Comparison of Vendor-Dependent versus Commercially-Available, Independent LINAC Quality Assurance (QA) for Daily QA

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INTRODUCTION

With the ever-increasing vendor-supplied quality assurance options available for use, it is very tempting to use built-in options on a LINAC opposed to an independent QA platform. Built-in tests are perceived as more efficient and while efficiency of data collection is important, other considerations such as data relevance, access, reporting, and trending are necessary when choosing a platform for clinical use. While there has been evidence that the vendor supplied QA is accurate[1–3], there has been little work done to quantify the time and interface for data acquisition of vendor-supplied platforms compared to those commercially available. Therefore, there is a need to evaluate such platforms.

AIM

To investigate and compare time efficiency, data collected, and results of vendor-based versus an independent-QA platform for daily LINAC QA.

METHOD

- Time needed to perform daily QA (DQA) on a single LINAC was collected for three months.
- TG-142-compliant DQA included:
  - Dosimetry checks
  - Imaging checks
  - Mechanical & safety checks
- DQA data was collected using a commercially available, web-based, independent QA platform: **SunCHECK Machine** (Sun Nuclear Corporation; hereafter SCM) in addition to the Daily QA3 (Sun Nuclear Corporation).
- Additionally, a set of 5 (rotating through 10) vendor-specific machine checks were performed daily using **Machine Performance Check** (Varian Medical Systems; hereafter MPC) using the EPID on the LINAC.
- Data were collected to identify the time required to complete vendor-specific, independent, and total DQA.
- Independent-QA was further analyzed to determine time spent on dosimetry checks.
- Output collected from both methods was compared using a Wilcoxon rank sum test for 6MV, 6MeV and 10FFF, and center shift was compared for 6MV.

RESULTS

	Total QA Time (min)	MPC (rotating selection) (min)	SCM (min)	
			Total	Dosimetry
Average	32	11	21	6
Min	21	7	13	4
Max	62	45	39	12
StDev	7	7	5	1
# Tests	128	15 geometry 10 Dosimetry	103	68

Table 1 *Time to perform various daily QA tests for both vendor and independent QA*

- As shown in Table 1, total time for DQA averaged 32 minutes, MPC averaged 11 minutes, and SCM averaged 21 minutes.
- MPC tests included geometry checks on isocenter, collimator, gantry and couch; output & uniformity for 2-3 photon and 2-3 electron energies; and center shift for photon energies (see alternating schedule below).
- Of the 21 minutes for SCM tests, on average six minutes was spent on dosimetry checks, which included output, symmetry, flatness, energy, field size and center shift for 4 photon and 4 electron energies. The remainder was spent on imaging and mechanical/safety checks.
- The time required to perform MPC geometry checks and a subset of dosimetry checks exceeded the time to perform all of the dosimetry checks for the independent-QA platform SCM and took approximately half the amount of time as a full DQA as seen in Table 1.
- Differences in measured output did not reach significance for any beam and the outputs measured with the two methods followed the same general trend (see Fig. 3). The center shift results for 6x showed a divergence in trending in early December, which resulted in statistically significant difference in results.

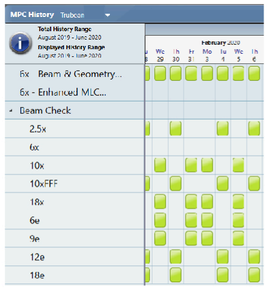

Fig. 1 *MPC schedule of tests. 6x output and geometry tests were performed every day, while the output for the remaining energies was performed every other day.*

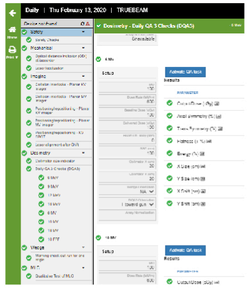

Fig. 2 *SCM DailyQA tests. All Safety, Mechanical, Imaging and Dosimetry tests were performed Daily prior to treatment.*

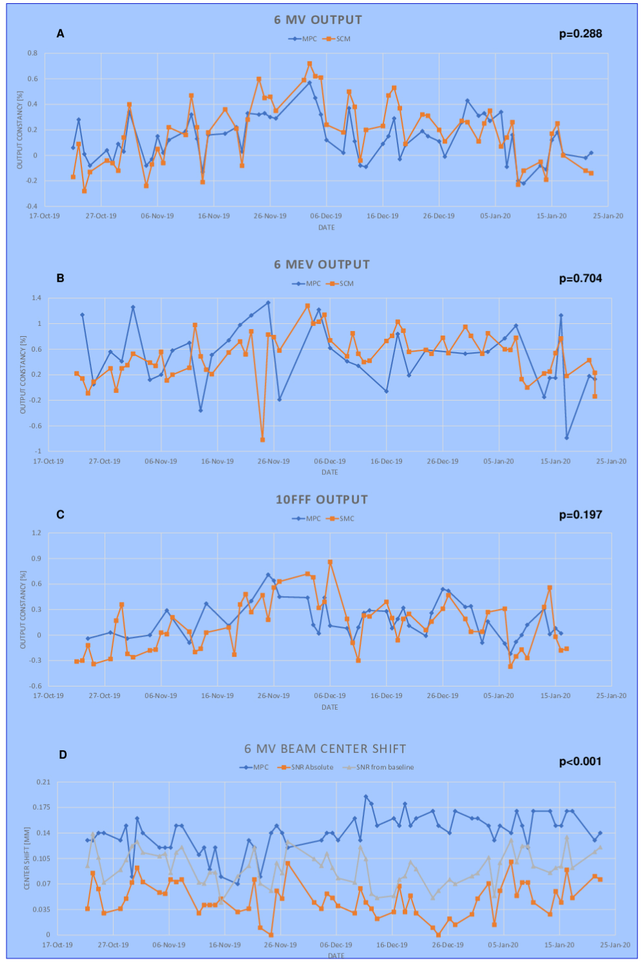

Fig. 3 *Daily output results for MPC (blue) and SCM (orange) for A) 6 MV (p=0.288), B) 6 MeV (p=0.704) and C) 10 FFF (p=0.197). D) Center shift results for MPC (blue) and SCM (orange is absolute while grey is difference from baseline)*

CONCLUSIONS

- The number of parameters assessed with SCM exceeded four times the parameters accessed with MPC. Performing all of the dosimetry checks for MPC (total of 20 dosimtery, 35 overall) would increase the time, bringing it closer to a full SCM DQA with SMC assessing approximately three times the number of parameters.
- The reported results for SCM included more detailed dosimetry checks than MPC, while MPC included extra geometry checks that are not all included in the recommendations for DQA per TG-142[4], but aid the vendor in troubleshooting and verification of the machine.
- The two systems agreed well for daily output as seen in Figure 3 A-C, but deviated on the beam's central shift as seen in Figure 3 D. Further evaluation is needed to investigate this discrepancy.
- Both platforms have a weekly schedule that prompt users to perform scheduled tests
- Both platforms allow for trending of data as well as data export for further analysis.
- SCM can obtain dosimetry results more efficiently and can provide a more user-friendly interface that can be adjusted to the specific clinic's needs to achieve complete DQA data collection.
- While MPC is attractive due to the built-in nature of the testing, and while it agrees well with the independent QA platform SCM for output, the need for a second platform for the remaining DQA tests as well as the greater efficiency of SCM, make SCM a more appropriate tool for DQA, while MPC is more appropriate for troubleshooting and Vendor use.

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