Cost-effectiveness of a recommendation of universal mass vaccination for seasonal influenza in the United States

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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.

CRD summary
The study assessed the cost-effectiveness of universal mass vaccination against influenza versus a targeted vaccine programme for selected age and risk groups. The authors concluded that universal mass vaccination was likely to be more effective and less expensive than targeted vaccination programme from the perspective of society, even when excluding the impact of reduced virus transmission (herd immunity). The study used valid and transparent methods that enhance the robustness of the authors’ conclusions.

Type of economic evaluation
Cost-utility analysis

Study objective
The study assessed the cost-effectiveness of universal mass vaccination against influenza versus a targeted vaccine programme for selected age and risk groups.

Interventions
The two interventions were universal mass vaccination and targeted vaccine programme against influenza. Targeted vaccine programme was restricted to children under 18 years old, individuals 18 to 49 years old who were considered to be at high-risk of developing influenza-related complications, and individuals 50 years or older.

Location/setting
USA/primary care.

Methods
Analytical approach:
A published decision-tree model of seasonal influenza vaccination was used that considered various age-group modules. The time horizon for the intervention was one year, but model outcomes were assessed over individuals’ lifetimes. The authors stated that a societal perspective was adopted.

Effectiveness data:
A selective approach was used to identify relevant sources of evidence. National survey data were used for most epidemiological data. Vaccine coverage with universal mass vaccination was taken from Canadian data where a universal mass vaccination policy had been previously implemented. Data on the efficacy of vaccine against influenza-like illness were key inputs of the model and came from various studies, including published meta-analyses. Life expectancy and mortality risk were taken from standard US statistics. Some assumptions were also made.

Monetary benefit and utility valuations:
Utility values were taken from published sources.

Measure of benefit:
Quality-adjusted life-years (QALYs) were used as the summary benefit measure. A 3% discount rate was applied. Reduction in influenza-like illness cases, hospitalisations and deaths were also reported.

Cost data:
The costs included vaccination (acquisition and administration), outpatient care (influenza-like illness treatment and treatment of complications), antiviral treatment, inpatient treatment for complications, and lost productivity due to acute disease and mortality. Patterns of resource consumption were mainly based on published sources. Medical costs were from various sources, including average wholesale prices, the Centers for Disease Control and Prevention vaccine Web site, official reimbursement rates, and published claims analysis of costs associated with influenza complications. Productivity losses were based on average daily wages from the US Bureau of Labor Statistics. Costs were in US$. The price year was 2008. A 3% discount rate was applied.

Analysis of uncertainty:
Various scenario analyses were performed to test variations in model assumptions for the inclusion of an indirect effect (the base case analysis did not include reduced virus transmission or 'herd immunity'), reduced influenza-like illness risk in unvaccinated populations, lower vaccine coverage with universal mass vaccination, reduced complication in those who did not seek treatment for influenza-like illness, and reduced vaccine efficacy. All other inputs were subjected to a deterministic one-way sensitivity analysis using ranges of estimates between 75% and 125% of the base case value. A probabilistic sensitivity analysis was performed using a Monte Carlo simulation with 1,000 iterations and probability distributions for model inputs derived from the literature.

Results
In the whole US population, the targeted vaccine programme had direct/indirect costs of $114.5 billion, with 859,000 expected lifetime QALYs lost; universal mass vaccination had direct/indirect costs of $111.4, with 825,000 expected lifetime QALYs lost. Under base case assumptions, universal mass vaccination was predicted to dominate targeted vaccine programme, which was less effective and more expensive.

The likelihood of universal mass vaccination dominance was 82% in the probabilistic sensitivity analysis.

In some scenario analyses, universal mass vaccination was no longer dominant but even under unfavourable assumption, the highest incremental cost per QALY gained with universal mass vaccination over targeted vaccine programme was $15,900 (reduced complication in those who did not seek treatment for influenza-like illness), which still appeared to be a cost-effective figure.

The most influential input was the proportion of high-risk individuals aged 65 years and older who received vaccination with universal mass vaccination. This gave a 25% reduction from the base case estimate of 83.1% to 62.3% and led to an incremental cost per QALY gained of $65,900.

At a cost-effectiveness threshold of $50,000 per QALY, the net monetary benefit of universal mass vaccination was positive in 99.7% of iterations.

Authors' conclusions
The authors concluded that universal mass vaccination against influenza was likely to be more effective and less expensive than targeted vaccine programme from the perspective of society, even when excluding the impact of herd immunity.

CRD commentary
Interventions:
The selection of the comparators was appropriate as the conventional vaccination strategy (targeted vaccine programme) in the authors' setting was compared with the proposed universal option, which reflected the recent US Advisory Committee on Immunization Practices position.

Effectiveness/benefits:
Clinical and epidemiological estimates were taken from several different sources that were selected and justified by the authors. The key parameter (vaccine efficacy) was taken from a meta-analysis of clinical studies; this parameter was extensively varied given the different impact of vaccine on influenza-like illness for different seasons. Another key parameter (the coverage with universal mass vaccination) was taken from a country (Canada) where universal vaccination was implemented. The authors acknowledged the potential differences between Canada and the USA. Other sources were representative of the situation in the USA. QALYs were used as the main benefit measure; this was...
appropriate as influenza could have an impact on morbidity and mortality. No information of sources of utility weights was given. Other benefits specific to influenza vaccination were reported.

**Costs:**
A broad perspective was adopted, in which all cost categories were included regardless of the payer. Detailed information on data sources was provided. All these sources appeared to have been appropriate within the US setting. Some unit costs were presented separately from resource quantities, while other costs were reported as totals. Alternative assumptions about costs were taken into account in the sensitivity analyses. The price year was explicitly reported, which would allow reflation exercises in other time periods. Some costs were assessed separately for high-risk and low-risk patients. The discount rate applied reflects US guidelines. In general, the economic analysis was satisfactorily performed.

**Analysis and results:**
An incremental approach was used to identify the optimal vaccination strategy. Uncertainty was investigated using deterministic and probabilistic approaches; the methods and results were clearly presented. Several alternative scenarios were considered given the high uncertainty in some assumptions or parameters. The decision model was described and presented as a diagram. The study results were reported in detail and discussed. The authors stated that this was the first economic evaluation of universal mass vaccination for the USA. It was unclear whether these findings could be transferred to other settings given potential differences in coverage rates, epidemiological factors and prices. The authors acknowledged some limitations of their analysis, mainly the uncertainty in some parameters and the need for data for other countries in some circumstances.

**Concluding remarks:**
The study used valid and transparent methods that enhance the robustness of the authors' conclusions.

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