



Cancer treatment with radiation therapy using mathematical modeling

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Abstract: A mathematical model was developed and validated to optimize radiation therapy for cancer treatment. The model considers factors such as tumor biology, radiation dose, and fractionation schedule. Results show the model can accurately predict tumor response and normal tissue toxicity, leading to improved tumor control and reduced side effects.

This study highlights the potential of mathematical modeling to personalize and optimize radiation therapy, improving treatment efficiency and minimizing side effects.

Keywords: Mathematical Modelling, Radiation Therapy, Cancer Treatment, Tumor Growth, Treatment Optimization, Side Effects.

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Introduction:

Cancer is a complex and deadly disease affecting millions worldwide. According to WHO, 9.1 lakh people died from cancer in India in 2024, with cases expected to rise to 2.08 million by 2040. To combat this, researchers and policymakers prioritize cancer prevention and control. Radiation therapy is a crucial component of cancer treatment, but its efficacy can be limited. Mathematical modeling has emerged as a powerful tool to optimize radiation therapy, predict treatment response, and identify optimal treatment strategies (Gatenby, R.A. and Vincent, T.L., 2003).

There are two main types of radiation therapy:

1. External Beam Radiation Therapy (EBRT): delivers radiation from outside the body.
2. Internal Radiation Therapy (Brachytherapy): places radioactive material inside the body, near the tumor.

Mathematical modeling plays a crucial role in optimizing radiation therapy:

1. Dose calculation and planning
2. Tumor growth modelling
3. Radiobiological modelling
4. Treatment optimization

These models help minimize side effects, predict treatment response, and identify optimal treatment plans. Despite advancements in cancer research, there is still a need for improved treatment strategies due to limitations such as drug resistance, side effects, and