ISPOR Europe 2025
Glasgow, 9 – 12 November

EE151

Conceptualizing an economic model structure for Parkinson's Disease

Monica Ruoss, MA[1], Anna Kotzeva, MD, MPH[1], Anshul Shah, MS[2], Saifuddin M. Kharawala, MBBS[2], Anadi Mahajan, M.Pharm [2], C Simone Sutherland, BSc, MSc, PhD[1].

[1]F. Hoffmann-La Roche Ltd, Basel, Switzerland, [2]Bridge Medical Consulting Ltd, London, United Kingdom.

Background

- Parkinson's Disease (PD) is a progressive neurodegenerative disorder with motor and non-motor symptoms (NMS) that substantially reduce health-related quality of life (HRQoL) and impose a significant caregiver burden.[1]
- While current treatments address PD symptoms, there is a substantial unmet need for disease-modifying therapies (DMTs) that can slow progression and delay loss of independence.
- A systematic literature review (2010 - 2022) of economic evaluations of PD treatments found 20 publications. The majority of them used the Markov cohort structure to assess the disease progression in terms of motor symptoms (e.g., using the Hoehn and Yahr (H&Y) scale and 'OFF' time) in patients with advanced PD from a narrow payer perspective. Such evaluations neglected the significant impact of NMS on costs and HRQoL for patients, family, and caregivers.[2]
- To capture the economic value of a DMT, new modelling approaches are needed that balance clinical relevance and transparency with credible long-term extrapolations while avoiding unnecessary complexity.

Objective

To develop an evidence-based conceptual framework for a robust and holistic economic model capable of analysing the economic evaluation (EE) of DMTs for PD.

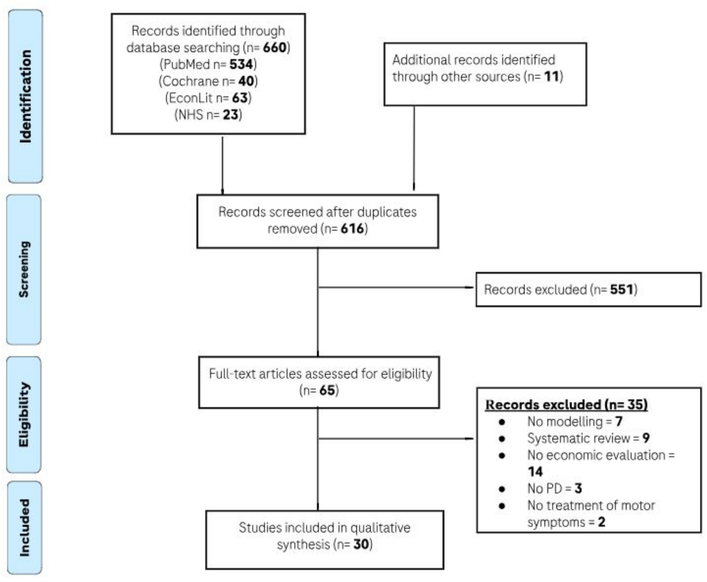
Methods

Systematic Literature Review (SLR) Update

We updated the Dams et al. (2023) systematic review of economic evaluations in PD using an artificial intelligence (AI)-assisted, human-in-the-loop protocol.

- **Databases:** Systematic searches were conducted across key databases (PubMed, EconLit, Cochrane, DARE, NHS EED, HTA) from July 2022 onward.
- **Supplementary searches**: Conference abstracts (Embase) were reviewed; bibliographic searches and searches using advanced keywords (PubMed, Google, Google Scholar) were also conducted.
- **Appraisal:** Studies were assessed for inclusion using the same PICOS criteria applied in the previous Dams (2023) SLR[2]. The quality of the included economic evaluations was critically appraised using Drummond's checklist.[3]

Figure 1: PRISMA flow diagram of included studies



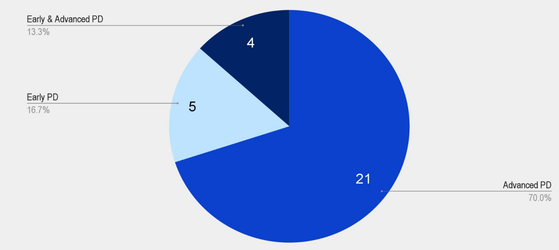
Dams (2023)[2] + Current update
NHS: National Health Service; PD: Parkinson's Disease; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

The resulting key components and gaps for future holistic economic evaluations were then reviewed and summarised.

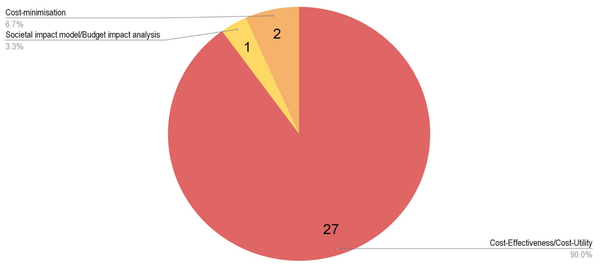
Results

The evidence base for this review comprised 30 economic evaluations. These evaluations were comprehensively reviewed for key insights, with 10 recent evaluations having been published between 2022 and 2025.[2,5-15]

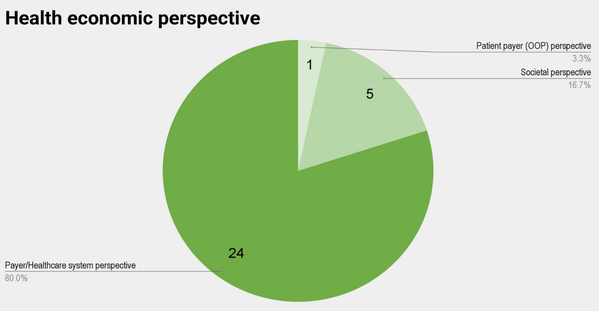
Disease stage



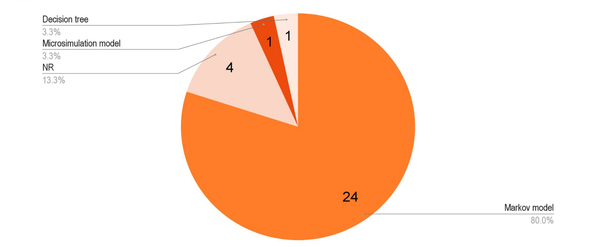
Type of economic analysis



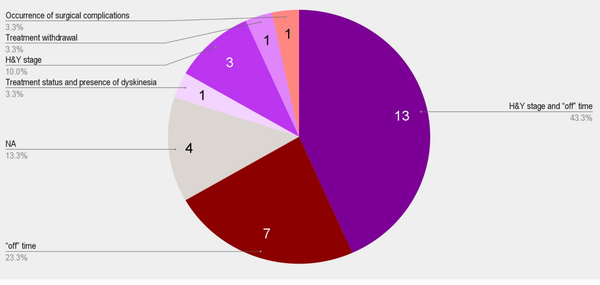
Health economic perspective



Type of model



Health states definition



Of the 30 studies, [2,5-15] only four full economic evaluations (cost-effectiveness analysis and cost-utility analysis) and one partial economic evaluation (budget impact analysis) claimed a **societal perspective**. Even within these models, the perspective was consistently narrow, primarily including patient direct medical/non-medical costs and indirect costs (productivity losses) but omitting patient out-of-pocket costs and all caregiver costs and utilities/disutilities (see Table 2).

Table 2: Societal perspective elements in economic evaluations

	Patient				Caregivers		
Study (Year), Analysis type, Country	**Direct costs (medical and non-medical)**	**Out of pocket costs (OOP)***	**Indirect costs****	**Utilities**	**Direct costs (OOP)***	**Indirect costs****	**Utilities**
Groenendaal (2010), USA, Cost-Effectiveness/Cost-Utility	✔	✘	✔	✔	✘	✘	✘
Fann (2020), Taiwan, Cost-Effectiveness/Cost-Utility	✔	✘	✔	✔	✘	✘	✘
Verschuur (2022), The Netherlands, Cost-Effectiveness/Cost-Utility	✔	✔	✔	✔	✘	✘	✘
Chaudhuri (2024), UK, Societal impact model / Budget impact analysis	✔	✔	✔	NR***	✔	✘	✘
Nyholm (2025), Sweden, Cost-Utility	✔	✘	✔	✔	✔	✘	✘

✔ Included ✘ Not included

*Out of pocket costs: travel, accommodation, etc. ** Indirect costs: for patient consider productivity loss due to illness (paid and unpaid work), while indirect costs of caregivers derived from informal care time/productivity loss. ***Not Reported: The societal impact model does not include utilities.

Non-Motor Symptoms: A Critical Gap in Existing EEs of PD

- Existing models severely **under-represent NMS** (e.g., cognitive, mood, sleep, urinary dysfunction, constipation, pain, and fatigue), despite these being core drivers of QoL burden and overall cost. [4,16]
- Models primarily rely on H&Y stages, which fail to capture NMS explicitly. Furthermore, even incorporating 'OFF' time captures only incomplete, indirect NMS effects via increased cost.
- Many models rely on broad disutilities, leaving sleep, fatigue, mood, and cognition only partially captured.[7,13,14]

Limitations Still Presented in Recent EEs of PD

- Over-reliance on traditional models (e.g., Markov structures) which struggle to capture complex PD dynamics.
- Failure to account for all relevant costs, especially non-hospital costs such as caregiver time/support and long-term care/nursing home costs.
- Persistent issues with data quality, including a lack of robust long-term clinical trial data, the use of historical/inconsistent data sources, and the absence of head-to-head evidence for comparators.
- Failure to account for patient heterogeneity or the true extent of loss of productivity.
- Use of simplifying assumptions, which affects the generalisability of inputs and leads to reliance on hypothetical effects or results requiring further validation.

Discussion & Conclusion

Based on recent findings, we propose a new conceptual framework that addresses **five critical aspects** to deliver robust and reliable economic evaluations in PD:

Acknowledge Full Disease Progression

-Model the full disease continuum, from diagnosis to late stage.
-Recognize patient heterogeneity.
-Incorporate realistic discontinuation and switching patterns.

Holistic Outcomes
(QoL impacts, patient-centered outcomes, incorporate both motor and NMS)

-Include objective measures (e.g., MDS-UPDRS).
-Account for the impact of NMS on utilities and costs for a comprehensive value assessment, especially for DMTs.

Societal Perspective

-Account for patient and caregiver costs and utilities, including out-of-pocket (OOP) expenses, productivity impacts (paid/unpaid work), and health spillover effects.

Treatment Effect Separation

-Model symptom control separately from progression to accurately assess DMTs.
-Test plausible effect-waning scenarios over short, medium, and long-term horizons.

Enhance Credibility by Developing a Comprehensive and Simple Model

-Design a simple, validated model that permits sensitivity analysis.
-Incorporate institutional care costs (e.g., nursing, home help, respite, equipment) and include all active comparators based on local guidelines.
-Conduct expert validation to ensure both clinical and economic credibility.

Future Challenges

The complexity of PD presents inherent modeling challenges:

- The need for face validity requires simplification of the highly heterogeneous PD progression.
- Robust data collection for model parameterization, especially across all NMS, remains a major source of uncertainty.
- While a societal perspective was recommended, additional elements like equity, health system capacity, environmental impacts of health technology, and gross domestic product (GDP) impacts were not fully integrated.

Next Steps: The proposed framework requires expert validation to ensure both its clinical and economic credibility.

References

1. Staunton H et al. J Parkinsons Dis. 2022; 12(1):137-151. 2. Dams J et al. Pharmacoeconomics. 2023; 41(10):1205-1228. 3. Drummond MF et al. Methods for the economic evaluation of health care programmes. Oxford university press; 2015. 4. Mammen JR et al. NPJ Parkinsons Dis. 2025; 11(1):65. 5. Chaudhuri KR et al. J Med Econ. 2024; 27(1):1267-1278. 6. Guo X et al. Neurosurgery. 2023; 92(4):812-819. 7. Kwak N et al. Clin Ther. 2024; 46(9):670-676. 8. Nyholm D et al. Neurol Ther. 2025; 14(3):801-812. 9. Oonk NGM et al. Eur J Clin Pharmacol. 2023; 79(2):289-297. 10. Pahwa R et al. Mov Disord. 2023; 38(12):2308-2312. 11. Verschuur CVM et al. J Parkinsons Dis. 2022; 12(7):2171-2178. 12. NICE/UK 2023. Foslevodopa–foscarbidopa for treating advanced Parkinson's with motor symptoms. Committee Papers. Available at: www.nice.org.uk/guidance/ta934. 13. NICE/UK 2023_1. Foslevodopa–foscarbidopa for treating advanced Parkinson's with motor symptoms. Public Meeting Slides. Available at: https://www.nice.org.uk/guidance/ta934/documents/1-2. 14. Canadian Agency for Drugs and Technologies in Health 2023. Foslevodopa Foscarbidopa (Vyalev). Available at: https://pubmed.ncbi.nlm.nih.gov/37782736/. 15. SMC 2024. Levodopa 20mg/mL + carbidopa monohydrate 5mg/mL + entacapone 20mg/mL intestinal gel (Lecigon®). Available at: https://scottishmedicines.org.uk/medicines-advice/levodopacarbidopaentacapone-lecigon-full-smc2507/. 16. Denham I et al. Front Public Health. 2024; 12:1351808.

Acknowledgements

This study was sponsored by F. Hoffmann-La Roche Ltd, Basel, Switzerland.
Author contact: Monica Ruoss (monica.ruoss@roche.com)