Cost-effectiveness analysis of influenza and pneumococcal vaccinations among elderly people in Japan

Cai L, Uchiyama H, Yanagiwasa S, Kamae I

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 a strategy of influenza vaccination and a strategy of combined influenza and pneumococcal vaccination in elderly people.

Type of intervention
Primary prevention (vaccination).

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a hypothetical cohort of elderly people, including individuals aged 65 years and older.

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

Dates to which data relate
The effectiveness data and most information on resource use were derived from studies published between 2002 and 2004. The price year was not reported.

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

Modelling
A decision tree model was constructed to assess the costs and benefits of the alternative vaccination strategies in a hypothetical cohort of 100,000 elderly individuals. The time horizon of the model was one year. Only one end point diagnosis was considered for cases involving multiple episodes or both diseases. Patients in each vaccination arm could remain healthy or develop influenza or pneumococcal disease requiring, or not requiring, hospitalisation. Hospitalised patients could recover or die as a consequence of the disease. The structure of the tree was presented graphically.

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

the mortality of inpatients with influenza,
the hospitalised proportion of incidents of influenza,
the incident probability of influenza,
the mortality of inpatients with pneumonia,
the hospitalised proportion of incidents of pneumonia,
the incident probability of pneumonia,
days of hospitalisation with influenza,
days of hospitalisation with pneumonia, and
the life expectancy of people aged 65 years or older.

Study designs and other criteria for inclusion in the review
It was not stated whether a systematic review of the literature was undertaken to identify the primary studies. Much of the data came from a Swedish cohort study. Other data came from a national patient survey.

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
Three primary studies provided the clinical evidence.

Methods of combining primary studies
Not relevant.

Investigation of differences between primary studies
Not reported.

Results of the review
The mortality of inpatients with influenza was 0.045 with influenza vaccination, 0.022 with combined vaccination, and 0.048 with no vaccination.

The hospitalised proportion of incidents of influenza was 0.071 with influenza vaccination, 0.061 with combined vaccination, and 0.040 with no vaccination.

The incident probability of influenza was 0.021 with influenza vaccination, 0.021 with combined vaccination, and 0.050 with no vaccination.
The mortality of inpatients with pneumonia was 0.140 with influenza vaccination, 0.139 with combined vaccination, and 0.150 with no vaccination.

The hospitalised proportion of incidents of pneumonia was 0.890 with all strategies.

The incident probability of pneumonia was 0.024 with influenza vaccination, 0.018 with combined vaccination, and 0.026 with no vaccination.

Days of hospitalisation with influenza were 13.3 with all strategies.

Days of hospitalisation with pneumonia were 43.3 with all strategies.

The life expectancy of people aged 65 years or older was 13.3 years.

**Measure of benefits used in the economic analysis**
The summary benefit measure was the number of life-years saved (LYS). This was estimated using a modelling approach. Discounting was not applied.

**Direct costs**
The analysis of the costs was performed from a societal perspective. It included the direct costs associated with vaccination and inpatient or outpatient treatment of disease (influenza or pneumococcal disease). The unit costs were not presented separately from the quantities of resources used since most costs were reported as macro-categories. Most information on resource use was derived from published data. The costs came from the Ministry of Health in Japan and from a published economic evaluation. The price year was not reported. Discounting was not relevant given the short time horizon of the analysis.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs (i.e. productivity losses) were appropriately included in the analysis as a societal perspective was chosen. The hourly wage was reported separately from the number of hours worked per month. Length of hospitalisation was derived from the Japanese Respiratory Society. Data on the unit costs and quantities of resources used for employed elderly people came from official Japanese data. The price year was not reported and the costs were not discounted.

**Currency**
Japanese yen (JPY). The authors stated that one US dollar was almost equivalent to JPY 120.

**Sensitivity analysis**
The issue of uncertainty was extensively addressed by running a Monte Carlo simulation in a cohort of 100,000 elderly people (10,000 trials). Normal distributions were attributed to all model parameters. The authors stated that a univariate sensitivity analysis was also carried out, but details of this analysis were not reported.

**Estimated benefits used in the economic analysis**
In a hypothetical cohort of 100,000 individuals, the expected LYS in comparison with no vaccination were 620.3 with influenza vaccination and 1,675.9 with combined vaccination.
Cost results
In a hypothetical cohort of 100,000 individuals, the expected costs were JPY 1,125,362,258 (range: 639,019,631 to 1,737,952,651) with no vaccination, JPY 1,445,642,749 (range: 1,006,363,352 to 1,987,630,080) with influenza vaccination only, and JPY 1,896,064,977 (range: 1,532,818,110 to 2,286,978,986) with combined vaccination.

Synthesis of costs and benefits
Incremental cost-effectiveness ratios (i.e. the cost per LYS) were calculated to combine the costs and benefits of the alternative strategies.

The incremental cost per LYS in comparison with no vaccination was JPY 516,332 with influenza vaccination and JPY 459,874 with combined vaccination.

The incremental cost per LYS was JPY 426,698 with combined vaccination over influenza vaccination.

The results of the univariate sensitivity analysis suggested that the model inputs with the greatest impact were the incident probability of pneumonia and the hospitalised proportion of incidents of pneumonia. However, the results in the base-case did not vary substantially.

Authors' conclusions
From a societal perspective, a combined strategy of vaccination against influenza and pneumonia was more cost-effective than influenza vaccination alone in the elderly in Japan.

CRD COMMENTARY - Selection of comparators
The authors justified their choice of the comparators and discussed their reasons for the exclusion of a strategy based on pneumococcal vaccination alone. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The analysis of the effectiveness was based on a synthesis of published studies. However, the authors did not report the methods and conduct of a systematic review of the literature, thus it appears that the primary studies might have been identified selectively. Most of the evidence on disease came from a cohort study carried out in Sweden, although the authors acknowledged that epidemiology patterns might vary between Sweden and Japan. Nevertheless, the use of Swedish data was required given the lack of recent published Japanese evidence. Other data were derived from local sources. The authors did not address the potential issue of heterogeneity among the primary studies. However, the issue of uncertainty surrounding some model inputs was addressed in the sensitivity analysis.

Validity of estimate of measure of benefit
The summary benefit measure was appropriate as LYS represent the most important dimension of health for elderly suffering from influenza or pneumonia. The impact of the interventions on quality of life was not investigated.

Validity of estimate of costs
The perspective chosen for the economic analysis was appropriate and all the relevant categories of costs were taken into account. Productivity losses were also considered, although only a small proportion of elderly people are in the workforce. Details on the unit costs and quantities of resources used were presented clearly for only some items, and a breakdown of the cost items was not provided. This limits the possibility of replicating the analysis in other settings. The source of the data was reported for all categories of costs, and most sources reflected the Japanese setting. The price year was not reported, which will hinder reflation exercises in other time periods. The unit costs were treated deterministically but probabilistic distributions were used in the Monte Carlo simulation.
Other issues
The authors did not make extensive comparisons of their findings with those from other studies, although they did report that pneumococcal vaccination had been shown to be cost-effective in another study. The issue of the generalisability of the study results to other settings was not explicitly addressed, and the authors did not provide any information on the use of a univariate sensitivity analysis. In particular, it was not stated which model inputs were varied and which ranges of values were used. The authors did not justify the choice of normal distributions for all model parameters, and this might not be appropriate for some items (e.g. resource use and probabilities). The study referred to the general population of elderly people and this was reflected in the authors’ conclusions. The authors acknowledged some limitations of their analysis. These were mainly related to the use of external epidemiological data (which appears to have been the main drawback of the analysis) and the uncertainty surrounding some model inputs.

Implications of the study
The study results support the use of a combined vaccination strategy against influenza and pneumonia in the elderly population. A future issue for decision-makers in Japan is the improvement of vaccine coverage in the elderly.

Source of funding
None stated.

Bibliographic details

PubMedID
16855372

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


Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Aged, 80 and over; Cost-Benefit Analysis; Female; Hospitalization /economics; Humans; Influenza Vaccines /economics; Influenza, Human /prevention & control; Japan; Male; Monte Carlo Method; Pneumococcal Infections /prevention & control; Pneumococcal Vaccines /economics

AccessionNumber
22006001824