Cost-effectiveness of split-night polysomnography and home studies in the evaluation of obstructive sleep apnea syndrome

Deutsch P A, Simmons M S, Wallace J M

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 study compared three strategies for diagnosing and treating obstructive sleep apnoea syndrome (OSAS).

Strategy 1 was full-night polysomnography (PSG). This consisted of an overnight in-laboratory PSG followed by continuous positive airway pressure (CPAP) titration during the next night if indicative.

Strategy 2 was split-night PSG. This consisted of in-laboratory monitoring during the first 2 hours of sleep. Eligible patients received CPAP titration for the rest of the sleep. Non-eligible patients were monitored overnight, while those with insufficient CPAP titration revisited the laboratory for a second overnight CPAP titration.

Strategy 3 was unattended home partial sleep monitoring (UHPSM). This consisted of unattended monitoring followed by a night of home CPAP titration if OSAS criteria were met (home study). If UHPSM were inadequate or negative, or if CPAP autotitration failed, patients entered the full-night PSG strategy.

Type of intervention
Diagnosis and treatment.

Economic study type
Cost-utility analysis.

Study population
As this was a modelling study, the target population comprised a hypothetical cohort of individuals aged between 30 and 64 years of whom 85% were men. The cohort included individuals at moderate to high risk of OSAS (OSAS indicative symptoms were excessive daytime somnolence, persistent snoring and witnessed apnoeas during sleep).

Setting
The interventions appear to have been provided in an inpatient setting (sleep laboratory) and in the community (patients' residence). The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data used to populate the model came from studies published between 1984 and 2003. The resource use data were derived from studies published between 1990 and 2003 and were augmented by authors' assumptions. The cost data were derived from official sources (Medicare Fee Schedule reimbursement rates) and referred to the year 2004. All costs were reported for the price year 2004.

Source of effectiveness data
The clinical parameters associated with the interventions included:
the sensitivity and specificity of the diagnostic procedures (PSG, UHPSM, split-night PSG after first 2 hours of sleep);
the pre-test probability of OSAS;
intervention-specific CPAP acceptance rates;
the success rate of UHPSM;
the probability of needing a second night for CPAP in the split-night PSG module;
the probability of full-night PSG after negative or unsuccessful UHPSM; and
the probability of unsuccessful CPAP autotitration for OSAS patients.

Modelling
The authors constructed a decision analytic model to model the different diagnostic procedures. The time horizon of the model was 5 years. Disease progression over the 5 years after the diagnostic assessment was modelled using Markov cycles. The health states were reported.

Sources searched to identify primary studies
The clinical effectiveness data were derived from a number of published studies, which the authors referenced. However, the study designs and methodology were not reported.

Methods used to judge relevance and validity, and for extracting data
The process used to identify the data was not reported. Although the authors stated that the data referred to similar study populations to the hypothetical cohort of the study, explicit inclusion criteria were not specified. The method used to select the estimates was neither reported nor discussed. It was reported that when published literature suggested more than one probability, a mean value weighted by sample size was used.

Measure of benefits used in the economic analysis
The measure of benefit used was the quality-adjusted life-years (QALYs). The utility values were derived from published studies, while life expectancy estimates for the health states over the 5-year horizon were calculated from published data. Utility values were discounted at an annual rate of 3%.

Direct costs
The study reported direct costs to the third-party payer. These were full- and split-night PSG, polysomnographic CPAP titration and autotitration, UHPSM, office visits, and the costs of CPAP rental and accessories (1, 2, and 3 to 5 years). Cost estimates were based on procedure reimbursement rates, derived from the Medicare Fee Schedule. The resources used appear to have been mainly derived from published studies. The costs were discounted at an annual rate of 3% and were reported for the price year 2004. Although assumptions about resource use were reported, the unit costs and the resource quantities were not reported separately.

Statistical analysis of costs
A statistical analysis of the cost estimates does not appear to have been undertaken.

Indirect Costs
Indirect costs were not included in the analysis.
Currency
US dollars ($).

Sensitivity analysis
Parameter uncertainty was investigated through one-way sensitivity analyses. The ranges over which the parameters were tested were obtained from published literature and were reported. The cost estimates were tested over a wide range of payment rates applied in the USA (50 to 150% of the Medicare reimbursement rate). Two-way and multi-way sensitivity analyses also appear to have been performed, but the variables tested were not reported. Parameter uncertainty was also investigated by means of a probabilistic sensitivity analysis. Probability distributions were assigned to all model parameters and the ranges of uncertainty were derived from published studies. Monte Carlo simulations with 10,000 iterations were performed, and parameter distributions were reported. The results were plotted on cost-effectiveness planes by comparing split-night and full-night PSG against UHPSM and full-night PSG against split-night PSG separately. It was reported that cost-effectiveness ratios were converted to net benefits and acceptability curves were plotted against third-party payer willingness-to-pay (WTP) thresholds.

Estimated benefits used in the economic analysis
The full-night PSG module resulted in 2.33 QALYs, the split-night PSG in 2.31 QALYs and the home studies (UHPSM) in 2.23 QALYs.

Cost results
The mean expected total costs were $4,886 for the full-night PSG module, $4,565 for the split-night PSG module and $4,096 for the home studies (UHPSM) module.

Synthesis of costs and benefits
An incremental cost-effectiveness analysis was performed.

When compared with UHPSM, the split-night PSG module resulted in an incremental cost of $5,932 per QALY gained and the full-night PSG module in an incremental cost of $7,383 per QALY gained. When full-night PSG was compared with split-night PSG it resulted in an incremental cost of $11,586 per QALY gained.

The one-way sensitivity analyses demonstrated that the results were only sensitive to variations in the rate of CPAP acceptance. Full-night PSG was dominated by split-night PSG when both modules were assumed to have the same CPAP acceptance rate.

The Monte Carlo iterations, which were plotted on cost-effectiveness planes, demonstrated that the WTP threshold should be set at $5,827 in order for split-night PSG to be cost-effective compared with home studies in 50% of the iterations. Similarly, the WTP threshold should be set at $7,317 for full-night PSG compared with home studies, and at $11,075 for full-night PSG compared with split-night PSG.

At a WTP of $10,000 per QALY gained, full- and split-night PSG appeared to be cost-effective compared with home studies in 80% of simulations, while full-night PSG was more cost-effective than split-night PSG in less than half of the iterations. At a WTP of greater than $20,000, both modules were more cost-effective than home studies in 90% of iterations. At a WTP of $30,000, full-night PSG was more cost-effective than split-night PSG in only one third of the iterations.

Net-benefit acceptability curves demonstrated that home studies were the most cost-effective module at a WTP of under $6,500, split-night PSG was most frequently cost-effective at a WTP threshold between $6,500 and $11,500, and full-night PSG was most frequently cost-effective at a WTP threshold above $11,500.

Authors’ conclusions
The home study and the split-night polysomnography (PSG) strategies were more cost-effective in comparison with full-night PSG.

**CRD COMMENTARY - Selection of comparators**
All three diagnostic strategies appear to have been commonly used approaches, with full-night PSG representing the most conventional strategy in the authors' settings. However, alternative treatment procedures to CPAP titration (i.e. oral appliances, surgical procedures) or alternative combination strategies (i.e. full-night PSG followed by home CPAP autotitration) were not accounted for in the model. These factors mean that the study was only a partial analysis. You should decide if these strategies represent widely used technologies in your own setting.

**Validity of estimate of measure of effectiveness**
The parameters were derived from published research, but no systematic search for data was reported. In certain cases, a mean value weighted according to sample size was used in the model; however, it was not clear for which parameters the calculations were performed. The authors did not report any search methods or inclusion criteria, nor did they provide any justification for their selection of the estimates. It is not possible to judge the quality of the evidence used to derive input model parameters, given the limited information reported.

**Validity of estimate of measure of benefit**
The estimation of health benefits (QALYs) was modelled using a Markov model. The utilities were taken from published studies and no details of the valuation method were reported.

**Validity of estimate of costs**
The analysis of the costs was performed from the perspective of the third-party payer. Direct health care costs due to complications of untreated OSAS were omitted from the analysis, but their omission is likely to have affected the cost-effectiveness results. Medicare procedure reimbursement rates were used as a proxy for costs, which was acceptable given the perspective adopted. However, this may have implications for the generalisability of the study beyond the study setting. You should consider whether U.S. Medicare reimbursement costs are likely to be similar to the costs in your own setting. The cost estimates were assigned prior distributions to characterise their uncertainty. The authors evaluated uncertainty in the cost data jointly with the effectiveness data in order to produce cost-effectiveness planes. The costs were appropriately discounted and the price year was reported, thus facilitating future reflation exercises.

**Other issues**
The authors briefly discussed the results of previous studies and acknowledged that methodological differences in study designs do not enable detailed direct comparisons. The authors acknowledged variation in different patient populations (e.g. asymptomatic or low-risk patients, paediatric or geriatric populations), but did not evaluate the impact of this on the economic results through a sensitivity analysis. The authors do not appear to have presented their results selectively and their conclusions reflected the scope of their analysis.

The authors reported a number of limitations to their study. For example, the use of Medicare reimbursement rates as proxies for costs (because of a lack of micro-costing data) might have resulted in the underestimation of long-term costs, especially in terms of the home study strategy. In addition, indirect costs were not accounted for in the analysis. A further limitation to the model was that patients were assumed to remain in the no-OSAS and OSAS-untreated health states over the 5-year period, without allowing patients to move to different health states (i.e. receive CPAP treatment) at a later stage in the model.

**Implications of the study**
The authors did not make explicit recommendations for changes in policy or practice. Based on the limitations to their study, they recommended that future research should account for different patient groups, while future economic evaluations should be undertaken from a societal perspective, estimating indirect costs in order to provide a more comprehensive cost-effectiveness analysis.

**Source of funding**
NHS Economic Evaluation Database (NHS EED)
Produced by the Centre for Reviews and Dissemination
Copyright © 2013 University of York
No industry support.

**Bibliographic details**

**PubMedID**
17557487

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Continuous Positive Airway Pressure /economics /methods; Cost-Benefit Analysis; Decision Trees; Home Care Services /economics; Humans; Models, Economic; Polysomnography /economics /methods; Severity of Illness Index; Sleep Apnea Syndromes /diagnosis /economics /therapy

**AccessionNumber**
22006001170

**Date bibliographic record published**
29/02/2008

**Date abstract record published**
29/02/2008