additional protection (herd immunity),

the number of deaths prevented, and

life expectancy at 13 years.
Study designs and other criteria for inclusion in the review
No inclusion criteria for the studies were stated, although two primary studies referred to the results of a population-based cohort study. Canadian life tables represented another source of data.

Sources searched to identify primary studies
Not stated.

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

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

Number of primary studies included
The effectiveness data were derived from four primary studies.

Methods of combining primary studies
The primary study estimates were combined using narrative methods.

Investigation of differences between primary studies
Not carried out.

Results of the review
During the 5-year period from 1993 to 1998, 39 CMD cases were observed among vaccinated individuals and 87 cases were expected among unvaccinated individuals.

In the group aged more than 20 years (not eligible for vaccination), the incidence of serogroup C cases increased from 2.1 per million in 1990 to 4.0 per million in 1992, and to 4.6 per million in March 1994.

Among non-vaccinated eligible individuals, the incidence of disease increased from 31.5 per million in 1990 to 49.7 per million in 1991, and to 47.3 per million in 1992.

Further data derived from the published studies were not reported.

Methods used to derive estimates of effectiveness
The authors made some assumptions to calculate the benefits of the vaccination programme.

Estimates of effectiveness and key assumptions
The authors assumed that the incidence of disease during April 1993 to March 1994 was similar to that observed among non-vaccinated persons in the year 1992. They also assumed that the fatality rate was 15%, and that the prevalence of survivors with reduced quality of life was 11%.

Measure of benefits used in the economic analysis
The benefit measures used in the economic analyses were cases of disease, death, and sequelae prevented, life-years (LYs) gained, and quality-adjusted life-years (QALYs) gained. These were calculated from a questionnaire survey of all
CMD survivors identified in Quebec from 1990 to 1994, and using the Euroqol EQ-5D.

**Direct costs**
A 3% discount rate was applied since the costs were incurred over more than two years. The unit costs were only reported for a limited number of items. The health service costs included in the analysis were for vaccination and disease. The vaccination costs were for vaccine purchase and distribution, communication and promotion, vaccine administration, physician services in the public and private sectors, the immunisation registry, programme monitoring and research, and the treatment of adverse reactions. The disease costs included prophylactic measures for contacts, acute hospital care, and long-term care and services for survivors with sequelae.

The cost/resource boundary for the direct costs was that of the healthcare service payer. The costs were estimated using actual data derived from the Quebec Ministry of Health and an independent survey consisting of postal questionnaires. The resource estimates were derived using published data and the authors’ assumptions. Disease costs were estimated using a microcosting approach. The price year was 1993, and Canadian health and personal care price indexes were used to adjust for inflation. The authors stated that one Canadian dollar (Can$) in 1993 was equal to Can$1.15 in 2002.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
Discounting was relevant and a 3% discount rate was applied. The unit costs were not reported separately from the quantities of resources. The indirect costs included in the analysis were the productivity gains associated with prevented mortality and sequelae. These were estimated from gender-specific earnings of Canadians using the human capital approach. The cost/resource boundary for indirect costs reflected the societal perspective adopted in the study. The price year was 1993.

**Currency**
Canadian dollars (Can$). In 2002, Can$1.00 = US$0.76.

**Sensitivity analysis**
One-way sensitivity analyses were conducted to assess the robustness of the estimated cost-effectiveness and cost-utility ratios to variations in the discount rate (range: 0% - 5%) and benefit measures (up to the death of all individuals in the study cohort).

**Estimated benefits used in the economic analysis**
Compared with no vaccination, 48 cases of disease were prevented in the scenario of direct immunity, 26 in the scenario of herd immunity, and 74 in the global scenario (direct and herd immunity). Similarly, the numbers of deaths prevented were 7 (direct immunity), 4 (herd immunity) and 11 (direct and herd immunity), and the numbers of cases of sequelae prevented were 6 (direct immunity), 3 (herd immunity) and 9 (direct and herd immunity).

The LYs gained (3% discount rate) were 202 in the scenario of direct immunity, 115 in the scenario of herd immunity, and 317 in the global scenario of direct and herd immunity. The corresponding QALYs gained (3% discount rate) were 243 (direct immunity), 131 (herd immunity) and 374 (direct and herd immunity).

**Cost results**
The immunisation costs were Can$26,416.

The total productivity gain over no immunisation was Can$4,106 in the scenario of direct immunity, Can$2,303 in the
scenario of herd immunity, and Can$6,409 in the global scenario (direct and herd immunity).

The health care costs reduction (HCCR) was Can$1,102 in the scenario of direct immunity, Can$597 in the scenario of herd immunity, and Can$1,699 in the global scenario (direct and herd immunity).

The net health system costs (immunisation costs minus HCCR) were Can$25,315 in the scenario of direct immunity and Can$24,718 in the global scenario (direct and herd immunity).

The health system costs-to-benefit ratio (immunisation costs divided by HCCR) was 24:1 in the scenario of direct immunity and 16:1 in the global scenario (direct and herd immunity).

The net societal costs (immunisation costs minus HCCR minus productivity gains) were Can$21,209 in the scenario of direct immunity and Can$18,309 in the global scenario (direct and herd immunity).

**Synthesis of costs and benefits**
An incremental analysis was performed to combine the costs and the benefits (deaths averted, LYs gained and QALYs gained) of the vaccination programme, compared with no vaccination.

The incremental net societal cost per death averted was Can$3,030 in the scenario of direct immunity and Can$1,664 in the global scenario (direct and herd immunity).

The incremental net societal cost per LY gained was Can$105 in the scenario of direct immunity and Can$58 in the global scenario (direct and herd immunity).

The incremental net societal cost per QALY gained was Can$87 in the scenario of direct immunity and Can$49 in the global scenario (direct and herd immunity).

These results were fairly robust to variations in the discount rate.

**Authors' conclusions**
The mass vaccination campaign against meningococcal disease was highly effective in saving and extending lives. However, the costs of such benefits were higher than other existing routine immunisation programmes implemented in Canada, although comparable with the cost-effectiveness of other screening programmes.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparator was clear. The 'do-nothing' alternative was selected, as the aim of the study was to assess the active value of the vaccination programme. You should decide whether it represents a valid comparator in your own setting.

**Validity of estimate of measure of effectiveness**
The analysis of the effectiveness used data derived from published studies, but a formal review of the literature was not undertaken. The primary study data were combined using narrative methods, although it was unclear whether the authors considered the differences among the primary studies when estimating the effectiveness. Some assumptions were also used in the model, but their impact on the results of the analysis was not investigated. The authors acknowledged that there was some uncertainty around some effectiveness estimates used in the analysis. Consequently, further sensitivity analyses could have increased the validity of the results obtained.

**Validity of estimate of measure of benefit**
The QALYs gained and LYs gained were used as the main benefit measures in the economic analysis. Both appear to have been appropriate and allow the outcomes of the vaccination programme to be compared with those of other interventions implemented in the health care system. However, the methodology used to calculate the benefit measures...
was unclear, making it difficult to ensure that they were calculated using a valid method. The authors also stated that the reduction in anxiety, as a result of the immunisation programme, represented a further beneficial effect of the intervention, although they did not investigate this fact further.

Validity of estimate of costs
The perspective adopted in the study was clearly stated, and it appears that all the relevant categories of costs have been included in the analysis. The authors stated that the costs of disease for families were not included, but their impact on the results of the analysis was likely to have been modest. The price year was appropriately reported, thus simplifying reflation exercises in other settings. The unit costs were only reported for a limited number of items. The costs and the quantities were treated deterministically and sensitivity analyses were only conducted on the discount rate. It would have been useful to have conducted sensitivity analyses on all assumptions, and to assess the impact that changes had on the study results. The cost estimates were fairly specific to the study setting. Some assumptions were made to estimate resource consumption.

Other issues
The authors compared their findings with those from other studies assessing other programmes. They stated that their study was the first analysis “aiming to evaluate the utility of a mass immunization campaign against meningococcal disease”. The issue of the generalisability of the study results to other settings was not addressed, thus the external validity of the analysis was quite low. The authors commented on both the advantages and disadvantages of their analysis (reported above).

Implications of the study
The main implication of the analysis was that mass vaccination against meningococcal disease, implemented in the province of Quebec in 1992 to 1993, led to substantial benefits at acceptable costs. The authors highlighted the fact that the study methodology could be used as references for decisions relating to the introduction of new vaccines against meningococcal disease.

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