

Development and Customization of the RayStation Automatic Breast Planning Module: A Program to Adapt the Provided Module to Suit Clinical Needs

C. Collins¹, M Kaluarachchi¹, E Yu¹, J Hepel¹, M Schwer¹

¹ Brown University Warren Alpert Medical School & Rhode Island Hospital, Providence, RI

INTRODUCTION

This work presents the development of a RayStation program created to run a customized adaptation of the original RayStation Automated Breast Planning (ABP) module. With the RayStation automated breast planning system embedded as the base of the developed and customized system, the new scripted workflow bypasses the RayStation auto breast contouring element to use a physician contour trained atlas-based segmentation program. It also incorporates a different dose normalization and scaling schema to deliver more coverage to the breast. Finally, it selects customized settings and plan specifications optimized to suit the specific clinic's needs. The development of this system was necessitated by the desire to implement automated planning in a clinic where physicians use different planning criteria than is inherent to the RayStation module. Additionally, the desire for contours specific to in-house physicians was expressed after early RayStation automated breast plans were found to contain conformality issues. With this in-house developed scripted workflow, we have found that a tangent breast plan can be created, from CT simulation to physician approval in under 20 minutes, with only 8 minutes of active time.

AIM

Automation is a powerful tool, but the raw RayStation system does not provide compatibility with all clinics. The hope is that the impact of this work will pave the way for widespread customization and development of this program across various clinics.

METHOD

Development of customized clinic-specific adaptation to the RayStation auto breast system:

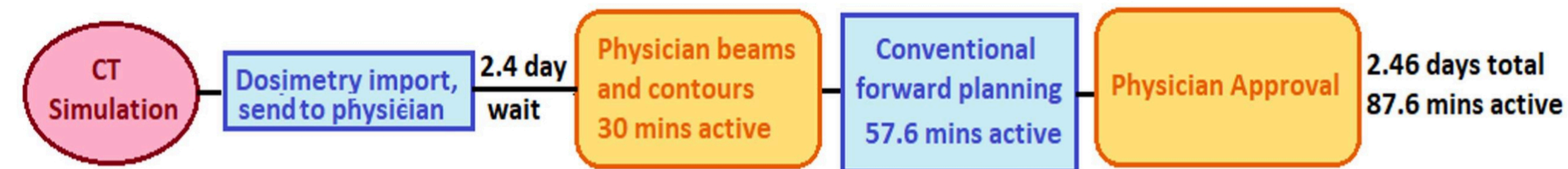
- Module developed as a complete scripted workflow from CT-sim to physician plan approval.
- New physician-trained atlas-based segmentation system developed and looped into scripted workflow to bypass raw RayStation contouring module.
- Incorporates a different dose normalization and scaling schema to deliver more coverage to the breast.
- Selects customized settings and plan specifications optimized to suit the specific clinic's needs

Plan and workflow comparison between clinical dosimetry plan, new adapted ABP plan, and raw RayStation auto plans:

- 14 clinical patients CT-sim'd with auto breast fiducial/wiring.
- Patient planned by dosimetry, raw RayStation auto module, & newly developed customized auto breast scripted workflow.
- Plans compared based on efficiency (active planning time, total planning time, total time from CT simulation to physician approval), plan quality (coverage, hot spot, dose to organs at risk), and contour quality (dice similarity between raw RayStation auto contouring & new atlas-based customized segmentation, physician contours as gold standard).

RESULTS

Current Workflow



New Automated Planning Workflow

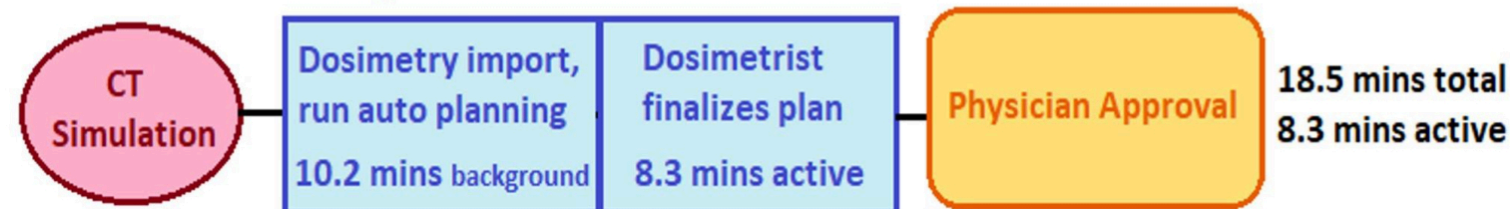


Figure 1: Diagram of workflow improvements, with average time totals, from current clinical to new automated planning workflow.

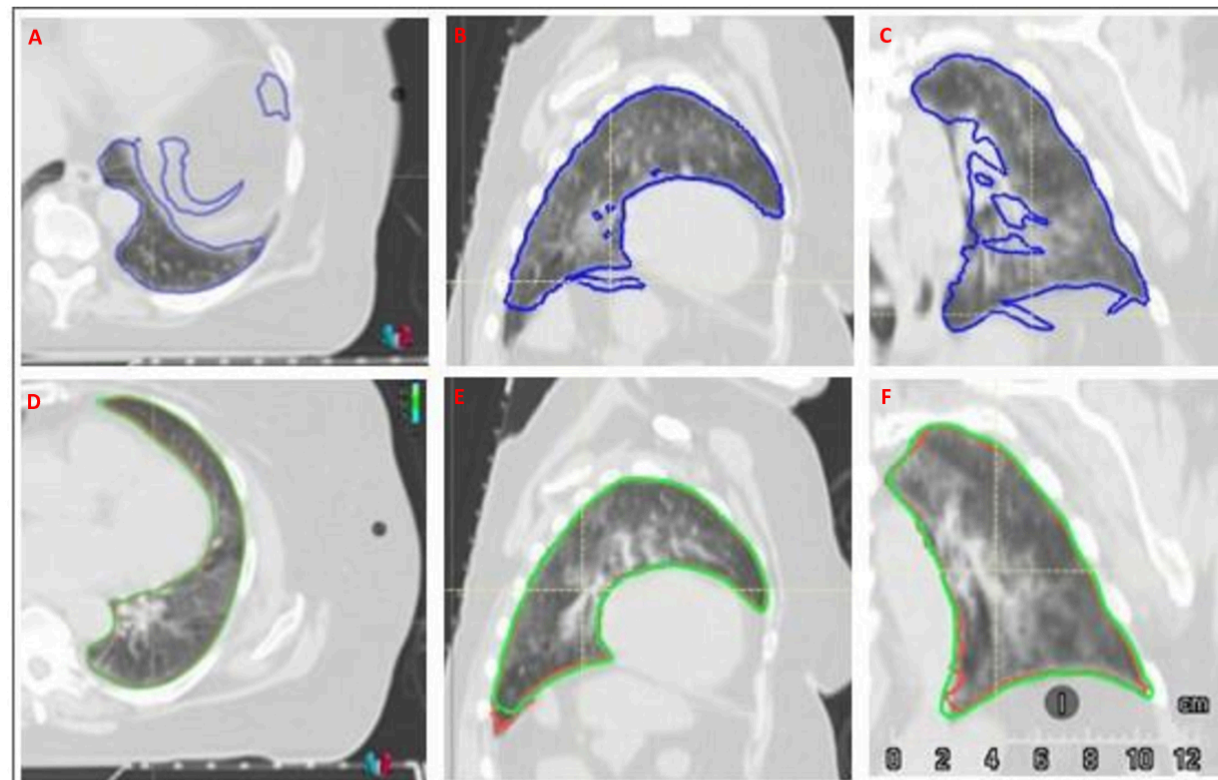


Figure 2: Comparison of raw RayStation auto contours (A-C blue), new atlas-based program contours (D-F green), and physician contours (D-F red) in the left lung for axial (A, D), sagittal (B, E), and coronal (C, F) views.

Table 1: Average difference in dose to organs at risk between the newly adapted auto breast system and conventional plans.

Criteria	Dose Difference (Auto-Conventional)
Mean Heart	1.8 cGy
Max Heart	462 cGy
Heart D20	-1.36 cGy
Heart D10	4.93 cGy
Ips Lung D20	143 cGy
Max CTV	-0.7 cGy

Table 2: Dice coefficient organ at risk values comparing the new contouring system with physician hand contours. Percent improvement between the dice values for the new system and the respective raw RayStation ABP contours.

Dice Similarity Coefficient Comparison - New Automated Breast Program					
Dice Coeff Value - New Auto			% Improvement - New vs. Raw RayStation		
Heart	Left Lung	Right Lung	Heart	Left Lung	Right Lung
0.902	0.972	0.977	0.735%	3.64%	1.51%

CONCLUSIONS

The newly developed institution-customized RayStation Automated Breast Planning module provided organ at risk dose reduction and dramatic workflow improvements compared with the current clinical workflow. Compared with the raw RayStation automated breast planning module, our adapted system improves efficiency, plan quality, and contour quality. The development and customization of this program to suit specific clinical needs demonstrates the potential for improvement upon the "one size fits all" model that the RayStation automated breast module represents in its current state. The hope is that the impact of this work will pave the way for widespread customization and development of this program across various clinics.

REFERENCES

1. Purdie T et al. Automated breast planning in RayStation. RayStation Whitepaper 2017.
2. Purdie TG, Dinniwell RE, Fyles A, et al. Automation and Intensity Modulated Radiation Therapy for Individualized High-Quality Tangent Breast Treatment Plans. Int. J. Radiat. Oncol. Biol. Phys. 90:688–695, 2014.
3. Purdie TG, Dinniwell RE, Letourneau D, et al. Automated planning of tangential breast intensity-modulated radiotherapy using heuristic optimization. Int. J. Radiat. Oncol. Biol. Phys. 81:575–83, 2011.
4. Vicini FA, et al. Initial efficacy results of RTOG 0319: Three dimensional conformal radiation therapy (3D-CRT) confined to the region of the lumpectomy cavity for Stage I/II breast carcinoma. Int J Radiat Oncol Biol Phys. 2008;72(1):S3.
5. Radiation Therapy Oncology Group. RTOG 1005: a phase III trial of accelerated whole breast irradiation with hypofractionation plus concurrent boost versus standard whole breast irradiation plus sequential boost for early-stage breast cancer. 2013.

CONTACT INFORMATION

Contact: cielle_collins@brown.edu, michelle_schwer@brown.edu