Domiciliary non-invasive ventilation for recurrent acidotic exacerbations of COPD: an economic analysis

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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
The use of domiciliary noninvasive ventilation (NIV) for the management of patients with recurrent admissions because of an acidotic exacerbation of chronic obstructive pulmonary disease (COPD).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients with severe acidotic (pH less than 7.35) exacerbations of COPD. The patients were required to tolerate NIV at home.

Setting
The setting was home and a hospital. The economic study was conducted in the UK.

Dates to which data relate
The effectiveness and resource use data were gathered from 1995 to 2000. The costs were presented in the financial year 1999/2000.

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

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

Study sample
Power calculations were not reported. A sample of 13 patients was identified at the study hospital during the study period (1995 to 2000). These patients had a mean age of 55 (+/- 7.5) years and 9 of them were men. All patients had received conventional treatment and were then offered home NIV for the management of COPD exacerbations. It was not stated whether some patients were excluded for any reasons from the study sample.

Study design
This was a retrospective within-group comparison study, which was conducted at the patients' homes. The intervention was coordinated at a single teaching hospital. The length of follow-up was not reported.

**Analysis of effectiveness**
All the patients included in the initial study sample were accounted for in the effectiveness analysis. The outcome measures used in the clinical study were:

- the number of admissions,
- the total days spent in hospital,
- the duration of admissions,
- the days spent in the intensive care unit (ICU), and
- the number of outpatient appointments.

**Effectiveness results**
There were 5 (+/- 3) admissions in the no home NIV group and 2 (+/- 2) in the home NIV group, (p=0.007).

The total days spent in hospital were 78 (+/- 51) in the no home NIV group versus 25 (+/- 25) in the home NIV group, (p=0.004).

The duration of admissions was 17 (+/- 10) days in the no home NIV group versus 8 (+/- 7) days in the home NIV group, (p=0.03).

The days spent in the ICU were 2 (+/- 5) in the no home NIV group versus 0.3 (+/- 1) in the home NIV group, (p non significant).

There were 5 (+/- 3) outpatient appointments in the no home NIV group versus 4 (+/- 2) in the home NIV group, (p non significant).

**Clinical conclusions**
The effectiveness analysis showed that domiciliary NIV reduced the number and length of hospital admissions.

**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 conducted.

**Direct costs**
A rate of 6% was applied to discount the capital cost of purchasing NIV machines due to the lifespan of 5 years. The other costs were not discounted. The unit costs were presented separately from the quantities of resources used for most cost items. The health services included in the economic evaluation were hospital admissions (either acute inpatient NIV or conventional treatment), intensive care treatment, chronic home NIV, and outpatient visits. Hospital admissions comprised nursing and medical staff costs, pharmacy costs, and hotel costs. Investigation costs were not included because they were considered negligible in comparison with the total costs incurred. The perspective of the acute hospital was used. Resource use was derived from a retrospective analysis of actual patient-level data obtained from the sample of patients involved in the effectiveness study. The costs were estimated from a published economic evaluation of a clinical trial, the hospital financial department, and price lists. All the costs were presented in 1999/2000 prices using the Health Services Cost Index.
Statistical analysis of costs
The costs were presented as mean values with 95% confidence intervals (CIs). The paired t-test was used to test the statistical significance of differences in the estimated costs.

Indirect Costs
The indirect costs were not considered.

Currency
UK pounds sterling (£). The exchange rate for conversion into Euros was 1 £ = Euro 1.42.

Sensitivity analysis
Univariate sensitivity analyses were conducted. These determined the robustness of the estimated costs to variations in the number of admissions during the NIV year, the length of stay per admission, and the length of ICU stay. CIs were used as the ranges over which the parameters were varied. The costs of home NIV machines and equipment were also varied.

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

Cost results
The mean cost per patient was 13,163 (95% CI: 8,695 - 17,631) in the no home NIV group and 4,909 (95% CI: 2,888 - 6,930) in the home NIV group, (p=0.002).

In the whole sample of 13 COPD patients, the total costs to the hospital were 171,118 in the no home NIV group and 63,820 in the home NIV group. There was a total cost-saving of 107,298.

The estimated cost-savings were robust to variations in the baseline factors.

Synthesis of costs and benefits
A synthesis of the costs and benefits was not relevant since a cost-consequences analysis was conducted.

Authors' conclusions
The implementation of a domiciliary noninvasive ventilation (NIV) service for the management of a highly selected group of patients with chronic obstructive pulmonary disease (COPD), who had recurrent admissions requiring NIV, was effective at reducing admissions. In addition, it led to cost-savings from the perspective of the acute hospital.

CRD COMMENTARY - Selection of comparators
The selection of the comparator appears to have been appropriate, as NIV provided at the hospital represented the conventional pattern of care at the authors' institution. You should decide whether this is a valid comparator in your own setting.

Validity of estimate of measure of effectiveness
The analysis of effectiveness was based on a within-group comparison study, which was appropriate for the study question. The study also had the advantage of not requiring a control group, as a single group of patients received both interventions. A potential limitation was that the two treatments were delivered in two different timeframes (before and after an index period), and this could have introduced some time-related bias and confounding factors. However, the
authors stated that no major changes in patient management had occurred during the study period. No statistical tests were carried out to show that the sample size was appropriate for the study question. Indeed, the study sample was very small. Nevertheless, statistically significant differences were observed between the groups for some outcome measures. A very selected sample of patients with severe COPD exacerbations was enrolled, which makes it difficult to determine whether the study sample was representative of the patient population. The outcomes used in the analysis were intermediate measures, which reflected only indirectly the impact of the interventions on the patients' health. 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 a cost-consequences analysis was conducted.

**Validity of estimate of costs**
The perspective adopted in the cost analysis was explicitly reported. As such, it appears that all the relevant categories of health services have been included in the study. A justification was provided for the exclusion of investigation costs. The source of the data was reported for all items, and detailed descriptions for the calculations of all categories of costs were given. Discounting was relevant for equipment and was applied, following UK Treasury recommendations. All the costs were updated to a common fiscal year, which makes reflation exercises in other settings easy. Some of the unit costs were varied in the sensitivity analyses, and the impact of variations in other resources used was also investigated. The costs were treated stochastically and appropriate tests were conducted to assess the statistical significance of observed differences in the total costs.

**Other issues**
The authors made few comparisons of their findings with those from other studies. They did not address the issue of the generalisability of the study results to other settings. A few sensitivity analyses were conducted, which in part increased the low external validity of the study. The authors noted that their analysis was restricted to a very selected group of COPD patients who were at high risk of death and consumed significant hospital resources. Therefore, the impact of the interventions on less severe COPD patients was not investigated.

**Implications of the study**
The authors stated that the current study could form the basis for a future prospective clinical trial aimed to corroborate their findings, although some ethical issues could make this difficult. Further research should also assess the impact of home NIV on quality of life.

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**Other publications of related interest**


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