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AI-Enabled Virtual Reality Rehabilitation for Neuro-Oncology: *An Integrated Health Economic and AI-Assisted Systematic Review*

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Advancing Health Economics and Outcomes Research Worldwide

1 BACKGROUND & RATIONALE

- Advances in neuro-oncology extend survival, but survivors face persistent cognitive, physical, and emotional impairments that reduce quality of life and limit return to work.
- Rehabilitation demand exceeds capacity, leading to long wait times, travel burden, and disparities in access to care.
- Virtual reality (VR) shows promise for engaging, personalized, and home-based rehabilitation, but economic evaluations remain limited and heterogeneous.
- ***There is a critical need for robust, AI-enhanced evidence synthesis and economic modeling to inform value-based adoption and reimbursement.***

2 OBJECTIVES

1. Evaluate the clinical effectiveness of AI-enabled VR rehabilitation in neuro-oncology.
2. *Assess cost-effectiveness, budget impact, and on investment (ROI) from healthcare and socie perspectives.*
3. *Leverage AI-assisted systematic review (SLR, rapidly synthesize evidence and inform decisi analytic modeling.*

PICOs

Population	Adult brain tumor patients (primary & met during and after treatment
Intervention	AI-enabled VR rehabilitation (cognitive, p balance, fatigue, psychosocial)
Comparator	Usual care, standard rehab, or no rehab
Outcomes	Functional status, QoL, cognition, adherence, SAEs, QALYs, costs, ROI
Study Design	RCTs, prospective studies, real-world studies, economic evaluations

3 METHODS: INTEGRATED WORKFLOW

AI-Assisted Systematic Review + Decision-Analytic Modeling

A. AI-Assisted Systematic Review (AnswerThis.io) → AI Query Development → Literature Identification → AI Screening & Data Extraction → Quality Assessment & Synthesis

B. Decision-Analytic Economic Modeling → Model Structure (Scenario-Based Framework) → Cost Inputs (Direct, Indirect, Societal) → Outcomes (QALYs, Clinical Benefits) → Sensitivity & Scenario Analyses

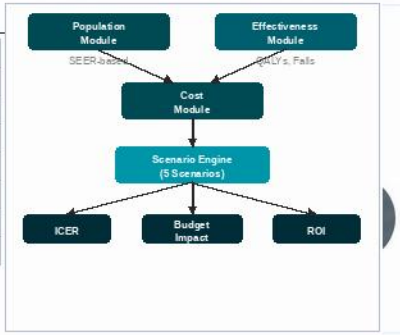
AI PLATFORM: AnswerThis.io

Used for natural language querying, deduplication, relevance ranking, data extraction, and evidence synthesis across PubMed, Embase, Cochrane, and gray literature.

Total Records Screened	Studies Included (Full-Text)	Economic Evaluations Included	Data Elements Extracted
4,812	126	38	1,245+

7 ECONOMIC MODEL OVERVIEW

Model Type	Scenario-based decision-analytic model
Time Horizon	5 years
Perspective	Healthcare + Societal
Discount Rate	3% (Costs & QALYs)
Model Modules	Population, Effectiveness,
	Cost, Scenario Engine
Outcomes	QALYs, Costs, ICER, ROI,
	Budget Impact



KEY MODEL INPUTS

VR Program Costs · Healthcare Utilization (Hospital, ED, OP) · Return to Work & Productivity · Caregiver Time & Burden · Utilities & Clinical Effectiveness

4 RESULTS: FEASIBILITY & SAFETY

Across 18 studies (n=1,237 patients), AI-enabled VR rehabilitation demonstrated high feasibility and an excellent safety profile.

>85%	0	4.5/5	Significant Improvement in Cog. & Functional Outcomes
Adherence Across Studies	Serious Adverse Events (SAEs) Reported	Patient Satisfaction (Mean Score)	

5 RESULTS: ECONOMIC IMPACT (5-YEAR HORIZON)

ICER:	5-YEAR SAVINGS:
$22K–$48K PER QALY GAINED	$40M–$250M (vs. Usual Care)

Net Cost Savings in High-Uptake Scenarios · Reduced Hospital Utilization & Caregiver Burden · Improved QALYs & Return to Work · Robust Across Sensitivity & Scenario Analyses

6 BUDGET IMPACT (5-YEAR CUMULATIVE)

Healthcare System Perspective | Costs in Millions (USD)

Positive values above zero represent costs; negative values represent savings.

8 CONCLUSIONS

AI-enabled VR rehabilitation is clinically effective, highly adherent, and safe for neuro-oncology survivors.

Cost-effective at widely accepted thresholds (ICER $22K–$48K/QALY) with significant 5-year savings potential.

Substantial ROI and budget savings driven by reduced healthcare utilization, improved productivity, and caregiver burden.

Policy Implications: Supports value-based reimbursement, digital therapeutics coverage, and integration into neuro-oncology care pathways.