Efficacy and cost-effectiveness of influenza vaccination of the elderly in a densely populated
and unvaccinated community

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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.

Health technology
Influenza vaccination for the elderly was examined. The influenza vaccine was Vaxgrip 98-99 (Pasteur Merieux Connaught, France). It contained A/Beijing/262/95-like (h1N1), A/Sydney/5/97-like (H3N2) and B/Beijing/184/93-like.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised the general population of the elderly within a typical township of southern Taiwan. High-risk elderly were defined as those who had been hospitalised for cardiovascular disease, pulmonary diseases, diabetes mellitus or influenza-related disease the preceding years. The study population also included elderly people who were residents in nursing homes.

Setting
The study setting was the community. The economic study was carried out at the A-Lein Community Health Centre in Taiwan.

Dates to which data relate
The effectiveness and resource use data were gathered during one year following a recruitment campaign from 1 October to 31 December 1998. The price year appears to have been 1999.

Source of effectiveness data
The effectiveness data came from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively. Since the costs were averages taken from the National Health Insurance they were not based on the same patient sample as that used in the effectiveness study.

Study sample
Power calculations to determine the sample size were not reported. From the whole sample of 2,351 elderly in the study town, 1,326 individuals agreed to be vaccinated. Their mean age was 73.3 (+/- 5.7) years, 44.4% were men and 13.7%
were high-risk patients). The remaining 1,025 individuals refused to participate and were included in the unvaccinated group. Their mean age was 74.2 (+/- 6.8) years, 44.7% were men and 0.9% were high-risk patients.

**Study design**
This was a prospective cohort study that was carried out in the A-Lein Community, a town in southern Taiwan. The patients were followed for one year. The mortality data were obtained from the registration office, while the hospitalisation data were obtained from the A-Lein Community Health Centre. Twenty-two individuals in the vaccinated group and 345 in the unvaccinated group were lost to follow-up.

**Analysis of effectiveness**
The patients lost to follow-up were not included in the analysis. The final analysis considered only those patients whose data were available after one-year. The primary health outcomes used in the analysis were hospitalisation and mortality. The hospitalisation data were obtained from the A-Lein Community Health Centre, either by telephone interviews or during outpatient visits. Mortality was assessed using death certificate archives in the registry office.

The analysis considered four groups of causes determining hospitalisation and death. These were cardiovascular disease, chronic obstructive pulmonary disease (COPD), pneumonia and influenza-related diseases, and other reasons. For both hospitalisation and death, the risk difference (RD), relative risk (RR) and preventive fraction (PF, used to estimate the percentage reduction in mortality and hospitalisation if the unvaccinated patients had been vaccinated) were calculated. A logistic regression analysis was used to identify significant risk factors for hospitalisation and mortality. The study groups were not comparable at baseline since both the age and proportion of high-risk patients were statistically different in the study groups, with the vaccinated group including more high-risk and younger patients.

**Effectiveness results**
Overall, there were 102 (7.8%) hospitalisations in the vaccinated group and 125 (18.4%) in the unvaccinated group. The RD was -10.6 (95% confidence interval, CI: -13.8 to -7.3), the RR was 0.43 (95% CI: 0.33 - 0.54) and the PF was 57%.

When analysing single causes of hospitalisation, the PF was 50% for cardiovascular diseases, 84% for COPD, 0.3367 for pneumonia and influenza-related diseases, and 49% for other causes.

Overall, there were 37 (2.8%) deaths in the vaccinated group and 87 (8.5%) in the unvaccinated group. The RD was -5.7 (95% CI: -7.6 to -3.8), the RR was 0.33 (95% CI: 0.13 - 0.75) and the PF was 67%.

When analysing single causes of death, the PF was 65% for cardiovascular diseases, 74% for COPD, 91% for pneumonia and influenza-related diseases, and 54% for other causes.

The logistic regression analysis showed that age, gender, high-risk condition, and vaccination were all significantly associated with the risk of both hospitalisation and death.

**Clinical conclusions**
The effectiveness analysis showed that influenza vaccination was highly effective in reducing the risk of hospitalisation and death in patients aged over 65 years.

**Measure of benefits used in the economic analysis**
The health outcomes were left disaggregated and no summary benefit measure was used. A cost-consequences analysis was therefore conducted.

**Direct costs**
Discounting was irrelevant since the costs were incurred in one year. The unit costs were reported separately from the
quantities of resources for some items. There was no detailed breakdown of the costs. The cost analysis focused on vaccination costs and hospitalisation costs. The mean cost-savings were calculated as the difference between the mean costs of hospitalisation for unvaccinated and vaccinated patients, minus the mean costs of the influenza-vaccine programme. The individual RD was used to calculate the cost-savings of the vaccination programme. The cost/resource boundary adopted appears to have been that of the National Health Insurance of Taiwan, which provided the cost data. The quantities were estimated during the follow-up period. The price year appears to have been 1999, although it was not explicitly reported in the paper.

### Statistical analysis of costs

The costs were treated deterministically, with average point estimates being reported.

### Indirect Costs

No indirect costs were included in the analysis.

### Currency

The costs were reported in US dollars ($). $1= NT$32 (New Taiwan dollar).

### Sensitivity analysis

No sensitivity analyses were conducted.

### Estimated benefits used in the economic analysis

See the 'Effectiveness Results' section.

### Cost results

The average per person cost-savings were $22.50 for decreasing pneumonia admission, $29.63 for decreasing COPD admission, and $24.33 for decreasing cardiovascular disease admission.

The cost of each vaccination was $18.75. Consequently, the total per person saving for decreasing cardiovascular disease, COPD, and pneumonia admissions (subtracting vaccination costs) was $57.71.

### Synthesis of costs and benefits

Not relevant as a cost-consequences analysis was carried out.

### Authors' conclusions

Influenza vaccination in the general population of elderly people was highly effective in reducing the risk of death and admissions. In addition, it led to substantial cost-savings as, in monetary terms, it produced three times more benefits than no-vaccination. The findings suggest that vaccination is independently and significantly protective for hospitalisation and mortality after adjusting for gender, age and risk of being in the high-risk group.

### CRD COMMENTARY - Selection of comparators

The rationale for the choice of the comparator was clear. The 'do-nothing' option was selected, as the aim of the analysis was to assess the active value of the vaccination programme. You should decide whether it represents a valid comparator in your own setting.

### Validity of estimate of measure of effectiveness
The analysis of effectiveness used a prospective cohort study, which appears to have been appropriate for the study question. The study sample was quite unselected, and was thus representative of the study population. However, the study groups were not comparable at baseline. The authors performed a statistical analysis to assess the factors having a significant impact on the outcome measures used in the analysis. The analysis was limited to patients who provided effectiveness data at the end of the follow-up study. Loss to follow-up was relevant in the unvaccinated group (33.7%).

The study samples were large, but no power calculations were performed. The sample appears to have been appropriate for the study question and representative of the defined study population. The authors noted, however, that selection bias may have occurred since no randomisation was applied (patients self-selected within the cohort) and there were significant baseline differences between the groups.

Validity of estimate of measure of benefit
No summary benefit measure was used in the economic analysis. The analysis was therefore categorised as a cost-consequences study.

Validity of estimate of costs
The analysis of costs was conducted from the perspective of the National Health Insurance. It appears that all the relevant direct costs have been included in the analysis. The unit costs and the quantities of resources were not reported separately in the analysis and cost items, such as personnel and drugs, were not given. The costs and the quantities were treated deterministically. The cost estimates were somewhat specific to the study setting and no sensitivity analyses were conducted. The price year was presumably 1999, although this was not explicitly reported, which would make any reflation exercise results dubious. The source of the cost and resource consumption data was appropriately reported.

Other issues
The authors made some comparisons of their findings with those from other studies. They found that the vaccination efficacy was similar to that found in industrialised countries. The issue of the generalisability of the study results to other settings was also discussed in that the cost analysis was limited to hospitalisations and the vaccination programme, and did not include family care and travel costs. No sensitivity analyses were conducted, which tends to limit the external validity of the analysis. The study referred to the general population of the elderly and this was reflected in the conclusions of the analysis.

Implications of the study
The authors emphasised the importance of administering influenza vaccination to all elderly and not only to high-risk people, especially in developing, densely populated and subtropical areas such as Taiwan. The authors suggest that the economic benefit associated with less (and probably shorter) hospitalisations among the vaccinated elderly should be further investigated in future research.

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