Economic Evaluation of Digital Health Interventions in Oncology: A Targeted Literature Review

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Presented at ISPOR Europe 2024: November 17-20, 2024; Barcelona, Spain

INTRODUCTION

- Chimeric antigen receptor (CAR) T-cell therapy is a novel treatment for blood cancers that uses engineered T-cells to target tumor markers, such as CD19 and BCMA.
- Cost-effectiveness analysis (CEA) ensures efficient and equitable resource allocation in oncology, where treatment costs are high and outcomes vary.[1]
- Conducting CEA for digital health interventions (DHIs) in oncology is challenging due to diverse patient profiles, varying cancer stages, different treatment regimens, and uncertain treatment outcomes.[2,3]
- Oncology treatments are expensive, and economic evaluations like quality-adjusted life years (QALYs) and incremental cost-effectiveness ratios (ICERs) help assess the financial impact of DHIs,[3] which can improve outcomes and reduce hospital stays.[1]
- Evidence supports the cost-effectiveness of DHIs, such as telemedicine and mobile health applications,[2] though study heterogeneity complicates comparisons,[3] thereby resulting in the lack of unequivocal evidence.
- Synthesizing evidence from various studies identifies trends, research gaps,[2] and supports decision-making for DHI implementation in oncology.[2]

OBJECTIVE

To synthesize existing evidence on the CEA of DHIs in oncology.

MATERIAL & METHODS

Database Search: PubMed

Study Publication Period: 2019 to 2024

Keywords used: digital AND cancer AND ("cost effectiveness" OR CEA OR cost-utility analysis [CUA]).

Inclusion Criteria	Exclusion Criteria
Randomized controlled trials (RCTs), observational studies, systematic reviews, meta-analyses.	Non-digital health interventions (non-DHIs).
Studies that report CEA or CUA with ICER values.	Studies involving non-cancer populations.
	Studies without reported ICER values.

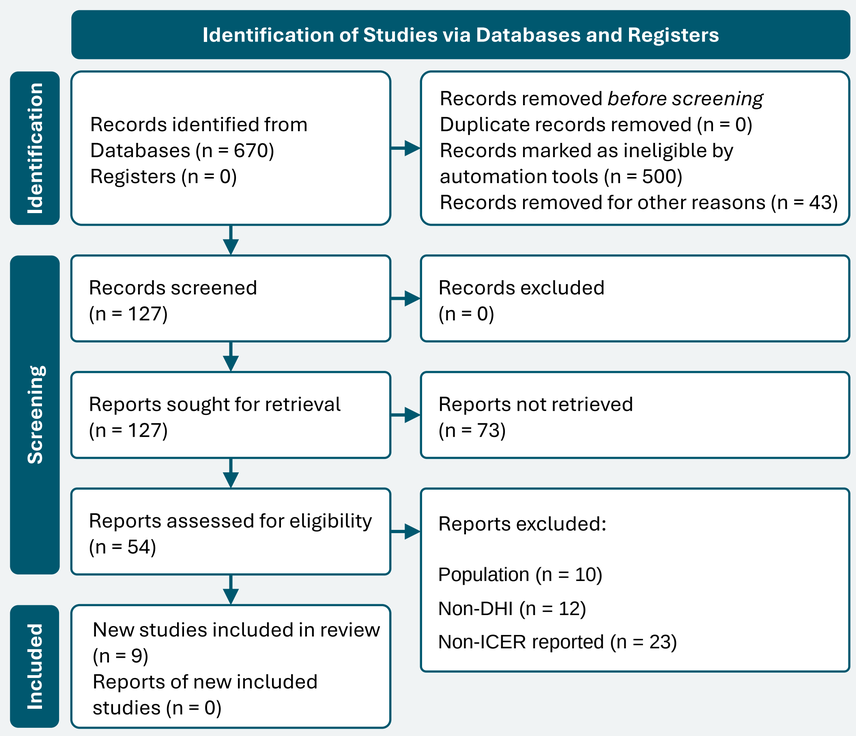
Data Extraction Elements:

- Demographics of study populations.
- Model characteristics (CEA and CUA frameworks).
- ICER values.
- Willingness-to-pay (WTP) thresholds.
- Key findings of the CEA and CUA analyses.

Reporting Guidelines: The methodology was compliant with the CHEERS-2022 checklist for reporting economic evaluations.

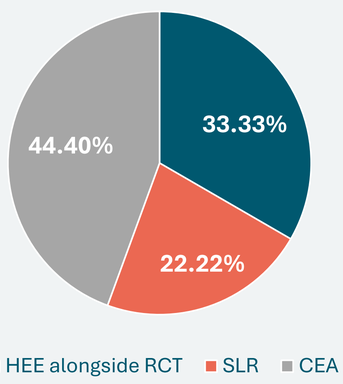
RESULTS

- A total of 670 records were retrieved from the structured search.
- After the first-pass screening of selected articles based on their relevance (Ti/Ab), 127 articles underwent eligibility-based screening.
- After second-pass screening of shortlisted articles, 22 articles were selected for the final analysis.



Report Characteristics

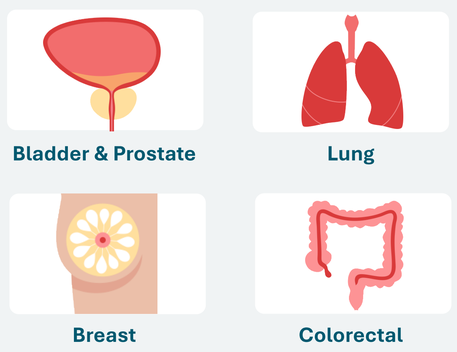
Study Type (n=9 reports)



- Of 9 reports, 7 and 2 reports focused on screening and behavioral interventions, respectively.

Record Characteristics

Affected Organs



- Of 7 individual CEA reports (excluding 2 SLRs), 3 were Markov model-based and remaining were non-model based real-time CEAs.

Cost-effectiveness Findings from Included Studies:

Patient Population	ICER/ICER Range (cost per QALY)	Willingness-to-pay Threshold	Perspective	Time Horizon
Behr, et al. 2023	US$10,000 to US$90,000	Not reported	Not reported	35 years
Song, et al. 2022	AU$21,147 (PSMA PET/CT vs CT+WBBS), AU$36,231 (PSMA PET/CT vs CT alone)	AU$50,000 per QALY gained	Australian healthcare	Not reported
Mujcic, Ajla; Blankers, Matthijs; Boon, Brigitte; Verdonck-de Leeuw, et al. 2022	US$ -1,158 (95% CI -1609 to -781)	Not reported	Societal	1 year
Mujcic, Ajla; Blankers, Matthijs; Boon, Brigitte; Berman et al. 2022	US$52,067 (95% CI US$32,515 to US $81,346) per reduced pack year	Not reported	Not reported	1 year
Rezapour, et al. 2022	Direct in-bore MRI-guided biopsy: €323 per QALY gained	Not reported	Not reported	Not reported
Chung, Wei-Shiuan et al. 2024	US$5,971.57/QALYs	US$33,004 (Gross Domestic Product of Taiwan in 2021) per QALY	Not reported	30 years
Cressman, et al. 2021	US$17,149 per QALY	US$100,000 per QALY	Government payer	Not reported
Machleid, et al. 2022	£25,536/QALY	£30,000/QALY	National Health Service England	3 months
Behr, et al. 2023	US$10,000 to US$90,000	Not reported	Not reported	35 years
Champion, et al. 2023	$14,462 in DVD group, $10,638 in DVD/PN group	Not reported	Not reported	Not reported

- Sensitivity analyses were conducted in 4 out of 7 studies (57.1%) with intervention costs and effectiveness being key drivers.

STRENGTHS & LIMITATIONS

Strengths

- Inclusion of diverse study types (HEEs, SLRs, CEAs) offers a broad view on cost-effectiveness across interventions.
- Focus on screening and behavioral interventions adds practical value to public health insights.
- Variety in models (Markov and real-time) accommodates different intervention complexities.
- Regional ICER comparisons reveal cost-effectiveness differences tailored to local healthcare systems.
- Region-specific WTP thresholds improve relevance for local decision-making.
- Sensitivity analysis in >50% of studies identify key ICER drivers, strengthening findings.

Limitations

- Lack of explicit WTP in some US studies limits cross-regional comparability.
- Missing or short time horizons may impact the long-term applicability of results.
- Differences in model approaches complicate direct CEA comparisons.
- Limited representation from lower-income regions may reduce global generalizability.

DISCUSSION

- ✓ Study types included 3 HEEs with RCTs, 2 SLRs, and 3 CEAs, focusing mostly on screening interventions.
- ✓ Among CEAs, 3 used Markov models and 4 were non-model, real-time CEAs, showing varied approaches.
- ✓ ICERs varied by region: US ($10,000–$90,000), Australia (AU$21,147–$36,231), Taiwan (US$5,972), UK (£25,536), Canada ($17,149).
- ✓ WTP thresholds reflected economic settings: AU$50,000 (Australia), £30,000 (UK), US$33,004 GDP-based (Taiwan), while some US studies lacked WTP.
- ✓ Sensitivity analyses in 57.1% of studies indicated intervention cost and effectiveness as main ICER drivers.
- ✓ Regional CEA variances reflect local healthcare costs, economic conditions, and resource allocations.
- ✓ WTP alignment with regional economic standards highlights the need for context-based CEA adaptation.
- ✓ Findings suggest that region-specific models are essential for accurate, multinational CEA comparisons.

CONCLUSIONS

- The cost-effectiveness of DHIs in cancer screening supports their integration into oncology care, enabling more accessible and potentially cost-saving screening solutions.
- There is a critical need for standardized CEAs across varied cancer populations and additional studies on DHIs for therapeutic purposes in oncology to guide evidence-informed policy and broaden DHI application in cancer care.

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Acknowledgment: We thank Reddikumar Reddy for his peer review and inputs for the development of this poster.

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