Cost effectiveness of child pneumococcal conjugate vaccination in GAVI-eligible countries
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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 updated a previous cost-effectiveness analysis of pneumococcal vaccination in low-income countries eligible for financial support from the Global Alliance for Vaccines and Immunization (GAVI). The authors concluded that pneumococcal vaccination was a highly cost-effective strategy in GAVI-eligible countries (especially higher valency vaccines such as PCV-10 or PCV-13). The analysis used valid and transparent methodology that should ensure the robustness of the conclusions.

Type of economic evaluation
Cost-utility analysis

Study objective
The study objective was to update a previous cost-effectiveness analysis of pneumococcal vaccination using seven-, 10-, and 13-valent vaccines (PCV-7, PCV-10 and PCV-13) in low-income countries eligible for financial support from the Global Alliance for Vaccines and Immunization (GAVI) using recent evidence on global disease burden, indirect effects, and higher valency vaccines.

Interventions
The immunisation strategies were PCV7, PCV10 and PCV13. Each three-dose vaccination schedule (six, 10 and 14 weeks of age) was compared to no vaccination. Catch-up vaccination for older children was not assessed.

Location/setting
Seventy-two GAVI-eligible low-income countries. Primary care.

Methods
Analytical approach:
The analysis was based on a decision simulation model that considered direct and indirect effects of the first 10 years of a vaccination programme as well as serotype replacement over a lifetime horizon. The authors stated that a societal perspective was adopted.

Effectiveness data:
A selective approach was used to identify relevant sources of evidence. Data were taken from country-specific sources, where available. Otherwise, information was based on sources from certain GAVI or high-income countries. Key sources for epidemiological data included the World Health Organization (WHO) Haemophilus influenzae type b and Streptococcus pneumoniae Global Disease Burden study and local databases. Incidence and case fatality rates for pneumococcal diseases were key inputs of the model. Vaccine efficacy rates (direct effect) were taken from a recent meta-analysis for PCV-7. It was assumed that PCV-10 and PCV-13 had the same treatment effect (but with a higher coverage of serotypes). Indirect effect and serotype replacements were taken from USA estimates and adapted to local contexts by means of experts’ opinions.

Monetary benefit and utility valuations:
Disability weights were based on estimates from the WHO Global Disease Burden study and were calculated using standard methods.

Measure of benefit:
Disability-adjusted life-years (DALYs) were used as the summary benefit measure and discounted at an annual rate of
Cost data:
The economic analysis included the costs of vaccination (acquisition and administration), medical costs associated with acute and long-term management of pneumococcal disease (in-patient and outpatient services, diagnostic tests and treatments) and non-medical costs of transportation and caregiver time. Medical costs were taken from country-specific unit costs from the WHO Choosing Interventions that are Cost-Effective (CHOICE) initiative. Other direct and indirect costs were based on published and unpublished sources as well as regional-level studies and databases. Vaccine prices were estimates using projections from the Advance Market Commitment. Costs were in USA dollars ($). A 3% annual discount rate was applied. The price year was 2005.

Analysis of uncertainty:
One-way sensitivity analyses were carried out on selected inputs of the model using plausible ranges of values.

Results
In the pooled 72 GAVI-eligible countries, when considering direct effects only compared to no vaccination the net costs and DALYs of vaccination were $9,995,182,000 and 61,475,000 with PCV-7, $9,842,812,000 and 88,020,000 with PCV-10, and $9,809,307,000 and 93,787,000 with PCV-13. The incremental cost per DALY averted was $163 with PCV-7, $112 with PCV-10 and $105 with PCV-13. The corresponding ratios when including both direct and indirect effects of vaccination as well as serotype replacement fell to $146, $88 and $77.

Using WHO criteria for three times the gross domestic product (GDP) per capita as the threshold for cost-effectiveness, considering both direct and indirect effects PCV-7 would be cost-effective for all but one GAVI-eligible country and highly cost-effective (less than per capita GDP) for 69 countries. PCV-10 and PCV-13 would be cost-effective for all 72 countries and highly cost-effective for all but one country.

Vaccination was more cost-effective in countries with higher mortality under five years of age. Influential inputs were serotype coverage, administrative costs and disease incidence. Vaccination remained a cost-effective strategy in almost all countries in all alternative scenarios.

Authors' conclusions
The authors concluded that pneumococcal vaccination was a highly cost-effective strategy in GAVI-eligible countries, especially when considering higher valency vaccines (PCV-10 or PCV-13).

CRD commentary
Interventions:
The comparators were appropriate as each available PCV type was compared against no vaccination (the pattern of care in several low-income countries). Vaccine price and efficacy was assumed to have been the same for the three vaccines and any differences were due only to serotype coverage.

Effectiveness/benefits:
Clinical inputs for the model were taken from published studies that might have been known to the authors. Most data were retrieved from publications by international agencies about developing countries and were likely to be valid sources. The authors acknowledged that when data from low-income countries were not available, sources from other settings were used and some assumptions were required to adapt them to GAVI-eligible countries. Treatment effect for PCV-7 was based on a meta-analysis of clinical trials that should have ensured high internal validity. Assumptions had to be made on the efficacy of the other two vaccines (given the lack of good published data). DALYs were an appropriate benefit measure for capturing the burden of disease in developing countries. Disability weights were taken from a WHO study. More details of disability estimates were reported in an online technical appendix.

Costs:
The included cost categories reflected the perspective of the society as direct (medical and non-medical) and some productivity costs related to caregiver time were considered. Country-specific unit costs and some resource use were taken from a WHO study that appeared to be an appropriate source. Other data were obtained from published sources that included Latin American countries at middle-income level. Other published sources were not fully described. The
cost of vaccine was based on annual price projections from the Advanced Market Commitment and a 10% wastage was assumed. Costs were varied in the sensitivity analysis. Other details such as the price year and discount rate were given.

Analysis and results:
The study results were presented extensively for various scenarios. An incremental approach was used to identify the optimal treatment strategy. The issue of uncertainty was investigated using a deterministic approach and the methods and results were clearly illustrated. The authors acknowledged some limitations of the analysis, mostly the lack of local data for some model parameters, and use of a static instead of a dynamic model. The analysis covered all GAVI countries and so was specific to low-income developing countries.

Concluding remarks:
The analysis used valid and transparent methodology that should ensure the robustness of the authors’ conclusions.

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