Towards Quantifying the Impact of Hypofractionation versus Standard Radiotherapy Treatment Regimens for Cancer on Costs, Workflow, and the Environment

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Background

Radiotherapy has a high environmental impact, treating around 120,000 UK cancer patients annually (50% of all cancer patients). Recent clinical trials show that shorter courses of radiotherapy are equally as effective as standard for tumour control and toxicity in many patient groups. Hypofractionation may significantly reduce the carbon footprint of a radiotherapy regimen, as 70% of this footprint is due to patients needing to travel to the hospital for their treatment. The process of delivering radiotherapy also has a carbon footprint.

Aim

To conceptualise and computationally implement a decision-analytic model to estimate the impact of delivering hypofractionation (shorter-course; 5 days) versus standard radiotherapy (15 - 20 days) for the treatment of cancer (breast and prostate) on hospital costs, workflow and environmental impact in a hospital setting in the United Kingdom (UK).

Methods

- Two rapid reviews that combined Boolean logic and bidirectional citation searching (2000 to 2025) of three databases (PubMed, MEDLINE, Google Scholar) to identify:
  - published decision-analytic models of the workflow for different radiotherapy regimens.
  - published examples of estimating the impact of radiotherapy regimens on healthcare costs and the environment.
- Semi-structured interviews with five experts (two oncologists; radiographer; physicist) to produce pathways of care for hypofractionation and standard radiotherapy.
- Model-conceptualisation process with four decision-analysts to inform the model type.
- One-to-one interviews with five experts (two treatment radiographers; two physicists; one treatment planner) to confirm the model structure and associated healthcare resources.
- Code an open-source discrete event simulation model (DES) using the R programming language.

Results

Nine studies were identified that each used a discrete event simulation to represent workflows. We identified **seven studies** that compared the environmental impact of hypofractionation versus standard treatment and **eight studies** that estimated the healthcare costs across different radiotherapy regimens.

Two pathways of care representing radiotherapy treatment workflows for prostate cancer (see Figure 1) and breast cancer (see Figure 2) were produced.

The staff and additional resources required for each stage of the treatment workflow were also identified (see Table 1).

Parts of treatment workflow	Radiation oncologist	Planning radiographer	Treatment radiographer	Practitioner	Medical physicist	Medical dosimetrist
Initial consultation	X					
Planning CT	X	X		X		
Contouring	X			X	X	
Developing/ reviewing treatment plan	X			X	X	X
Administering fractions			X			
Treatment delivery	X		X		X	

Table 1: Key staff involved in radiotherapy treatment workflow (breast and prostate cancer)

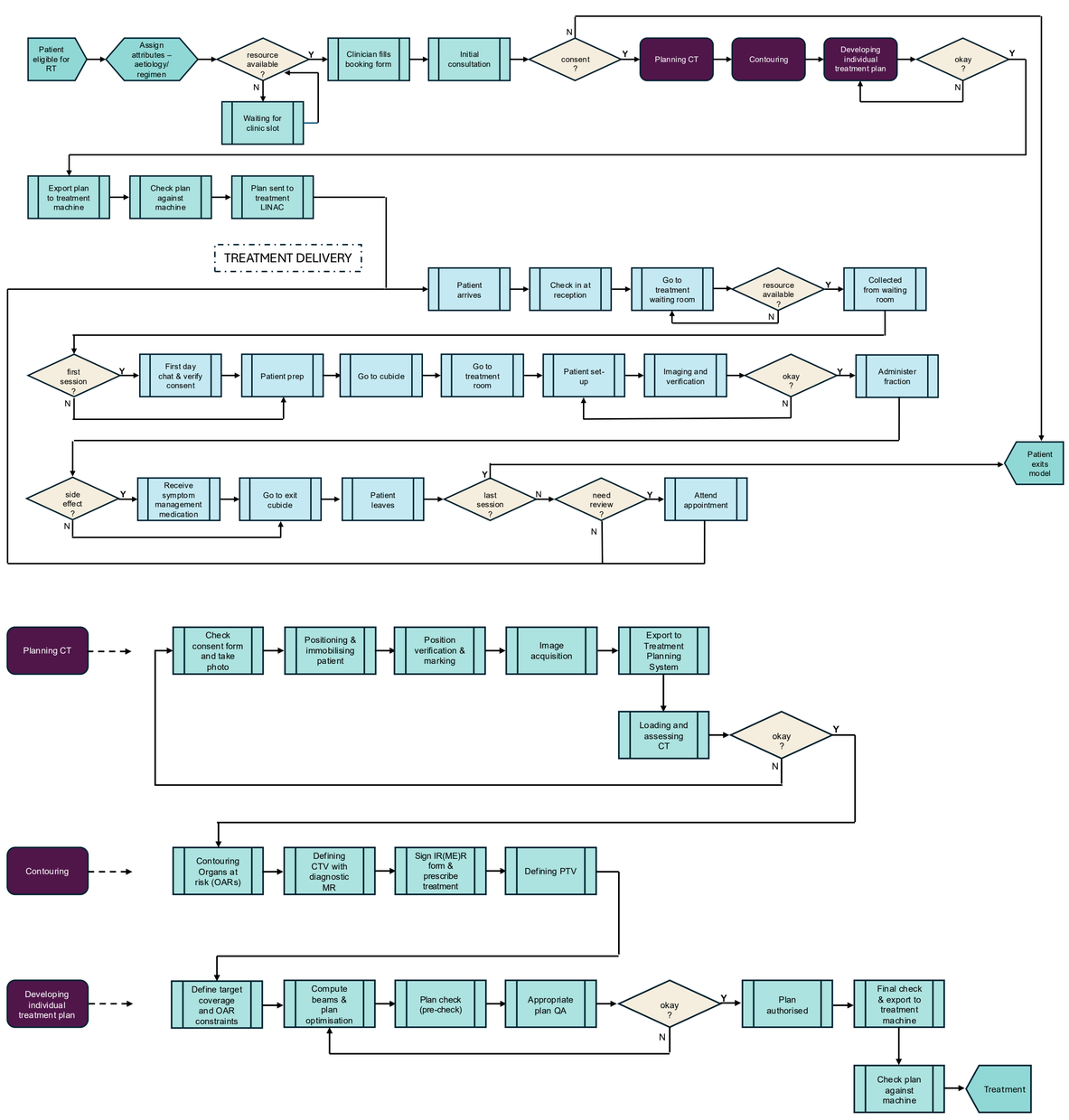

Figure 1: Prostate cancer treatment workflow

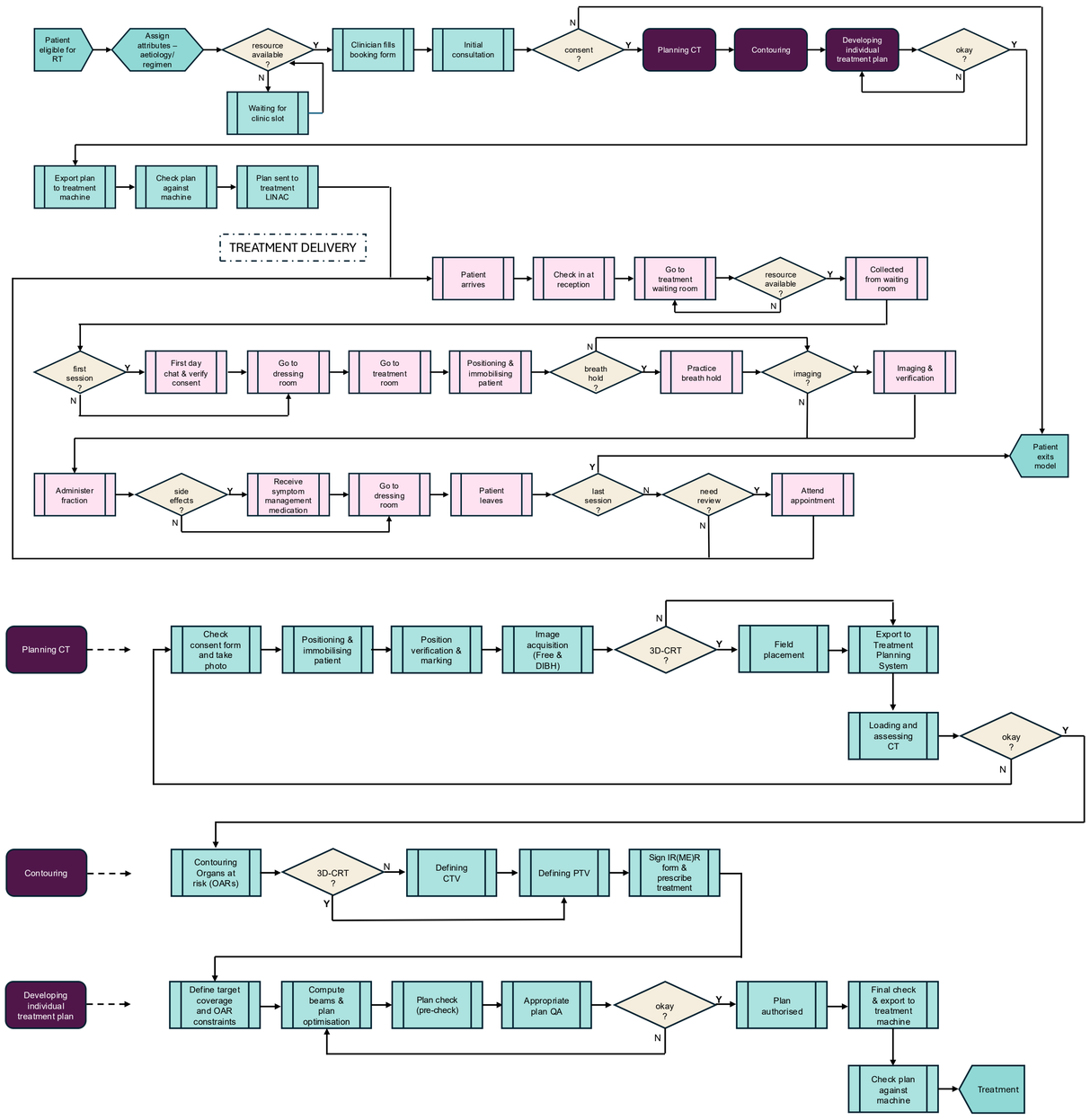

Figure 2: Breast cancer treatment workflow

Conclusion

The two discrete event simulation models produced in this study will be used to quantify the impact of hypofractionation on hospital costs, workflow and the carbon footprint when compared with standard radiotherapy treatment regimens for the two exemplar cancers (breast and prostate).

References

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