Display or Dismay? Initial Experience in Deploying 52 Workstations with Consumer-grade Displays for Remote Diagnostic Workstations

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Background/Problem Being Solved

Institutional demand necessitated a large-scale cost-effective solution be provided within a consolidated time frame to facilitate hybrid work for our radiologists

Intervention(s)

52 remote workstations with commercial-grade displays (WCD) were deployed alongside 30 workstations with diagnostic-grade displays (WDD) over 12 months. The selected WCD display (Dell Technologies, G3223Q) met the specifications for diagnostic (non-mammography) displays outlined in the 2022 ACR-AAPM-SIIM Technical Standard. Displays were calibrated to the Grey Scale Standard Display Function (GSDF) at a white point of 375 cd/m^2 using a handheld photometer (X-Rite, i1Display Pro) and software (QUBYX, Perfectlum 4). Displays were evaluated for uniformity, visual integrity, and GSDF conformance prior to deployment. Quality control (QC) training was provided to radiologists. QC consisted of display calibration and visual assessment of a test pattern and was required to be performed monthly.

Barriers/Challenges

While WDDs have built-in photometers and can automatically run scheduled QC tasks, QC for WCDs require user-initiation; increased rates of non-compliance (overdue QC or unresolved failures) coupled with frequent QC failures for WCDs require workflow improvements and support effort from imaging informaticists and physicists.

Outcome

QC test histories were exported for analysis from all remote workstations. Stations had been deployed, on average, for 128 days (WCD) and 238 days (WDD). Failures in GSDF compliance occurred 20% of the time for WCD compared to 1.5% for WDD, with maximum absolute deviations from GSDF of 10.8% for WCD, on average, compared with 3.4% for WDD. WCD were able to maintain a white point of 375 cd/m^2 over the evaluated period, but with higher variability than WGD.

Conclusion/Statement of Impact/Lessons Learned

The deployed WCDs performed within specifications but with more variability and higher failure rates, suggesting post-deployment operational expenses may offset initial capital savings. Diagnostic-grade displays may prove more cost-effective over time through a comparative total cost analysis.

Figure(s)

		Display Model	#	Usage: Av. Data Range (days)	Usage: Backlight Runtime (average) (hr)	GDSF Compliance: Av. # Data Points #	GDSF Compliance: Failure Rate (wt. average) %	GDSF Compliance: Max % Deviaiton (wt. average) $\|\%\Delta GSDF_{max}\|$	GDSF Compliance: STD (wt. average) STD ($\|\%\Delta GSDF_{max}\|$)	White Point: Av. # Data Points #	White Point: Target L_{max} (cd/m^2)	White Point: Measured L_{max} (wt. average) (cd/m^2)	White Point: Av Deviation from Target L_{max} (wt. average) $\%\Delta L_{max}$	White Point: STD ($\%\Delta L_{max}$) (wt. average) STD($\%\Delta L_{max}$)
Newly Deployed (<12 months)	Commercial-Grade	Dell G3223Q	52	128	*	16	20.0%	10.8%	12.8%	16	375	361.7	-3.56%	4.92%
Newly Deployed (<12 months)	Diagnostic-Grade	Barco MDCC-6530	30	238	3534	34	1.5%	3.4%	3.6%	34	600	599.9	-0.01%	0.03%
3+ Years Old	Diagnostic-Grade	Barco MDCC-6130	7	4440	26611	520	1.9%	*	*	3259	400	400.2	0.05%	0.31%
		Barco MDCC-6230	3	2920	27849	243	11.0%	*	*	1225	450	439.4	-2.35%	10.98%
		Barco MDCC-6330	3	2047	31057	216	0.3%	*	*	1228	450	449.9	-0.20%	0.03%
		Barco MDCC-6430	85	2099	17742	217	0.4%	*	*	1268	600	600.0	0.01%	0.04%
		Barco MDCC-6530	53	1107	9093	108	0.8%	*	*	616	600	599.7	-0.05%	0.08%

**Data either unavailable or not readily available for preliminary analysis*

Table 1. QC histories for 52 consumer-grade displays and 30 diagnostic-grade displays deployed within the last 12 months were extracted and analyzed. Maximum absolute deviation with GSDF (|%ΔGSDFmax|) and deviation from the target white point (%ΔLmax) and were determined for each data point; average and standard deviation, weighted by the number of data points per display, were then calculated for each metric as a function of display model. Rate of failure in GSDF compliance (defined as |%ΔGSDFmax| >10%) was additionally calculated. Conformance with DICOM GSDF could be achieved with the consumer-grade display, however average |%ΔGSDFmax|=10.8% with a failure rate of 20%, compared to |%ΔGSDFmax|= 3.4% and a failure rate of 1.5% for the diagnostic-grade displays. Initial data also shows backlights for the consumer-grade display exhibit greater drift than diagnostic-grade; average %ΔLmax was -3.56% (SD 4.92%), compared to %ΔLmax =-0.01% (SD 0.03%) for the diagnostic-grade displays.

QC histories were additionally extracted for 151 diagnostic-grade displays that have been in use for several years. Backlight stability and GSDF conformance for these displays were superior to the commercial-grade displays (apart from the MDCC-6230), even after significant backlight runtime. Further data binning by time window and statistical analysis may shed light on expected display lifespans.

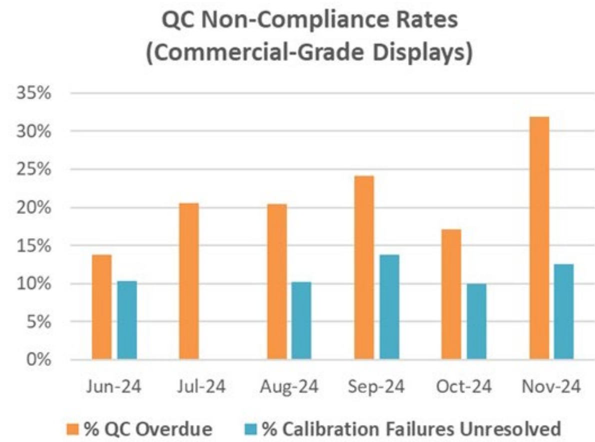

Figure 1. While diagnostic-grade displays generally have built-in photometers and can automatically run scheduled QC tasks, calibration of consumer-grade displays requires user-initiation. Compliance tracking was initiated in June 2024. Reports were gener

Keywords

Administration & Operations; Quality Improvement & Quality Assurance; Standards & Interoperability