Clinical Evaluation of the QA BeamChecker™ Pro: Workflow, Data Integrity, and Usability in a Radiation Oncology Setting

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1 Introduction

Daily quality assurance in radiation therapy represents one of the most time-sensitive and consequential routines in a clinical department. The morning QA process must satisfy two distinct and often competing demands: the therapy team requires a fast, reliable workflow that does not delay patient care, while the physics team requires complete, defensible data that accurately reflects linac performance. Historically, most QA devices have addressed one requirement at the expense of the other.

This paper presents a structured clinical evaluation of the QA BeamChecker™ Pro (Standard Imaging, Inc., Middleton, WI), conducted as part of a beta testing program at Beloit Health System UW Cancer Center. The evaluation encompassed all functional areas of the device, including initial configuration, baseline acquisition, standalone and real-time measurement modes, data management, and overall interface usability. Findings were documented across both therapy and physics workflows, with direct comparison to the predecessor device, the QABC Plus.

The objective of this paper is to provide a practical clinical account of the QABC Pro's performance, highlight its measurable improvements, identify areas for further development, and offer an evidence-based assessment for departments considering adoption of the platform.

2 Device Overview and Hardware Design

The QABC Pro introduces several hardware refinements over the QABC Plus that have direct implications for measurement consistency and clinical usability. These changes were evaluated not only for their effect on ease of use but for their downstream impact on data quality.

2.1 Form Factor and Handling

The QABC Pro features a thinner, more ergonomic profile compared to its predecessor. In daily clinical use, this translates to more consistent device placement during each measurement session. Positioning variability, even when minor, accumulates over time and can introduce systematic uncertainty into QA data. The refined form factor reduces this risk.

2.2 Alignment Aids

The most immediately impactful hardware improvement identified during beta testing was the extension of the graticule lines, both centrally and along the crosshair extensions. These additional alignment marks significantly improve the ability to align the device with the machine crosshair at the gantry. Accurate alignment at the point of measurement reduces setup-induced variability and directly improves the reliability of the data received by the physics team. Beta evaluators consistently identified this as the most tangible hardware advancement over the QABC Plus.

2.3 Touchscreen Legibility

The QABC Pro touchscreen display is clear, responsive, and readable from the control room via camera zoom. This allows both therapists and physicists to verify device status and readiness without re-entering the treatment room during setup confirmation, a practical efficiency in departments with strict access protocols.

3 Device Configuration and Settings

Initial device configuration, including clinic setup, user management, and baseline preparation, was completed without difficulty. Navigation through the settings menu and all associated tabs was straightforward, and the logical structure of the interface minimized the learning curve for first-time users. Staff unfamiliar with the device were able to prepare baselines and configurations without requiring escalation to physics support.

Early beta testing identified one area for improvement being the flexibility of the user management and clinic configuration tools. The ability to more easily edit or remove outdated entries from the system would improve long-term administrative usability. Additional training from the development team and more testing of the administrative management tools built into the software proved that there are appropriate means to add, edit, archive, and customize clinics, machines, and users. This functionality is particularly relevant as departments accumulate configuration records over time and require a cleaner active environment.

4 Standalone Mode: Therapy Workflow Evaluation

Standalone mode is designed for therapist-led daily QA and was evaluated extensively in the clinical environment. The mode performed reliably across all testing conditions, with several features representing meaningful improvements over the QABC Plus.

4.1 Zero-Flip Measurement Design

The most significant workflow improvement in standalone mode is the elimination of device repositioning between photon and electron measurements. With the QABC Plus, the device must be physically flipped between energy types, a step that adds time, introduces handling variability, and creates an additional point of potential error. The QABC Pro accommodates both energy types in a single orientation. This change was consistently described by therapy staff as a major improvement and represents a genuine reduction in daily workflow burden.

4.2 Pass/Fail Confirmation at Point of Measurement

A Pass/Fail result is displayed immediately upon measurement completion in standalone mode. This is a clinically meaningful feature. Under previous workflows, therapists were required to wait until end-of-day data download to confirm whether a measurement was valid. The immediate confirmation eliminates that uncertainty, provides therapists with actionable information at the gantry, and reduces the likelihood of unresolved measurement questions carrying into the patient treatment day.

4.3 Auto-Ready Recovery

When a measurement fails, the QABC Pro automatically returns to a Ready state without requiring manual intervention. In the QABC Plus workflow, failed measurements often required the user involvement to reset the device, creating unnecessary interruptions to the morning routine. Auto-Ready recovery resolves this by keeping minor failures contained within the therapy workflow.

4.4 Room-Agnostic Deployment

The removal of room allocation restrictions allows the QABC Pro to be deployed in any treatment room without device reconfiguration. This provides scheduling flexibility and removes a logistical constraint that was present in older QA systems.

4.5 Data Download Behavior

Data availability has been streamlined in the current release. Measurement data is accessible as soon as the device is placed on the power/data cradle connected to the local area network (LAN). Transfer also initiates automatically upon cable connection to the LAN or via a Wi-Fi access point. This resolves an issue identified during beta testing in which users were required to manually navigate to the Analysis tab to trigger the download. Updated behavior eliminates that extra step and ensures data is ready for review without additional action from the therapist or physicist.

5 Real-Time Mode: Physics Workflow Evaluation

Real-Time mode is intended for physicist-level assessment during live beam delivery. Across all testing sessions, the mode demonstrated stable connectivity, clear feedback, and an interface that was easier to navigate during live measurements than the QABC Plus equivalent.

5.1 Ion Chamber Real Measurement Values

The Real Measurement Value window, which provides live numeric ion chamber readings during acquisition, is among the most clinically valuable features available to physicists in Real-Time mode. The practical significance lies in timing: the physicist has access to actual chamber values before a measurement result is committed, enabling real-time judgment about the physical plausibility of the data. This capability, which was also present in the QABC Plus, has been preserved and refined in the Pro and should be considered a core component of the physicist review workflow.

5.2 Connectivity and Interface Stability

Real-Time mode communication was stable throughout beta testing. The interface was consistently described as more polished than the QABC Plus, with clearer navigation during live delivery and no connectivity issues observed. Enhanced visualization options or integrated quick-comparison views would be a beneficial addition in future software iterations, though current functionality is clinically sufficient.

6 Baseline Management and Data Integrity

Data integrity in daily QA depends not only on the accuracy of individual measurements but on the reliability of the baseline environment against which those measurements are evaluated. This is an area of significant clinical importance, and the current version of the QABC Pro provides a complete and practical solution for baseline management.

6.1 Baseline Confusion Risk

A recognized risk in daily QA data management arises when older and newer baselines share similar parameters, such as energy, field size, and monitor unit count. In this scenario, a morning measurement may inadvertently be evaluated against the wrong baseline, creating a data integrity error that may not be detected until physics review. This risk increases as baseline lists accumulate over time without active management. The current version of the QABC Pro directly addresses this concern by giving users full control over baseline records.

6.2 One-Click Archiving

The QABC Pro now allows users to archive outdated historical baseline test data associated with a particular linac-device combination via the settings menu. This gives departments increased control over the baseline environment, eliminating the risk of measurement confusion caused by similar legacy entries coexisting in the active list. Departments are encouraged to incorporate routine baseline review and deletion into their standard QA procedures to maintain a clean and unambiguous measurement record.

6.3 Baseline Reconstruction

The ability to fully delete outdated baselines and reconstruct them from scratch provides a level of long-term baseline governance that was previously unavailable. Rather than relying on archiving alone to manage legacy records, users can now remove entries entirely and establish a fresh baseline when clinical conditions change. This capability was identified as a priority during beta testing and has been implemented in the current release, completing the baseline management framework of the platform.

6.4 Baseline Reset

It is necessary to manage baselines annually and after linac field service or repairs. In these instances, it is important to keep the baseline parameters for each energy along with historical data for physicists to track machine performance pre- and post- such events. QABC Pro's one-click re-baseline functionality saves the user a significant amount of time in making these updates. Adding notes each time re-baselining is done makes recordkeeping easy as this information is stored in the database and reported in CSV export files.

7 Interface Design and Overall Usability

Across all tabs and operational modes, the QABC Pro interface is logically organized and easy to navigate. Settings and features were readily accessible without unnecessary menu depth, and each page presented relevant information in a clear, interpretable format. The interface supports efficient onboarding of new users with minimal physics escalation required.

7.1 Analysis Tab Layout

One area of the interface identified for improvement during beta evaluation is the Analysis tab, which currently displays Constancy, Flatness, Axial Symmetry, and Transverse Symmetry as four separate graphs. These parameters are conceptually related, and their fragmented presentation adds cognitive overhead during a time-pressured morning review. Consolidating these into a single unified graph view, with ion chamber Real Measurement Values integrated into the same tab, would reduce the analytical burden and improve the efficiency of the physics review workflow. This recommendation was submitted during beta testing and is under active roadmap consideration.

7.2 Color-Coding Consistency

Beta evaluation identified an ambiguity in the device status color scheme. The waiting-for-beam state was displayed in orange, while the beam-on and acquiring-data state was displayed in green. Because both states represent normal operational conditions, the use of different colors introduced unnecessary uncertainty, particularly for therapy staff without physics training to interpret the distinction. This issue was treated as a data integrity concern and was resolved in the release candidate: green now represents all normal operational states, establishing a clear and unambiguous visual protocol in which any deviation from green signals a condition requiring attention.

8 Clinical Validation and Development Responsiveness

The beta testing program for the QABC Pro was structured as a formal clinical validation process. Feedback from evaluators was systematically reviewed and, where appropriate, acted upon prior to the release candidate. The following outcomes illustrate the responsiveness of the development process to clinical input.

- Color-coding ambiguity. Identified during beta as a usability and data integrity concern. Resolved in the release candidate through consistent green status indicators for all normal operational states.
- Archiving capability. The feature was present in the software but had not been adequately covered in training materials. Onboarding documentation was updated prior to release.
- Baseline history management. The need for direct deletion and recreation of historical baselines was formally logged as a user story during beta testing and has been fully implemented in the current release.
- Analysis tab consolidation. The recommendation to consolidate the four-graph layout into a unified view with integrated ion chamber data is in active roadmap consideration.

For clinical departments evaluating a new QA platform, the responsiveness of a vendor to pre-release clinical feedback is a relevant consideration. The QABC Pro beta program demonstrated a direct and documented pathway from clinical observation to development action, with issues resolved before release and longer-term requests formally tracked. This reflects a development model oriented toward continuous clinical improvement rather than fixed product releases.

9 Conclusion

The QA BeamChecker™ Pro represents a clinically meaningful advancement over the QABC Plus across all evaluated dimensions: hardware design, therapy workflow efficiency, physicist data access, and interface usability. Key improvements, including the zero-flip measurement design, immediate Pass/Fail confirmation, auto-recovery from failed measurements, enhanced graticule alignment, and live ion chamber readouts, were validated under real clinical conditions and confirmed to produce measurable benefits for both therapy and physics workflows.

Areas identified for further development, particularly Analysis tab consolidation, were formally documented during the beta process and are actively tracked in the product roadmap. Baseline management, previously flagged as an open item, has been fully resolved in the current release. The structured feedback loop between clinical evaluators and the development team provides confidence that the platform will continue to evolve in response to clinical need.

Based on this evaluation, the QABC Pro is a well-designed, clinically validated system suitable for adoption in radiation oncology departments seeking to modernize their daily QA workflow. Its current capabilities represent a genuine improvement over legacy QA hardware, and its development trajectory supports continued advancement in alignment with clinical requirements.

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Disclosures

The QA BeamChecker™ Pro is a product of Standard Imaging, Inc. (Middleton, WI). The author has no financial relationship with Standard Imaging, Inc. Clinical observations and conclusions represent the independent professional assessment of the author based on direct clinical use of the device during structured beta evaluation.

About the Author

Negar Charchi, MSc., is a clinical physicist at Beloit Health System UW Cancer Center. She served as a beta evaluator for the QA BeamChecker™ Pro and contributed structured clinical feedback that informed the device's development and release.