The economic burden of Parkinson’s disease (PD) has become a very important health topic. From the perspective of a typical neurologist, health economics can appear quite dry; however, it is a growing topic in most modern healthcare systems, so doctors should have at least a minimal understanding of how health economic information is derived.

Starting in Australia in 1993 with the establishment of the Economics Subcommittee of the Pharmaceutical Benefits Advisory Committee (PBAC), various authorities worldwide have been set up to analyse the cost-effectiveness of drugs and other medical products. Examples are the German Institute for Quality and Efficiency in Health Care (IQWIG), established in 2004, and the National Institute for Health and Clinical Excellence (NICE), established in 1999 in the UK.

Calculating the Costs
Costs, according to health economic theory, are categorised as direct, indirect or intangible1 (see Table 1). Direct costs are those that are incurred as a direct result of treating the patient and can be divided into direct medical (e.g. drug costs) and direct non-medical costs (e.g. cost of care). Indirect costs are those caused by the disease, and usually relate to the patient’s employment status. Intangible costs are the hardest to quantify and measure, as suitable instruments are lacking. Traditionally, in health economic evaluations only the direct and indirect costs are included, but there can be a huge difference in the calculation simply by including or excluding one category of costs.

The gold standard of health economic evaluations is comparative analysis. There are four different kinds: cost minimisation analysis, cost–benefit analysis, cost-effectiveness analysis and cost–utility analysis.1 The first two are rarely used in medicine; the last two are the most common. The cost-effectiveness analysis compares a monetary amount with a measurable clinical effect, such as change in blood pressure, weight, etc., and the result is presented in these units, for example € per mmHg or € per kg. The cost–utility analysis compares the monetary differences of two interventions with non-monetary outcome, with a typical result being € per quality-adjusted life year (QALY) gained or € per disability-adjusted life year (DALY) gained, with QALYs being the most commonly used aggregate. However, there is a large debate as to what could be the best outcome measure for utility analyses.2 Non-comparative studies include the cost-analysis study, where only the cost of the outcome is considered. If only the burden of the illness is taken into account, the analysis is called cost of illness analysis.

Abstract

Objective
To evaluate costs and health-related quality of life (HRQoL) in patients with Parkinson’s disease (PD) in Europe.

Study Design and Methods
Costs and HRQoL were evaluated in patients with idiopathic PD recruited from outpatient departments for movement disorders in Germany. The generic EQ-5D instrument was used to assess HRQoL. Clinical data – Hoehn and Yahr (H&Y) stage, Unified Parkinson’s Disease Rating Scale (UPDRS) III and motor and non-motor symptoms – were assessed in detail. Drug costs over the previous three months were assessed using a questionnaire. PD medication costs were stratified by H&Y stages. Bivariate correlations were calculated of the EQ-5D index score and sociodemographic and clinical outcomes. Statistical significance was proved by means of t-tests and Kruskall-Wallis tests.

Results
Direct costs per patient range from €2,500 to €13,000, with an estimated average of €7,600. Total costs per patient increase with increased H&Y disease stage, from average cost of €3,400 for H&Y stage 1 to €15,000 for H&Y stage 5. EQ-5D index score decreased with increasing disease severity: 0.66 and 0.48 for H&Y stages 1/2 and 3/4, respectively. Differences in household income also had a distinct relationship with HRQoL score: 0.54 and 0.75 for income <€750 and income >=€1,500, respectively. In terms of clinical factors, patients with dementia (0.40 versus 0.61), depression (0.57 versus 0.63), pain (0.49 versus 0.62) and constipation (0.43 versus 0.76) showed the largest differences in HRQoL compared with the average.

Conclusion
The results show that PD places a major burden on the individual, the family and society. Costs associated with PD increase substantially with disease progression, and the majority of costs originate from outside the formal healthcare system. Owing to the scarcity of epidemiological and health economic data, cost calculations are conservative and probably underestimate the true burden of PD.

Corresponding author:
Richard Dodel
Philipps-University Marburg, Germany
E: dodel@med.uni-marburg.de
There are also different ways to gather data. It is possible to gather them as field research, for example performing a clinical study including economic variables in the protocol. This is usually done in a phase II or III trial. Alternatively, there is a naturalistic design, for example as part of a post-marketing study, or the ‘Delphi method’, where a certain number of specialists convene to determine a consensus on the costs involved. The other way to gather data is through desk-based research. The meta-analysis is a common way to pool and analyse published data, but in recent years ‘decision analysis’ has become the most popular tool. It employs a similar process to the calculation of an opportunity cost in economics: it looks at the overall impact of taking a particular decision versus making an alternative choice. It is such a powerful tool that many agencies are adopting it: IQWIG in Germany, for instance, has stated that decision analysis is one of its preferred tools for determining cost-effectiveness.

**The Macro View**

The European Brain Council (EBC) published a study on brain disorders and their epidemiology in 2005. There are around 466 million people in Europe, 127 million (27%) of whom have brain disorders (both neurological and general mental health). If those with co-morbidities are excluded, that still leaves 104 million people (22%), roughly half of whom (51.2 million people; 11%) have a neurological condition. The number with PD is estimated to be around 1.1 million (0.2%).

The number of patients with PD differs across the various countries. As of 2004, The Netherlands had the highest percentage of brain disorders, with around 36% of the population suffering from either a neurological or a mental disorder (17 and 19%, respectively); Spain had the lowest at around 19% (10 and 9%, respectively). The reason for these discrepancies is not known.

In terms of the annual cost of treatment, Germany had the highest expenses for brain disorders, at nearly €1,400 per person in 2004; Estonia spent the least, at barely €200 per person. There is also a clear correlation with gross domestic product (GDP) in the different countries.

**Where Is the Money Spent?**

The public view in most countries is that the main medical expense is doctors’ salaries, with drug costs second. However, in actual fact 33% of the total cost associated with a brain disorder is caused by sick leave from work (see Figure 1). Early retirement adds a further 7% and premature death an additional 7%. Therefore, nearly half of the total cost is not directly under the control of neurologists.

According to the EBC data for 2004, annual spend in Europe on PD was €10.7 billion, consisting of €4.6 billion on healthcare costs and €6.1 billion on direct non-medical costs. This is more than 12% of the total spend on neurological diseases in Europe, which was €83.9 billion. These data do not include either the intangible or the indirect costs, in the case of the latter because they assumed a population over 65 years of age and thus already in retirement. This is a critical omission: with migraine, for example, indirect costs dwarf direct costs by 17:1, a fact rarely mentioned in public debates. Nevertheless, according to current data the cost per patient of treating PD is close to

---

**Table 1: Health Economics Distinction**

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indirect</th>
<th>Intangible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>Unemployment</td>
<td>Dependency</td>
</tr>
<tr>
<td>Ambulatory/patient care</td>
<td>Part-time work</td>
<td>Psychological effects</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Early retirement</td>
<td>Pain</td>
</tr>
<tr>
<td>Therapy</td>
<td>Care</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1: Cost Breakdown for Brain Disease**

**Figure 2: Cost per Patient of Brain Disorders in Europe**

Source: Adapted from Andlin-Sobocki et al., 2005.
the median value of the cost of all brain disorders, where brain tumours cost society the most and migraines the least (see Figure 2).

In order to evaluate the cost and the health-related quality of life (HRQoL) of patients with PD in Europe, we undertook a study in seven European countries: Austria, Czech Republic, Italy, Germany, Portugal, Russia and the UK. Drug costs over the previous three months were assessed with a questionnaire. The generic EQ-5D instrument was used to assess HRQoL, while clinical data – Hoehn and Yahr (H&Y) stage, Unified Parkinson’s Disease Rating Scale (UPDRS) III and motor and non-motor symptoms – were retrieved from the EuroPa database. The results from this study are currently being analysed and will be published soon.

The Micro View
The results presented here are derived from a health economics study that took place in Germany in 2004–2006, although the results are assumed to be representative of those found in other major European countries. The study examined 145 PD patients with an average age of 67 years in different H&Y stages and with a range of UPDRS scores over three years. The researchers used a range of questionnaires in order to fully understand the HRQoL of all of the participants, as well as other emotional aspects. Treatment was provided by different groups from university level through peripheral level down to the community level.

Results were total annual costs of €20,860 per PD patient. This consisted of €3,720 in direct costs (excluding medications) and €3,840 in drug costs, accounting for slightly more than one-third of the total (see Figure 3). The indirect costs are quite high at €6,360 of the total cost, or slightly less than one-third.

Within direct costs, hospital costs were found to be the largest contributor at €1,420 (38%). All other costs, including for the office-based physician, diagnostics, physiotherapy, inpatient rehabilitation, transportation and walking aids, are less than €1,000 each, and thus do not represent excessive spending where savings can be made. Of the drug costs of €3,840, 65% is accounted for by dopamine agonists (see Figure 4). Therefore, high-dose dopaminergic therapies – particularly those including more than one dopamine agonist – will significantly add to the overall cost.

One of the claims in Germany is that office-based physicians are too expensive. In order to properly assess this claim, we undertook an additional three-month study in Berlin of 12 office-based neurologists who specialised in PD. The findings of the study show that the average reimbursement received by these neurologists was €42 per patient over the three months. This ranged from €22.00 for a newly diagnosed patient at an early stage of PD to €45.78 for an advanced, H&Y 5 patient. These do not appear to be unreasonable amounts.

Costs as Disease Progresses
During the course of PD costs do change. When analysing the costs by H&Y stage, several trends become apparent. Indirect costs remain pretty stable over the course of the disease (with an anomalous minor blip for H&Y 4), but the costs of health insurance and care (represented by PV and RV [Pflegversicherung and Rentenversicherung, respectively; these are special German retirement and care insurance payments] and direct costs) in the advanced disease stages increase disproportionately (see Figure 5).
Economic Burden

Figure 5: Parkinson’s Disease Costs by Disease Stage

![Costs by Disease Stage]

Source: Adapted from Spottke et al., 2005.

Figure 6: Mini-mental State Examination

![Mini-mental State Examination]

Source: Adapted from Spottke et al., 2005.

One aspect of PD care that was not covered in the study is the cost incurred when a patient has to leave home and enter institutional care. There are no data available anywhere that directly relate to these costs. However, there are data available for Alzheimer’s disease, which is assumed to be at least comparable to PD. As with PD, the therapeutic and drug costs for Alzheimer’s disease are quite low at the beginning, but when patients reach a mini-mental state examination (MMSE) state of less than 10, about 90–95% of the total is taken up by care costs.

Costs by Disease Complication
As illustrated in the article by José Obeso, progressive PD brings with it new complications over time. These include: motor complications, such as dyskinesias and motor fluctuations; psychiatric disorders, including dementia, depression and hallucinations; and autonomic dysfunction, such as loss of bladder control and gastrointestinal complications. In Germany, treatment for patients with dyskinesias, at €10,760 per year, was roughly double that for patients without. Meanwhile, motor fluctuations caused treatment costs to rise to €11,040 from €6,040 at baseline.

With dementia in PD, the odds ratio for nursing home placement is 2.5 times higher than for non-demented PD patients. Meanwhile, psychosis in PD raised the odds ratio to 17 times higher than baseline. This difference, measured using the MMSE score, is consistent across age groups (see Figure 6). Furthermore, for demented patients with low MMSE scores, inpatient stay is nearly doubled on average, while rehabilitation costs are more than tripled. Interestingly, the result was that PD patients with dementia were no more likely to visit their physician than those without dementia, but drug costs were around one-third higher. Similarly, the cost to HRQoL, for both the patient and the care-giver, is higher when the PD patient has dementia. Autonomic dysfunction does not appear to affect costs, although quality of life is reduced.

Summary and Conclusions
PD is an expensive disorder, a fact that must be faced by both the medical community and patients to ensure that enough funding is available for suitable and innovative treatments. The indirect costs associated with Parkinson’s disease are greater than the direct costs: roughly 50% of the latter are accounted for by the cost of the drugs themselves. However, as a patient develops complications, costs increase.

These data largely come from the results of a study undertaken by the EBC. Overall, the epidemiological and disease-specific data available in most European countries are insufficient for an accurate health economic assessment. Without these data, the different healthcare systems will not be able to determine the best areas for investment for the different neurological disorders. It is imperative that more epidemiological and disease-specific data are gathered so that healthcare systems and neurologists are not pushed away from the patient.