Cost-effectiveness of varicella vaccination of healthcare workers
Chodick G, Ashkenazi S, Livni G, Lerman Y

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
Four strategies for the management of future varicella cases among health care workers (HCWs) were examined.

The do nothing strategy involved no testing or vaccination.

Anamnestic screening consisted of screening by history of varicella, followed by antibody tests for those who are uncertain or report no prior varicella, and then vaccinating those who test negative for varicella antibody.

Serotesting selection involved the vaccination of all serologically proven susceptible HCWs.

Presumptive vaccination involved the mass vaccination of all eligible HCWs.

Type of intervention
Primary prevention (vaccination).

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a cohort of physicians and nurses with at least 20 future potential work years (i.e. those aged younger than 45 years).

Setting
The setting was a hospital. The economic study was carried out in Israel.

Dates to which data relate
The effectiveness data and some resource use data were derived from studies published between 1990 and 2004. The price year appears to have been 2004.

Source of effectiveness data
The effectiveness evidence was derived from a synthesis of completed studies.

Modelling
A Markov model was constructed to assess the clinical and economic impact of the four strategies examined in the study. The model incorporated not only the efficacy of each intervention, but also compliance rates and accuracy of diagnostic tests.

In the do nothing policy, a person could or could not already have natural protection against varicella depending on the
accuracy of clinical history. In the anamnestic selection policy, all workers would be asked to report history of chickenpox and only those with no recall and who were proven seronegative would undergo immunisation. In the serotesting selection policy, all persons would have blood drawn during the initial visit for an enzyme-linked immunosorbent assay (ELISA) for varicella antibodies. Those with a positive test would receive no further intervention, while those with negative serology would be immunised. Given the imperfect validity of self-reported history of varicella and varicella test, in both policies some workers would be categorised as falsely positive or falsely negative. Further, workers could be lost to follow-up or refuse testing or vaccination. In the presumptive vaccination policy, all workers received presumptive vaccination indifferently to their self-reported varicella history or varicella test. However, due to incomplete compliance or vaccine effectiveness, this policy would not eliminate all future varicella cases.

A simplified version of the model was reported. The time horizon of the model was 20 years, which corresponded to the vaccine's potential protection period.

Outcomes assessed in the review
The outcomes estimated from the literature were:

- the size of the eligible HCW population in Israel,
- the age-specific rates of varicella antibodies among HCWs,
- the annual attack rate among HCWs aged 25 - 45 years,
- the annual incidence rate,
- the sensitivity and specificity of varicella recall and varicella antibody testing,
- vaccine protection,
- the proportion of eligible individuals accepting varicella vaccination, and
- compliance with vaccination.

Study designs and other criteria for inclusion in the review
It was unclear whether a review of the literature was undertaken to identify the primary studies. Some information on the design and characteristics of the primary studies was provided. The majority of these studies were taken from other countries and adapted to the Israeli context.

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 reported.

Number of primary studies included
Eleven primary studies provided data.
Methods of combining primary studies
The primary estimates appear to have been combined using a narrative method.

Investigation of differences between primary studies
Not stated.

Results of the review
The overall target population in Israel included 63,353 workers. Of these, 19,048 were physicians (61.2% of all registered physicians in Israel), 17,081 were registered nurses (51.6% of all registered nurses), and 11,210 were nursemaids (65.1% of all registered nursemaids).

The age-specific rates of varicella antibodies among HCWs were 94.4% (95% confidence interval, CI: 75.5% - 99.7) in the 20- to 24-year age group, 96.3% (95% CI: 92.5 - 98.5) in the 25- to 44-year age group, and 88.3% (95% CI: 88.3 - 99.9) in the 45- to 49-year age group.

The annual attack rate among HCWs aged 25 - 45 years was thus estimated at 1.61 per 1,000. The corresponding crude annual incidence rate used in the analysis was 6.15 per 100,000 (range: 3.84 - 192.2).

The sensitivity of varicella recall was 57% and the specificity was 82%. Thus, 62% of the study cohort was estimated to report a positive varicella history.

The sensitivity of varicella antibody testing was 97% (range: 86 - 97) and the specificity was 99% (range: 82 - 99).

Vaccine protection was 80% (range: 50 - 100) and it lasted at least 20 years.

The proportion of eligible individuals accepting varicella vaccination was 70%.

Compliance with vaccination for HCWs undergoing blood testing or reporting no history of varicella was 100%.

Measure of benefits used in the economic analysis
The summary benefit measure was the expected number of varicella cases. This was estimated using a modelling approach. The cumulative incidence per 100,000 was also reported. The number of future cases was discounted at an annual rate of 3%.

Direct costs
The analysis of the costs was undertaken from the perspective of the health care payer. It focused on the costs of vaccination, such as vaccine acquisition, nurses' time, training, swabs, disposable syringes, needles, side effects, work absence, travel and waste. The costs of serology testing included blood collection and the varicella ELISA test. The unit costs were presented separately from the quantities of resources used. Resource consumption was estimated from authors' assumptions and some published data. The costs came from published sources. The total costs associated with each intervention were estimated using a modelling approach. Discounting was not relevant as the costs were incurred during a short time. The price year might have been 2004.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
The indirect costs were not included.
Currency
US dollars ($).

Sensitivity analysis
Univariate sensitivity analyses were performed to assess the robustness of the cost-effectiveness ratios to variations in almost all clinical and economic inputs used in the decision model. The ranges of values were, in general, derived from the literature.

Estimated benefits used in the economic analysis
The expected number of varicella cases was 58.3 with the do nothing strategy, 33 with immunisation following anamnestic and serotesting selection, 27.3 with immunisation following serotesting selection, and 26.9 with presumptive vaccination of all HCWs.

The rate of cumulative incidence per 100,000 was 92.0 with the do nothing strategy, 52.2 with immunisation following anamnestic and serotesting selection, 43.2 with immunisation following serotesting selection, and 42.5 with presumptive vaccination of all HCWs.

Cost results
The total campaign costs were $0 with the do nothing strategy, $598,517 with immunisation following anamnestic and serotesting selection, $1,182,438 with immunisation following serotesting selection, and $4,425,841 with presumptive vaccination of all HCWs.

Synthesis of costs and benefits
Incremental cost-effectiveness ratios were calculated to combine the costs and benefits of the alternative strategies.

The incremental cost per avoided case in comparison with the next less effective strategy was $23,713 with immunisation following anamnestic and serotesting selection, $206,692 with immunisation following serotesting selection, and $10,426,867 with presumptive vaccination of all HCWs.

The sensitivity analysis showed that the variations of model inputs did not alter the base-case results with respect to the number of expected cases. The cost per avoided case was highly sensitive to the assumed varicella incidence rate. When the upper limit of incidence rate was used (192.2 per 100,000), the lowest incremental costs per avoided case were achieved ($1,464 and $8,525 for the anamnestic and serotesting selection policies, respectively).

A rough calculation showed that the estimates of the cost per life-year gained were $84 million for anamnestic screening, $736 million for serotesting and $37,107 million for presumptive policies.

The cost per quality-adjusted life-year saved was $2 million for anamnestic screening, $17,692 million for serotesting and $906,144 million for presumptive policies.

Authors' conclusions
Routine varicella vaccination programmes for health care workers (HCWs), with or without the selection of susceptible workers, were extremely expensive in Israel from the employer's perspective, compared with other high-cost practised approaches.

CRD COMMENTARY - Selection of comparators
The rationale for the choice of the comparators was clear. The 'do nothing option' represented the status quo in the authors' setting, while the other three strategies were all possible vaccination options for HCWs. The authors noted that a further option, vaccinating all HCWs who had a negative self-reported varicella history, could have been included but
was omitted as it was found to be more costly than vaccination after sero-testing. You should decide whether they are valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**

The effectiveness evidence was derived from published sources. However, it was not stated whether a systematic review of the literature was undertaken. In fact, the primary studies appear to have been identified selectively. Some aspects of the primary studies, such as the country where the study was carried out, were reported, but in general few details were provided. Thus, it was difficult to assess the validity of the primary sources. Further, the issue of homogeneity of the primary studies was not addressed, although extensive sensitivity analyses were performed. The authors stated that historical data were used to estimate varicella susceptibility, which accurately reflected the background immunity rates in the targeted population.

**Validity of estimate of measure of benefit**

The summary benefit measure was specific to the study setting and would be difficult to compare with the benefits of other health care interventions. The impact of the interventions on mortality or quality of life was not investigated. Discounting of future cases was applied.

**Validity of estimate of costs**

The costs included were consistent with the perspective that was adopted in the study. However, only the direct medical costs strictly associated with the interventions under examination were considered. Other medical costs associated with the care of varicella cases (e.g. avoided hospitalisations or outpatient visits) were not taken into consideration, and the impact of the inclusion of such costs was unclear. The source of the data was reported for all items, and extensive information on the unit costs was provided. Resource use was based on assumptions or clinical patterns in the authors’ setting. The price year was not explicitly stated but, since it can be inferred to have been 2004, reflation exercises in other time periods should be feasible. The cost estimates were varied in the sensitivity analysis.

**Other issues**

The authors reported the results of other studies, stating that at least three studies recommended vaccinating HCWs. The issue of the generalisability of the study results was not explicitly addressed, although the use of extensive sensitivity analyses and the comparison with studies performed in other countries will have enhanced the external validity of the analysis. As the authors noted, the current study did not consider specific issues such as post-exposure administration or passive immunisation to high-risk patients.

**Implications of the study**

The study results did not support anamnestic and/or serology testing for varicella antibodies, followed by the vaccination or mass vaccination of HCWs. They suggested “monitoring VZV immunity status in HCWs potentially exposed to the virus may be routinely performed to allow the detection of changes in the susceptibility rates in the future”.

**Source of funding**

None stated.

**Bibliographic details**


**PubMedID**

16046036
Other publications of related interest


Indexing Status

Subject indexing assigned by NLM

MeSH

Chickenpox /economics /epidemiology /prevention & control; Chickenpox Vaccine /economics; Cost of Illness; Cost-Benefit Analysis; Decision Support Techniques; Health Care Costs /statistics & numerical data; Humans; Immunization Programs /economics; Personnel, Hospital; Vaccination /economics