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
The use of carotid endarterectomy (CEA) was examined. In particular, three main changes in the management of patients undergoing CEA were considered. First, a policy of selective angiography was implemented, and intensive diagnostic procedures were restricted to specific conditions. Second, a full-time nurse practitioner was hired to manage postoperative inpatient care, with the objective of reducing length of stay. Third, there was an increase in the use of eversion endarterectomy and cervical block anaesthesia, which reflected a more efficient practice.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients undergoing CEA. Patients undergoing combined CEA and coronary artery bypass were excluded, as were patients who had an inflow correction planned before entrance into this algorithm. Also excluded were patients with truly emergent problems.

Setting
The setting of the study was a hospital. The economic study was carried in the USA.

Dates to which data relate
The effectiveness and resource use data were gathered from July 1993 to December 2000. The price year was 2000.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out retrospectively on the same sample of patients as that used in the effectiveness analysis.

Study sample
Power calculations were not reported. The hospital records of all patients undergoing CEA at the authors' institution from July 1993 to December 2000 were identified and included in the study. Of 1,379 patients initially identified, 37 underwent combined CEA and coronary artery bypass, 40 presented with predominantly inflow symptoms, and 21 had emergent problems. In addition, 113 patients had insufficient data to undertake the clinical analysis. Therefore, the final study sample comprised 1,168 patients (57% men and 53% asymptomatic). The patients were grouped as routine
patients (n=229) or selective patients (n=939). Routine patients were defined as those who underwent operation before July 1995 and received routine angiography. Selective patients were defined as those who underwent CEA after July 1995 and received selective angiography. One surgeon had consistently followed a policy of selective angiography before July 1995 and his patients were included in the selective group. A further sub-group classification split the study period before and after December 1998, to define the period before and after the nurse practitioner was hired. There were 795 patients in the pre-nurse period and 373 patients in the post-nurse period.

**Study design**
This was a retrospective comparative study with historical controls, which was carried out at a single centre, the University of Rochester Medical Center, Rochester (NY). The patients were followed for 30 days postoperation. The loss to follow-up was not explicitly reported.

**Analysis of effectiveness**
The analysis of the clinical study was restricted to those patients who had completed follow-up data. The main outcome measure used was the combined stroke and death rate. The secondary outcome measures were morbidity and mortality rates, length of stay, and the use of angiograms. The comparability of the study groups was not discussed.

**Effectiveness results**
The combined stroke and death rate was 2.1% in 1993, 4.9% in 1994, 3% in 1995, 2.9% in 1996, 4.2% in 1997, 1.9% in 1998, 2.8% in 1999, and 2.6% in 2000. The differences between the years were not statistically significant.

In the sub-group analysis, the stroke and mortality rates were comparable between the routine and selective groups. However, the percentage of patients who had experienced a transient ischaemic attack was significantly higher in the routine group than in the selective group (4.3% versus 1.7%, p=0.017).

The length of stay was 3.8 (+/- 4.9) days in the routine group and 2.7 (+/- 4.6) days in the selective group, (p=0.005).

Angiograms were used in 96% of routine patients and in 14.8% of selective patients.

Angiogram use changed the surgical plan in 5% of routine patients and 16.8% of selective patients, (p=0.02).

The authors estimated that the incidence of significant problems found on angiography would have been 0.9% in routine patients and 1.2% in selective patients. The difference was not statistically significant.

The combined rate of stroke or death was comparable in the periods before and after the nurse practitioner was hired.

**Clinical conclusions**
The effectiveness analysis showed that the main shifts in hospital policy for patients undergoing CEA did not affect the clinical outcomes.

**Measure of benefits used in the economic analysis**
The health outcomes were left disaggregated and no summary benefit measure was used in the economic analysis. In effect, a cost-consequences analysis was carried out.

**Direct costs**
Discounting was not relevant since the costs were incurred during a short timeframe. The unit costs were not presented separately from the quantities of resources used and the costs were reported as macro-categories. The cost categories in the economic evaluation were surgery, inpatient stay, imaging, and other services. Billed charges and actual income to the hospital were not considered. The cost/resource boundary of the hospital appears to have been adopted. Resource use was estimated using patient-level data that were derived from the sample of patients included in the effectiveness
analysis. The costs were derived from the hospital accounting office and were varied according to the department. All the costs were presented in 2001 values.

**Statistical analysis of costs**
Statistical analyses were used to test the statistical significance of differences in the estimated costs.

**Indirect Costs**
The indirect costs were not considered.

**Currency**
US dollars ($).

**Sensitivity analysis**
Sensitivity analyses were not performed.

**Estimated benefits used in the economic analysis**
See the 'Effectiveness results' section.

**Cost results**
The costs per patient were $9,302 in 1993. The costs decreased, almost constantly, to $6,216 in 2000 (all in 2001 corrected dollars). The reduction in costs was statistically significant, (p<0.0001).

The average total costs per patient were $10,240 (+/- 7,202) in routine patients and $6,518 (+/- 7,870) in selective patients, (p=0.0001).

The total costs per patient were $7,776 (+/- 8,733) in the pre-nurse period and $5,871 (+/- 5,001) in the post-nurse period, (p=0.0001).

The greatest cost reductions were observed when the shifts took place.

**Synthesis of costs and benefits**
A synthesis of the costs and benefits was not relevant since a cost-consequences analysis, in effect, was carried out.

**Authors' conclusions**
Changes in patient care management (i.e. selective angiography and short postoperative stay) led to reductions in hospital costs without affecting the quality of care provided to patients undergoing carotid endarterectomy (CEA).

**CRD COMMENTARY - Selection of comparators**
The rationale for the selection of the comparators was clear. The same surgical procedure was examined in two different times when major shifts in hospital policy were being implemented. You should decide whether they are valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**
The analysis of effectiveness was based on a retrospective study, which usually has a low internal validity because of the potential impact of bias and confounding factors. The two groups of patients (before and after the patient management
changes) were not studied concurrently and the authors did not investigate whether factors other than the changes under examination had an impact on the clinical outcomes. Further, the baseline comparability of the two study groups was not stated, which introduces further uncertainty into the reliability of the comparison. The patients were identified at a single centre, thus caution is required when extrapolating the results to other patient samples. Power calculations were not reported and there was no evidence that the sample size was appropriate. These issues tend to limit the internal validity of the analysis.

**Validity of estimate of measure of benefit**
No summary benefit measure was used in the analysis because, in effect, a cost-consequences analysis was conducted.

**Validity of estimate of costs**
The perspective adopted in the study was not explicitly reported, although it appears to have been that of the hospital. The costs were presented as macro-categories and a detailed breakdown of the items was not provided. This limits the possibility of replicating the study. The source of the data and the price year were reported, which aids reflation exercises in other settings. Statistical analyses were carried out, but the cost estimates were specific to the study setting and sensitivity analyses were not performed.

**Other issues**
The authors reported the results of other studies that had findings comparable to those observed in the current analysis, especially in terms of the impact of limiting the use of angiograms. The issue of the generalisability of the study results to other settings was not addressed and sensitivity analyses were not carried out. This reduced the external validity of the analysis. The study referred to patients undergoing CEA and this was reflected in the authors' conclusions.

**Implications of the study**
The study results suggested that the use of selective angiography, reliance on defined postoperative care protocols, and the use of both eversion endarterectomy and cervical block anaesthesia resulted in cost-savings with no compromise in clinical outcomes.

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**Other publications of related interest**

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