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Standardization and Automation of Quality Assurance Utilizing a Commercial Platform

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ABSTRACT

Purpose: The goal of this project to standardize and automate the QA program of a multi-site radiation oncology practice. Our practice includes eleven linear accelerators, five CT scanners, and four HDR afterloaders across four separate treatment sites.
Methods: A commercial platform (Radmachine) was selected as the platform for implementation. Within this platform, each QA task was that is performed was translated into a "Test List", which is the vendor specific analysis routine for that specific QA task. Each test list is then assigned to different treatment machines which standardizes the practice across our program. Using a scripting server, custom developed scripts were created to automatically relocate QA files as they are acquired into a directory that is monitored by the Radformation Agent. Each of these directories, when new images/files are detected is it uploaded to Radformation and automatically processed and placed into the review queue.
Results: Images and other file types for various QA tasks have all been migrated into the commercial platform over the past three years. The entire QA program for our site has been transitioned into this commercial platform. Planar images, volumetric images, Winston Lutz Images, profiles and PDDs, as well as volumetric CT sets from the CT scanner have been transitioned into the automated analysis system to name a few. Over 1,100 test lists (corresponding to a QA task) have been implemented in the Automated program. In addition to the automated analysis, simple QA checks have been implemented to standardize the QA platform across our multisite practice.
Conclusion: Standardization is a key component to keeping a large QA practice in compliance with current recommendations and guidelines. Automated QA analysis program improves group efficiency allowing the physicist to concentrate on other tasks.

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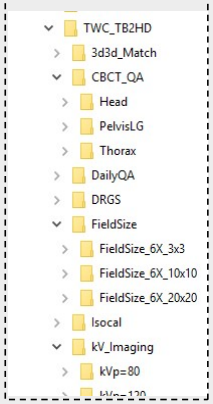
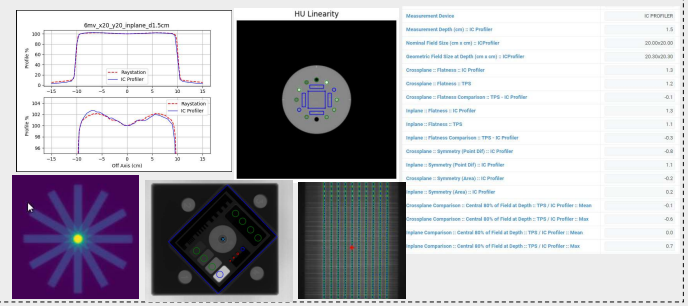
QA images and other QA data files (e.g., profiles and PDDs) are acquired and automatically saved to a network share. Designated directories are continuously monitored by the scripting server, which detects newly acquired data and initiates automated processing.

Upon detecting a new file, the scripting server automatically identifies the source machine and QA test, then renames, reformats, and routes the data into the appropriate directory structure for seamless processing by the commercial QA analysis software. This automated data handling eliminates manual file management while ensuring consistent data organization and analysis.

QA Test Associated with Linac or CT



QA Test Results are Accessible Via Web Interface



Results are automatically analyzed via the Radmachine Local Agent, archived in a centralized database, and made available through a web-based interface for convenient review and trending.

INTRODUCTION

An in-house scripting server was developed to automatically retrieve QA images and associated data and import them into the commercial QA analysis platform (RadMachine), creating a scalable, fully automated QA workflow. Following QA acquisition, data are automatically analyzed, archived, and post-processed without requiring physicist intervention. Processed results are immediately available through a web-based interface, providing centralized access to QA results across all supported systems. This closed-loop automated workflow eliminates manual data transfer and analysis, reducing the potential for human error while improving the efficiency, consistency, and scalability of the QA program. The automated architecture enables standardized QA analysis across multiple treatment centers and imaging systems while minimizing engineering and clinical effort required to maintain routine QA operations.

METHODS AND MATERIALS

The platform provides fully automated analysis of routine QA tasks without requiring user intervention, including Picket Fence, Dose Rate/Gantry Speed, MLC Speed, Radiation Field Size, imaging QA (kV, MV, and CBCT), Winston–Lutz (MV, kV, and ExacTrac), profile analysis, isocenter calibration, profile constancy, profile comparison with the treatment planning system (TPS), percentage depth dose (PDD) analysis, PDD comparison with the TPS, CT Hounsfield unit (HU) verification, and many additional tests.
The commercial QA analysis platform is highly flexible, allowing users to create or customize QA workflows for institution-specific analyses. In addition to supporting custom workflows, the platform includes a comprehensive library of standard QA tests and compatibility with a wide range of commercially available QA phantoms.

DISCUSSION & CONCLUSIONS

The implementation of an automated quality assurance (QA) analysis platform has standardized QA processes across multiple centers (four), linear accelerators (eleven), and CT scanners (five). By applying consistent analysis methods and centralized data management, the platform reduces variability in QA review while improving the consistency and reliability of results across the organization. Automation has also streamlined routine QA workflows, reducing the time required for data analysis and allowing staff to focus on clinical tasks. In addition, consolidating QA data from all treatment and imaging systems into a single platform provides a comprehensive view of equipment performance, facilitates trend analysis, and simplifies documentation and oversight. Overall, this approach has improved operational efficiency while supporting a more standardized and scalable QA program.