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Cost-consequence analysis of radiographer target volume online contouring for prostate MR-guided adaptive radiotherapy

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Purpose/Objective:

MRI guided radiotherapy (MRIgRT) using the Elekta Unity MR Linac (MRL) (Elekta AB, Stockholm, Sweden), has opened promising opportunity for hypofractionation, dose escalation and potential of reduced target volume margins in adaptive prostate radiotherapy. In conventional adaptive MRL workflows, the responsibility of online contouring of target volumes and OAR lies with the clinician, yet this approach poses challenges in terms of resource intensity. Alongside delegation of plan approval to physicists, a way to alleviate this is through a shift towards entrusting therapeutic radiographers (RTT) with the task of online target volume contouring.

Following a successful training programme and evaluation, this transition was implemented for prostate MRIgRT in 2021, requiring clinicians to contour fraction one only ⁽¹⁾. Releasing clinicians from this role has the potential to improve the machine capacity of the MRL, whilst increasing the scope of practice of the RTT. Our study aims to assess the impact, in terms of the costs and consequences, of RTT online target volume contouring versus clinician online contouring for prostate MRIgRT on the MRL.

Material/Methods:

A total of 296 fractions were analysed from 15 patients prescribed 60.0Gy/20#, with clinicians contouring 136 fractions and RTTs contouring 160. In addition, 74 fractions from 16 patients prescribed stereotactic 36.25Gy/5# were analysed, with clinicians contouring 59 fractions and RTTs contouring 15. Under the RTT contoured online workflow, the first fraction is contoured by the clinician, while the subsequent fractions are contoured by the RTTs. In the conventional workflow, all fractions are contoured by the clinicians. All stages of the online workflow were timed.

A cost-consequence analysis modelling the workflow of online adaptive prostate MRIgRT was conducted through a discrete event simulation (DES) that was implemented in Simul8, populated with workflow timing data. Input parameters for the DES model were estimated through distribution fitting in R. Unit costs were sourced from the PSSRU following economic evaluation analysis standards ⁽²⁾.

We modelled an annual cohort, to reflect the number of patients referred for prostate MRIgRT in one department for financial year 2022-23. This enabled us to make comparisons between RTT and clinician online contouring, as well as between 20 and 5 fraction regimens.

An additional analysis was conducted to demonstrate the potential increase in the MRL's annual capacity for prostate MRIgRT, as a result of increased RTT availability (40 hours per week) compared to clinicians (16.5 hours per week). Acknowledging MRL does not only deliver prostate MRIgRT and that RTT's need to be available for other treatment sites, we modelled the proportion of patients

treated on the MRL for prostate radiotherapy (53%) compared to other sites treated in the same year. For both scenarios, the workflow timing data was used to analyse use of clinician time.

Results:

For retrospective analysis of financial year 2022-2023, preliminary results of a cohort of 58 patients show there would be a total cohort saving of £80,866.74 in the 20-fraction regimen and £18,934.78 in the stereotactic 5-fraction regimen if fractions were contoured online by RTTs instead of clinicians. This translates to a per-patient cost reduction of £1394.25 for 20 fractions and £326.46 for 5 fractions. Transferring the role of contouring to RTTs from clinicians results in time savings for the clinicians and was equivalent to 693.12 hours for the 20-fraction schedule and 183.70 hours for the 5-fraction schedule.

In the additional analysis, that modelled the proportion of patients treated on the MRL for prostate radiotherapy (53%) compared to all other sites treated on MRL in the same year, the increased availability of RTT compared to clinicians resulted in 28% increase in capacity for prostate treatments. At this capacity with RTT availability, a cohort of 55 patients receiving 20 fractions or 221 patients receiving 5 fractions, RTT contouring demonstrated a total annual saving of £76,683.98 for 20 fractions treatment and £72,148.04 for 5 fractions. This would save clinicians 657.27 hours in the 20-fraction regimen and 699.95 hours in the 5-fraction regimen.

Conclusion:

Implementation of RTT target volume contouring for adaptive prostate MRIgRT is cost saving, demonstrated using both the actual number patients treated in one year on a MRL and the maximum proportion of prostate patients that could be treated over a year. Delegation of plan approvals to physicists and online contouring to RTTs, saves clinicians attending MRL, allowing their time to be utilised elsewhere. Furthermore, it expedites patient appointments, as they are not bound by clinician scheduling constraints, increasing machine capacity and availability for other treatment sites. Further analysis is to be conducted to conclude impact on increased machine capacity and improved patient access.

Keywords: MR Linac, Adaptive Prostate Radiotherapy, RTT

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