An integrated health-economic analysis of diagnostic and therapeutic strategies in the treatment of moderate-to-severe obstructive sleep apnea

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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.

CRD summary
This study assessed the cost-effectiveness of three diagnostic strategies (full-night or split-night polysomnography, and unattended portable home monitoring), with continuous positive airway pressure (CPAP) titration and treatment, for patients who might have had moderate-to-severe obstructive sleep apnoea. The authors concluded that full-night polysomnography, with CPAP treatment, was cost-effective and the preferred diagnostic strategy for these patients. The methods were valid and various areas of uncertainty were considered, showing that the authors’ conclusions are robust.

Type of economic evaluation
Cost-utility analysis

Study objective
This study assessed the cost-effectiveness of three common diagnostic strategies, combined with continuous positive airway pressure (CPAP) titration and treatment, for patients with moderate-to-severe obstructive sleep apnoea.

Interventions
The three strategies were full-night polysomnography, split-night polysomnography, and unattended portable home monitoring. Diagnosed patients were treated with CPAP. A fourth strategy was considered, in which all patients were titrated and then treated with CPAP, and a fifth strategy was no diagnosis and no treatment.

Full-night polysomnography was conducted overnight in a laboratory and CPAP titration was performed on a subsequent night in the laboratory, if the criteria for obstructive sleep apnoea were met.

Split-night polysomnography was performed in the laboratory over the first two hours, with the remainder of the night spent in CPAP titration for patients who met the criteria or polysomnography continued for the whole night for patients who did not meet the criteria in the first two hours, with titration on a subsequent night if the criteria were met.

Patients who were positively diagnosed with home monitoring were given unattended home CPAP autotitration, and those who were not diagnosed were referred for full-night polysomnography.

Location/setting
USA/in-patient and out-patient care.

Methods
Analytical approach:
The analysis started with a decision tree, which was followed by a Markov model, with 10-year and lifetime horizons. The authors stated that it was carried out from the perspective of the third-party payer.

Effectiveness data:
The clinical data were from a selection of studies. The key inputs were the accuracy (sensitivity and specificity) of the diagnostic procedures and these were from published clinical trials and meta-analyses. The treatment effect and compliance with CPAP were from large cohort studies. Other data were from published sources, which included...
longitudinal studies and official US databases. Some assumptions were needed.

**Monetary benefit and utility valuations:**
Health-related quality of life was determined by three negative health outcomes from untreated obstructive sleep apnoea. These were stroke, myocardial infarction, and motor vehicle collisions due to lack of sleep. These values were from various published sources, including health reported by participants in the nationally representative Medical Expenditure Panel Survey (MEPS), measured using the European Quality of life (EQ-5D) questionnaire.

**Measure of benefit:**
Life-years and quality-adjusted life-years (QALYs) were the summary benefit measures and they were discounted at an annual rate of 3%. Other model outcomes were reported.

**Cost data:**
The economic analysis included the costs of the diagnostic tests, monitoring and treatment during CPAP, treatment of hypertension, management of a cardiovascular event, non-fatal and fatal motor vehicle collisions, and end-of-life care. These data were derived from Medicare reimbursement rates (diagnosis, monitoring, and treatment), a US Department of Transportation study (collisions), and published studies (hypertension and cardiovascular events). All costs were in US dollars ($) and the price year was 2008. A 3% annual discount rate was applied.

**Analysis of uncertainty:**
One-way and multi-way sensitivity analyses were carried out to examine the impact of variations in the inputs on the model outcomes. The ranges of values were from the literature. Scenario analyses focused on the reduction in cardiovascular events with CPAP.

**Results**
In a hypothetical cohort of 50-year-old men, the lifetime costs were $216,934 with no treatment and $243,656 with CPAP treatment. The life-years were 16.062 with no treatment and 17.165 with CPAP. The QALYs were 10.814 with no treatment and 12.493 with CPAP. The incremental cost with CPAP over no treatment was $24,222 per life-year gained or $15,915 per QALY gained.

Over 10 years, the incremental cost was $102,585 per life-year gained or $16,172 per QALY gained.

Comparing diagnostic strategies, the lifetime costs were $217,602 with no intervention, $231,553 with full-night polysomnography, $232,060 with split-night polysomnography, $232,716 with home monitoring, and $243,879 with treatment for all. The life-years were 16.7920 with no intervention, 17.3271 with full-night polysomnography, 17.3271 with split-night polysomnography, 17.3061 with home monitoring, and 17.3436 with treatment for all. The QALYs were 12.3600 with no intervention, 13.1743 with full-night polysomnography, 13.1683 with split-night polysomnography, 13.1269 with home monitoring, and 13.0994 with treatment for all.

The incremental cost per QALY gained analysis showed that split-night polysomnography, home monitoring, and treatment for all were dominated, as they were more expensive and less effective than full-night polysomnography. The incremental cost for full-night polysomnography, compared with no intervention was $26,073 per life-year gained or $17,131 per QALY gained.

In general, these findings were robust to the variations considered in the sensitivity analyses. Slightly less favourable cost-effectiveness estimates were observed for women than for men. The cost-effectiveness of diagnosis depended on the cost-effectiveness of treatment.

**Authors' conclusions**
The authors concluded that full-night polysomnography, with CPAP treatment, was cost-effective and the preferred diagnostic strategy for patients suspected of having moderate-to-severe obstructive sleep apnoea.

**CRD commentary**
**Interventions:**
The selection of the comparators was appropriate in that all possible and commonly used diagnostic strategies for obstructive sleep apnoea were analysed. The authors acknowledged that other treatments in addition to CPAP were available, but a comparison of treatments was not within the scope of this study.

Effectiveness/benefits:
No systematic literature review to identify the relevant sources of evidence was reported and sources might have been missed. Few details of the methods of these studies were given, making it impossible to objectively assess their quality. In general, clinical trials and meta-analyses are considered to be valid sources of evidence, but the details would have been helpful. The utility values were from valid sources and the instruments used to elicit the patient preferences were appropriate. Both benefit measures captured the impact of the disease on patients' health, but the authors stated that the utility weights were generally from few individuals and were therefore uncertain. Several outcomes relating to cardiovascular events and collisions were reported.

Costs:
The cost categories were appropriate for the perspective of the third-party payer. The unit costs and resource quantities were reported for diagnostic tests and visits, but others costs were presented as category totals. The costs were generally from Medicare, which was consistent with the economic viewpoint, but some estimates were from published reports, which were not described. Details, such as the price year and discount rate, were clearly stated. The impact of variations in the cost estimates was tested in the sensitivity analyses.

Analysis and results:
The results were clearly presented and extensively discussed. The projected costs and benefits of the various approaches were synthesised using both average and incremental ratios. The uncertainty was satisfactorily investigated using valid approaches and the findings were well illustrated. The authors stated that the main difference between their study and other published economic evaluations was the lifetime horizon of the analysis. They stated that the results might not be generalisable to other settings, but extensive sensitivity analyses were conducted to improve their transferability.

Concluding remarks:
The methods were valid and various areas of uncertainty were considered, showing that the authors' conclusions were robust.

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