Containment of heart failure hospitalizations and cost by angiotensin-converting enzyme inhibitor dosage optimization
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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
Angiotensin-converting enzyme (ACE) inhibitor therapy initiated or titrated by a clinical pharmacist was evaluated for patients with heart failure (HF).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients with HF. Specific inclusion or exclusion criteria were not reported.

Setting
The setting was secondary care (a hospital). The economic study was carried out at Buffalo (NY), USA.

Dates to which data relate
The dates to which the effectiveness and resource use data related were unclear. 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 prospectively on the same sample of patients as that used in the effectiveness study.

Study sample
Power calculations were reported. Enrolling 30 patients in each treatment group would be necessary to detect a statistical difference (t-test, alpha error of 0.05) at a power of 0.80. A total of 110 patients were enrolled in the HF programme. The mean age of the patients was 73 years and 64 were men. Group A comprised 28 patients who were considered appropriately treated according to AHCPR guidelines (mean enalapril dose of 30 +/- 14 mg/day at admission). Group B comprised 51 patients with suboptimal treatment, where recommendations were accepted (mean enalapril dose of 4 +/- 5 mg/day at admission). Group C comprised 31 patients remaining on suboptimal treatment (mean enalapril dose of 6 +/- 9mg/day at admission). The mean age of the patients was 65.5 years in group A, 65.8 years in group B and 66.4 years in group C. There were 16 (group A), 29 (group B) and 19 (group C) men in the three groups, respectively.
Study design
This was a prospective, non-randomised controlled study that was carried out in a single centre. The patients, physicians and pharmacists were not blinded to the patient's treatment regimen. Each patient was followed up at 90 and 180 days after discharge. No patients were lost to follow-up.

Analysis of effectiveness
It was unclear whether all the patients in the study were included in the analysis. The outcomes used were the mean enalapril dose at discharge, and the proportion of hospital readmissions at 90 and 180 days after discharge. At analysis, the three groups were not shown to be comparable in terms of demographics and disease characteristics.

Effectiveness results
In group A, the mean dose of enalapril increased from 30 (+/- 14) mg/day at admission to 36 (+/- 18) mg/day at discharge.

In group B, the mean dose of enalapril increased from 4 (+/- 5) mg/day at admission to 16 (+/- 9) mg/day at discharge.

In group C, the mean dose of enalapril was the same on admission and at discharge (6 +/- 9 mg/day).

Patients on suboptimal therapy (group C) had a higher rate of readmission at 90 days (29%; p=0.02) and at 180 days (63%; p=0.002) compared with groups A and B. The readmission rate was 14% at 90 days and 31% at 180 days for group A and, respectively, 19% (90 days) and 35% (180 days) for group B.

Clinical conclusions
The optimisation of ACE inhibitor doses by a clinical pharmacist improved the rehospitalisation rates in the treatment of HF.

Measure of benefits used in the economic analysis
No summary benefit measure was used in the economic evaluation. In effect, this was a cost-consequences analysis.

Direct costs
Discounting was not relevant since the costs were incurred during a short time. The health services included in the economic evaluation were hospital readmission, outpatient clinic visits, laboratory tests and procedures. The unit costs and the quantities of resources used were reported separately. The cost/resource boundary of the study was not stated. It is likely that resource use was estimated using actual data derived from the sample of patients involved in the effectiveness study. Charges rather than costs were used. All charges were tabulated from hospital databases. The dates to which the price data referred were not reported.

Statistical analysis of costs
Statistical tests, to test the statistical significance of differences in the estimated costs, were conducted. The costs were presented as mean values with standard deviations (SDs).

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
In the 90-day follow-up period, group C cost $7,024 (SD=2,263) compared with $2,444 (SD=986) in group A and $3,297 (SD=987) in group B. The differences were not statistically significant.

The total charges at 180 days were significantly higher in group C, that is, $9,848 (SD=4,007) versus $5,692 (SD=3,433), (p=0.02) in group A and $3,808 (SD=1,131), (p=0.04) in group B.

Synthesis of costs and benefits
A synthesis of the costs and benefits was not relevant as a cost-consequences analysis was carried out.

Authors’ conclusions
The optimisation of angiotensin-converting enzyme (ACE) inhibitor doses by a clinical pharmacist improved the rehospitalisation rates and significantly lowered the cost of care in a heart failure (HF) management programme.

CRD COMMENTARY - Selection of comparators
A justification for the comparator used (suboptimal treatment for HF) was given. It represented the current practice across the USA. You should decide whether it represents a valid comparator in your own setting.

Validity of estimate of measure of effectiveness
The analysis of effectiveness was based on a prospective non-randomised controlled study. This was appropriate for the study question, although a prospective randomised controlled trial would have been a more appropriate design. In the absence of random assignment, selection bias might have occurred. In addition, the patient groups were not shown to be comparable at baseline in their demographic profiles and in clinical status, so confounding factors and potential biases might have been high. The outcomes were not assessed in a blinded manner, therefore some biases could have affected the results of the analysis. Hence, it may be difficult to generalise the authors’ findings to other patients. A potentially good feature of the effectiveness analysis was that the analysis was handled credibly, with power calculations and appropriate statistical analyses.

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

Validity of estimate of costs
The authors did not report the perspective adopted in the study. Thus, it is thus not possible to assess whether all the relevant categories of costs were included in the analysis. The authors noted that the major reason for the misuse of ACE inhibitor programmes was the fear of adverse effects of ACE inhibitors. However, it is unclear whether adverse effects were analysed in the effectiveness analysis and whether the treatment of adverse effects was considered in the cost analysis. This omission may result in the underestimation of the costs of the ACE inhibitor programme. Details of the unit costs, quantities of resources used, and price year were not reported. Charges to proxy prices were used in order to estimate the cost of care. These facts limit the transferability of the economic analysis to other settings. Discounting was unnecessary since all the costs were incurred during a very short time. Statistical tests were carried out when the
cost estimates were compared. However, it would appear that the estimates were specific to the study setting, and sensitivity analyses on resource quantity and unit costs were not performed.

**Other issues**
The study referred to patients with HF and this was reflected in the conclusions of the analysis. The results were not presented selectively and the conclusions accurately reflected the scope of the study. The authors compared their effectiveness results with those from published studies, showing similar results. However, they did not compare of their cost results with those from other studies. The authors did not report any limitations of their study. The issue of the generalisability of the study results to other settings was not addressed and sensitivity analyses were not carried out. Therefore, the external validity of the analysis was low.

**Implications of the study**
The authors did not make any recommendations for policy or practice as a result of their study.

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