

An open systematic review on methodology, quality, and results of economic evaluations of breast cancer screening strategies

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Introduction

- Accurate health economic evaluations of breast cancer screening are crucial for determining cost-effectiveness, requiring suitable methodological approaches like empirical data or model-based analyses.
- We conducted an open systematic review focussing on methodological approach, quality, and results of existing health economic evaluations of breast cancers screening strategies. Results are made openly accessible which allows researchers to reuse.

Methods

PROTOCOL AND REGISTRATION

- A protocol was registered with PROSPERO (registration number: CRD42023423840)¹. The review was reported in accordance with the updated PRISMA 2020 statement: an updated guideline for reporting systematic reviews².

SEARCH STRATEGY

- A systematic search was performed in the MEDLINE, EMBASE, Web of Science, Econlit, and the international HTA database.
- The search included blocks for 1) breast cancer, 2) screening modalities, and 3) economic evaluations. The search was limited to studies published between 2013 and July 2023.
- Eligibility criteria were based on the PICO and study design (Table 1).

Table 1. Summary of eligibility criteria

Eligibility criteria (PICOS)
Population: Eligible women for breast cancer screening including general women or women with risk factors of breast cancer
Intervention: Clinical breast examination or any types of breast cancer imaging modalities for screening purpose including but not limited to: Mammography, Thermography, Ultrasound, Magnetic resonance imaging, Breast computed tomography, Photoacoustic Mammography, Positron Emission Mammography, Breast microwave imaging
Comparator: Any modality mentioned above and self-breast examination
Outcomes: ICER in terms of cost per QALY; or cost per DALY; or cost per life year saved/gained; or cost per event
Study design: Model-based and empirical-data-based cost-utility studies
Search date: January 1, 2013 to July 23, 2023

DALY, disability-adjusted-life-year; ICER, Incremental Cost-Effectiveness Ratio; QALY, quality-adjusted life year

STUDY SELECTION AND DATA EXTRACTION PROCEDURES

- Article screening and data extraction was done using the Pitts platform³. Two reviewers independently assessed all studies against the eligibility criteria, in case of disagreement they met and discussed until consensus.
- Quality assessment was done using the ISPOR checklist⁴ for model-based studies and the CHEC-extended checklist⁵ for empirical-data-based studies.
- Quantitative summaries of methodological aspects and quality assessments were performed.

OPEN ACCESS

- An openly accessible platform was developed using R shiny and R flex dashboard packages. The platform provides an interface for users to interact and download data based on their inputs⁶. All relevant documents related to this work are openly accessible through the Open Science Framework (DOI 10.17605/OSF.IO/V6W9A).

Results

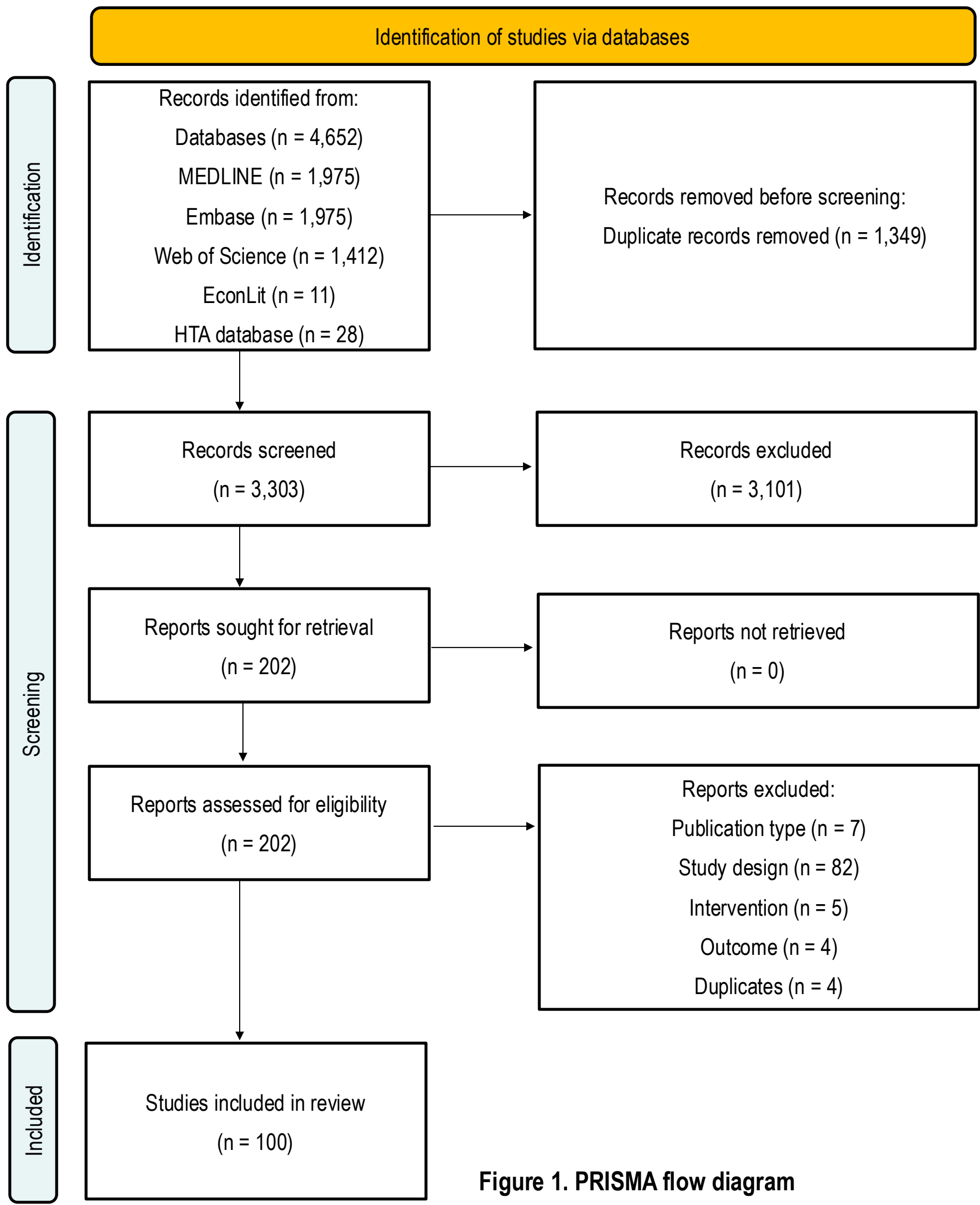


Figure 1. PRISMA flow diagram

SEARCH RESULTS

- In total 100 eligible studies were identified (Figure 1).
- Included studies were conducted in 27 countries, primarily focusing on women with unspecified risk factors, with common starting ages for screening between 50 and 59 years.
- Mammography was the most evaluated screening method in health-economic studies, either alone or with other techniques, featured in 87 studies as an intervention and 59 as a comparator, while other modalities like MRI, ultrasound, and tomosynthesis were less frequently studied.

Results

METHODOLOGICAL APPROACHES

- Among the 100 included studies, 73 employed model-based health-economic evaluations, 11 were based solely on empirical data, and 13 combined empirical data with extrapolation through a modelling approach. Three studies did not specify their methodological approaches (Table 2).

Table 2. Summary of methodological approaches used in the included studies.

Methodology aspect	Category	# studies (N=100)
Type of health economic evaluation	Model-based	73
	Empirical-data-based + model extrapolation	13
	Empirical-data-based	11
	Unspecified	3
Study design	Cost utility analysis	45
	Cost effectiveness analysis	35
	Cost effectiveness analysis, cost utility analysis	17
	Cost consequence analysis	3
	State-transition model	27
Model type	Combined model	14
	Discrete-event simulation	11
	Natural history model	11
	Others	10
Analytical approach	Cohort simulation	39
	Microsimulation	38
	Unspecified	3
Perspective	Health care sector	43
	Payer	26
	Societal	18
	Unspecified	18
	Patient and patient family	1
Sensitivity analysis	DSA only	44
	PSA + DSA	28
	Unspecified	16
	PSA only	10
	Other	2

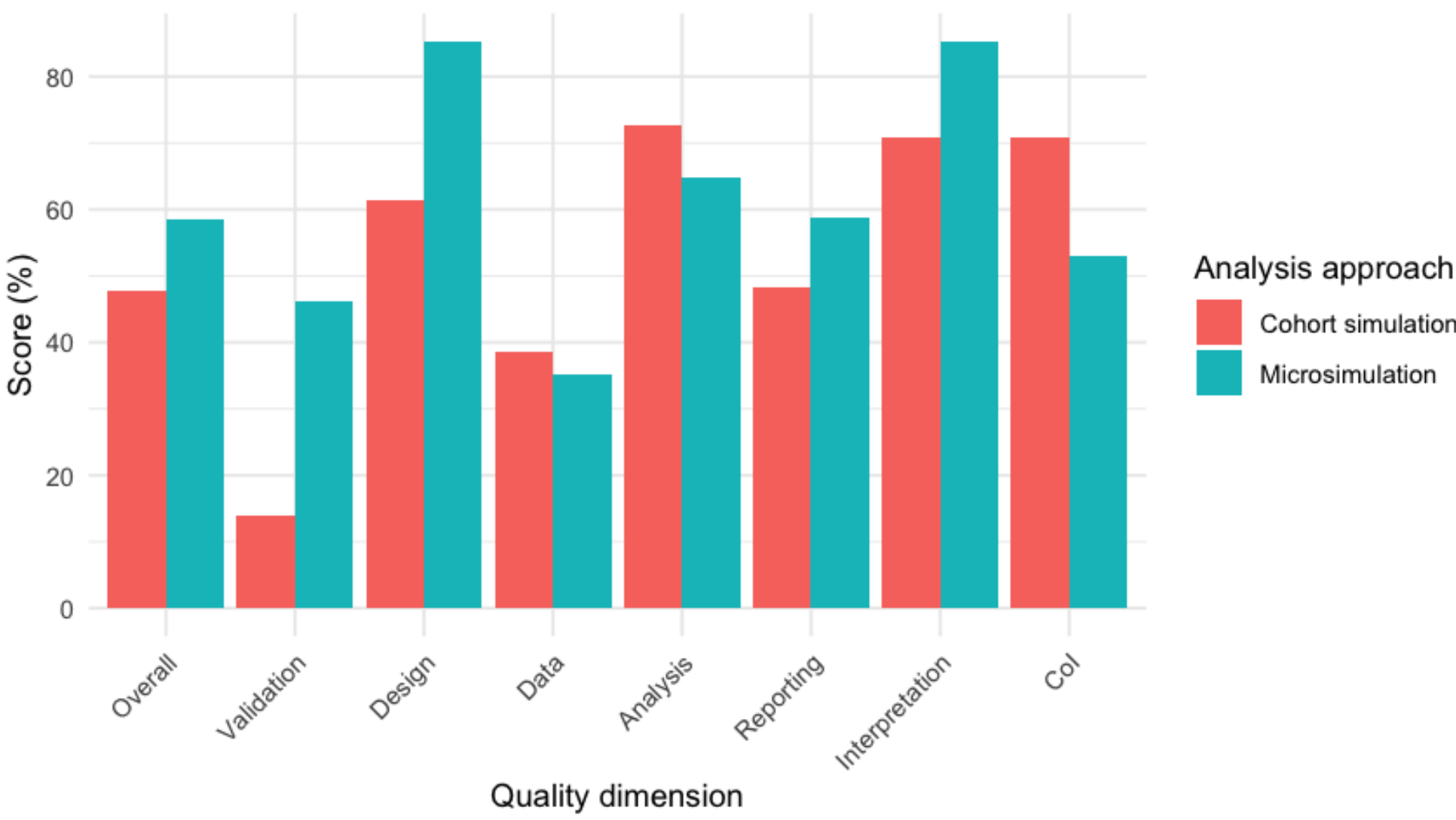


Figure 2. Quality assessment of model-based evaluations using ISPOR checklist, stratified by analytical approach

- Cohort simulation models slightly outperformed microsimulations in the domains of data, analysis, and conflict of interest. However, microsimulations demonstrated substantially superior performance in the domains of model validation, design, and interpretation resulting in a higher overall quality score compared to cohort simulations (58.5% vs 48.3%) (Figure 2).
- State-transition and natural history models showed the highest quality with the median score of 60% (Figure 3). Discrete-event simulations and combined models had a median score of 50%. Other model types, for example, solely decision tree, had the lowest scores (40%).
- Empirical-data-based studies combined with extrapolation achieved the highest quality with 65%. Solely empirical-data-based evaluations score slightly lower (60%). Studies with unspecified methods exhibited the lowest quality score (30%) (Figure 3).

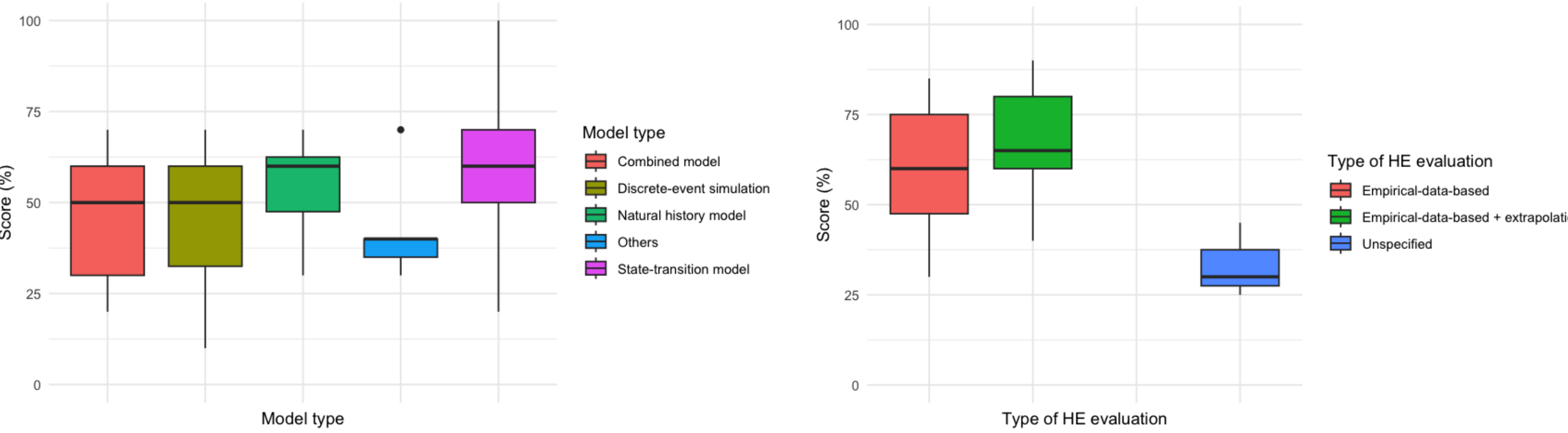


Figure 3. Quality score per model type based on ISPOR checklist⁵ (left) and empirical health economic evaluation based on CHEC-checklist (right).

Conclusion

- The overall quality of economic evaluations of breast cancer screening strategies is suboptimal, emphasizing the need for more rigorous and robust economic evaluations in this area.
- There is necessity for greater transparency, thorough validation, and comprehensive reporting in future health economic evaluations.
- The interactive open access platform we have developed provides a valuable resource for stakeholders, enabling them to access and analyze the included studies effectively. This tool supports informed decision-making and encourages further research by offering detailed insights into the evidence base.

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