AQUA™ transforms QA workflows and increases understanding of machine performance

Contributors

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**Location**
Toronto, Canada

**Staff**
- 36 Radiation Oncologists
- 33 Medical Physicists
- 160 Radiation Therapists
- 115 Support Staff

**Technology**
- 16 Linear Accelerators
  - 11 Eleka - All with Agility™ and 2 with HexaPOD™
  - 5 Varian
- 1 Orthovoltage System (Xstrahl)
- 2 Leksell Gamma Knife®
- 2 Eleka HDR Afterloaders
- 4 CT Simulators
  - 1 GE
  - 1 Toshiba
  - 2 Philips
- 3 MRI Simulators
  - 1 GE
  - 2 Siemens
When the Princess Margaret Cancer Center Radiation Medicine Program, one of the largest single-site radiation treatment facilities in the world, could not find a QA management software package that would meet their needs for advanced radiation treatment and imaging techniques, they set about developing their own. Now, with over four years’ experience in using AQUA™ clinically, they share how this system has improved their quality assurance program and the assessment of machine performance throughout the department.

Ensuring safety and performance

With around 350 staff and treating over 8,000 patients every year, the Princess Margaret Cancer Center (PMCC) Radiation Medicine Program is Canada’s leading radiation treatment center and one of the largest single-site radiation treatment facilities in the world. The center’s team of radiation oncologists, physicists, therapists, nurses and researchers is dedicated to advancing best practices in radiation medicine through innovative research, education and the uptake of cutting-edge radiation technology and techniques.

The center is well equipped with state-of-the-art technologies that facilitate high precision and quality care, including 16 linear accelerators, two Leksell Gamma Knife systems, brachytherapy and orthovoltage equipment, as well as a variety of imaging equipment and measuring devices. The precision and performance of all of this equipment is vital to ensuring the safe and effective treatment of over 400 patients every day.

Dr. Daniel Létourneau, Associate Head of Physics, is responsible for quality assurance for all external beam radiation treatment (EBRT) equipment at this large facility. He explains why quality assurance plays an increasingly important role in today’s radiation oncology departments:

Firstly, QA is essential for ensuring optimum safety and performance of simulation, imaging and treatment delivery equipment.

“QA programs help to create a safe environment for radiation oncology patients and staff,” says Dr. Létourneau. “They also contribute to maintaining optimum machine performance for high-quality radiation oncology treatments.

“Like many other Radiation Oncology Departments, our QA program is based on a combination of regulatory requirements and professional guidelines.”

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Dr. Daniel Létourneau
Associate Head of Physics
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PMCC complies with the regulations of the Canadian Nuclear Safety Commission (CNSC). In addition, they have adopted and adapted guidelines provided by professional organizations, such as the American Association of Physicists in Medicine (AAPM) and the Canadian Partnership for Quality Radiotherapy (CPQR).

Secondly, as radiation treatments advance and become increasingly complex, there is a requirement for greater and greater accuracy, which places additional demands on QA programs.

“Technological developments over the years have increased the requirements on EBRT equipment performance,” adds Dr. Létourneau, “resulting in tighter specifications for our quality control (QC) tests and more exacting QA requirements.”

Changing QA requirements

“At PMCC, we wanted to improve the accuracy of our routine, frequent QA tests and, where possible, to reduce the cost of these tests through automation,” recalls Dr. Létourneau. “This would allow us to perform high accuracy QC tests on a daily basis to satisfy tight specifications and to ensure high-quality machine performance.”

To achieve this aim in a large, busy Radiation Oncology Department, with so many different pieces of radiation delivery and imaging equipment to monitor, would be an enormous challenge.

Head of Radiation Physics, Dr. David Jaffray, Dr. Létourneau and their team recognized that such goals would require powerful workflow management software.

Dr. Létourneau continues, “We needed a platform that would centralize all of the quality assurance activities for radiation therapy throughout the department and provide a single interface for the entry, management, analysis and archiving of all test data.”

The team determined that a centralized quality management system would streamline workflows, improve productivity and provide a convenient, accessible database to track all QA tests and results. At the time, the department used a commercially available software package to manage their QA program, but it had significant limitations.

“Our previous QA tool did not help with managing day to day QA tasks efficiently,” explains Dr. Létourneau. “It was difficult to verify if tests had been completed; it was even more difficult to assess equipment performance; and we were not able to access all the information required easily. In addition, there was a large number of spreadsheets containing QA data and no mechanism to maintain version control. Since this did not meet our needs, we knew we needed an alternative solution.”

It was against the backdrop of these requirements that AQUA, a new departmental QA management tool, was developed.
“Our vision was to optimize the performance of our radiation oncology machines to support the clinical requirements of the future.”

Dr. Daniel Létourneau
Associate Head of Physics

A new departmental QA management tool

“Our main objectives were to demonstrate compliance with our QA program and to assess the performance of our equipment,” says Dr. Létourneau. “In particular, we wanted to have the ability to analyze and use the data collected to learn more about the true performance of the machines. In the long term, this could help to optimize performance through establishing appropriate frequency of testing and servicing. None of the QA solutions available at that time were even considering such an approach. Our vision was to optimize the performance of our radiation oncology machines to support the clinical requirements of the future.”

The QA management tool was designed to communicate directly with the treatment delivery, imaging and simulation equipment, as well as the measurement devices used for QA purposes.

“Integration between the QA management software and the equipment would allow the possibility to automate some of the time-consuming, routine QA tests,” says Dr. Létourneau. “This was also an opportunity to improve the accuracy of some of these tests. Such integrated and automated processes would streamline our routine testing and would allow us to perform high accuracy QC tests every day before the first patient treatment. Previously, such high accuracy testing could only be performed on a weekly or monthly basis.”

In-house development of the new QA management software began in December 2009, and the first release was used clinically at PMCC in February 2012. Initially, it was used to manage QA for one linear accelerator and, after just 3 months, it was extended to all the linear accelerators in the department. The new system was called AQUA (Automated Quality Assurance).

Now, AQUA is used to manage QA for all radiation treatment delivery, simulation and imaging devices at PMCC, including: 16 linear accelerators, 1 orthovoltage system, 2 Leksell Gamma Knife systems, 2 HDR afterloaders, 4 CT simulators and 3 MRI simulators. In addition, the measurement equipment used to perform QA tests, such as ion chambers, electrometers and survey meters, are all defined (modeled) in AQUA’s equipment inventory.

A positive impact throughout the department

AQUA is a web-based application that is accessible through a browser. Anyone who has access to the hospital intranet can log on to a computer and, providing they have the correct permissions, can access and run AQUA, making distribution and accessibility of the software very easy.
When they log on, each user has their own personalized ‘To Do’ list, which is responsibility-based, and the system guides them through any actions required, with color-coded indicators on the test lists to help prioritize what tests need to be performed. “AQUA helps us to achieve accountability within our QA policies,” comments Dr. Létourneau. “It has reduced the burden on users by guiding them intuitively through tasks and increases their confidence to release equipment for clinical use.

“Managers within the department have access to a near real-time dashboard that displays what tests and processes have been completed (and whether results are within tolerances) and what tests are due to be performed, giving them oversight of machine compliance and performance throughout the entire department at a glance.

“For physicists, the task of reviewing QA results for each piece of equipment is much easier. Not only can they access this data easily on AQUA, but they can also perform analyses and monitor trends on a single machine or multiple machines very quickly, which supports decisions regarding the adjustment or servicing of equipment.”

With several years’ clinical experience of using AQUA behind them, the team at the PMCC Radiation Medicine Program has recognized a number of significant benefits that this new QA management tool has brought to the department, including:

- Consolidation of QA processes across the department for more streamlined workflows
- Increased productivity through automation of certain tasks
- Vendor-neutral interfacing with treatment devices and machine QA devices
- A centralized database for tracking and further analysis of all QA test results
- Departmental oversight of machine status
- Greater understanding of machine performance through the analysis of high-frequency, meaningful QA data
- Greater transparency and understanding of QA processes, and increased confidence to release equipment for clinical use
- Increased accountability through easier conformance with QA policies
- Intuitive data analysis, including longer term trending
- Clinical confidence, especially in the use of advanced, complex treatment techniques

“AQUA provides management with oversight of all machine compliance and performance at a glance.”

Dr. Daniel Létourneau
Associate Head of Physics
“The wealth of data that is accessible in AQUA has enormous potential to increase our understanding of machine performance,” continues Dr. Létourneau. “For example, the AQUA MLC QA test is performed daily on our Elekta linear accelerators to assess the performance of Agility. This test is automated and takes just seven minutes: a beam is delivered and a set of images is acquired; these images are exported to AQUA for analysis; AQUA provides a result to the user. One such test run generates 800 data points. Previously, with the old MLC QA test, we performed one test run per month, which took over an hour. AQUA has transformed this test, allowing us to obtain meaningful data much more frequently. With this unique, rich amount of data, we are able to examine MLC performance over time and to make important decisions regarding the frequency of testing and servicing.”

“By giving us greater control of our QA program and providing meaningful data about the compliance and performance of our equipment, AQUA has given the clinical team increased confidence to use the advanced, complex treatment delivery techniques that are available today,” concludes Dr. Létourneau. “This is important because such techniques help to ensure precise tumor targeting and OAR sparing for safer and more effective radiation treatments.”

References


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Elekta has exclusive distribution rights to AQUA, which is an Acumyn Inc. product. The PMCC software described here is an early version of the final commercial release.