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Multi-country cost analyses of artificial intelligence diagnostics in radiotherapy

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Introduction

- Radiotherapy (RT) is widely incorporated in oncology care.
- RT can cause toxicities (e.g., fatigue, skin reactions, breast swelling, tenderness, lymphedema and fibrosis) which decrease HRQoL in the short or long term.
- Probability of experiencing toxicities varies by cancer stage, RT regimen, demographics, comorbities, genetics and medication exposure. In clinical practice population average probabilities are communicated to the patient.
- Prediction tools utilising artificial intelligence (AI) have the potential to estimate a more precise, individual probability of toxicities from RT, allowing for:
    - personalised treatment or toxicity-preventive measures through shared decision-making between treating physician and patient.
- Challenging clinical uptake since upfront investment in resources and time are needed to obtain, understand and utilise such AI tools with uncertainty about the outcomes.
- Health economic studies signal cost-effectiveness of introducing AI in breast cancer screening, guiding both technology development and value-based healthcare systems.

Objective

- Provide an adaptable, multi-country cost analysis framework for health technology assessment of implementing AI diagnostics in the RT treatment pathway.
- Applied to eligible breast cancer patients, reporting costs on current RT care with the AI tool added for the intervention treatment.

Methods

- Patients operated for invasive breast cancer pT1-4, N0-N3, M0 requiring RT for regional nodes
- Resource use of intervention (RT + AI tool) vs comparator (RT alone)
- Time horizon: RT period (approx. 2 months for 5-25 fractions) including development costs and implementation of AI tool in RT schedule
    - AI tool development (PRE-ACT): data management, explainable AI model training, RCT, stakeholder co-design, ethical aspects, economics, administration, valorisation
- Country cost guidelines (NL[1], UK[2]), in 2024 €/ £

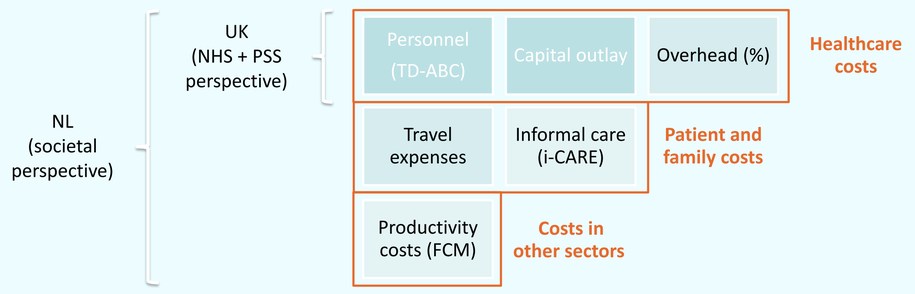

Figure 1: Costing methods.

Results (for 15 fractions)

- NL: cost increase of €37.77 (CI_{95}%: 16.09; 96.49) per treatment (15.7% non-personnel costs, 84.3% healthcare personnel costs)
    - Costs of RT + AI tool = €24,150.50 (CI_{95}%: 12,839.82; 42,830.99)
    - Costs of RT = €24,112.74 (CI_{95}%: 12,788.67; 42,779.64)
    - DOWSA: most impactful parameter was additional time needed for radiation oncologist to discuss the toxicity risk predictions with the patient (€16.66 to €47.56)
    - Scenario analyses (selection)
        - Adding whole genome sequencing: greatest impact on incremental costs, increasing the cost difference to €4,694.46 (CI_{95}%: 2,847.04; 7,105.13)
        - Country-specific instead of EU+UK+CH incidence: increased the cost difference to € 154.66 (CI_{95}%: 66.97; 372.62)
- UK: cost increase of €22.49.77 (CI_{95}%: 12.78; 35.27) per treatment
    - Costs of RT + AI tool = £2,604.13 (CI_{95}%: 1,579.41; 4,066.14)
    - Costs of RT = £2,581.64 (CI_{95}%: 1,558.54; 4,044.08)

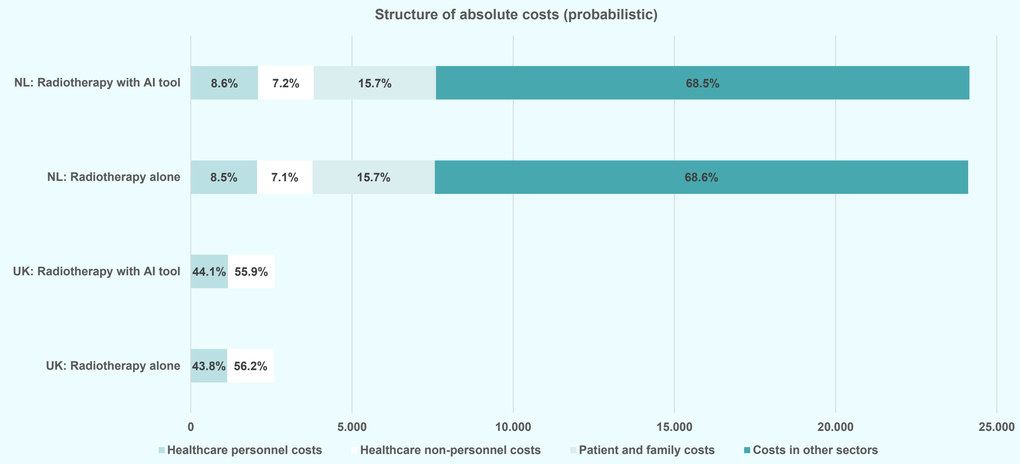

Figure 2: Structure of costs per strategy for 15 fractions (probabilistic, respective currency).

Conclusion

- AI-based RT toxicity prediction in breast cancer care amounts to €37.77 (UK: £22.49) more costs in contrast to RT alone.
- Adding information (testing) to AI tool may be more expensive than development itself, calling for careful consideration what should be added (diagnostic performance, patient burden, organisation of care, costs).
- AI tool costs dependent on defined target group size of eligible breast cancer population.

➢ Cost analysis framework for health technology (AI) useful in other indications requiring RT.

➢ Can inform health economic models, which can assess the potential impact of AI-based RT-induced toxicity prediction on costs and health outcomes.

References

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2. NICE health technology evaluations: the manual. NICE process and methods: National Institute for Health and Care Excellence; 2022.

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