Automated Data Extraction and Quality Assurance Tests for High Dose Rate Brachytherapy Treatment Plans

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Purpose

High Dose Rate (HDR) brachytherapy requires a rapid turnaround from treatment planning to delivery. Medical physicists perform dose planning and quality assurance (QA) checks prior to treatment, but these tasks are time-consuming and involve repetitive manual steps that can slow workflow and introduce transcription errors. This project automates extraction of patient and plan data from the treatment planning system (TPS) to support quality assurance and retrospective analysis of HDR brachytherapy plans.

Methods

A quality assurance analysis was performed across all clinical documentation used in the brachytherapy treatment planning workflow at BC Cancer Kelowna. Available data outputs from the treatment planning system (TPS) were reviewed to identify parameters suitable for automated QA, and multiple approaches for extracting relevant data from clinical documents were evaluated.

A Python-based data parsing pipeline was developed and validated using anonymized HDR brachytherapy cases, including 45 prostate plans generated in Oncentra Prostate and 30 gynecological plans generated in Oncentra Brachy. The core functionality is demonstrated in Figure 1. Two extraction approaches were implemented and compared: PDF-based text parsing of TPS-generated summary documents, and DICOM-based data extraction to enable a broader set of QA checks. Pipeline validation was performed on an independent subset of 40 prostate and 15 gynecological HDR cases, confirming accurate retrieval of patient and plan parameters across both treatment sites and document formats.

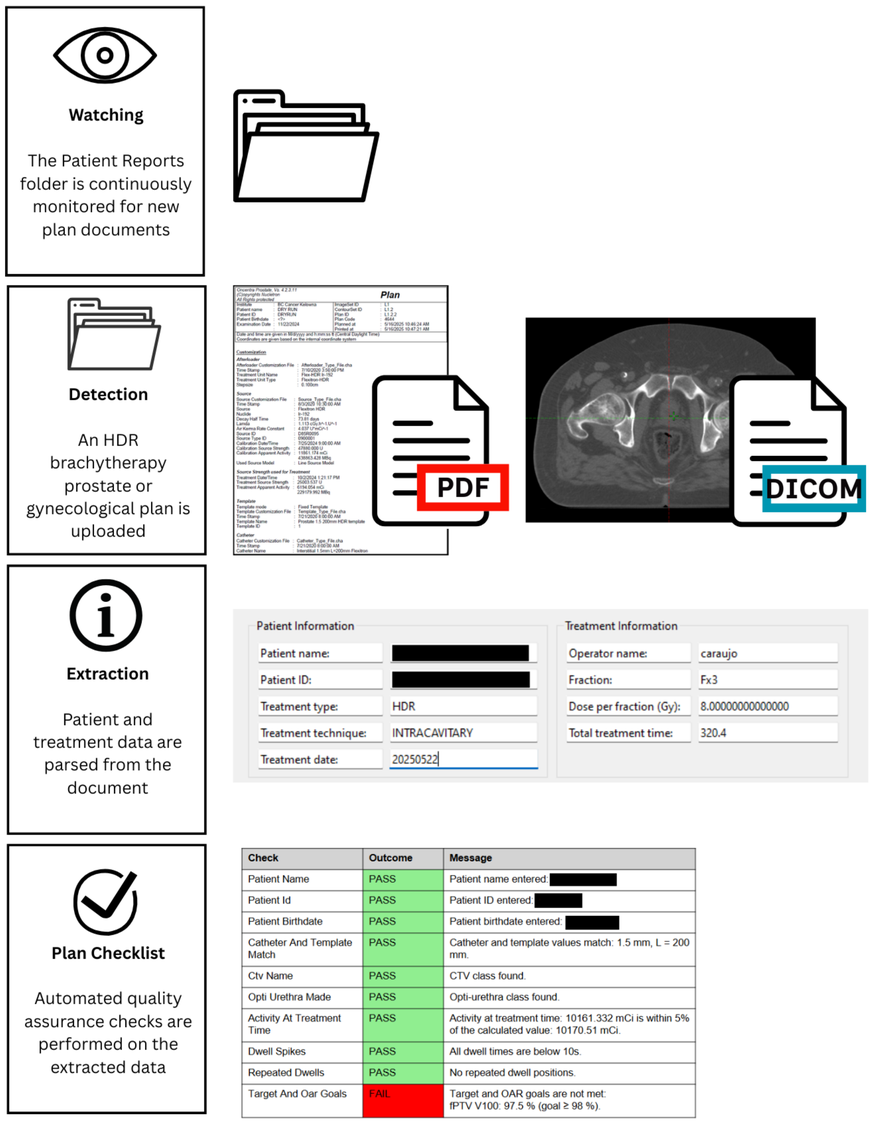

Figure 1: Infographic showing the HDR brachytherapy plan checking automated pipeline.

Results and Discussion

A monitoring (“watcher”) script continuously observes a designated folder for new files. Once new documents are detected during the planning process, the system automatically performs a series of QA checks and generates a standardized PDF report. These reports summarize key patient information for physicist review and include QA calculations such as a total dwell time check, an independent secondary dose estimate at two reference points as recommended by TG-43 [1], and patient identification verification.

The PDF-based extraction approach integrates seamlessly into the existing workflow with no additional user steps but is sensitive to document formatting changes. The DICOM-based approach offers more robust and consistent extraction with access to a broader parameter set, at the cost of additional steps for data retrieval.

The core QA automation workflow is ready for clinical deployment. Future work will focus on expanding DICOM-based data extraction to support a wider range of QA tests and enabling direct querying of the DICOM server to further automate data retrieval and analysis.

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Conclusion

Automated data extraction and quality assurance checks can significantly **decrease the physics workload** and improve consistency in brachytherapy treatment planning.

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