Cost-effectiveness of influenza vaccination in working-age cancer patients

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 influenza vaccination in a high-risk group, namely working-age cancer patients. The routine vaccination strategy was compared with no vaccination.

Type of intervention
Primary prevention.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of working-age (20 to 64 years) adult cancer patients within 5 years of diagnosis.

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

Dates to which data relate
The clinical data were derived from studies published between 1978 and 2006. Resource use was derived from studies published between 2000 and 2005. The price year was 2005.

Source of effectiveness data
The two key clinical parameters used in the decision model were the risk of influenza vaccination and the effectiveness of the influenza vaccine in cancer patients. Other clinical inputs were:

- the rate of influenza-related hospitalisations,
- the rate of influenza-related ED visits,
- the life expectancy of a 51-year-old person,
- the cancer-specific mortality rate, and
- the influenza-related in-hospital mortality rate for cancer patients.

Modelling
A simple decision tree was constructed to simulate the clinical and economic outcomes of inactivated influenza vaccination versus no vaccination in a hypothetical 51-year-old patient within 5 years of their diagnosis of cancer. The
structure of the decision tree was represented graphically. The model considered the possibility that patients developing influenza infection could experience hospitalisations or emergency department (ED) visits. The time horizon of the model was 1 year.

**Sources searched to identify primary studies**
The annualised incidence of influenza infection was derived from a community study conducted in the USA in the 1970s. Vaccine effectiveness was based on a meta-analysis of published studies of seroconversion in adult cancer patients after immunisation with split virion influenza vaccine. Life expectancy was estimated from US Life Tables. Cancer-specific mortality was derived using data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) population. Influenza-related hospitalisations, the rate of influenza-related ED visits and the influenza-related in-hospital mortality rate for cancer patients came from two published studies, details of which were not given.

**Methods used to judge relevance and validity, and for extracting data**
No systematic search for data was reported. The authors described in detail the approach used in the meta-analysis. Studies were selected on the basis of their quality and their sample size.

**Measure of benefits used in the economic analysis**
The summary benefit measure used was the quality-adjusted life-years (QALYs). These were estimated by combining survival data and utility weights in the decision model. Life expectancy was derived from the literature. The utility weights for influenza infection were based on a published study that employed the Quality of Well Being Scale. Utility for malignancies came from a study in which a large, randomly selected sample of cancer patients was asked to evaluate their current state of health using time trade-off methodology. The benefits were discounted at an annual rate of 3%.

**Direct costs**
The analysis of the costs was conducted from a societal perspective. It included the direct medical costs associated with hospitalisations, ED visits, office visits, vaccination and pharmaceuticals (antiviral drugs and over-the-counter medications). The unit costs were presented separately from the quantities of resources used for most items. The estimation of costs was based on published studies and a micro-costing analysis performed at the accounting department of the authors' institution. The costs of medication reflected average wholesale prices. Resource consumption was derived from published studies, the main details of which were reported. Discounting was not relevant given the short time horizon of the analysis (1 year) and was not applied. The price year was 2005. The costs estimated from previous years were inflated to 2005 values using the Consumer Price Index for medical care.

**Statistical analysis of costs**
No statistical analyses of the costs and quantities were carried out.

**Indirect Costs**
Productivity costs associated with work absenteeism were included, in accordance with the societal perspective of the study. These costs were estimated using the mean per capita income by age obtained from the US Census. Some assumptions about resource use were made. The hourly wage was reported. As in the analysis of the direct costs, the price year was 2005 and no discounting was performed.

**Currency**
US dollars ($).

**Sensitivity analysis**
A deterministic sensitivity analysis was undertaken to assess the robustness of the study results to variations in key clinical and economic inputs such as the rate of influenza infection, the effectiveness and cost of influenza vaccination, and the patient's life expectancy. These parameters were varied over plausible ranges in a one-way sensitivity analysis. The rate of influenza infection and vaccine effectiveness were further analysed in a two-way sensitivity analysis in order to consider the seasons in which the circulating strains and the vaccine strains are a poor match. The benchmark of $50,000 per QALY was used as the threshold for acceptable cost-effectiveness of an intervention.

**Estimated benefits used in the economic analysis**
The expected lifetime QALYs were 6.02 with vaccination and 6.01 with no vaccination.

**Cost results**
The expected costs were $30.10 with vaccination and $27.86 with no vaccination.

**Synthesis of costs and benefits**
An incremental cost-utility ratio was calculated to combine the costs and benefits of the two strategies. The incremental cost per QALY gained with vaccination over no vaccination was $224.

The results of the sensitivity analysis showed that the vaccination strategy remained below the threshold of $50,000 per QALY in most scenarios. Therefore, the base-case results were generally robust. Vaccination became the dominant strategy (more effective and less expensive) over no vaccination when the incidence of influenza was greater than or equal to 12.9%. In contrast, the model was sensitive to changes in cancer survival, with a cost per QALY over the threshold of $50,000 when survival was below 2.8 months. The two-way sensitivity analysis suggested that only in extreme scenarios did the cost per QALY gained with vaccination exceed the cost-effectiveness threshold.

**Authors' conclusions**
An influenza vaccination programme for working-age cancer patients with at least 3 months of expected survival was cost-effective from a societal perspective.

**CRD COMMENTARY - Selection of comparators**
The rationale for the selection of the comparator (no vaccination) was clear as, despite national recommendations, most non-elderly adult cancer patients would not have been vaccinated against influenza in the authors' context. 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 sources, but there was no report of the methods and conduct of a systematic review of the literature. Thus, the primary studies might have been identified selectively. However, some of these studies were described and typical sources were used for survival and cancer-related deaths. Vaccine effectiveness was determined on the basis of a meta-analysis, which represents a valid source of data, although the authors noted the heterogeneity amongst the studies included in the meta-analysis. The meta-analytic approach was described in detail. Data on influenza incidence came from an old population-based study which may not be representative of current epidemiological patterns. However, the sensitivity analysis addressed the issue of uncertainty in key clinical inputs.

**Validity of estimate of measure of benefit**
The benefits (QALYs) were modelled and details of the estimation of QALYs were reported. In particular, the sources used to derive the utility weights were described. QALYs are an appropriate measure of the impact of the intervention on patient health since they take both survival and quality of life, which are two relevant dimensions of health for cancer patients, into account. QALYs have the further advantage of being comparable with the benefits of other health care interventions.

**Validity of estimate of costs**
The analysis of the costs was carried out from a broad perspective, which was appropriate given that patients were still in the workforce. A breakdown of the cost items was provided, and also some details of the unit costs and quantities of resources used. This enhances the possibility of replicating the analysis in other settings. The sources of the economic data were reported for all items. The cost estimates were treated deterministically and only one key cost item was tested in the sensitivity analysis. The price year was reported, which will facilitate reflation exercises in other time periods. Overall, the cost analysis was conducted and presented satisfactorily.

Other issues
The authors did not make explicit comparisons of their findings with those from other studies, but stated that their findings were in-line with the results from other studies in high-risk populations such as the elderly. They also noted that some conservative assumptions were made. For example, assuming an attenuated response to vaccination might result in an underestimation of the cost-effectiveness of the vaccination strategy. However, the fact that adverse events associated with vaccination were not taken into account might have favoured the vaccination strategy. Nevertheless, these events are usually mild and their inclusion should not have had a strong impact on the results of the analysis. Another potential limitation was the assumption that cancer patients had similar rates of resource use to individuals in the general population, despite some evidence suggesting an increase in the severity of influenza infection in cancer patients. The final effect of these counterbalancing effects was not clear, although the authors noted that, if future studies confirm a reduction in the severity of illness in vaccinated versus unvaccinated patients, more favourable results might be achieved for the vaccination strategy.

Implications of the study
The study results support the implementation of routine influenza vaccination in working-age, cancer patients.

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Other publications of related interest
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