An automated, web based MR quality control program in compliance with the American College of Radiology accreditation guidelines

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Introduction: The American College of Radiology (ACR) certification program for MR scanners requires that accredited sites maintain a weekly quality control program in compliance with ACR specifications [1]. These specifications include scanning an ACR approved quality control (QC) phantom, a manual check of the MR table and positioning, prescan parameter evaluation, and assessment of four image quality metrics (high, low contrast resolution, artifact analysis, and distortion). For sites with a large number (>10) of accredited MR systems, the manual review and calculation of these metrics requires substantial effort, often taxing personnel resources allocated to this task.

The purpose of this work is to describe the development of an automated, web based QC program that complies with ACR recommendations while simultaneously reducing QC personnel (technologist and physicist) effort.

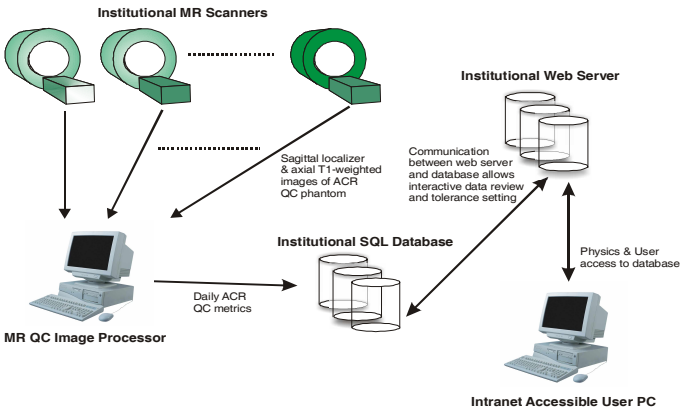

Figure 1: Schematic representation of web based QC program.

Materials and Methods: Figure 1 shows the schematic representation of the automated web based QC program. Multiple MR scanners scan the ACR QC phantom at the beginning of the imaging day. The MR technologist manually checks the table positioning and after acquiring the sagittal localizer and T1-weighted axial series, evaluates the images for artifacts. The imaged phantom data is then DICOM pushed to an analysis server, which detects a new study and initiates a series of image processing algorithms to measure high and low contrast resolution, artifact analysis, and distortion. These data are then sent to a SQL database that stores the data into the respective scanner QC tables. The total processing time including data transfer and database update is typically less than two minutes. The MR technologist then logs onto a secure web page and identifies the MR scanner from which the data has been sent and documents the remaining QC checks by entering Pass/Fail criteria into their respective fields.

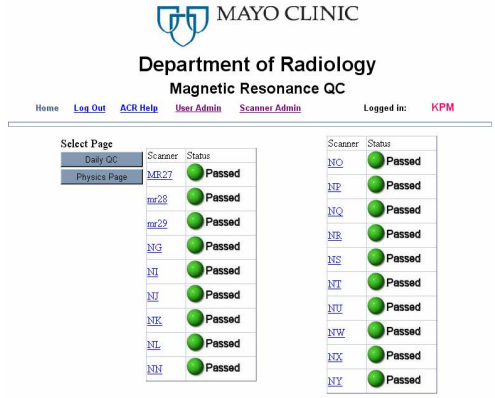

Figure 2: Initial QC web page showing QC status of MR scanners.

Figure 2 shows the main screen of the QC web site. For each of the MR systems in the database, a Pass/Fail/Not Completed icon is shown next to the hyperlink for the QC results for that system. If a system has passed the QC test, no action is required by the physicist or QC technologist. If a scanner fails, a hyperlink takes the user to the data for that day (figure 3) in order to rapidly identify the cause of the failure.

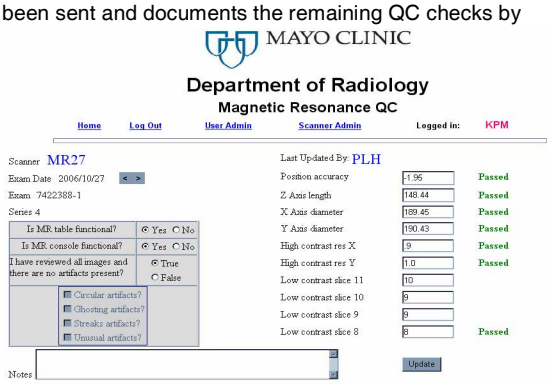

Figure 3: QC results for single MR scanner

The web page also provides analysis, plotting and administrator access. Analysis of QC data allows physics and service personnel the ability to diagnose trends and trouble shoot specific scanner problems. Administrator access allows setting and calculation of tolerance limits for each of the QC parameters.

Results: A total of 19 MR systems are currently enrolled in our MR QC program. These include two Siemens (Erlangen, Germany) Espree and one Avanto 1.5T scanners, 14 GE Healthcare (Waukesha, WI) 1.5T systems and two GE Healthcare 3.0T MR scanners. To date, 7,709 individual QC scans have been processed by this web based application. Figure 4 shows the QC data presented in table and graphical format as part of the physics / QC review pages.

Discussion: An automated QC program in compliance with ACR accreditation recommendations has been developed and implemented in a multiple vendor, multiple field strength environment. The system is potentially expandable to as many MR systems as a site can maintain. Automatic calculation of the quality control metrics represents a significant time saving for QC and medical physics staff. Web access provides rapid trouble shooting and maintenance of MR systems to ensure continued compliance with ACR guidelines.

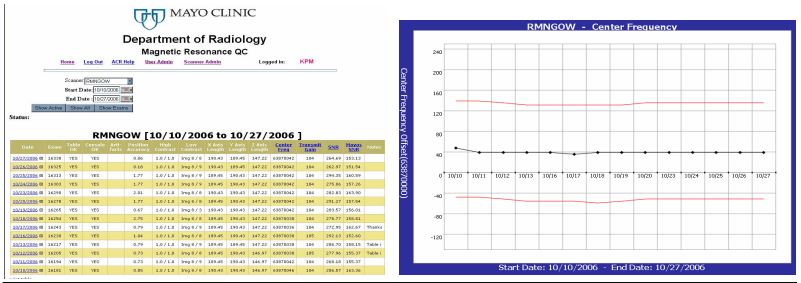

Figure 4: Physics review page and graphical presentation of QC parameters (center frequency) with associated tolerance limits.

References:

1. MR Imaging Quality Control Manual, ACR, 2004.