

# The Danish study on cost effectiveness in sleep related breathing disorders - a possible example for Europe

Ingo Fietze

Procedures for the diagnosis and therapy of sleep disordered breathing have been well established in healthcare systems for quite some time and effective management of patients with sleep disordered breathing is established in many healthcare settings.<sup>1</sup> However, there remain many unanswered questions, not only in relation to pathophysiology, prevalence and management but also in relation to cost of the condition and the cost-effectiveness of treatments. These questions have come into sharper focus with the current economic pressures. Healthcare payers may accept evidence that treatment reduces comorbidities, costs for physician service and drug treatment, lost working days, stays at hospitals and accidents caused by sleepiness but they could legitimately ask a number of other questions. Which patient has to be treated with which treatment and when should it be started? Are there identifiable patients where a more conservative treatment strategy suffices and others where alternative treatment methods are needed? And do these treatments increase life expectancy and quality of life, and reduce healthcare costs? We have to convince the national reimbursement agencies in every country that sleep medicine does provide cost-effective treatment so that they provide us with sufficient resources to effectively diagnose and treat obstructive sleep disordered breathing.

There is good evidence that untreated sleep apnoea is associated with reduced life expectancy<sup>2</sup> and high comorbidity. Important comorbid disorders include arterial hypertension, atrial fibrillation, stroke, coronary heart disease, heart

failure, diabetes mellitus, atherosclerosis and depression. As a consequence, patients with obstructive sleep disorders consume around 70% more healthcare resources than matched control patients.<sup>3</sup> In this issue of *Thorax*, Poul Jennum and Jakob Kjellberg detail the direct and indirect costs in patients with obstructive sleep apnoea (OSA) compared with a control group and patients with snoring or obesity hypoventilation syndrome (OHS).<sup>4</sup> Patients with sleep apnoea and OHS had more physician visits, were treated more often in outpatient clinics, were hospitalised more, had higher demand of the primary care system and consumed more medical drugs. These costs were not related to age. Interestingly, there was no burden of costs or health-related mortality in snorers in comparison with the matched controls.

OSA and OHS patients also had greater indirect health costs reflecting increased use of social services, a lower income and higher unemployment. In OSA patients costs increased progressively with increased severity of disease. The authors estimate the annual mean excess health-related cost for each OSA patient to be 3860 €.

In both disease conditions the mortality rate was increased; in patients with OSA this was reduced by continuous positive pressure ventilation (CPAP) treatment.

Whether an effective treatment of sleep apnoea such as CPAP reduces the severity or prevents the occurrence of comorbid disorders remains to be proven definitively. However, the economic benefit of effective therapy as a result of reduced hospital and physician visits, and reduced cost of medication, is likely to be large<sup>5</sup> and above the threshold of the quality adjusted life year (QUALY) mandated by various agencies including the National Institute for Health and Clinical Excellence (NICE). Excessive daytime sleepiness may also have an important economic impact for the patients and others by reducing work

performance and productivity or by causing a catastrophe such as a road accident or house fire.<sup>6,7</sup> One study estimated OSA-related motor-vehicle collision costs as US\$15.9 billion in the USA in 2000 and suggested that effective treatment of sleep apnoea patients could lead to savings of up to US\$8 billion per year even after allowing for the costs of OSA treatment.<sup>8</sup> In Australia, the sum of indirect health costs caused by all patients with sleep disorders were estimated to be US\$2.75 billion in 2004 (including 808 million for motor vehicle accidents) which is approximately one-third of all (direct and indirect) costs (US\$7.5 billion).<sup>9</sup>

The effect of nocturnal CPAP therapy in patients with OSA has been shown to increase the health-related quality of life index from 0.738 to 0.811<sup>10</sup> (a value of 0 means death and a value of 1 means perfect health). One way to estimate cost-effectiveness is to calculate the incremental cost-effectiveness ratio (ICER). This is the ratio between the difference in costs and the difference in benefits of two interventions or treatment and non-treatment. For CPAP we can assume that in North America the ICER per QUALY is nearly US\$3500 based on an investigational period of 5 years.<sup>11</sup> This value is well below US\$50 000 which is the threshold used to judge whether a therapy is effective in USA; it is important to remember that much of the cost of treating OSA is up-front provision of equipment so that treatment costs tend to decrease with time.<sup>12</sup> If one relates the treatment costs to QUALY gained, then this amounts to £20 000 in the first year, and £3000 in the fifth year.<sup>13</sup> After 12 years, the treatment becomes cost-saving. Another study of patients recruited from a sleep clinic with a diagnosis of moderate-to-severe sleep apnoea estimated treatment cost at between US \$2000 and US\$11 000 per QUALY.<sup>13</sup> The first European study on this topic from Spain<sup>11</sup> estimated an ICER for CPAP therapy of 7861 € per QUALY considering an observational period of 5 years and 4938 € per QUALY for treatment over the entire lifespan. Thus, it seems very likely that treatment costs are also well below the assumed NICE threshold of £20 000 or 30 000 € per QUALY.<sup>14</sup>

In their study, Jennum and Kjellberg<sup>4</sup> have examined patients during a therapy period of 2 years, so their contribution cannot be regarded as a substantial contribution to the issue of effectiveness of CPAP therapy from the economical point of view. It is interesting to note that

Department of Cardiology, Interdisciplinary Center of Sleep Medicine, CCM, Charité—Universitätsmedizin Berlin, Berlin, Germany

**Correspondence to** Ingo Fietze, Center of Sleep Medicine, Chariteplatz 1, 10098 Berlin, Germany; ingo.fietze@charite.de

uvulopalatopharyngoplasty failed to show cost-effectiveness.

All health economic assessments have to be treated with some caution, as had been pointed out by a recent health technology assessment report.<sup>15</sup> Almost no randomised controlled trials were considered in the cost calculations, different disease severities were included, different age ranges for patients were selected and different observational time intervals were investigated. The cost models included different cost categories and the impact of therapy on sleepiness and comorbidities were not adequately addressed. Comparison of cost-effectiveness between countries is problematic as diagnostic and therapeutic procedures differ so much. Other studies have been limited as they compare the value of CPAP therapy with real or imagined subject groups identified from patient registries.<sup>10–12</sup>

From the methodological point of view, the usual basis for cost modelling is the Markov model. A new approach is the York model. Whether these changes in cost modelling do approximate costs better still needs to be proven. In essence, all calculations show that CPAP therapy is more expensive than no treatment at all and dental appliances, but that CPAP is more effective in terms of costs. And the ICER of CPAP is substantially lower than the threshold of £20 000 required by NICE.

Another important question that remains is how to lower costs for CPAP therapy in the future. One approach is to select the patients who do need therapy early with the use of a more economical diagnostic workup.<sup>16</sup> Jennum and Kjellberg<sup>4</sup> come to the same conclusion. Finally, we have to determine whether there is a relationship between

the timing of the OSA diagnosis and the expense of therapy. Strategies that improve adherence to therapy are also likely to help. Possible interventions to do this include more intense supervision of patients during the first 2 weeks of CPAP therapy or an improved long-term follow-up management of patients.

The European Sleep Apnea Database which collects data of sleep apnoea patients and their comorbidities with follow-up visits can provide additional data if data from enough years are collected.<sup>17</sup> A European network of sleep centres engaged in a cooperative arrangement with regard to patient documentation protocols funded by a European COST (Cooperation in Science and Technology) action can support this initiative further.<sup>1</sup>

**Competing interests** None.

**Provenance and peer review** Commissioned; internally peer reviewed.

*Thorax* 2011; **■**:1–2.

doi:10.1136/thoraxjnl-2011-200052

## REFERENCES

1. **Fietze I**, Penzel T, Alonderis A, *et al*; on behalf of the COST Action B26 Group. Management of obstructive sleep apnea in Europe. *Sleep Med* 2010;**12**:190–7.
2. **Punjabi NM**, Caffo BS, Goodwin JL, *et al*. Sleep-disordered breathing and mortality: a prospective cohort study. *PLoS Med* 2009;**6**:e1000132.
3. **Tarasiuk A**, Greenberg-Dotan S, Brin YS, *et al*. Determinants affecting health-care utilization in obstructive sleep apnea syndrome patients. *Chest* 2005;**128**:1310–14.
4. **Jennum P**, Kjellberg J. The health, social and economical consequences of sleep disordered breathing: a controlled national study. *Thorax*. Published Online First: 2 January 2011. doi:10.1136/thx.2010.143958.
5. **Albarak M**, Banno K, Sabbagh AA, *et al*. Utilization of healthcare resources in obstructive sleep apnea

- syndrome: a 5-year follow-up study in men using CPAP. *Sleep* 2005;**28**:1306–11.
6. **AlGhanim N**, Comondore VR, Fleetham J, *et al*. The economic impact of obstructive sleep apnea. *Lung* 2008;**186**:7–12.
  7. **Rodenstein D**. Sleep apnea: traffic and occupational accidents—individual risks, socioeconomic and legal implications. *Respiration* 2009;**78**:241–8.
  8. **Sassani A**, Findley LJ, Kryger M, *et al*. Reducing motor-vehicle collisions, costs, and fatalities by treating obstructive sleep apnea syndrome. *Sleep* 2004;**27**:453–8.
  9. **Hillman DR**, Murphy AS, Pezzullo L. The Economic Cost of Sleep Disorders. *Sleep* 2006;**29**:299–305.
  10. **Mar J**, Rueda JR, Durán-Cantolla J, *et al*. The costeffectiveness of nCPAP treatment in patients with moderate-to-severe obstructive sleep apnoea. *Eur Respir J* 2003;**21**:515–22.
  11. **Tan MC**, Ayas NT, Mulgrew A, *et al*. Cost-effectiveness of continuous positive airway pressure therapy in patients with obstructive sleep apnea-hypopnea in British Columbia. *Can Respir J* 2008;**15**:159–65.
  12. **Guest JF**, Heltzer MT, Morga A, *et al*. Cost-effectiveness of using continuous positive airway pressure in the treatment of severe obstructive sleep apnoea/hypopnoea syndrome in the UK. *Thorax* 2008;**63**:860–5.
  13. **Kapur VK**, Alfonso-Cristancho R. Just a good deal or truly a steal? Medical cost savings and the impact on the cost-effectiveness of treating sleep apnea. *Sleep* 2009;**32**:135–6.
  14. **Groot W**, van den Brink HM. The value of health. *BMC Health Serv Res* 2008;**8**:136.
  15. **McDaid C**, Griffin S, Weatherly H, *et al*. Continuous positive airway pressure devices for the treatment of obstructive sleep apnoea-hypopnoea syndrome: a systematic review and economic analysis. *Health Technol Assess* 2009;**13**:iii–iv, xi–xiv, 1–119, 143–274.
  16. **Ayas NT**, Fox J, Epstein L, *et al*. Initial use of portable monitoring versus polysomnography to confirm obstructive sleep apnea in symptomatic patients: an economic decision model. *Sleep Med* 2010;**11**:320–4.
  17. **Hedner J**, Grote L, Lavie P, *et al*. The European Sleep Apnea Database (ESADA)—design and first interim cross-sectional description of results from 22 European sleep laboratories. *Am J Respir Crit Care Med* 2010;**181**:A6857.