Cost effectiveness of vaccination against pandemic influenza in European countries: mathematical modelling analysis
Lugner AK, van Boven M, de Vries R, Postma MJ, Wallinga J

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
This study examined the cost-effectiveness of having one strategy, for three countries, for vaccination against influenza during a pandemic. The authors concluded that the most cost-effective strategy depended on vaccine availability and the country. In most scenarios, vaccinating young people with high transmission rates, was preferred, but vaccinating elderly people was cost-effective in some circumstances. The methods were valid and the authors’ conclusions appear to be robust.

Type of economic evaluation
Cost-utility analysis

Study objective
This study examined the cost-effectiveness of the optimal strategy, across three countries, for vaccination against influenza, in a pandemic, to assess whether guidance on vaccination should be tailored to each country, instead of one recommendation for all countries.

Interventions
The four strategies were: no vaccination, vaccination for the whole population, vaccination of people 65 years old or older, and vaccination of people with a high transmission rate (those aged five to 19 years).

Several scenarios were considered, including whether the vaccine was available early or at the peak of the pandemic (optimistic versus pessimistic scenario), and whether everyone was initially susceptible or older people already had immunity.

Location/setting
UK, Germany, and Netherlands/primary care.

Methods
Analytical approach:
The analysis used an age-structured model of influenza transmission from susceptible to exposed to infected to recovered. The time horizon was lifetime. The perspective was not explicitly stated.

Effectiveness data:
The epidemiological and demographic data were mainly from country-specific sources (national registries and surveillance databases), while the vaccine efficacy, which was the main input for the model, and the other parameters, were from published international studies. Some assumptions were made. Some values were not available for the UK or for Germany, and Dutch estimates were used.

Monetary benefit and utility valuations:
The utility values were from a Dutch source, for the scenario with no immunity, and from a UK pandemic study, for the scenario with existing immunity.

Measure of benefit:
Quality-adjusted life-years (QALYs) were the summary benefit measure and were discounted at an annual rate of 5% in
Germany, 1.5% in the Netherlands, and 3.5% in the UK. Life expectancy was based on demographic predictions, using a weighting factor for the high- and low-risk groups.

Cost data:
The analysis included the costs of over-the-counter drugs, visits to a general practitioner, prescription drugs, and admissions to hospital on a normal ward or in intensive care. The quantities of resources were from country-specific sources, wherever available; Dutch data were used for hospital admissions. The unit costs were based on Dutch estimates, where estimates were not available for Germany or the UK. Productivity losses were included in a separate analysis and were calculated, using the friction cost method, for the Netherlands, and the human capital approach, for the UK and Germany. As the costs were incurred within one year, no discounting was applied. The costs were reported in Euros (EUR) and, for the UK, they were also reported in UK £ and US $. The price year was 2008.

Analysis of uncertainty:
Sensitivity analyses were carried out, focusing on five parameters, which were the cost of the vaccine, the discount rate for life expectancy, the basic reproduction ratio, the vaccination coverage, and the level of existing immunity. The six possible combinations of three values for the basic reproduction ratio, and two values for the vaccine costs, were explored.

Results
In the UK, compared with no vaccination and not including productivity losses, a strategy of early vaccination for the whole population led to additional costs of EUR 1,001 million assuming no previous vaccination and EUR 1,219 million assuming existing immunity. The QALYs gained were 470,000 with no immunity and 248,000 with existing immunity. The incremental cost per QALY gained was EUR 2,128 with no immunity and EUR 4,906 with existing immunity. For late vaccination it was EUR 9,145 with no immunity and EUR 15,140 with existing immunity.

With early vaccination for elderly patients, the incremental cost per QALY gained was EUR 1,029 with no immunity and EUR 4,077 with existing immunity. With late vaccination for the elderly patients, it was EUR 3,313 with no immunity and EUR 8,499 with existing immunity. With early vaccination for young patients, the incremental cost per QALY gained was EUR 163 with no immunity and EUR 509 with existing immunity. With late vaccination for young patients, it was EUR 6,759 with no immunity and EUR 7,280 with existing immunity.

All these figures were well below commonly used cost-effectiveness thresholds. The findings were similar in the other countries. When including productivity losses, all vaccination strategies were dominant, as they were more effective and less expensive, in all countries, except vaccination for elderly people, in all countries, and late vaccination for the whole population, in the UK. Vaccination was highly cost-effective in all three countries.

The best strategy, when considering only direct costs, with existing immunity for older people, was vaccinating young people, in the three countries. With no previous immunity, early or late vaccination of elderly people was the best strategy, in Germany; and early vaccination of young people, or late vaccination of elderly people were preferred, in both the Netherlands and the UK.

The sensitivity analysis showed that vaccinating young people was the preferred option, in most scenarios.

Authors' conclusions
The authors concluded that the most cost-effective strategy depended on vaccine availability and the country. In most scenarios, vaccinating young people with high transmission rates, was preferred, but vaccinating elderly people was cost-effective in some circumstances.

CRD commentary
Interventions:
The rationale for the selection of the comparators was clear and they appear to have been relevant for other health care settings.

Effectiveness/benefits:
Little information was provided on the sources for the clinical parameters, and no systematic search for these sources
was reported. Country-specific data were used, where available, for the epidemiologic and demographic inputs. The vaccine efficacy is likely to have been from a trial, but this was not explicitly stated. This lack of information makes it difficult to fully judge the validity of the clinical sources. QALYs were a relevant benefit measure, given the impact of influenza mainly on the patients’ quality of life. Little information on the sources for the utility weights was provided.

Costs:
A broad perspective appears to have been adopted, but this was not explicitly stated. Analyses including and excluding productivity losses showed the strong impact of vaccination in reducing productivity costs. The unit costs and quantities of resources were explicitly reported for all countries. Most of the resources were from a Dutch source for all three countries. The price year was clearly stated, allowing reflation exercises. The cost of vaccination was uncertain and was appropriately varied in the sensitivity analysis.

Analysis and results:
The results were clearly reported, for each country and for each of the four scenarios. An incremental approach was appropriately used to synthesise the costs and benefits of the strategies. The authors justified their selection of the countries, which were geographically close and culturally similar, but differed in their population structures. They stated that a dynamic model was used, rather than a static one, because it was crucial to capture not only the direct effect of vaccination on those who were vaccinated, but also the indirect effect from the reduced risk of infection in the community. The uncertainty was investigated, but only for five parameters for the model; the results were clearly reported. The results should be considered to be specific to these three countries, as highlighted by the different findings for different the age distribution in each country.

Concluding remarks:
The methods were valid and the authors’ conclusions appear to be robust.

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