Cost-effectiveness analysis of universal childhood vaccination against varicella in Brazil
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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
This study assessed the cost-effectiveness of a universal varicella vaccination programme compared with the current varicella vaccination practice in Brazil. The authors concluded that universal vaccination was cost-effective, but its cost-effectiveness was highly sensitive to the price of the vaccine and the number of doses administered. In general, the methodology was appropriate and the authors' conclusions appear to be valid, given the limitations of the available data.

Type of economic evaluation
Cost-effectiveness analysis

Study objective
The aim was to compare the cost-effectiveness of two varicella vaccination strategies for children in Brazil.

Interventions
The strategies were universal varicella vaccination of 12 month-old children and the current strategy of targeted vaccination for individuals at high-risk for severe diseases.

Location/setting
Brazil/primary care.

Methods
Analytical approach:
An age- and time-dependent dynamic model of varicella zoster virus transmission, namely the Susceptible to infection, Infected or infectious, Recovered from natural infection, and Vaccinated individuals (SIRV) model, was used to project the incidence of varicella. A decision analytic model was also used to estimate the costs and resource use for seven age groups. The time horizon was 30 years and the authors reported that the perspectives of the health care system and society were adopted.

Effectiveness data:
The disease-related epidemiological data were derived from official national sources. Vaccine efficacy data were derived from published studies and the incidence rates were derived from seroprevalence studies in Brazil. No information on the design or other characteristics of these primary studies was reported. Some assumptions required were reported. The primary outcome was the number of varicella cases by age and year under the two strategies.

Monetary benefit and utility valuations:
None.

Measure of benefit:
The authors used the number of varicella cases averted, deaths averted, and life-years saved (LYS) as measures of benefit. These were discounted at an annual rate of 3%.

Cost data:
The direct and indirect medical costs were included. Direct costs included those of vaccination (administration and varicella zoster immunoglobulin), physician visits, laboratory tests, medications, hospital treatment (including outpatient), annual long-term disability treatment, and transportation. Productivity losses because of work-absenteeism due to varicella infection, but also due to long-term neurological sequelae, were also included. Resource use data were
derived from the health care services in Sao Paolo city, except for out-patient visits, where data were obtained from published studies. The human capital approach was used to estimate the indirect costs. All costs were reported for the price year 2004 in Brazilian reais (BRL). They were appropriately adjusted for inflation using different indices for health care costs, transportation costs, and income. They were discounted at an annual rate of 6%.

Analysis of uncertainty:
The parameter uncertainty was investigated using one-way sensitivity analysis on numerous model parameters, which were explicitly reported. The ranges, over which these parameters were tested, were reported in detail. A threshold analysis was carried out to estimate the optimal vaccine price at which universal vaccination would be cost-effective according to the World Health Organization (WHO), which was when the cost of averting one disability-adjusted life-year was one to three times the gross domestic product (GDP) per capita (very cost-effective if less than the GDP).

Results
Compared with current vaccination practice the universal vaccination programme would prevent 74,422,058 additional cases, 112,292 hospitalisations, and 2,905 deaths from varicella. Universal vaccination was still more expensive than the current strategy as the costs savings from averted disease did not offset the vaccination programme cost.

The incremental cost-effectiveness ratio, using discounted costs and benefits, of universal vaccination compared with current practice was BRL 11,042 per LYS from the societal perspective, and BRL 12,248 from the health care system perspective, and the GDP per capita was BRL 10,692. According to the WHO definition, the programme was therefore cost-effective.

Sensitivity analysis demonstrated that these results were most sensitive to variation in the vaccine price and the number of doses administered.

Depending on the number of doses, the vaccine price would have to be reduced by 22.9% to 70.1% in order for the universal vaccination programme to become a very cost-effective intervention, according to the WHO definition.

Authors’ conclusions
The authors concluded that universal varicella vaccination was cost-effective in Brazil, but its cost-effectiveness was highly sensitive to the price of the vaccine and the number of doses administered.

CRD commentary
Interventions:
The rationale for the choice of interventions was explicitly stated. The authors compared current varicella vaccination practice in Brazil against a universal varicella vaccination programme.

Effectiveness/benefits:
Data derived from national sources were appropriate for the Brazilian setting. No systematic literature review was reported, so it’s not clear if the best available evidence was used. The basic characteristics of the primary data sources (the study population, design, follow-up, etc.) were not given, which makes it hard to assess the validity of the clinical inputs. LYS were derived from the model and are a validated benefit measure and they allow cross-disease comparisons to be made.

Costs:
The costs reflected both the societal and the health care system perspectives and all the relevant costs were included. The resource use data were derived from actual data from a Brazilian city, but it was not clear whether these data could be generalised to the whole Brazilian population. The costs were discounted at an annual rate of 6%, which would appear to be appropriate for this setting, but may have implications for the generalisability of the study elsewhere. The uncertainty around the discount rate and further cost estimates was investigated in the sensitivity analysis, making the results more robust. With the exception of the costs and resource use, which were not reported separately, the cost analysis was reported adequately, including discount rate, the price year, and adjustments for inflation.

Analysis and results:
The mathematical SIRV model and the decision analytic model were reported in detail along with the parameter estimation methods. The synthesis of the costs and benefits was appropriately performed by means of an incremental analysis. The issue of uncertainty was investigated using only a deterministic approach. The results of the base-case and sensitivity analyses were clearly presented. The authors compared their results with those from other studies and highlighted the reasons for some differences. The authors also discussed a number of limitations to their study, especially in relation to the quality of the data used to populate the models.

**Concluding remarks:**
Overall, the study was based on valid methodology, although more details of the primary data sources would have been useful. In general, the authors’ conclusions appear to be valid given that they acknowledged the sensitivity of the results to some model parameters, as shown in the sensitivity analysis.

**Funding**
Supported by the Ministry of Health of Brazil, and the National Council of Technological and Scientific Development (CNPq).

**Bibliographic details**

**PubMedID**
18674582

**DOI**
10.1016/j.vaccine.2008.07.021

**Original Paper URL**
http://dx.doi.org/10.1016/j.vaccine.2008.07.021

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Adolescent; Adult; Algorithms; Brazil /epidemiology; Chickenpox /epidemiology /prevention & control; Chickenpox Vaccine /economics /therapeutic use; Child; Child, Preschool; Cost of Illness; Cost-Benefit Analysis; Health Care Costs; Hospitalization /economics /statistics & numerical data; Humans; Immunization Programs /economics; Infant; Mass Vaccination /economics; Models, Economic; Models, Statistical; Transportation of Patients /economics; Young Adult

**AccessionNumber**
22009100146

**Date bibliographic record published**
31/03/2009

**Date abstract record published**
11/11/2009