Cost-effectiveness of different caries preventive measures in a high-risk population of Swedish adolescents

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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
Four programmes to prevent dental caries in teenagers identified as at high risk were examined. The programmes were of increasing intensity, and all involved writing to the patient's parent or guardian to inform them that the patient was at high risk of developing dental caries.

Programme A gave instructions on how to brush teeth with fluoridated toothpaste. This information was repeated at annual dental examinations.

In programme B, the patients were asked to attend a clinic where information on and a prescription for fluoride lozenges would be given. The prescribed dose was 0.25 mg thrice daily for teenagers aged up to 16 years, and 0.25 mg four to six times daily for those aged 16 or older.

In programme C, the patient was asked to attend a clinic where their teeth would be professionally cleaned and coated with a fluoride varnish (Duraphat), three times in the first week. Cleaning and varnishing were repeated every 6 months.

In programme D, the patient was asked to attend a clinic for an oral health examination, and to have their teeth professionally cleaned and a fluoride varnish applied. If appropriate, information about the connection between diet and dental caries was provided. The patient was reviewed and fluoride varnish was reapplied every 3 months.

Type of intervention
Secondary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised 12-year-olds who were identified as being at high risk of developing dental caries. High-risk patients were defined as those who had one or more decayed approximal surface, enamel or dentine caries, or had a filled approximal surface or a missing tooth due to caries. Patients that, in the opinion of the examining dentist, had a high risk of caries due to mental or physical disability or chronic disease were also identified as high risk.

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

Dates to which data relate
The effectiveness and resource use data were collected between 1995 and 1999. The price year was 1994.
Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The effectiveness and resource data were collected prospectively from the same sample of patients as that used in the effectiveness analysis. The unit cost per minute was collected from account records for 1994 to 1995, and was used to calculate the treatment costs for all 4 years.

Study sample
A total of 3,373 children were recruited to the study. Of these 1,165 children were identified as being at high risk of developing dental caries. This group was the focus of the cost-effectiveness analysis. No power calculations to determine the sample size were reported. A total of 292 patients were allocated to programme A, 257 to programme B, 284 to programme C, and the remaining 281 followed programme D. The paper did not report how the patients were recruited to the study, nor provide details of those who refused to participate. No baseline characteristics were reported.

Study design
The study was a multi-centred, randomised controlled trial that was conducted in 26 centres. The method of randomisation was not reported. The patients were followed up for the duration of the intervention (5 years), but this paper only analysed data from the first 4 years of the study. The paper did not explicitly state the loss to follow-up. However, since data were only reported for 968 high-risk patients, it suggested that 197 (16.9%) high-risk patients were lost to follow-up.

Analysis of effectiveness
The study measured effectiveness in terms of the number of new caries that developed during the study period. It appears that only data on those who were still in contact with the study after 4 years have been included in the analysis. No details of the patients’ characteristics were reported.

Effectiveness results
In the 4-year study period, 23% of the patients did not develop any dentine caries while 21% developed one or two dentine caries.

The mean caries increment was 6.1 (standard deviation, SD=4.6) for programme A, 5.4 (SD=1.5) for programme B, 5.0 (SD=5.7) for programme C, and 5.2 (SD=2.5) for programme D. The confidence intervals for these results were not reported.

Clinical conclusions
According to the authors, only programme C had a significantly lower caries increment in comparison with programme A. This conclusion was derived from unpublished data.

Methods used to derive estimates of effectiveness
The authors made assumptions to derive the compliance rate.

Estimates of effectiveness and key assumptions
The authors assumed that equal numbers of false positive and false negatives would be made by all three of the examiners. They also assumed that all the groups receiving fluoride tablets would have the same compliance rate as group B (26%).
Measure of benefits used in the economic analysis
The measure of benefit in this study was the caries increment.

Direct costs
The average direct costs incurred by the dental health service provider, the patient and the patient's family were reported. The costs of the dental health care received by the patients was calculated by multiplying the mean time of the intervention in each of the 4 years by the unit cost of treatment by dental nurses, dental hygienists and dentists. The unit costs were calculated by dividing the dental health professional's salary and overheads by working time. Figures for this calculation were taken from the participating clinics' accounts for the financial year 1994 to 1995.

The source of the unit cost of the fluoride tablets was not reported, although the quantity and total cost were. The date of the costs used was not reported.

The costs incurred by the patient and any accompanying person for travel to the clinic were determined by a questionnaire completed at the clinic visit. If the patient used public transport then the actual fare paid was used. The paper did not report any inflation of the costs to a single price year. It was uncommon for an accompanying person to travel to the clinic on public transport, and these costs were therefore excluded. Where the accompanying person and the patient travelled to the clinic by car, the costs were calculated using the governmental reimbursement rate for travel (SEK 2.50 per km) for a median distance of 6 km.

All the costs were discounted at a rate of 3% per annum. In all cases the quantity of resources and their total costs were reported separately.

Statistical analysis of costs
The cost data included in the study were treated deterministically.

Indirect Costs
The alternative activities that would have been undertaken by the patients were determined through the costing questionnaire. If the patient attended the clinic in their leisure time this was valued at SEK 10 per visit. The authors described this as a “prudent estimate”. The presence, alternative occupation and travelling time of any person accompanying the patient to the clinic were also determined through the costing questionnaire. The total time taken up by the visit was valued at SEK 2.41 per minute. This rate was the mean wage including social insurance in 1999. All the costs were discounted at 3% per annum.

Currency
Swedish kroner (SEK).

Sensitivity analysis
A one-way sensitivity analysis was performed to test for variability in the data. The treatment time, unit cost for each of the dental health professionals, caries averted and discount rate were varied. No rationale for the ranges tested was provided.

Estimated benefits used in the economic analysis
The estimated benefit used in the economic evaluation was the cost per decayed enamel and dentine missing and filled surface averted (DeMFS).

Cost results
All the costs were discounted at a rate of 3%. The total cost of programme A was SEK 141.39 when delivered by a
The total cost of programme B was SEK 146.26 when delivered by a dental nurse, SEK 223.75 when delivered by a hygienist, and SEK 471.66 when delivered by a dentist.

The total cost of programme C was SEK 1,478.14 when delivered by a dental nurse, SEK 2,261.28 when delivered by a hygienist, and SEK 4,766.65 when delivered by a dentist.

The total cost of programme D was SEK 1,565.79 when delivered by a dental nurse, SEK 2,398.37 when delivered by a hygienist, and SEK 5,049.31 when delivered by a dentist.

**Synthesis of costs and benefits**

Programme C was the only one that showed a significantly lower caries increment in comparison with programme A. Consequently, a cost-effectiveness ratio was only calculated from these programmes. This showed a total cost of SEK 2,034 per DeMFS avoided over 4 years. Of this total cost, SEK 1,336 represented the treatment costs.

The sensitivity analysis showed that a 10% decrease in the treatment time resulted in a 10% increase in the unit cost of nurses and hygienists. Also, changing the base salary used by 10% resulted in a change in the unit cost of 7% for nurses, 10% for hygienists and 4% for dentists. Varying the outcome by one and two additional caries prevented reduced the cost-effectiveness ratio from SEK 2,043 to SEK 1,022 (one DeMFS prevented) and SEK 681 (2 DeMFS prevented), respectively. Changes to the applied discount rate had little effect on the results.

**Authors’ conclusions**

Only programme C showed a significantly lower caries increment. The authors did not draw any clear conclusions about the economic results of the study, as they only reported the cost-effectiveness results and did not consider how they might be interpreted in clinical practice.

**CRD COMMENTARY - Selection of comparators**

The lack of an explicit comparator in this study limited its quality. The cost and effectiveness results for programmes B, C and D were compared with programme A. However, it was unclear whether programme A represented standard practice. Standard practice in the relevant setting should be considered before applying the results of this study to other settings. The inclusion of a ‘do-nothing’ group in the study would have clarified the effectiveness and costs of all four programmes.

**Validity of estimate of measure of effectiveness**

The paper did not report the characteristics of the study sample. Therefore, it is not possible to comment on how representative the sample was of the study population or whether the different intervention groups were comparable. The method of randomisation was not reported. Thus, it is possible that a number of confounding factors, such as dental hygiene at the start of the study and social characteristics, might have skewed the results of the study. Although the effectiveness data were taken from a randomised controlled trial, only data on those who completed the study were analysed. Since no allowance was made for those who were lost from the interventions, it is possible that the reported results overestimated the impact of the programmes. No power calculations were reported. The paper did not provide any information on the children recruited to the study who were classified as low risk.

**Validity of estimate of measure of benefit**

The estimate of benefit used in the economic study was taken directly from the effectiveness results.

**Validity of estimate of costs**

The paper clearly reported the quantities and total costs for each item included in the analysis. This makes it possible...
to apply the results to other settings. The calculation of treatment costs for the various health professionals who could undertake the treatment shows what the intervention might cost in different settings. The inclusion of the time allocated to patients who failed to attend for their appointment makes the estimate of the costs more applicable to actual practice. The costs incurred by the patient and accompanying persons and a valuation of their time were also included. This broadens the perspective and provides a more holistic evaluation of the intervention. In addition, the paper reported the treatment costs separately, thus enabling the study to be viewed from the perspective of the health care provider. In calculating the costs of the intervention, the authors considered the distribution of the costs when choosing the average measure to be used. This limits the potential impact of patients at the extremes of the scales. The lack of a clear and consistent price year for the cost data introduces a degree of inconsistency in the study and would make reflation exercises difficult.

**Other issues**
The authors compared their results with five similar economic studies. However, the date of the comparisons varies and the results were not reflationed to a date that would permit a clear, consistent comparison with this study. The authors also noted that their study was the first to consider the costs incurred outside of the health care sector. The issue of generalising this study to other settings was not explicitly considered in the paper. However, in comparing their results to a number of studies that appear to have been undertaken in the UK, the authors imply that their results are generalisable to the National Health Service.

**Implications of the study**
The authors did not make clear recommendations. They stated that a cost-benefit analysis would have to be undertaken to establish whether the cost of the intervention justifies the expense.

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**Other publications of related interest**

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