Cost-effectiveness of universal influenza vaccination in a pregnant population

Roberts S, Hollier L M, Sheffield J, Laibl V, Wendel G D

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
The study examined the universal influenza vaccination of pregnant women with inactivated trivalent influenza vaccine. This strategy of routine vaccination was compared with an option of supportive care alone. Supportive care consisted of symptomatic treatment such as fluids, analgesics and antitussives (no treatment specific for influenza such as osaltamivir or amantadine was included, unless women were hospitalised).

Type of intervention
Primary prevention (vaccination).

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of pregnant women aged 18 to 44 years.

Setting
The setting was primary care. The economic study was carried out in the USA.

Dates to which data relate
Most of the clinical and economic data were derived from studies published between 1979 and 2005. The price year was 2004.

Source of effectiveness data
The clinical data used in the decision model were:

- the rate of ILI,
- the rate of Guillain-Barre syndrome,
- the rate of hospitalisation,
- the use of antibiotics,
- the frequency of medical visits,
- vaccine effectiveness,
- vaccine uptake, and
the percentage of pregnant women vaccinated.

**Modelling**

An analytic model based on a decision tree was constructed to simulate the management of influenza and influenza-like illness (ILI) in pregnant women, and to assess the clinical and economic impact of the two strategies under examination. Each strategy was associated with a similar pathway. The pathway was described in detail and included typical ILI consequences (visit to doctor, hospitalisation, medications etc.) but not death. A simplified structure of the decision tree was represented graphically. The time horizon of the analysis was 1 year.

**Sources searched to identify primary studies**

There was little information on the primary studies used to derive clinical inputs for the decision model. It was assumed that vaccine uptake was 50%.

**Methods used to judge relevance and validity, and for extracting data**

The approach used to derive the clinical data was not described. No systematic search for data was reported. Much of the data were taken from US or Canadian sources in order to be representative of the study context. Vaccine efficacy was calculated as a weighted average of estimates obtained from healthy workers because of a lack of data for pregnant women.

**Measure of benefits used in the economic analysis**

The summary benefit measure used was the quality-adjusted life-years (QALYs). These were estimated using the modelling framework. The analysis assumed that no deaths would occur as a result of influenza. Thus, the estimation of QALYs focused on the assessment of health-related quality of life, which was estimated from published sources using the Quality of Well Being scale for a person with ILI.

**Direct costs**

The analysis was carried out from a societal perspective. It included the direct costs of the vaccine (acquisition and administration cost), hospitalisation, treatment of Guillain-Barre syndrome, ambulatory visits for ILI, antibiotics, over-the-counter medications, adverse effects from medications and transportation. The cost of the vaccine did not include an extra visit as vaccination was assumed to be part of routine prenatal care. The unit costs were presented separately from the resource quantities for some items.

The costs associated with influenza-related hospitalisations were derived from the 2002 Healthcare Cost and Utilization Project, which includes information about approximately one half of all hospital discharges in the USA. Hospital charges were converted into costs using a cost-to-charge ratio derived from Medicare/Medicaid Services. Other costs were derived from published studies. Drug consumption was estimated from published, randomised clinical trials. Discounting was not relevant as the costs were incurred during 1 year. The price year was 2004. Costs estimated in previous periods were inflated to 2004 values using the Consumer Price Index for medical care.

**Statistical analysis of costs**

The costs were treated deterministically in the base-case.

**Indirect Costs**

The analysis included several indirect costs. These were associated with productivity lost from work and leisure time in the hospital, caregiver time, and patient time spent in transportation. These costs were derived using data from the medical literature and the Bureau of Labor Statistics. The unit costs and quantities of resources used were reported for some items. As in the analysis of the direct costs, discounting was not relevant and 2004 prices were used.
Currency
US dollars ($).

Sensitivity analysis
The issue of uncertainty was addressed in a sensitivity analysis. First, all clinical and economic inputs of the model were varied around published ranges of values in a univariate sensitivity analysis. Those variables with the greatest impact on the results were further analysed using two-way sensitivity analyses. Second, a Monte Carlo simulation was performed, assuming a triangular distribution for all model inputs.

Estimated benefits used in the economic analysis
The expected QALYs were 0.89676 with vaccination and 0.89420 with supportive care (difference 0.00256).

Cost results
The expected costs were $81.38 with vaccination and $106.60 with supportive care (difference $25.22).

Synthesis of costs and benefits
Average and incremental cost-utility ratios were calculated to combine the costs and benefits of the alternative strategies.

The average cost per QALY was $91 with vaccination and $119 with supportive care.

The incremental analysis revealed that the vaccination strategy was dominant, meaning that it was both more effective and less expensive than the strategy of supportive care. This conclusion refers to a scenario in which 50% of pregnant women were vaccinated. Under the assumption that all women were vaccinated (100% uptake), the strategy of vaccination led to a net gain of 0.00512 QALYs and savings of approximately $50 per pregnant woman.

The sensitivity analysis revealed that vaccination remained the dominant strategy for every probability of IILI. The results of the base-case analysis held when the model inputs were varied around plausible ranges of values. The probabilistic sensitivity analysis showed that vaccination remained dominant in 100% of the simulations. When an additional visit to an obstetric care giver was required for vaccination (so this was not part of routine prenatal care), the incremental cost per QALY gained with vaccination over supportive care was $7,563, which still represents a favourable value.

Authors' conclusions
Vaccination against influenza in pregnant women aged 18 to 44 years was an effective and cost-saving strategy in comparison with no vaccination (supportive care alone).

CRD COMMENTARY - Selection of comparators
The choice of the comparators appears to have been appropriate in that the strategy of vaccinating pregnant women is widely recommended, but supportive care may represent the standard of care in some contexts. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The clinical data were derived from published studies, but it was not stated whether a systematic review of the literature had been undertaken to identify them. The methods and conduct of a systematic review were not reported. No information on the design and other characteristics of the primary studies was given, which means that it is impossible to objectively assess the validity of the clinical data. This introduces some uncertainty around the clinical inputs, although their validity was tested in the sensitivity analysis.
Validity of estimate of measure of benefit
The use of QALYs as the summary benefit measure was appropriate since the focus of the analysis was on quality of life associated with ILI. The aspect of life expectancy incorporated in QALYs was not considered as the disease was assumed not to affect survival. QALYs can be compared with the benefits of other health care interventions. The instrument used to derive utility weights was described.

Validity of estimate of costs
The analysis of the costs was carried out from the broadest perspective. All the relevant categories of costs were included. The sources of most cost items were reported. Patterns of resource consumption were mainly derived from the literature. The costs were treated deterministically but probabilistic distributions were assigned to them in the stochastic sensitivity analysis. However, the use of triangular distributions would appear inadequate for costs. All cost items were varied in the deterministic sensitivity analysis. The price year was reported, which enhances the generalisability of the study results.

Other issues
The authors did not make extensive comparisons of their findings with those from other studies. They also did not address the issue of the generalisability of the study results to other settings, although a sensitivity analysis was performed which will have enhanced the external validity of the study. The assumption that no deaths would occur as a result of influenza biased the results in favour of the supportive care option. Thus, the results of the analysis should be considered conservative. The authors noted that the main drawback of the analysis was the paucity of data around influenza parameters in pregnant women. It was noted that many model inputs were derived from populations of healthy working adults. However, the sensitivity analysis addressed this along with other issues concerning the robustness of the cost-effectiveness results to variations in model inputs.

Implications of the study
The study results support the use of routine vaccination against influenza in pregnant women. The results of the study should encourage obstetric providers to follow CDC recommendations more strictly.

Source of funding
None stated.

Bibliographic details

PubMedID
16738159

DOI
10.1097/01.AOG.0000210225.45986.99

Other publications of related interest
Because readers are likely to encounter and assess individual publications, NHS EED abstracts reflect the original publication as it is written, as a stand-alone paper. Where NHS EED abstractors are able to identify positively that a publication is significantly linked to or informed by other publications, these will be referenced in the text of the abstract and their bibliographic details recorded here for information.


Tuyishime JD, De Wals P, Moutquin JM, Frost E. Influenza-like illness during pregnancy: results from a study in the

Indexing Status
Subject indexing assigned by NLM

MeSH
Adolescent; Adult; Cost-Benefit Analysis; Decision Support Techniques; Female; Humans; Immunization Programs /economics; Influenza Vaccines /economics /supply & distribution; Influenza, Human /economics /prevention & control; Monte Carlo Method; Orthomyxoviridae /immunology; Pregnancy; Pregnancy Complications, Infectious /economics /prevention & control; Quality-Adjusted Life Years

AccessionNumber
22006001835

Date bibliographic record published
31/12/2007

Date abstract record published
31/12/2007