Introduction of ultra-hypofractionation in breast cancer: implications for costs and resource use

1. Purpose/Objective: The objectives are twofold: (1) to calculate the costs of and resources consumed by different fractionation schedules in breast cancer, and (2) to model the consequences of adopting ultra-hypofractionation as the standard procedures for work times, costs, resource utilisation and throughput.

2. Material/Methods: Time-driven activity-based costing (TD-ABC) is applied to calculate the costs and resources consumed where the perspective of the radiotherapy department in adopted. Three fractionation schedules are considered: ultra-hypofractionation (5 x 5.2 Gy, UHF), hypofractionation (15 x 2.67 Gy, HF) and normofractionation (25 x 2 Gy, NF). Subsequently, a discrete event simulation (DES) model of the radiotherapy care pathway is developed and scenarios are compared in which the following factors are varied: distribution of fractionation schedules (100% adoption of UHF vs. 100% adoption of HF vs. 100% adoption of NF vs. mixed schedule (i.e. UHF for node-negative (68%) and HF for node-positive breast cancer), patient volume (low caseload – 250 patients per year vs. medium caseload – 500 patients per year vs. high caseload – 750 patients per year).

3. Results: A 100% application of UHF leads to reductions in mean work time and cost compared to a 100% application of HF (25% and 43%, resp.) and a 100% application of NF (43% and 61%, resp.). The mixed schedule also results in reductions in mean work time and cost in comparison to a 100% application of HF (18% and 30%, resp.) and NF (37% and 51%, resp.). These results can be attributed to a shorter treatment phase and an associated lower utilisation of the linac and radiation therapy technicians (RTTs). Both adopting UHF as the standard of care as the mixed schedule allows a treatment centre to reach a throughput of 750 patients per year with one linac and three RTTs. Treating 750 patients requires two linacs and four RTTs in the HF schedule and three linacs and six RTTs in the NT schedule.

4. Conclusion: Adopting UHF as the standard procedure for breast cancer leads to substantial work time and cost savings. Treating node-negative breast cancer patients with UHF and the remainder with HF provides similar, yet slightly lower savings. Both strategies entail a lower utilisation of linacs and RTTs and therefore permit radiotherapy departments to maximise throughput with a minimum of resources, assuming an equivalent clinical effectiveness in treatment schedules. This study illustrates the potential of combining DES with TD-ABC to minimise costs and optimise resource planning in radiotherapy.

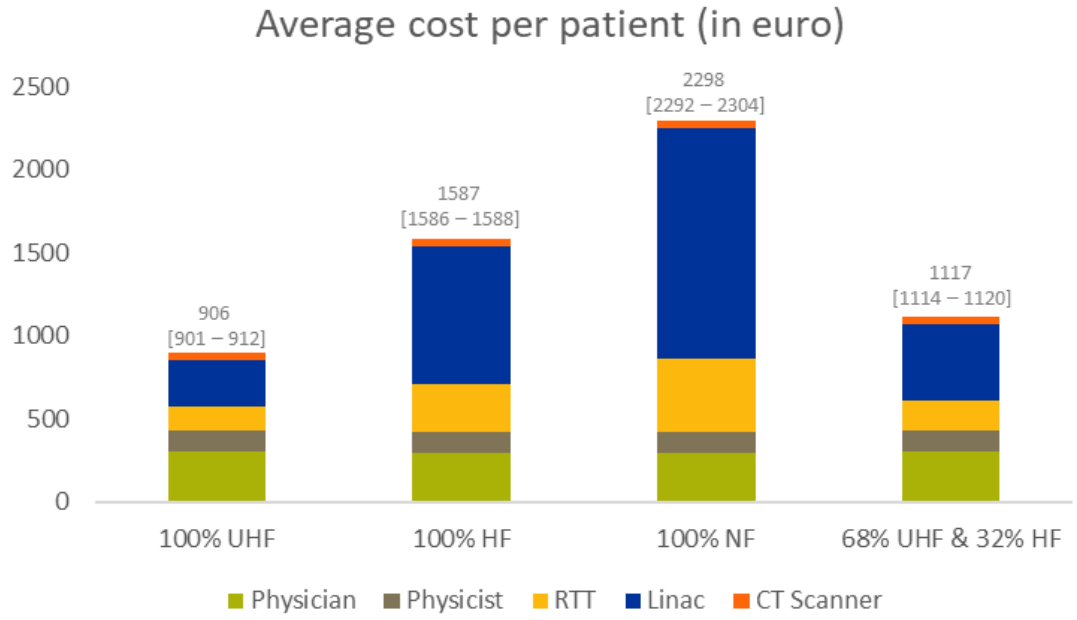

Fig. 1: Average cost per patient for different fractionation schedules divided up by resource. Total average cost is displayed above bars, with 95% confidence interval between brackets.