Erasmus School of Health Policy & Management

MT56

Beyond the Hype - Economic Evaluation and Technology Readiness of Artificial Intelligence in Healthcare: Systematic Review and Meta-Analysis

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Background

- Recent reviews reveal inadequate quantity and quality of health economic evaluations (HEE) on medical AI.
- These studies have also highlighted methodological deficiencies as the main problem.
- An often-overlooked element is the maturity (developmental stage) of the AI under evaluation.

Aim

- Investigate the link between medical AI maturity and HEE quality.

Methods

- Search was conducted in 6 databases (EMBASE, MEDLINE, Web of Science, Cochrane Database, NHS EED, and Google Scholar) following PRISMA 2020 guidelines.
- Maturity of the medical AI was assessed using the Technology Readiness Level (TRL) scale (*Table 1*).
- HEE quality was evaluated using the CHEERS checklist and the rigor of the cost assessments, specifically examining whether AI's implementation and operational costs were accounted for.

Results

- Of 6503 articles, 69 met the selection criteria (*Table 2*).
- Most (75%) of the AI technologies were evaluated in the early development stages (TRL 4 and 5, *Table 3*).
- Notably, most HEE's overlooked the implementation and operational costs when assessing low TRL AI technologies (*Table 4 and Figure 1*).

*Table 1: Technology Readiness Level (TRL).**

**Adapted from NASA TRL into a clinically applicable scale by Fleuren et al. (Clinical Machine Learning Readiness Level).*

***TRL 9:** Model integration*

***TRL 8**: Clinical outcome evaluation*

***TRL 7:** Workflow implementation*

***TRL 6:** Real-time testing*

***TRL 5:** Model validation*

***TRL 3-4:** Model prototyping & Model development*

***TRL 2:** Proposal of model/solution*

***TRL 1:** Clinical problem identification*

Table 2: Overview of the 69 studies.

Variable	% (N)
Medical Field: [a]	
General medicine	14% (*10*)
Ophthalmology	11% (8)
Radiology	9% (6)
Cardiology	7% (5)
Other	58% (40)
Application type:	
Prevention and screening	37% (26)
Care process management	25% (17)
Clinical diagnostics	25% (17)
Automatic triage	13% (9)
AI model type:	
Neural network	45% (31)
Unknown	26% (18)
Ensemble	9% (6)
Expert system	9% (4)
Other	11% (8)
Year of publication:	
1996-2020	48% (33)
2021-2022	52% (36)

Table 3: Overview of the methodological specifics of the 69 studies.

Variable	% (N)
Type of HEE:	
CEA	55% (37)
CMA	40% (28)
BIA	4% (3)
Total Cost	1% (1)
Perspective:	
Healthcare	61% (42)
Hospital	22% (15)
Societal	10% (7)
Patient	3% (2)
Hospital + Societal	2% (1)
Healthcare+ Societal	2% (1)
Time Horizon:	
< 1 year	28% (19)
1 year	22% (15)
> 1 year	43% (30)
Not Reported	7% (5)
CHEERS (0-100%):	
Mean	61%
CMA mean	47%
CEA mean	71%
TRL (1-9):	
Low (TRL 1 - 5)	75%
High (TRL 6 - 9)	25%

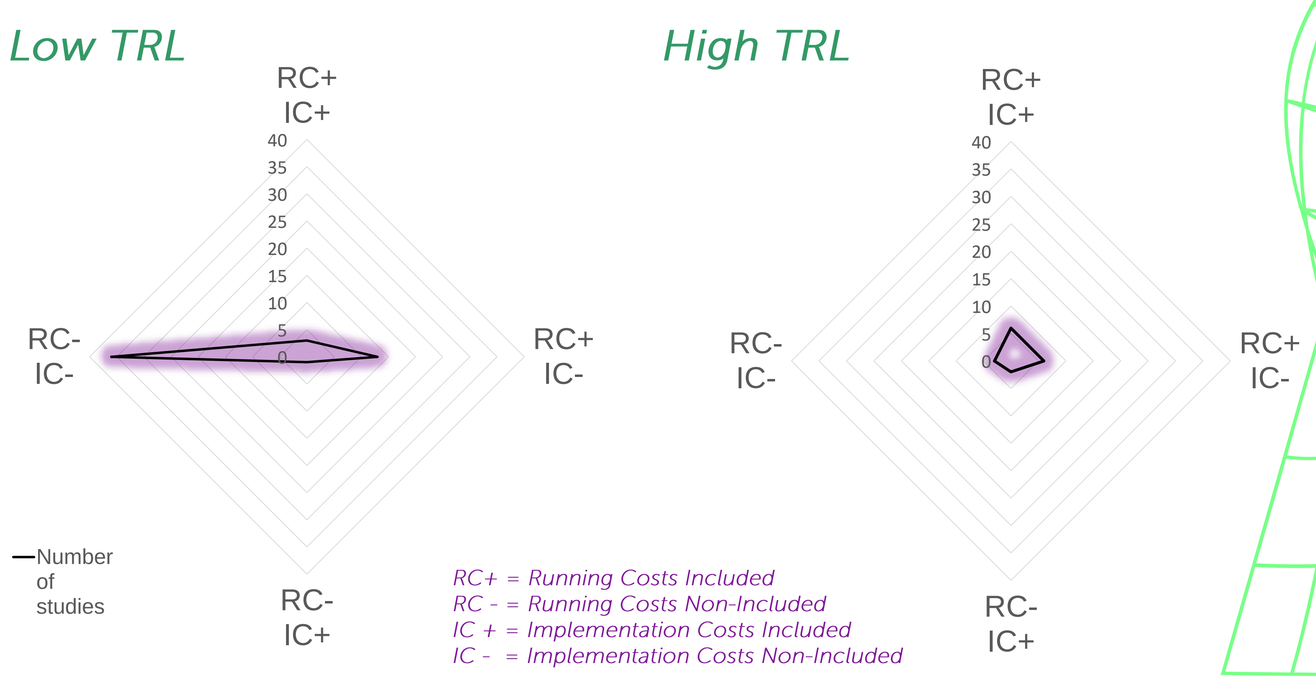
Table 4: Correlation between AI's implementation or operational costs and TRL.

	Low TRL % (N)	High TRL% (N)	OR [a]
Implementation Costs Not Included	92% (48/52)	53% (9/17)	10.15***
Operational Costs Not Included	69% (36/52)	29% (5/17)	5.26**

***Low TRL (TRL 1-5):** medical AI not tested or implemented in clinical settings*
***High TRL (TRL 6-9):** medical AI already tested or implemented in clinical settings*
***Implementation Costs:** investments in physical infrastructure, education expenditures & training, and outlays for data preparation*
***Operational Costs:** ongoing costs such as software licensing fees, hardware maintenance and associated utility expenses*

[a]=***p<0.001, **p<0.01

Figure 1: Correlation between AI's implementation or operational costs and TRL.



Key Take-Aways

- *TRL of the AI technology under evaluation should always be reported as it describes a technology's maturity at one point in time.*
- *Health economic evaluations of AI technologies often neglect implementation and operational costs.*
- *This oversight is especially true for relatively immature (Low TRL) AI technologies.*
- *Implementation and running costs should be incorporated in health economic evaluations for medical AI technologies.*

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