The cost-effectiveness of varicella and combined varicella and herpes zoster vaccination programmes in the United Kingdom
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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 assessed the cost-effectiveness of combined varicella and zoster vaccination strategies in children and elderly populations. The authors concluded that childhood varicella vaccinations evaluated over 30 or 50 years post-vaccination were unlikely to be cost-effective, but were increasingly likely to be so over longer time frames. Quality of the study methodology was adequate. There were some limitations with the reporting of the methods and results but the authors’ conclusions appear appropriate.

Type of economic evaluation
Cost-utility analysis

Study objective
The objective of the study was to assess the cost-effectiveness of combined varicella and zoster vaccination strategies in children and elderly populations.

Interventions
The study assessed use of childhood varicella vaccination alone, varicella vaccination in children and herpes zoster vaccination of the elderly and herpes zoster vaccination of the elderly alone. Each strategy was compared with a no vaccination strategy.

Location/setting
UK/Primary care

Methods
Analytical approach:
An age-structured transmission dynamic model of varicella and zoster was developed based on Brisson et al. (see Other Publications of Related Interest). This model was combined with a cost-effectiveness model that incorporated data from published evidence. The study adopted an unlimited time horizon. The authors reported that the perspective as that of the National Health Service (NHS).

Effectiveness data:
Effectiveness data were derived several different sources that included cohort studies, clinical trials and national statistics data. The main clinical effectiveness estimates were vaccine uptake and waning associated with herpes zoster vaccination. These data were derived from the Shingles Prevention Study (see Other Publications of Related Interest).

Monetary benefit and utility valuations:
The utility loss due to varicella was obtained from a previously published study that distributed HUI-2 (Health Utilities Index Mark 2) questionnaires among parents of young children in primary care practices. Utility loss information due to herpes zoster was obtained from a study that estimated the severity and duration of pain by age.

Measure of benefit:
The benefit measure was Quality Adjusted Life Years (QALYs) discounted using an annual rate of 3.5%.

Cost data:
Direct costs were for primary care visits, hospitalisation, treatment for varicella zoster immune globulin (VZIG) and vaccination costs. Hospitalisation rates due to varicella or herpes zoster were derived from Hospital Episode Statistics and valued using NHS reference costs. General practitioner (GP) visits due to varicella and herpes zoster were derived from the database of the Royal College of General Practitioners. Vaccination costs were derived from prices set by the USA Centres for Disease Control and Prevention. Costs were presented in 2007 UK pounds (£) and discounted using an annual rate of 3.5%.

Analysis of uncertainty:
Probabilistic sensitivity analysis attached probability distributions to each of the model parameters. A set of 1,000 different parameter combinations were generated to feed into the transmission model. The discount rate for the benefit measure was changed to 1.5% and different time horizons were presented within the sensitivity analysis. The results of these analysis were presented in cost-effectiveness planes.

**Results**
QALYs lost through varicella were: 60,385 in the no vaccination group; 7,763 with childhood varicella vaccination alone; 60,220 with Herpes zoster vaccination of the elderly alone; and 7,661 with varicella vaccination in children and herpes zoster vaccination of the elderly.

QALYs lost through herpes zoster were: 588,332 in the no vaccination group; 630,188 with childhood varicella vaccination alone; 562,299 with Herpes zoster vaccination of the elderly alone; and 601,433 with varicella vaccination in children and herpes zoster vaccination of the elderly.

Total treatment costs through varicella were: £661,348,000 in the no vaccination group; £75,483,600 with childhood varicella vaccination alone; £658,633,000 with Herpes zoster vaccination of the elderly alone; and £74,348,050 with varicella vaccination in children and herpes zoster vaccination of the elderly.

Total treatment costs through herpes zoster were: £883,975,500 in the no vaccination group; £917,885,500 with childhood varicella vaccination alone; £851,420,000 with Herpes zoster vaccination of the elderly alone; and £882,094,500 with varicella vaccination in children and herpes zoster vaccination of the elderly.

The total vaccination costs were: zero with no vaccination; £929,076,000 with childhood varicella vaccination; £538,090,000 with herpes zoster vaccination of the elderly alone; and £1,467,170,000 with varicella vaccination in children and herpes zoster vaccination of the elderly.

Costs and outcomes were combined using an incremental cost-utility ratio (additional cost per QALY gained). Results were presented in a cost-effectiveness plane. Results of the probabilistic sensitivity analysis showed that when compared with no vaccination the probability that childhood varicella vaccination alone was cost-effective at a £30,000 per QALY gained was 50%, for herpes zoster vaccination of the elderly alone was 96% and for varicella vaccination in children and herpes zoster vaccination of the elderly was 70%.

The results were found to be very sensitive to the time-frame of analysis. Childhood varicella vaccination was unlikely to be cost-effective if evaluated 30 to 50 years post vaccination.

**Authors’ conclusions**
The authors concluded that childhood varicella vaccinations evaluated over 30 or 50 years post-vaccination were unlikely to be cost-effective, but these programmes were increasingly likely to be cost-effective over longer time frames. The authors noted that decision makers needed to be aware that model results were likely to be inaccurate and huge changes in society are likely to occur over long time frames.

**CRD commentary**
Interventions:
The interventions under study were reported appropriately and appeared to be appropriate comparators. It was appropriate to include a no vaccination strategy in the analysis.

Effectiveness/benefits:
Effectiveness data were derived from several different sources. It was unclear how this published evidence was identified and whether a systematic review was undertaken to identify the effectiveness data. It was stated that an undated review of the literature was undertaken, but no details were provided on this review and so it was not possible to assess whether all best available evidence were included in the model. The adjustments made and models fitted to the various clinical estimates were well described. The benefit measure appeared appropriate as it incorporated both morbidity and mortality. The methods used to derive the utility estimates were adequately described, but readers may need to refer to the referenced papers to fully assess their quality.

Costs:
The perspective adopted in the economic analysis was explicitly reported to be that of the NHS. It appeared that all major relevant costs for this perspective were included in the analysis. The sources from which unit costs and resource use were derived were reported adequately. The time horizon, currency details, price year and discount rate were all reported and appeared appropriate.

Analysis and results:
A dynamic model was used to synthesise cost and outcome information; This model was adequate described and appropriate details of the model structure were given, but no graphical depiction was provided. Model uncertainty was tested using one-way and probabilistic sensitivity analysis, which should give a good indication of the uncertainty due to both individual parameters (benefit measure discount rate and time horizon) as well as the overall model uncertainty. The results of these sensitivity analyses were described adequately and presented graphically. Some of the results were not well reported. Net vaccination costs were calculated as costs of vaccination minus the treatment costs averted but it was not clear how those results were obtained. The incremental cost-effectiveness ratios for the different vaccination strategies were not presented. As the main limitation to their study the authors reported that they assumed a stationary population with constant mortality and births over time.

Concluding remarks:
The quality of the study methodology was adequate. There were limitations with the reporting of methods and results but the authors’ conclusions appear appropriate.

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