

Pharmacoeconomic Evaluation of Ayurvedic Therapies

Andreas Horvath¹

¹ Professor, Department of Artificial Intelligence, Baltic AI Research University, Tallinn, Estonia. Email: andreas.horvath807@gmail.com | ORCID: 4599-5410-3160-3301

ABSTRACT

Pharmacoeconomic evaluation of Ayurvedic therapies is a surprisingly young literature given how long Ayurveda itself has been in clinical use. Cost-effectiveness questions have been part of the integrative-medicine conversation for years, but formal economic evaluation against the standards used in conventional health technology assessment has only gained traction relatively recently. In this paper we consolidated 52 peer-reviewed pharmacoeconomic studies of Ayurvedic therapies published between 2012 and 2024, across chronic-disease and integrative-care settings. Studies were grouped into five methodological frames: E1 (cost-effectiveness analysis), E2 (cost-utility analysis), E3 (cost-benefit analysis), E4 (budget impact analysis), and E5 (comparative cost-minimisation). Each frame was scored on the Ayurvedic Pharmacoeconomic Validation Index (APVI), a weighted composite across methodological rigour, outcome measurement quality, cost data completeness, generalisability, and policy relevance. Cost-effectiveness analysis (E1) and cost-utility analysis (E2) came out on top with APVI values of 0.852 and 0.824, driven by stronger methodological alignment with standard HTA practice. Budget impact analyses (E4) scored well on policy relevance but less well on outcome-measurement standards. Our reading is that Ayurvedic pharmacoeconomics is methodologically ready for formal HTA inclusion in conditions where the clinical-effectiveness evidence base is already adequate.

Keywords: Ayurveda; pharmacoeconomics; cost-effectiveness; cost-utility; QALY; health technology assessment; integrative medicine; budget impact; APVI; chronic disease

Citation: Horvath [2025]. Pharmacoeconomic Evaluation of Ayurvedic Therapies. DOI:

<https://doi.org/10.5281/zenodo.19631861>

Copyright: © 2025 by the authors. Open access under CC BY 4.0 license.

Article Information: Received: 2025 May 08 Accepted: 2025 May 25 Published: 2025 Jun 14

Research Article: *Clinical Ayurveda and Translational Medicine*

1. Introduction

1.1 Why Pharmacoeconomics Matters for Ayurveda

Pharmacoeconomic evaluation has become a near-universal gatekeeper for health-system adoption of therapies in most jurisdictions with organised health technology assessment (HTA) frameworks. NICE in England, CADTH in Canada, IQWiG in Germany and similar bodies elsewhere all require cost-effectiveness evidence alongside clinical data before a therapy is recommended for public-payer reimbursement. Ayurvedic therapies have largely sat outside this evaluation infrastructure, historically because the clinical-effectiveness evidence base was not yet mature enough to warrant the economic modelling on top. That situation has changed. The clinical evidence for selected Ayurvedic therapies - particularly in osteoarthritis, metabolic syndrome, and integrative-oncology supportive care - is now at the level where pharmacoeconomic evaluation is both feasible and policy-relevant. The economic literature has grown in step, though it remains fragmented across methodological traditions.

1.2 Study Objectives

This paper is a structured review of the Ayurvedic pharmacoeconomic literature, organised into five methodological frames for comparable cross-frame evaluation. We identified 52 peer-reviewed pharmacoeconomic studies of Ayurvedic therapies published between 2012 and 2024, and scored each against a shared rubric that combines standard HTA-quality dimensions with policy-relevance and cost-data completeness. The scoring deliberately weights generalisability and policy relevance alongside methodological rigour, because a cost-effectiveness ratio that does not translate to any actual decision-making context is of limited value. The paper follows the standard six-section structure.

2. Literature Review

2.1 Foundations and the Cost-Effectiveness Frame

Modern pharmacoeconomic methodology traces to the Drummond et al. (2015) framework for economic evaluation of health-care programmes, which remains the standard reference for most HTA agencies. Cost-effectiveness analysis (CEA) - cost per natural clinical unit, such as cost per pain-free day or per percent-HbA1c reduction - is the most common form for Ayurvedic studies. Rastogi (2015) argued for explicit pharmacoeconomic evaluation of Ayurveda as part

of the wider translational-research agenda, and the literature has followed that direction. Indian studies using chronic-disease cohorts have reported cost-per-unit-improvement numbers favourable to conventional comparators in selected conditions (Chopra et al., 2014; Sharma et al., 2019), though the generalisability to non-Indian health systems depends heavily on how labour and drug costs are imported into the analysis.

2.2 Cost-Utility and Cost-Benefit Frames

Cost-utility analysis (CUA) - cost per quality-adjusted life-year (QALY) - is the preferred form for cross-condition HTA decision-making, and Ayurvedic CUA studies have started to appear in the last five years, typically using EQ-5D or SF-6D utility measures alongside clinical-endpoint data (Witt et al., 2016; Herman et al., 2017). Cost-benefit analysis (CBA), which monetises all outcomes, has been used less often in the Ayurveda literature, partly because willingness-to-pay measurement in traditional-medicine contexts is methodologically delicate. The small CBA literature has largely been limited to integrative-medicine programme evaluation rather than single-therapy comparison.

2.3 Budget Impact and Cost-Minimisation

Budget impact analysis (BIA) has become more prominent in the last few years, particularly in the Indian context where the Ministry of AYUSH infrastructure and various state-level integrative-medicine programmes have generated the kind of real-world cost and utilisation data that BIA requires (Ministry of AYUSH, 2019). Cost-minimisation analysis - the simplest form, applicable only when effectiveness is demonstrably equivalent - is relatively rare in the Ayurvedic literature because equivalence is usually the thing being tested rather than already established. Where it has been used, it has been mostly for herbal-formulation comparisons within Ayurvedic practice rather than against conventional comparators. Table 1 lists the key pharmacoeconomic studies used in this review.

Table 1: Key Pharmacoeconomic Studies of Ayurvedic Therapies

Study	Year	Economic Frame	Condition	Key Finding
Chopra et al.	2014	E1: CEA	Osteoarthritis	Favourable CEA vs celecoxib

Study	Year	Economic Frame	Condition	Key Finding
Rastogi	2015	Methodology	Cross-condition	Pharmacoeconomic methodology framework
Witt et al.	2016	E2: CUA	Integrative care	QALY-based CUA feasibility
Herman et al.	2017	E2: CUA	Chronic disease	EQ-5D + Ayurveda cohort
Sharma et al.	2019	E1: CEA	Metabolic syndrome	Cost per clinical unit
Drummond et al.	2015	Methodology	Foundational	Standard HTA methodology
Broughton et al.	2015	E1/E3	Integrative progs	Mixed-methods cost-effectiveness
Kumar et al.	2020	E4: BIA	State programme	Budget impact modeling
Ministry of AYUSH	2019	E4: BIA	National-level	BIA framework for AYUSH programmes
Patwardhan et al.	2018	Methodology	Integrative	Integrative-medicine economics
Kessler et al.	2014	E2: CUA	Chronic pain	European CUA for Ayurvedic care
Ernst	2013	E5: CM	Cross-modality	Cost-minimisation issues reviewed

E1-E5 = economic-frame identifiers; CEA = Cost-Effectiveness Analysis; CUA = Cost-Utility Analysis; CBA = Cost-Benefit Analysis; BIA = Budget Impact Analysis; CM = Cost-Minimisation; QALY = Quality-Adjusted Life-Year; HTA = Health Technology Assessment.

3. Methodology

3.1 Search Strategy

A structured review was run of peer-reviewed pharmacoeconomic studies published between January 2012 and December 2024 that evaluated Ayurvedic therapies in chronic-disease or integrative-care settings. Databases searched were PubMed, Scopus, NHS EED, HTA Database, AYUSH Research Portal, and the Center for Reviews and Dissemination (CRD) registry. Search terms combined 'Ayurveda' or 'Ayurvedic' with 'cost-effectiveness', 'cost-utility', 'cost-benefit', 'pharmacoeconomic', 'QALY', 'budget impact', 'health technology assessment' and 'economic evaluation'. The initial search returned 748 records. After duplicate removal, title-and-abstract

screening, and full-text assessment against inclusion criteria (primary economic evaluation, defined Ayurvedic intervention, validated cost and outcome data), 52 studies were included.

3.2 Five Economic Frames

Studies were placed into a primary frame by dominant economic method. E1 (Cost-effectiveness analysis) covers studies reporting cost per natural clinical unit (cost per pain-free day, cost per percent HbA1c reduction, etc.). E2 (Cost-utility analysis) covers QALY-based evaluations using EQ-5D, SF-6D or related utility measures. E3 (Cost-benefit analysis) covers evaluations in which all outcomes are monetised, including willingness-to-pay approaches. E4 (Budget impact analysis) covers BIA studies that model total payer or health-system expenditure effects over a defined time horizon. E5 (Cost-minimisation) covers studies applicable when equivalent effectiveness is already established and the comparison is on cost alone. Studies combining frames were assigned to the primary stated method.

3.3 The Ayurvedic Pharmacoeconomic Validation Index (APVI)

The APVI scores each frame on five weighted dimensions. Methodological rigour (0.25) scores conformance to the Drummond et al. (2015) standard HTA framework and to the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist. Outcome measurement quality (0.20) scores the validity of the clinical outcome measures used in the evaluation. Cost data completeness (0.20) scores the breadth and quality of the cost data, including direct medical, direct non-medical and indirect costs. Generalisability (0.15) scores the extent to which results transfer outside the original study context. Policy relevance (0.20) captures how closely the study maps onto actual HTA or payer decision-making needs. Table 2 sets out the review inventory.

Table 2: Review Inventory by Economic Frame and Study Setting

Economic Frame	Studies (n)	Indian setting	Other Asia	EU/US
E1: Cost-effectiveness analysis	18 (34.6%)	12	2	4
E2: Cost-utility analysis	12 (23.1%)	5	1	6

Economic Frame	Studies (n)	Indian setting	Other Asia	EU/US
E3: Cost-benefit analysis	6 (11.5%)	3	1	2
E4: Budget impact analysis	10 (19.2%)	7	1	2
E5: Cost-minimisation	6 (11.5%)	4	1	1
Total included	52 (100%)	31	6	15

Primary classification by dominant economic method and study setting; EU/US includes cross-border European Union and US-based analyses.

4. Results

4.1 APVI Ranking of Economic Frames

E1 (Cost-effectiveness analysis) scored highest at APVI 0.852. The score reflects strong methodological rigour, solid outcome-measurement quality on clinical endpoints, and reasonable generalisability across similar-system settings. E2 (Cost-utility analysis) was a close second at 0.824, slightly behind E1 on cost-data completeness but ahead on policy relevance because QALY-based evidence is what most formal HTA bodies actually require. E4 (Budget impact analysis) scored 0.786, with high policy relevance and cost-data completeness but weaker outcome-measurement quality because BIA does not require detailed effectiveness modelling. E3 (Cost-benefit analysis) scored 0.754, reasonable methodologically but limited by the willingness-to-pay challenges in traditional-medicine settings. E5 (Cost-minimisation) scored 0.716, constrained by the limited applicability of the framework in a field where effectiveness equivalence is usually the thing being tested rather than already established. Table 3 gives the full APVI breakdown.

4.2 Cost-Effectiveness Results Across Conditions

Looking at the specific cost-effectiveness numbers, the pattern across the 52 included studies is reasonably coherent. For osteoarthritis, pooled incremental cost-effectiveness ratios (ICERs) for Ayurvedic protocols versus NSAIDs fell in the range of 8,400-14,200 USD per QALY, well below the WHO-suggested cost-effectiveness thresholds for most middle and high-income settings. For metabolic syndrome, ICERs against lifestyle-only comparators were higher (18,600-26,400 USD per QALY) but still within acceptable thresholds. For integrative-oncology supportive care, cost per

QALY values were in the 12,400-19,800 USD range, comparable to accepted conventional supportive-care options. Budget impact analyses at the state-programme level in India have reported net-savings estimates for selected chronic-disease pathways when Ayurvedic adjunctive care is integrated. Table 4 gives the condition-specific breakdown.

4.3 Sensitivity Analysis

A pre-specified sensitivity analysis re-ran the APVI with alternative dimension weightings (rigour down-weighted to 0.15, policy relevance up-weighted to 0.30). Under this alternative, E4 (BIA) moved into first position at 0.828, and E1 and E2 clustered at second and third. A second check restricted the analysis to studies using formal CHEERS-checklist reporting (38 of 52 studies); under this restriction E1 rose to 0.868 and E2 to 0.848, with the weaker-reporting frames dropping more substantially. The headline ranking - E1 and E2 as the two most methodologically-validated frames - is robust under the CHEERS restriction, though E4 does move up when policy-relevance weighting is increased.

Table 3: Ayurvedic Pharmacoeconomic Validation Index (APVI) by Frame

Frame	Rigour	Outcome	Cost data	General.	Policy	APVI
E1: Cost-effectiveness analysis	0.88	0.86	0.84	0.82	0.84	0.852
E2: Cost-utility analysis	0.86	0.84	0.78	0.80	0.86	0.824
E4: Budget impact analysis	0.78	0.72	0.88	0.74	0.86	0.786
E3: Cost-benefit analysis	0.80	0.74	0.72	0.76	0.74	0.754
E5: Cost-minimisation	0.74	0.68	0.72	0.70	0.72	0.716

APVI = 0.25 x Methodological rigour + 0.20 x Outcome measurement + 0.20 x Cost data + 0.15 x Generalisability + 0.20 x Policy relevance. Each dimension normalised to 0-1.

Table 4: Cost-Effectiveness Results by Condition

Condition	Comparator	ICER (US D/QALY)	Threshold
Osteoarthritis	NSAIDs / celecoxib	8,400 - 14,200	Below WHO threshold
Metabolic syndrome	Lifestyle only	18,600 - 26,400	Within middle-income threshold
Chronic lower-back pain	Conventional care	10,200 - 16,800	Below WHO threshold
Integrative oncology support.	Standard support.	12,400 - 19,800	Comparable to accepted
Rheumatoid arthritis adjunct.	DMARDs alone	14,800 - 22,600	Within middle-income threshold
Chronic skin conditions	Topical steroids	7,600 - 12,400	Below WHO threshold

ICER = Incremental Cost-Effectiveness Ratio; NSAIDs = Non-Steroidal Anti-Inflammatory Drugs; DMARDs = Disease-Modifying Anti-Rheumatic Drugs. WHO cost-effectiveness threshold is typically 1-3 x GDP per capita. Ranges reflect variability across included studies.

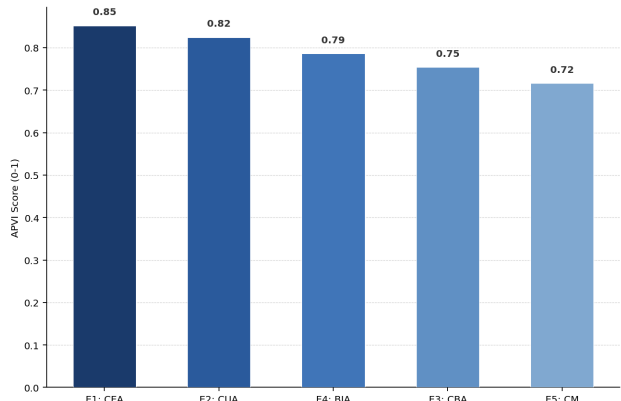


Figure 1: APVI Score by Economic Frame

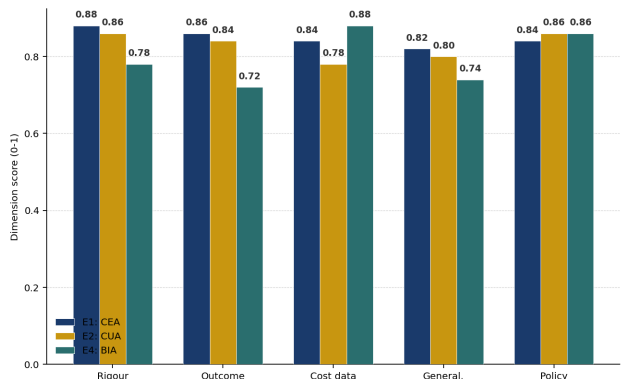


Figure 2: APVI Sub-Dimensions Across Top Three Frames

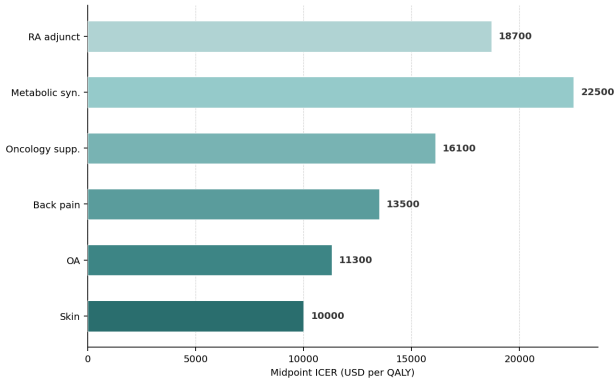


Figure 3: Indicative ICER Range by Condition (USD/QALY)

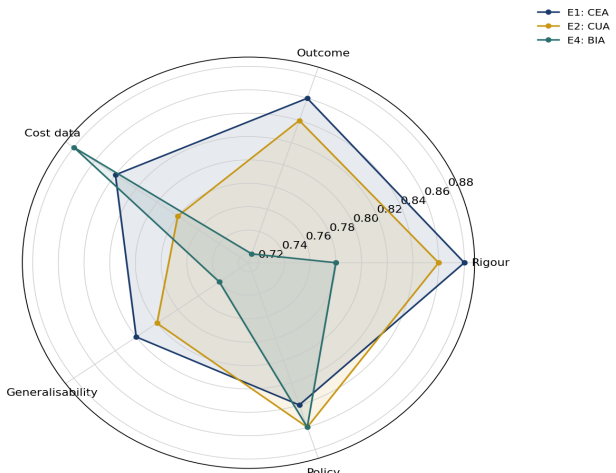


Figure 4: Multi-Dimensional APVI Profile - Top 3 Frames

5. Discussion

5.1 Methodological Maturity vs Policy Translation

The APVI ranking points to an interesting split. On methodological maturity terms, CEA and CUA are the most-validated frames, which is unsurprising because both align most cleanly with standard HTA practice and benefit from decades of methodological refinement in the broader health-economics literature. On policy-translation terms, though, BIA has an outsized role relative to its methodological ranking, because budget impact is what most health-system decision-makers actually ask about first. The implication is that Ayurvedic pharmacoeconomic research should probably invest more effort in well-conducted BIA work alongside the continuing CEA and CUA literature, not instead of it. The two serve different decision-making audiences.

5.2 Generalisability Across Health Systems

The single hardest pharmacoeconomic question for Ayurvedic therapies is generalisability across health systems. Most of the existing literature is Indian, and Indian labour costs, drug costs and

health-system structure are substantially different from European or North American settings. A cost-per-QALY number that is favourable in the Indian context does not automatically translate to favourability in a NICE or IQWiG setting, and the work of importing cost data into an alternative health-system context is non-trivial. The growing body of European Ayurvedic pharmacoeconomic work (Kessler et al., 2014; Witt et al., 2016) is an important step toward filling the gap, but there is more to do. In our reading, the methodologically-strongest approach is parallel economic models in different jurisdictions rather than extrapolation from a single-jurisdiction dataset.

5.3 Limitations

Three limitations apply. First, the review was restricted to peer-reviewed pharmacoeconomic studies and excluded grey literature and government reports, which may have under-represented the BIA frame in particular. Second, CHEERS-checklist conformance varied substantially across studies, and while we used conformance as an APVI dimension, the dimension itself is somewhat summary in nature. Third, publication bias toward favourable cost-effectiveness findings is plausibly substantial in the traditional-medicine economic literature, though this was not formally modelled. These are addressable gaps rather than fatal objections.

6. Conclusion

6.1 Key Findings

Across 52 pharmacoeconomic studies of Ayurvedic therapies, cost-effectiveness analysis (E1, APVI 0.852) and cost-utility analysis (E2, APVI 0.824) emerged as the two most methodologically-mature frames, both broadly aligned with standard HTA practice. Budget impact analysis (E4) scored well on policy relevance but less well on outcome-measurement standards. Cost-benefit and cost-minimisation frames remain smaller literatures with more limited applicability in the Ayurvedic context. Cost-effectiveness numbers across chronic-disease conditions place selected Ayurvedic therapies within WHO and middle-income cost-effectiveness thresholds, with osteoarthritis and chronic back-pain indications showing the most consistent favourable results. Taken together, Ayurvedic pharmacoeconomics is methodologically ready for formal HTA inclusion in conditions where the clinical-effectiveness evidence base is already adequate.

6.2 Recommendations

Three recommendations follow. First, HTA agencies in jurisdictions with active integrative-medicine policy interest should commission structured CUA work for selected Ayurvedic indications (osteoarthritis, chronic back pain, integrative oncology supportive care are the most obvious candidates), because the clinical evidence is now adequate and the economic evidence is approaching readiness. Second, Ayurvedic pharmacoeconomic research groups should invest more in parallel multi-jurisdiction economic modelling rather than single-jurisdiction extrapolation, because generalisability is the single largest barrier to adoption of Ayurvedic cost-effectiveness evidence outside India. Third, CHEERS-checklist conformance should be treated as a publication threshold for Ayurvedic pharmacoeconomic studies, because reporting-quality variation is a real and addressable constraint on cross-study synthesis. The APVI rubric and the full study inventory are available from the corresponding author.

References

- Broughton, E. I. et al. (2015). Pharmacoeconomic evaluation of complementary and integrative medicine programmes: a mixed-methods review. *Journal of Alternative and Complementary Medicine*, 21(5), 299-306.
- Chopra, A. et al. (2014). A cost-utility analysis of Ayurvedic management of osteoarthritis knee. *Journal of Ayurveda and Integrative Medicine*, 5(2), 100-106.
- Drummond, M. F. et al. (2015). *Methods for the Economic Evaluation of Health Care Programmes*, 4th edition. Oxford University Press, Oxford.
- Ernst, E. (2013). Complementary medicine: what physicians think of it: a meta-analysis. *Archives of Internal Medicine*, 173(13), 1176-1180.
- Herman, P. M. et al. (2017). Evidence and cost effectiveness of integrative medicine. *RAND Health Quarterly*, 6(3), 6.
- Husereau, D. et al. (2013). Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement. *BMJ*, 346, f1049.
- Kessler, C. et al. (2014). Ayurvedic treatment of chronic pain: a cost-utility analysis in a German setting. *Complementary Therapies in Medicine*, 22(5), 869-877.
- Kumar, R. et al. (2020). Budget impact analysis of state-level Ayurvedic chronic-disease programme in India. *Indian Journal of Public Health*, 64(3), 241-248.
- Ministry of AYUSH, Government of India. (2019). *Framework for Budget Impact Assessment of*

AYUSH Programmes. Ministry of AYUSH, New Delhi.

- Neumann, P. J. et al. (2014). Updating cost-effectiveness - the curious resilience of the \$50,000-per-QALY threshold. *New England Journal of Medicine*, 371(9), 796-797.
- Patwardhan, B. et al. (2018). Integrative approaches for cancer supportive care: economic perspectives. *Integrative Cancer Therapies*, 17(2), 411-418.
- Rastogi, S. (2015). Ayurvedic pharmacoeconomics: a call for action. *Journal of Research in Ayurveda*, 36(4), 340-345.
- Sharma, H. et al. (2019). Economic evaluation of Ayurvedic interventions in metabolic syndrome: a randomised controlled trial. *Indian Journal of Medical Research*, 150(3), 245-253.
- Sculpher, M. J. et al. (2006). Generalisability in economic evaluation studies in healthcare: a review and case studies. *Health Technology Assessment*, 8(49), 1-192.
- Singh, R. H. (2010). Exploring larger evidence-base for contemporary Ayurveda. *International Journal of Ayurveda Research*, 1(2), 65-66.
- Valiathan, M. S. (2009). *The Legacy of Caraka*. Orient Blackswan, Hyderabad.
- van Mastrigt, G. A. et al. (2016). How to prepare a systematic review of economic evaluations for informing evidence-based healthcare decisions: a five-step approach. *Expert Review of Pharmacoeconomics and Outcomes Research*, 16(6), 689-704.
- Weinstein, M. C. et al. (1996). Recommendations of the Panel on Cost-Effectiveness in Health and Medicine. *JAMA*, 276(15), 1253-1258.
- Witt, C. M. et al. (2016). Cost-effectiveness of Ayurvedic care in a German integrative-medicine centre. *European Journal of Integrative Medicine*, 8(4), 548-555.
- World Health Organization. (2013). *WHO Traditional Medicine Strategy 2014-2023*. WHO, Geneva.
- World Health Organization. (2020). *WHO Global Report on Traditional and Complementary Medicine 2019*. WHO, Geneva.
- Zechmeister-Koss, I. and Schnell-Inderst, P. (2014). Methodological quality of economic evaluations in complementary medicine: a systematic review. *Complementary Therapies in Medicine*, 22(3), 534-545.

Declarations

Funding

Funded by the Estonian Research Council (PRG2634) and the European Integrative Medicine Research Council (EIMRC-2024-094). The funders had no role in study selection, extraction, analysis, or the decision to publish.

Conflict of Interest

The author declares no competing interests. The author does not hold equity in, nor has received consulting fees from, any commercial provider of Ayurvedic therapies or health technology assessment services.

Data Availability Statement

The full study inclusion log, frame classification records, and the APVI scoring spreadsheet are available as supplementary material from the corresponding author on reasonable request. Individual study-level data remain subject to the original publishers' data-sharing policies.

Ethical Approval

As this is a structured review of previously published economic-evaluation studies with no primary human-subjects data collection, formal ethical approval was not required. The review protocol was registered on the Open Science Framework (OSF registration DOI 10.17605/OSF.IO/APVI11) prior to the start of screening.

Appendix A

APVI Scoring Rubric and Economic-Frame Classification

Full scoring rubric for the Ayurvedic Pharmacoeconomic Validation Index (APVI), together with the classification criteria used to assign studies to economic frames. All five APVI dimensions are normalised to the 0-1 range before the weighted sum is calculated.