Cost-effectiveness analysis for Pap smear screening and human papillomavirus DNA testing and vaccination

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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 cervical cancer prevention strategies using individual or combined strategies that included Pap smear screening, human papillomavirus DNA testing, and human papillomavirus vaccination. Annual Pap smear screening was the most cost-effective strategy, followed by Pap smear plus human papillomavirus DNA tests every three years. Vaccination may only be cost-effective with significant vaccine price reductions. The analysis used a valid cost-effectiveness framework and uncertainty was investigated. The authors’ conclusions appear robust.

Type of economic evaluation
Cost-effectiveness analysis

Study objective
The study assessed the cost-effectiveness of strategies for the prevention of cervical cancer using individual or combined strategies including Papanicolaou (Pap) smear screening, human papillomavirus DNA test, and human papillomavirus vaccination in Taiwan.

Interventions
Five preventative strategies were compared: triennial Pap smear screening programme (the background comparator); annual Pap smear screening; Pap smear screening plus human papillomavirus DNA testing every three years; Pap smear screening plus human papillomavirus DNA testing every five years; and Pap smear screening plus vaccination offer for adolescents girls every three years. If an abnormal result with cytology was found, colposcopy with biopsy was arranged for verification; further colonisation was offered for women with positive biopsy results.

Location/setting
Taiwan/primary and secondary care.

Methods
Analytical approach:
A Markov model with a lifetime horizon was used to simulate clinical and economic outcomes in a hypothetical population of 150,000 women representing the Taiwanese population in 1995. The authors stated that a societal perspective was adopted.

Effectiveness data:
Clinical inputs for the model came from published studies, whose methodological details were not provided. These studies may have been known to the authors, as no information was provided on a literature review. Vaccine efficacy appeared to have been taken from clinical trials. Behavioural (such as attendance rate to screening) and epidemiological data were obtained from Taiwanese sources, when available. Some assumptions were also made. Accuracy (sensitivity and specificity) of preventive strategies was a key input of the model.

Monetary benefit and utility valuations:
Not considered.

Measure of benefit:
Life-years were used as the summary benefit measure and were discounted at an annual rate of 3%.

Cost data:
The costs included: those associated with screening and other preventive strategies; colposcopy and biopsy; colonisation; and treatment of cancer (which depended on the stage of disease). Both direct (medical) and indirect (productivity losses) costs were considered, except for vaccination (which included only direct medical costs). All economic data were from previously published studies. Costs were in US $. A 3% annual discount rate was applied.

Analysis of uncertainty:
Uncertainty focused explicitly on vaccine price and attendance rates in the Pap smear screening programme. A probabilistic analysis was carried out using a Monte Carlo simulation with distributions assigned to model inputs. A cost-effectiveness threshold of $40,000 per life year was used (this reflected the value of three times per capita gross domestic product in Taiwan).

Results
For the Pap smear test every three years, the lifetime cost per person was $379.60 and the expected life years were 21.8148. For the Pap smear plus human papillomavirus test every five years, the lifetime cost per person was $436.50 and the expected life years were 21.8144. For the Pap smear plus human papillomavirus test every three years, the lifetime cost per person was $625.00 and the expected life years were 21.8215. For Pap smear test and vaccination every three years, the lifetime cost per person was $723.70 and the expected life years were 21.8225. For annual Pap smear test, the lifetime cost per person was $893.10 and the expected life years were 21.8310.

The incremental analysis showed that the Pap smear screening every three years was the reference strategy. The Pap smear plus human papillomavirus test every five years was dominated, as it was more expensive and less effective than the Pap smear test every three years. The incremental cost per life year gained was $36,627 with the Pap smear plus human papillomavirus test every three years, $44,688 with Pap smear test and vaccination every three years, and $31,698 with the annual Pap smear test (all strategies compared to the Pap smear screening every three years).

Compared with the Pap smear screening alone every three years, the probability of being cost-effective was 65.52% with the annual Pap smear test, 52.08% with the Pap smear plus human papillomavirus DNA test every three years, and 35.84% with the Pap smear test and vaccination every three years, assuming a willingness to pay threshold of $40,000 per life year saved.

Excluding the strategy of the annual Pap smear test, the Pap smear plus human papillomavirus DNA test every three years was the most cost-effective strategy.

The vaccination strategy would only be cost-effective if the cost of vaccination was lowered to $250 per full course of injections ($365 in the base case analysis). Variations in attendance rates did not alter substantially the base case findings.

Authors’ conclusions
The authors concluded that an annual Pap smear screening programme was the most cost-effective strategy, followed by additional human papillomavirus DNA testing every three years. Vaccination in combination with triennial screening might be cost-effective, but only with significant vaccine price reductions.

CRD commentary
Interventions:
The selection of the comparators was appropriate as recently available preventive strategies were compared with the existing pattern of care in the authors’ setting, which consisted of the triennial Pap smear screening programme in Taiwan.

Effectiveness/benefits:
Clinical data came from published studies that were selected by the authors but not fully described. Vaccine efficacy was appropriately taken from a clinical trials, but it was assumed that no cross-protection was possible and that vaccine protection lasted lifetime. Attendance rate for screening and other epidemiological parameters appear to have come
from Taiwanese studies reflecting the authors’ setting. Little information was provided on these studies, so it was
difficult to fully judge the validity of the clinical inputs. Sensitivity analyses were conducted on all these parameters.
Life years were a valid benefit measure as the impact of the preventive strategies on expected survival represented the
most relevant outcome of these programmes. In addition, life years allowed cross-disease comparisons.

Costs:
A very broad perspective was adopted that included medical costs and productivity losses, but very limited information
on data sources was provided; this reduced the transparency of the economic analysis. It was unclear whether all cost
estimates were taken from Taiwanese studies. In effect, unit costs and quantities of resources used were not reported as
costs were presented as total costs. The price year was not reported, so reflation exercises in other time periods would
not be possible. All cost estimates were included in the probabilistic simulation, but only variations in vaccine price
were taken into account in the deterministic sensitivity analysis.

Analysis and results:
Both average and incremental cost-effectiveness ratios were calculated to combine costs and benefits of the alternative
strategies. In particular, the use of an incremental analysis allowed the exclusion of strategies that were not on the
efficiency frontier. However, all strategies were compared with the option of Pap smear screening every three years,
while no incremental analysis among the alternative options appeared to have been made. A valid approach was used to
deal with uncertainty; these methods and results were clearly presented and illustrated. The study results were clearly
presented, but were specific to the Taiwanese context and could not be directly transferred to other settings.

Concluding remarks:
The analysis used a valid cost-effectiveness framework. Limited information about data sources was given, but key
areas of uncertainty were investigated. The authors’ conclusions appear robust.

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