Vaccinating first-year college students living in dormitories for meningococcal disease: an economic analysis

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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
Vaccination against meningococcal disease using the quadrivalent A,C,Y,W-135 vaccine, which consists of purified bacterial capsular polysaccharides, was examined.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness and cost-benefit analyses.

Study population
The study population comprised a cohort of 591,587 first-year students living in dormitories during the 1998 to 1999 school year.

Setting
The setting was a college campus. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness and resource use data were derived from studies published from 1982 to 2001. The price year was 1999.

Source of effectiveness data
The effectiveness data came from published studies, augmented by the authors’ assumptions.

Modelling
An analytic model was used to assess the cost-effectiveness and cost-benefit ratios of the vaccination strategy. Vaccination was performed at the beginning of year one, while the incidence of disease, premature death, and sequelae occurred over four years. Five different values of cases and deaths averted and costs of vaccination (low, intermediate, high, worst and best) were considered in the model. These were considered under three assumptions about vaccine coverage (80, 85 and 90%) and under three different discount rates (0, 3 and 5%). Thus, 135 scenarios were evaluated in the study.

Outcomes assessed in the review
The outcomes estimated from published studies were:
the number of vaccine-preventable meningococcal cases, premature deaths and cases of sequelae without a vaccination programme;

vaccine efficacy;

the number of meningococcal disease-related amputations; and

the additional life expectancy for people aged 18 to 19 years.

**Study designs and other criteria for inclusion in the review**
Not stated.

**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 evidence were derived from seven primary studies.

**Methods of combining primary studies**
The method used to combine the primary studies was not explicitly stated, although it appears to have been a narrative one.

**Investigation of differences between primary studies**
Not stated.

**Results of the review**
Results without a vaccination programme:

in the first year of occurrence there were 18 vaccine-preventable meningococcal cases, 2 premature deaths, and 2 cases of sequelae;

in the second year of occurrence, there were 4 vaccine-preventable meningococcal cases, 1 premature death, and 1 case of sequelae;

in the third year of occurrence, there were 4 vaccine-preventable meningococcal cases, 0 premature deaths, and 0 cases of sequelae; and

in the fourth year of occurrence, there were 4 vaccine-preventable meningococcal cases, 0 premature deaths, and 0 cases of sequelae.

The efficacy of the vaccine ranged from 80 to 90%.
The number of meningococcal disease-related amputations was 1.5% of cases with disease-related sequelae.

The additional life expectancy for people aged 18 to 19 years was 59.1 years.

**Methods used to derive estimates of effectiveness**
The authors made some assumptions used in the model.

**Estimates of effectiveness and key assumptions**
The authors assumed the following:

- the cohort lived in dormitories for at least their first year of college;
- the number of meningococcal disease-related amputations was 1.5% of cases with disease-related sequelae;
- the cohort of first-year students remained constant in size;
- the incidence of cases was distributed equally over time;
- vaccine efficacy was constant over the 4-year study; and
- vaccination did not generate herd immunity.

**Measure of benefits used in the economic analysis**
The benefit measures used in the economic analyses were the cases averted, deaths averted and life-years saved. All benefit measures were calculated using modelling and applying a discount rate.

**Direct costs**
Discounting was applied since the costs were incurred during a period of longer than two years. Three discount rates (0, 3 and 5%) were used. The unit costs were only reported separately from the quantities of resources for some items. The health service costs used to calculate the costs of the intervention were for the vaccine, vaccine administration, and treatment of vaccine-related side effects. Cost-savings were calculated in order to estimate the economic benefits. These included the costs related to cases averted, such as hospitalisation and the cost of treating a case of sequelae. The unit costs and resource use were derived from published studies. The costs were inflated to 1999 values (price year) using the health service component of the Consumer Price Index.

**Statistical analysis of costs**
The costs were treated deterministically in the base-case analysis.

**Indirect Costs**
The costs were discounted as the time horizon of the study was longer than two years. The cost-savings included the costs related to deaths averted. The value of life lost was estimated using different age-weighted productivity estimates (lifetime productivity losses) for the group aged 16 to 19 years for the low, intermediate and worst scenario, and using the value of a statistical life for the high and best scenarios.

**Currency**
US dollars ($).

**Sensitivity analysis**
Sensitivity analyses were performed to estimate the robustness of the estimated cost-effectiveness and cost-benefit ratios to variations in several model parameters. The parameters investigated were the number of vaccine-preventable cases and pricing schemes for the values of a human life with different vaccination costs. The 135 scenarios evaluated in the study were also considered as sensitivity analyses. A threshold analysis was performed to determine the break-even cost of vaccination (cost of the vaccine plus the cost of vaccine administration) for each of the 135 scenarios, so that the sum of the economic benefits was equal to the sum of the costs.

**Estimated benefits used in the economic analysis**
The expected number of cases and deaths averted were not reported. The number of life-years saved due to vaccination was 177.3 years when no discount rate was applied, 85.9 with a 3% discount rate, and 60.1 when a 5% rate was used.

**Cost results**
The total costs and economic benefits were not reported.

**Synthesis of costs and benefits**
An incremental cost-effectiveness analysis was performed to combine the costs and benefits of the vaccination programme in comparison with no vaccination.

The net costs per life-year saved ranged from $62,042 under the best scenario to $489,185 under the worst scenario.

The net cost per case averted ranged from $617,000 under the best scenario to $1.85 million under the worst scenario.

The net cost per death averted ranged from $16.2 million to $20.4 million according to different assumptions made under the worst scenario. It ranged from $6.8 million to $8.3 million according to different assumptions made under the best scenario.

A cost-benefit analysis was also performed, calculating the net present value (NPV). The NPV was defined as the difference between cost-savings (the sum of the costs of disease treatment averted, value of premature death saved, costs of treated disease-related sequelae saved and the value of disease-related sequelae) and vaccination costs.

The analysis showed that the vaccination costs outweighed the economic benefits under all model scenarios from the societal perspective. This meant that all of the NPVs were negative, ranging from -$11 million to -$49 million.

In the case of vaccine coverage at 60%, the break-even vaccination cost per student vaccinated ranged from $5.25 to $23.07.

The sensitivity analyses showed that only under quite unrealistic assumptions, the cost per death averted was similar to that of other vaccination programmes.

**Authors' conclusions**
A publicly funded programme to vaccinate first-year students living in dormitories against meningococcal disease was not cost-effective. In addition, it would lead to an economic loss from the societal perspective.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparator was clear. No vaccination 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 effectiveness used data from published studies, but a formal review of the literature was not undertaken.
The authors did not state how the primary studies were combined, and it was unclear whether the authors considered the impact of differences in the primary studies when estimating the effectiveness. The authors made some assumptions used in the decision model, some of which were investigated in the sensitivity analyses. These issues may affect the internal validity of the analysis.

**Validity of estimate of measure of benefit**

The benefit measures in the economic analysis were cases averted, deaths averted, and life-years saved. These allowed comparisons to be made with the benefits of other vaccination programmes. Quality of life issues were not discussed and the authors stated that there were some intangible benefits, such as those associated with reduced fear and stress arising in a university community due to the presence of meningococcal disease.

**Validity of estimate of costs**

The analysis of the costs was performed from a societal perspective, and it would appear that all the relevant categories of costs have been included in the analysis. The indirect costs were considered. The NPV of the vaccination programme was calculated by identifying all the relevant economic benefits and costs of the programme. The price year was reported, thus simplifying reflation exercises in other settings. The costs were treated deterministically in the base-case analysis, but several sensitivity analyses were performed and multiple scenarios were considered. The costs and resource use data were derived from published studies. Not all the economic benefits related to the vaccination programme were captured in the analysis.

**Other issues**

The authors compared their findings with those from other published studies. However, they did not address the issue of the generalisability of the study results to other settings, although several sensitivity analyses were conducted. The authors acknowledged that the study results could have been biased towards vaccination as, when dividing NPV by death averted (to calculate the cost per death averted), there was double counting of the effect of the intervention in both the denominator and the numerator of the ratio. The authors also noted that the lack of information on programme implementation and compliance costs could have limited the validity of the study.

**Implications of the study**

The main implication of the analysis is that, although vaccination against meningococcal disease may not be convenient from the societal perspective, students or their families may be willing to pay for a vaccination to avoid the dramatic health consequences of the disease. More information on meningococcal disease should be provided to students living in dormitories.

**Bibliographic details**


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