A cost-effectiveness model for analyzing two varicella vaccination strategies

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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 programme for vaccinating employees at a health care institution against varicella zoster virus (VZV, chickenpox). Three employee groups were considered: all employees (vaccinate-all group), employees providing direct patient care (direct care group), and employees working in a high-risk patient areas (high-risk group). The patient care areas considered to be high risk were the nephrology, oncology, peripartum, and nursery areas. Two strategies for employee vaccination were used: screen (by antibody titer testing) and then vaccinate, and vaccination alone.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
Employees at a health care institution. The study specifically considered those employees unable to state when they were infected with chickenpox as the target population of the model: employees who reported a negative or uncertain VZV infection history.

Setting
Hospital (health care institution). The economic study was carried out in the USA. The analysis adopted the perspective of the study institution, which both paid for services and provided services.

Dates to which data relate
Effectiveness data were obtained from studies published between 1984 and 1997. The price year does not appear to have been explicitly specified.

Source of effectiveness data
The evidence for the final outcomes was based on a literature review and assumptions made by the author.

Modelling
A model was used to estimate the costs and effects associated with each strategy.

Outcomes assessed in the review
The outcome variables obtained from the literature were as follows: natural immunity, annual varicella exposure, varicella infection after exposure, vaccine efficacy, vaccine-induced vesicular rash.
Study designs and other criteria for inclusion in the review
Not reported.

Sources searched to identify primary studies
Not reported.

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

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

Number of primary studies included
A total of 10 studies were included in the review.

Methods of combining primary studies
Not reported.

Investigation of differences between primary studies
Not reported. The authors acknowledged that there was tremendous variability in the reported incidence of immunity and infection in adults. To tackle this problem, when feasible, values reported in the literature were confirmed by taking small random samples from the study institution's data.

Results of the review
The outcome values (range, representing best-case and worst-case scenarios) for the variables obtained from the literature were as follows:

natural immunity, 90% (32 - 93%);
annual varicella exposure, 15% (2 - 18%);
varicella infection after exposure, 35% (18 - 80%);
vaccine efficacy, 70% (70 - 96%);
vaccine-induced vesicular rash, 4% (4 - 6%).

Methods used to derive estimates of effectiveness
Assumptions made by the author.

Estimates of effectiveness and key assumptions
It was assumed that 5% of the employees eligible to receive the vaccine (VZV susceptible or potentially susceptible) would not receive it because of contraindication or non-compliance.

Measure of benefits used in the economic analysis
The measure of benefits was the number of patients prevented from being exposed to VZV and the number of employees prevented from contracting VZV infection in a cohort of 10,000 employees potentially susceptible to VZV.

**Direct costs**
Costs were not discounted due to the short time frame of the cost analysis. Some cost items were reported separately. Cost analysis covered the costs of pharmaceuticals (medications for managing patient exposures and employee infection), laboratory tests, vaccines, and personnel (health employees, infection control employees, furloughed employees, and replacement workers for furloughed employees). The perspective adopted in the cost analysis was that of the study institution, which both paid for and provided the preventive programmes. The values used in the model were the most frequently reported values or the values agreed upon by the institution's expert as the reference values. The least and most favourable values were combined to estimate the worst-best case scenarios. The price year was not reported. The consequences and costs of a false-positive antibody test were negligible and therefore were excluded. The impact of vaccination on costs associated with herpes zoster virus infection was not included.

**Indirect costs**
Indirect costs were not included.

**Currency**
US dollars ($).

**Sensitivity analysis**
Analyses of extremes were performed by considering worst-best case scenarios on effectiveness and cost variables.

**Estimated benefits used in the economic analysis**
The reduction in employee infections and patient exposures was the same for both a screen, then vaccinate strategy and a vaccinate-all strategy. Either strategy reduced employee infections by approximately 35 (range: 10 - 146) per 10,000 employees. The number of patient exposures reduced by vaccination varied only with the proportion of vaccinees directly involved in patient care. The reduction in patient exposures if all employees were vaccinated was approximately 674 (range: 57 - 7,285) per 10,000 employees. If all vaccinees could potentially expose patients (the direct care and high-risk groups), about 1,496 patients exposures (range: 192 - 12,142) were prevented for every 10,000 employees vaccinated.

**Cost results**
The cost per patient for the screen only strategy was $75 (range representing best-worst case scenarios: 31 - 292) for the all-vaccinate group, $103 (range: 35 - 62) for the direct care group, and $143 (range: 39 - 1,013) for the high-risk group.

The corresponding costs for the screen and vaccinate strategy were $52 (range: 35 - 200) for the all-vaccinate group, $62 (range: 36 - 338) for the direct care group and $75 (range: 36 - 445) for the high-risk group.

For the vaccination alone strategy the costs were $133 (range: 108 - 217) for the all-vaccinate group, $146 (range: 112 - 357) for the direct care group and $159 (range: 112 - 464) for the high-risk group.

**Synthesis of costs and benefits**
The (incremental) cost per patient exposure prevented for the screen and vaccinate strategy was $772 (range: 275 - 6,140) for the all-vaccinate group, $414 (range: 278 - 1,875) for the direct care group, and $501 (range: 366 - 1,875) for the high-risk group.
The corresponding values for the vaccination alone strategy were $1,973 (range: 298 - 18,947) for the all-vaccinate group, $976 (range: 294 - 5,833) for the direct care group and $1,063 (range: 382 - 5,833) for the high-risk group.

The (incremental) cost per employee infection prevented for the screen and vaccinate strategy was $14,857 (range: 13,699 - 35,000) for the all-vaccinate group, $23,151 (range: 17,714 - 36,000) for the direct care group, and $30,479 (range: 21,429 - 36,000) for the high-risk group.

The corresponding values for the vaccination alone strategy were $38,000 (range: 14,863 - 108,000) for the all-vaccinate group, $41,714 (range: 24,452 - 112,000) for the direct care group, and $45,429 (range: 31,781 - 112,000) for the high-risk group.

Authors' conclusions
An employee vaccination programme is a good investment in preventing patient exposures to VZV and may be cost-effective compared with only screening employees.

CRD COMMENTARY - Selection of comparators
A justification was given for the choice of the comparator. It was the health care organization's only option for effectively managing nosocomial outbreaks of varicella before the development of the vaccine against VZV. You, as a database user, should consider whether this is relevant in your own setting.

Validity of estimate of measure of effectiveness
The internal validity of the effectiveness outcomes cannot be guaranteed in view of the apparent lack of a systematic literature review describing the sources searched and methods of critical appraisal of the primary studies included in the review. Furthermore, no justification was provided for the author's assumptions regarding the effectiveness outcomes. However, the analysis of extremes and the use of a random sample of the institution's data to confirm the values extracted from the literature may have rectified some of the shortcomings of the effectiveness analysis.

Validity of estimate of measure of benefit
The estimate of benefit measures was modelled. Given the information provided it is not clear how appropriate the model was. Furthermore, the impact of vaccination on outcomes associated with herpes zoster virus infection was not included.

Validity of estimate of costs
The following characteristics of the cost analysis may have enhanced its validity: some details about the sources and components of the cost data were given, the perspective adopted in the cost analysis was reported by the authors and worst-best case scenarios were performed on cost values. However, the price year was not reported, no justification appears to have been provided for some of the assumptions made regarding the resource use quantities and some of the components of the direct costs were omitted from the cost calculations. Furthermore, the effects of the adopted strategies on indirect costs were not evaluated and it is not entirely clear whether the cost data were based on true costs or on charges.

Other issues
Given the limitations of the literature review and cost analysis, the study results may need to be interpreted with a degree of caution. It was acknowledged that the study results depended on the assumptions made by the authors. The issue of generalisability was addressed implicitly by performing analysis of extremes and by comments made by the author (which was reported in the implications section of this abstract). Some comparisons were made with other studies.
Implications of the study
The magnitude of cost savings and the patient care benefit depend on the individual health care organisation, because these outcomes are directly related to employees' ability to accurately report a negative history of VZV infection, employees' susceptibility, and the stringency of the infection control programme.

Source of funding
None stated.

Bibliographic details

PubMedID
9872686

Indexing Status
Subject indexing assigned by NLM

MeSH
Chickenpox Vaccine /economics; Cost-Benefit Analysis; Herpes Zoster /prevention & control; Herpesvirus 3, Human /immunology; Hospitals, Public; Humans; Mass Screening; Models, Economic; North Carolina; Occupational Health; Personnel, Hospital /economics; Vaccination /economics /methods

AccessionNumber
21999000231

Date bibliographic record published
31/07/2001

Date abstract record published
31/07/2001