SCMPCR
South Asia Centre for Medical Physics and Cancer Research
SCMPCR Newsletter
A sister organization of Alo-BT
July 2025 / Volume 7 / Issue 2
QUALITY EDUCATION AND HEALTH SCIENCE FOR PATIENT BENEFIT

Smarter, Faster, Safer: The Rise of Fully Automated Radiotherapy Planning

Ijaj Ahamed Rifat[1], Md. Mokhlesur Rahman[1]
[1]Department of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay (University).

Introduction: A New Era in Cancer Treatment

Imagine if creating a radiation treatment plan for a cancer patient could be done with just one click. No long hours of manual work, no back-and-forth between different steps — just fast, efficient, and reliable results. This might sound like science fiction, but thanks to a groundbreaking system developed by a research team at the University of Alabama at Birmingham, it is quickly becoming a science fact.

Their new method for fully automated treatment planning recently outperformed dozens of other international teams in the 2023 Auto-RTP Challenge, a global competition focused on improving how we plan radiotherapy for cancer patients. Their success shows us that the future of cancer care could be faster, more precise, and more consistent than ever before.

What is the problem?

Radiotherapy is a common treatment for cancer that uses carefully targeted radiation beams to kill cancer cells. But before any treatment can happen, doctors need to create a detailed plan — a sort of "radiation map" to make sure the beams hit the tumor and avoid healthy organs. This process is complex, time-consuming, and depends heavily on expert judgment. Small mistakes or delays can affect treatment outcomes.

So, what if we could automate that process — and still make it just as good, or even better?

The Team's Mission: A Smarter Way to Plan

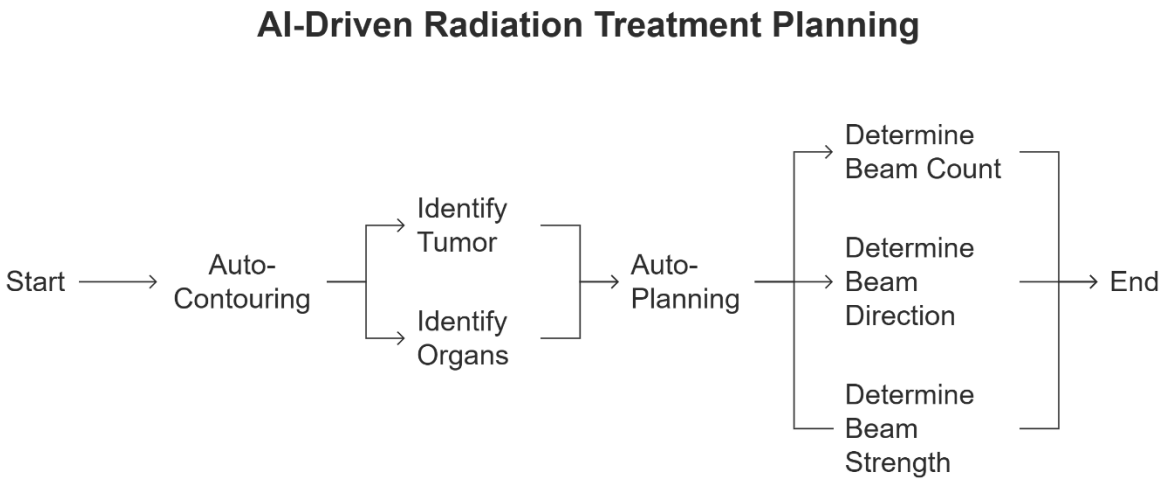
The team's goal was to develop a fully automated radiotherapy treatment planning system that could work on its own — from start to finish — with minimal human input. To test their system, they took part in the Auto-RTP Challenge, where participants were asked to create treatment plans for prostate cancer patients with the participants CT scans.

This challenge was tough. The plans had to follow unfamiliar guidelines and different dose levels than what the team usually used in their clinic. Yet, the team's system adapted easily — and it won first place in all three phases of the competition.

How Does the System Work?

Think of the system like a self-driving car — but for treatment planning. It works in two major stages:

1. **Auto-contouring**: First, it uses artificial intelligence to identify and label important parts of the body on a CT scan. These include the tumor and organs like the bladder and rectum, which need to be protected from too much radiation.
2. **Auto-planning**: Next, it creates the best possible radiation plan based on those labels. It decides how many radiation beams to use, where to aim them, and how strong each beam should be.



To do this, the system uses three powerful tools:

- **Knowledge-Based Planning (RapidPlan)**: It learns from past treatment data to guide current planning.
- **Multicriteria Optimization (MCO)**: It balances trade-offs between different goals — like hitting the tumor hard while avoiding healthy tissue.
- **Plan Scorecards**: These are like report cards that grade the quality of each plan, ensuring high standards are met every time.

Why Does This Matter?

There are a few big reasons this research is exciting:

- **Speed**: The system created full treatment plans in under 41 minutes on average — a process that usually takes hours or even days.
- **Consistency**: Unlike humans, the system does not get tired or make mistakes. It can produce high-quality plans again and again.
- **Adaptability**: Even when asked to follow unfamiliar rules and prescriptions, the system performed well — a sign that it could be used in clinics around the world, even those with different treatment styles.
- **Reduced Workload**: This can significantly ease the burden on busy clinical staff, giving them more time to focus on patients.

Results That Speak for Themselves

The team tested different combinations of planning strategies and found that combining Rapid Plan with MCO and scorecards gave the best results. This combination scored the highest on both their own data and in the challenge.

In one part of the challenge, called the “Plan Only” phase, their best strategy achieved an average score of 90 out of 100 — topping the leaderboard. This score reflects how well the treatment protected healthy organs while effectively targeting the cancer.

Looking Ahead: What is Next?

While the results are promising, there is still work to do. The current system relies on mathematical scores to judge plan quality, but doctors also need to visually inspect plans to make sure everything looks safe and effective. Future studies will focus on how these automated plans perform in real clinical settings, where human overview remains essential.

Still, this research marks a major step forward. It proves that with the right combination of AI tools, we can create safe, high-quality radiotherapy plans — automatically.

Conclusion: Towards a Smarter Future in Cancer Care

This study is more than a technical achievement. It is a glimpse into the future of cancer treatment — where powerful algorithms support medical teams, speed up care, and ensure every patient receives the best possible plan.

As automated systems continue to improve, they could help expand access to top-quality cancer care, especially in areas with limited medical staff. In short, this research is helping turn a time-consuming, expert-heavy task into a streamlined, smart process that brings better outcomes to more people.

Reference:

1. Thompson, R. F., Valdes, G., Fuller, C. D., et al. (2018). *Artificial intelligence in radiation oncology: A specialty-wide disruptive transformation?* Radiotherapy and Oncology, **129**, 421–426. https://doi.org/10.1016/j.radonc.2018.05.030
2. Callens, D., Malone, C., Carver, A., et al. (2024). *Is full-automation in radiotherapy treatment planning ready for take off?* Radiotherapy and Oncology, **201**, 110546. https://doi.org/10.1016/j.radonc.2024.110546
3. Babier, A., Zhang, B., Mahmood, R., et al. (2021). *OpenKBP: The open-access knowledge-based planning grand challenge and dataset.* Medical Physics, **48**(11), 5549–5561. https://doi.org/10.1002/mp.14845
4. Rayn, K., Clark, R., Magliari, A., et al. (2023). *Scorecards: Quantifying dosimetric plan quality in pancreatic ductal adenocarcinoma stereotactic body radiation therapy.* Advances in Radiation Oncology, **8**, 101295. https://doi.org/10.1016/j.adro.2023.101295
5. Jayarathna, S., Shen, X., Chen, R. C., Li, H. H., & Guida, K. (2023). *The effect of integrating knowledge-based planning with multicriteria optimization in treatment planning for prostate SBRT.* Journal of Applied Clinical Medical Physics, **24**(7), e13940. https://doi.org/10.1002/acm2.13940