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
A clinical pathway of early discharge following carotid endarterectomy was compared with the standard practice of discharge on the third or fifth postoperative day.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients requiring carotid endarterectomy in a university hospital setting.

Setting
The setting was tertiary care. The economic study was carried out in a university hospital in Philadelphia, USA.

Dates to which data relate
The effectiveness, resource use and cost data were collected from patient records over the 45-month period beginning September 1992 and ending in December 1996. The clinical pathway was implemented at the beginning of January 1995. The price year was not reported.

Source of effectiveness data
The effectiveness data were 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 to collect the effectiveness data.

Study sample
Calculations to assess the power of the study sample to detect statistically significant differences, or the sample size required to detect an important difference, were not reported. The patients' records were reviewed for the 45-month time period, during which 174 carotid endarterectomies were performed. Of these procedures, 22 (12.6%) were excluded from the study because the patients required other elective operative procedures during the same admission. The final sample comprised 152 carotid endarterectomies, of which 119 were in the clinical pathway group and 33 were in the standard practice group.

Patients with evolving strokes, staged or multiple procedures were excluded, as were those receiving warfarin sodium.
Patients transferred from outlying institutions were also excluded.

**Study design**
This was a single-centre before-and-after study using two separate cohorts of patients. The patients were not randomised to the intervention or comparator group. The records of consecutive patients admitted for carotid endarterectomies were included in the study. The authors did not report explicitly the duration of the follow-up. The loss to follow-up was not reported. The authors did not report any procedures to mask the investigators during the treatment period or assessment and analysis of outcome.

**Analysis of effectiveness**
The effectiveness was analysed on the basis of treatment completers only. The primary health outcomes used in the study were:

- the rates of perioperative complications, including death, stroke and myocardial infarction;
- the length of stay;
- the percentage of patients admitted on the day of surgery;
- the percentage of patients discharged within 48 hours postoperatively; and
- the percentage of patients with complications after discharge who required readmission.

All patients included in the study who were undergoing carotid endarterectomy were treated in an identical fashion. In other words, each procedure was performed under general anaesthesia, using routine shunting and closure with a dacron patch. The groups were shown to be comparable in terms of the age, gender, co-morbid conditions and surgical indication. There was no statistically significant difference between the intervention and comparator groups, (p>0.05).

**Effectiveness results**
There was no statistically significant difference in perioperative complications between the intervention and comparator groups, (p>0.05). There was one fatal stroke and no myocardial infarctions in the intervention group, and one fatal stroke and two myocardial infarctions (one fatal) in the comparator group.

The mean total length of stay was 3.3 days in the intervention group and 6 days in the comparator group, (p<0.01). The postoperative length of stay was 2.3 days in the intervention group and 3.8 days in the comparator group, (p<0.01).

The implementation of the clinical pathway increased the number of same day admissions, from 6.1% in the comparator group to 54.6% in the intervention group, (p<0.0001).

The implementation of the clinical pathway increased the percentage of patients discharged within 48 hours postoperatively, from 19.4% in the comparator group to 77.9% in the intervention group, (p<0.001).

The implementation of the clinical pathway decreased the use of contrast arteriography. The percentage of patients receiving arteriograms decreased from 96.9% in the comparator group to 43.7% in the intervention group, (p<0.001).

No patients in either group experienced complications after discharge or required readmission to the hospital.

**Clinical conclusions**
Compared with standard practice, the clinical pathway for carotid endarterectomy resulted in the early discharge of stable patients, the elimination of preoperative hospitalisation, and a decrease in the use of arteriography. These outcomes could be accomplished while maintaining acceptable complication rates following carotid endarterectomy in a university hospital setting.
Measure of benefits used in the economic analysis
The outcomes were reported in a disaggregated way. Thus, the study was categorised as a cost-consequences analysis.

Direct costs
The costs and the quantities were not reported separately. The direct costs for the hospital included in the analysis were those associated with preoperative vascular testing ($206 for duplex and $2,360 for angiography). It was unclear whether further costs were considered in the analysis. Further, it was unclear what approach was used to record the resource use. The costs used were derived from the Medicare fee reimbursement schedule (charges) rather than the prices. The price year was not reported. Discounting was not carried out due to the short timeframe of the study (less than one year).

Statistical analysis of costs
Power calculations to detect statistically significant differences were not reported. Student's t-test and the chi-squared test were used to analyse the differences between the mean values of the cost data. The resource use and cost data were treated as point estimates and analysed as deterministic data.

Indirect Costs
No indirect costs were included in the analysis.

Currency
US dollars ($). No currency conversions were reported.

Sensitivity analysis
A sensitivity analysis was not carried out.

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

Cost results
The mean cost of vascular studies per patient was $1,228 in the intervention group and $2,441 in the comparator group. There was a statistically significant decrease in the cost of vascular studies, (p<0.001). This was associated with the significant decrease in the number of patients receiving arteriograms.

Synthesis of costs and benefits
The estimated costs and benefits were not combined.

Authors' conclusions
Carotid endarterectomy length of stay and cost can be significantly decreased by the implementation of a patient care pathway in a university hospital setting.

CRD COMMENTARY - Selection of comparators
The comparator used was justified on the grounds that it represented hospital practice prior to the implementation of the early discharge clinical pathway. You should decide if this is a widely used approach in your own setting.
Validity of estimate of measure of effectiveness
The analysis used a before-and-after study with two separate cohorts of patients, which did not account for selection bias. A more appropriate study design would have involved the randomisation of patients to the intervention or comparator group. This would have allowed potential biases and confounding factors to be accounted for in the analysis. The study sample was representative of the study population. The two groups were shown to be comparable at analysis in terms of the gender, age, co-morbid conditions, and the number of symptomatic patients. Statistical analyses were conducted on the basis of treatment completers only. Power calculations were not reported but there was still a statistical difference between the intervention and comparator groups. This implies that the sample was of sufficient size to detect a statistically significant difference for the primary outcome measure.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit or prove statistical equivalence in the clinical outcome. The analysis was therefore categorised as a cost-consequences study.

Validity of estimate of costs
The costs and the quantities were not reported separately. In addition, the perspective from which the study was conducted and the time horizon for the study were unspecified. The authors referred only to the costs of vascular testing and some relevant costs were omitted from the analysis. The resource use associated with implementing the clinical pathway compared with standard practice, such as the costs associated with providing patient education, was not considered. The authors implied that the anaesthesia and surgery costs were excluded because a common approach was used in both the intervention and comparator groups. It was unclear whether the other omitted costs had also been excluded because they were common between the groups. Thus, it is uncertain whether the authors’ conclusions would have been affected by omitting these costs from the analysis.

A sensitivity analysis of the costs was not conducted. Discounting was not carried out because of the short timeframe of the study. Appropriate currency conversions were not performed. The price year was not reported. The charges were used to estimate the total cost. The use of charge data may limit the generalisability of the study’s findings to other health care settings.

Other issues
The authors made appropriate comparisons of their findings with those from other studies. However, the issue of generalisability to other settings was not addressed for two reasons. First, the omission of a sensitivity analysis and, secondly, the use of charge data. The omission of a sensitivity analysis is of particular importance because the statistical analysis used a deterministic approach. The authors did not present their results selectively. The study enrolled patients undergoing carotid endarterectomy and this was reflected in the authors’ conclusions. The authors did not report any limitations of their study.

Implications of the study
The authors suggest that the decreases in the length of stay and the use of arteriography, as implemented by the new clinical pathway, significantly decrease the costs while maintaining the quality of the care. This was achieved in a university hospital setting using routine anaesthetic techniques. The authors caution that the successful implementation of the clinical pathway would depend on the education of patients and hospital staff.

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Bibliographic details
Su L T, Carpenter J P. Decreasing carotid endarterectomy length of stay at a university hospital. Cardiovascular Surgery