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Faculty of Health, Medicine and Life Sciences

Adaptable framework for probabilistic cost-analyses in radiotherapy: *Application to proton and photon therapy for lung cancer in the Netherlands*

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Introduction

Literature on the comparative costs for proton and photon radiotherapy in the Netherlands is scarce (3). Accurately understanding these costs is essential for assessing cost-effectiveness.

Aim: To assess the costs incurred at a combined radiotherapy centre for the treatment of lung cancer with protons and photons.

Methods

Study Design: Cost-analysis framework developed in Microsoft Excel ©. Dutch Costing Guidelines followed. Societal perspective.

Population: Lung cancer patients treated with protons (**intervention**) or photons (**comparator**).

Sources: Lung cancer database, empirical measurements, literature, expert consultation, national registry, collective labour agreement.

Outcomes: Absolute costs, cost ratio (protons to photons), probabilistic sensitivity, deterministic one-way sensitivity, and scenario analyses (*Future* scenario: equating proton fraction time and treatment adaptations to photons, increased annual proton capacity to government cap).

Distinguished cost categories & methods:

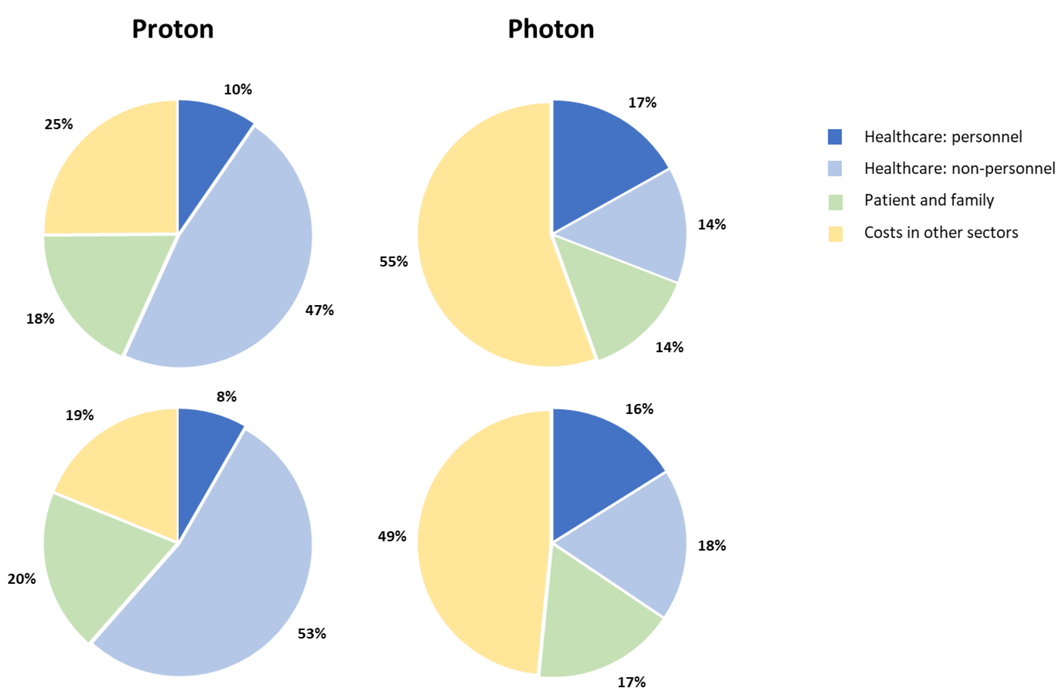
- ***Healthcare costs (personnel)***: Time-Driven Activity Based Costing
- ***Healthcare costs (capital outlays/overheads)***: Annuity amortisation, surcharge method
- ***Patient & family costs***: Reference price x resource use, replacement cost method
- ***Cost in other sectors*** (i.e., productivity costs): Friction cost method - friction period = 19.55 weeks

Results

	Proton	Photon	Absolute difference	Ratio (PT:XRT)
Healthcare Costs (probabilistic mean)				
*Non-personnel**				
20 fractions	€15,318	€2,028	€13,290	7.55
30 fractions	€22,977	€3,042	€19,935	7.55
Personnel				
20 fractions	€3,125	€2,447	€678	1.28
30 fractions	€3,594	€2,676	€918	1.34
Patient and family costs (probabilistic mean)				
20 fractions	€5,830	€1,945	€3,885	3.00
30 fractions	€8,415	€2,815	€5,599	2.99
Costs in other sectors (probabilistic mean)				
Productivity costs				
20 fractions	€7,687	€7,687	€0	1.00
30 fractions	€7,687	€7,687	€0	1.00
Final cost calculations				
20 fraction scheme	€31,960	€14,128	€17,832	2.26
30 fraction scheme	€42,673	€16,242	€26,431	2.63

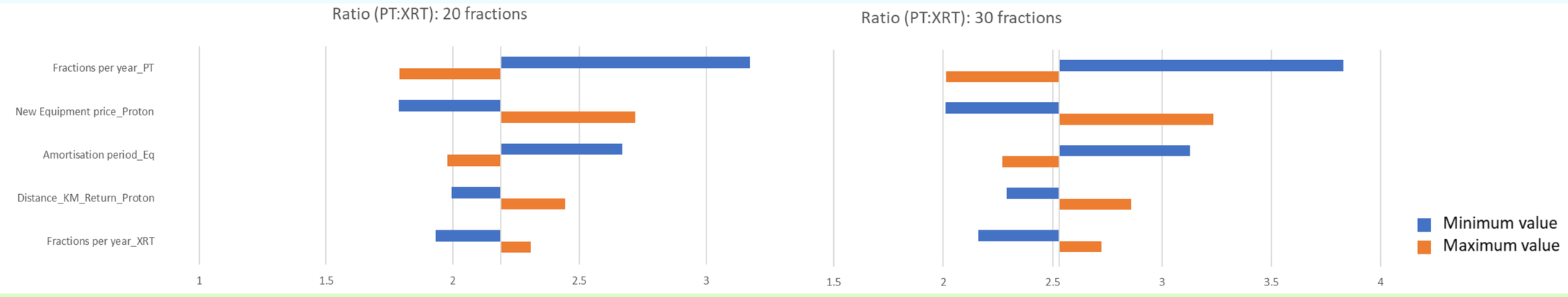
Overhead costs and capital outlays for land, buildings and medical equipment

20 fractions



30 fractions

- Total proton costs (mean[95% confidence interval]) were 2.26 (1.65-3.14) and 2.63 (1.92-3.64) times higher than photon costs for 20 and 30 fraction schedules, respectively. Absolute difference amounted to €17,935 (10,710-27,929) and € 26,557 (16,826-40,907).
- Non-personnel healthcare costs accounted for largest share in proton costs, with productivity costs accounting for highest share in photon costs. Top three proton to photon therapy cost ratio drivers: number of proton fractions; proton equipment investment, and; amortisation period (equipment).
- Future scenario reduced the cost differences (cost ratio) to € 12,791 (1.90) for 20 fractions and € 18,955 (2.17) for 30 fractions.



Conclusion

An adaptable framework was developed for cost analyses that can provide a foundation for assessing costs for alternative indications, centre settings and treatment schedules. Results revealed the largest cost deviations were those associated with overheads and capital outlays. Scenario analyses highlighted the potential for future developments in PT to reduce relative cost disparities.

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