Cost-effectiveness analysis of IMRT for localized prostate cancer

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INTRODUCTION

Prostate cancer (PCa) is the fourth most common neoplasm in the world and the second most prevalent in men, accounting for approximately 10% of all neoplasms[1,2]. For Brazil in 2019, 68,220 new PCa cases were expected[1]. Furthermore, PCa also affects society through premature death and disability with economic consequences.

Intensity-modulated radiation therapy (IMRT) significantly decreases treatment toxicities and achieves better PSA relapse-free survival than that of the three-dimensional conformal radiation technique (3DCRT)[3]; additionally, IMRT is recommended for prostate treatment in the major international guidelines[4,5]. Until now, 3DCRT was regarded as the standard of care for PCa treatment in Brazil. Although the IMRT technique is available and performed in the Brazilian Public Health System (SUS), there are no economic evaluation studies that assess its potential use as a treatment for PCa.

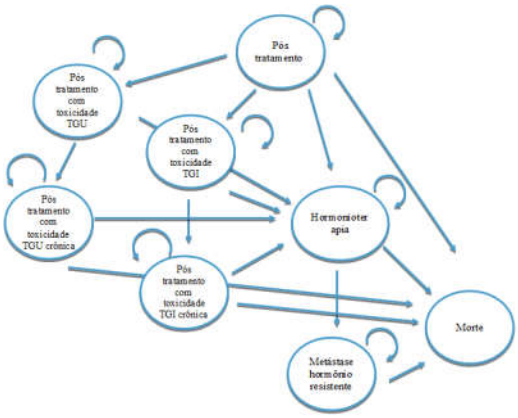
This study **aims** to compare the cost-effectiveness of IMRT versus 3DCRT for the treatment of clinically localized PCa in a hypothetical cohort of patients eligible for treatment in the Brazilian Public Health System.

METHODS

A Markov model was used to compare IMRT with 3DCRT for the treatment of clinically localized prostate cancer. From the perspective of Brazilian Public Health System, the target study population was a hypothetical cohort of men aged 60 to 75 years with clinically localized prostate cancer. The base case analysis assumed both techniques were delivered at a dose of 74 Gy to 76 Gy for intermediate-risk prostate cancer patients. The time horizon was ten years, and the cycle length of the model was one year.

The model was set up to include eight health states, according to a schematic representation (Figure 1).

Figure 1: Diagram of the eight health states for the transition model



Transition probabilities, toxicity rates, and utilities are based on the academic literature for IMRT and 3DCRT. We used the software TreeAge® Software Inc. to construct the model.

Direct medical costs that were considered, were divided into three categories: medicines, specific medical resources involved in care and procedures. All the outpatient costs directly included the care provided by the health system. The 3DCRT value increases by 22% compared to that of the IMRT technique. This rate is based on comparisons with the Brazilian Medical Association (AMB) and agrees with the difference calculated in another international cost-effectiveness study [6]

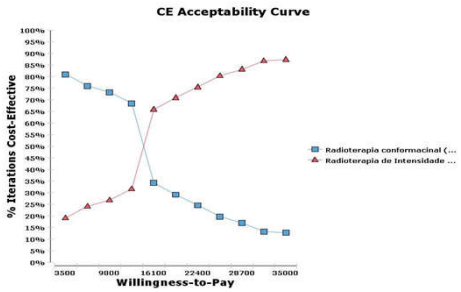
A probabilistic sensitivity analysis was performed based on the Monte Carlo simulation to construct a threshold of acceptability for incorporating the technology

RESULTS

IMRT as a treatment for PCa had an incremental cost of U$ 2,555.65 and an incremental effectiveness of 0.79. The model calculated an incremental cost-effectiveness ratio of U$ 3,235 per QALY gained for IMRT.

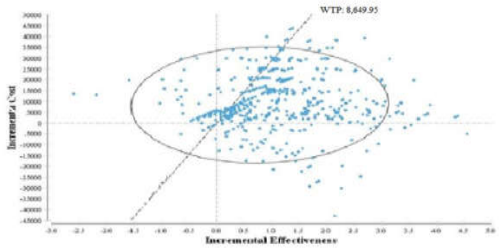
An acceptability curve was constructed to evaluate the cost-effectiveness probabilities of the two technologies, when compared to those of different possible acceptability thresholds (Figure 2). For the incremental cost obtained, the probability of IMRT generating a cost per QALY below this value is 25%. For the threshold of acceptability of U$ 3,500, it is likely to be cost-effective over 55% and to be 72.5% for thresholds at approximately U$ 4,500.

Figure 2: Cost-effectiveness acceptability curve



Considering a threshold acceptability of U$ 8,649.95, which corresponds to once per capita GDP in 2016 (Figure 3), IMRT is the most effective strategy and was also more costly than was 3DCRT.

Figure 3: Incremental cost-effective ratio (ICER) scatterplot comparing IMRT to 3DCRT



CONCLUSION

In Brazil, cancer costs in SUS were estimated at US$1 billion for 2012[18]. This value refers to a set of therapeutic modalities, including chemotherapy, radiotherapy, and cancer surgery. From this perspective, the relevance of using economic evaluations in the subject area to allocate available resources is evident.

The present study found that the IMRT technique is cost-effective in the proposed scenario. In the probabilistic sensitivity analysis, this technology presented a 72.5% chance of being cost-effective for the acceptability thresholds of approximately R$ 15,000.00. Given the aging population and the increase in incidence of PCa, it is important to consider the health gains, expressed in quality-adjusted life years, of IMRT, with a decrease in toxicity and an increase in the biochemical failure-free survival. These factors deserve prospective analysis due to the potential cost reductions with chemotherapy and hormone therapy when treatment fails.

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