Savings obtained using an oxygen economizer device: a cost-minimization analysis

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
Use of an oxygen economiser device in administering oxygen for treating hypoxemic patients. The economiser device (Companion 5 Oxygen Saver) utilises a standard nasal cannula for oxygen, delivering a pulse of oxygen in response to a negative pressure, within the cannula, of -0.04 cm H2O. The volume of each oxygen pulse was continuously adjusted by the device in response to the sensed trend in respiratory frequencies so that the total oxygen delivered to the patient each minute remained constant. Three safety mechanisms were incorporated, protecting the patient in case of low (less than 8 breath/min) or high respiratory frequencies (greater than 50 breath/min, with provision of additional O_2) or failure of power or the sensing device (delivering continuous oxygen flow).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
Patients affected by restrictive (interstitial lung disease (ILD)) and obstructive (chronic obstructive lung disease (COLD)) lung disease, in stable condition (no modifications of oxygen flow and infective exacerbation's in the previous 2 months). The following exclusion criteria were applied: respiratory insufficiency requiring ventilatory support; saturation <90% and/or PaO2 of >/= 8.0 kPa (60 mm Hg) at enrolment; severe heart disease and/or general conditions contraindicating the execution of a walking test.

Setting
Hospital. The economic analysis was carried out in Italy.

Dates to which data relate
Effectiveness and resource use data corresponded to those patients admitted to the study institution between 1 June 1995 and 30 November 1996. The price year appears not to have been explicitly reported.

Source of effectiveness data
The evidence for the final outcomes was based on a single study.

Link between effectiveness and cost data
Costing was prospectively conducted on the same patient sample as that used in the effectiveness analysis.

Study sample
Power calculations were used to determine the sample size (with a power of 85%, estimated difference of clinical relevance of 3%, estimated SD of 0.03, standardised difference of 1, and significance level of 0.05, a total of 35 patients were required in the study). The study sample consisted of 29 patients (out of 35 initially enrolled) with a mean (SD) age of 69 (7) years.

**Study design**
This was an open, randomised, self-controlled trial, carried out in a single centre. The duration of the follow-up appears to have been the morning following the administration of oxygen with or without the device. The loss to follow-up appears to have been 6 patients, who did not complete the planned examinations. The choice to start oximetry with or without the economiser was based on a randomisation list derived from a table of randomised numbers. Patients were to use their usual oxygen flow, provided it was able to guarantee a saturation of greater than 90% and an arterial oxygen tension (PaO2) of equal to or greater than 8.0 kPa (60 mmHg) during rest, sleep and exercise with and without the economiser.

**Analysis of effectiveness**
The principle used in the analysis of effectiveness appears to have been treatment completers only. The primary clinical outcome measure was saturation measure via oximetry during rest, sleep and exercise. The presence of side-effects due to oxygen therapy was evaluated by means of a questionnaire.

**Effectiveness results**
The effectiveness results were as follows:

The mean +/-SD oxygen saturation during sleep was 91.2 +/- 19.5% without and 97.2 +/- 3.9% with the economiser device (p=0.09);

the mean saturation during rest was 88.8 +/- 22.7% without and 92.1 +/- 14.9% with the economiser device (p=0.42);

and the mean saturation during exercise was 84.7 +/- 19.3% without and 91.8 +/- 15.9% with the economiser device (p=0.04).

There were no reported side-effects due to oxygen treatment either with or without the economiser device.

**Clinical conclusions**
The results of the study indicate that when using the economiser device, the saturation levels obtained during sleep, rest and exercise were not significantly different from those obtained with a continuous oxygen flow in a sample of patients large enough to protect from type II error.

**Measure of benefits used in the economic analysis**
No summary benefit measure was identified in the economic analysis, and only separate clinical outcomes were reported. Because of the therapeutic equivalence of the two alternative procedures, the economic study proceeded on the basis of cost-minimisation analysis.

**Direct costs**
A discount rate was applied to estimate the annual equipment cost. Quantities were reported separately from the costs. Some cost items were reported separately. Cost analysis covered the costs of the economiser device and oxygen consumption. Although the perspective adopted in the cost analysis was reported to have been that of society, this was not supported by the items included in the cost analysis. The average unit cost was calculated with and without the economiser, based on the average unit oxygen consumption. The cost calculations were extrapolated to two Italian regions. The price year appears not to have been reported.
Statistical analysis of costs
A statistical analysis was performed on resource use data, but not on costs.

Indirect Costs
Not considered.

Currency
Italian lire (L). A conversion was made to US dollars ($).

Sensitivity analysis
A sensitivity analysis was performed by varying the oxygen consumption and costs over an 'appropriate' range of values.

Estimated benefits used in the economic analysis
Not applicable.

Cost results
The mean potential savings, estimated per patient per year, were L530,114 (184,233), corresponding to $2,492 (866).

Synthesis of costs and benefits
Costs and benefits were not combined since the economic study proceeded on the basis of cost-minimisation analysis.

Authors' conclusions
The savings, consistently relevant alongside the whole range of variation by sensitivity analysis both during the first and the following years, justify considering the adoption of similar economisers on a large scale. The conclusion is strengthened by the absence of observed side-effects during the use of the economiser.

CRD COMMENTARY - Selection of comparators
A justification was given for the choice of the comparator, which appears to have been the routine procedure in the context in question. You, as a database user, should consider which health technology is used widely in your own setting.

Validity of estimate of measure of effectiveness
The internal validity of the effectiveness results is likely to be high due to the randomised nature of the study design and the power calculations that were performed to justify the sample size. However, the fact that the effectiveness analysis was based on treatment completers only rather than on intention-to-treat may have adversely affected the validity. The study sample appears to have been representative of the study population.

Validity of estimate of measure of benefit
The analysis of benefits was based upon therapeutic equivalence of treatment alternatives. Therefore the economic analysis only included costs.

Validity of estimate of costs
The validity of the cost results was enhanced by the following positive features of the cost analysis: quantities were
reported separately from the costs; statistical analyses were performed on resource consumption, but not on cost data; cost results may be generalisable outside the study setting given the sensitivity analysis (although the results were not reported in detail in the paper). However, the following limitations may have adversely affected the validity of the cost results: adequate details of methods of cost estimation were not given; the price year was not reported; the perspective adopted was stated although the effects of alternative procedures on indirect costs, required by the societal perspective, were not appropriately addressed.

Other issues
The authors’ conclusions appear to be justified given the uncertainties in the effectiveness data. The issue of generalisability to other settings or countries was addressed by performing sensitivity analysis. Some comparisons were made with other studies. The degree to which the study sample was representative of the study population was not addressed in the author’s comments.

Implications of the study
Further studies should be performed to evaluate whether or not liquid oxygen really represents the most cost-effective method of treating hypoxemic patients.

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