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IN MY OPINION

Cancer Moonshot Initiative Supports the Value and Need for Quantitative Imaging Standards

By DANIEL C. SULLIVAN, MD

Soon after the Obama administration announced formation of the Cancer Moonshot Initiative to accelerate cancer research in January 2016, a Blue Ribbon Panel of experts provided advice on the vision, proposed scientific goals and implementation of the Cancer Moonshot. Among the initiative's goals are [unleashing the power of data](#) and [enhancing data sharing](#). The activities of the RSNA Quantitative Imaging Biomarkers Alliance (QIBA) are intricately involved in those two goals. In particular, QIBA

committees have been developing Profiles related to the use of CT, PET and MRI in cancer patients. Medical imaging plays a central role in cancer treatment and research: each year in the U.S., about 23 million CT scans and 1.6 million PET scans are performed.

In addition to the Cancer Moonshot activity, the Obama administration in recent years created an [Interagency Working Group on Medical Imaging](#) (IWGMI), a consortium of 12 federal agencies to coordinate imaging research across the federal government. One of its goal is to help promote high-value imaging. The IWGMI co-chairs proposed that the Moonshot staff evaluate and consider endorsing the [two standardized QIBA Profiles](#) relevant for acquiring and analyzing images used in cancer studies and treatments: 1) accurate and reproducible 18F-fluorodeoxyglucose (FDG) PET/CT measurements; and 2) CT tumor volume measurements.

They Moonshot staff did so, and over the course of several weeks text was written and edited to post on the Cancer Moonshot website to endorse and promote the implementation of the QIBA Profiles in cancer clinical trials and clinical care. The Moonshot blog post, “Standards for Quantitative Imaging Biomarkers to Advance Research and Outcomes as part of the Cancer Moonshot,” can be found here: (<https://medium.com/cancer-moonshot/standards-for-quantitative-imaging-biomarkers-to-advance-research-and-outcomes-in-the-cancer-6e4e4ebf4e75#.9b9c2z284>).

The blog text notes that “to obtain the greatest value from cancer imaging the scans must be compared across time for a given patient, and across patients and research institutions and that this is not a trivial undertaking. Image-based assessments of treatment responses can be highly variable, depending on the make and model of the imaging equipment used and how the images were acquired, processed and the guidelines by which they were interpreted. If images are not uniformly acquired, doctors and researchers may not be able to compare the results of one study with another in the same patient, between groups of patients in a clinical trial, or between studies or institutions. It may be difficult to determine whether any apparent changes between the two studies are due to real changes in the cancer or due to technical differences between the scans.”

In conjunction with the blog on the Moonshot website, a large number of medical practices, imaging vendors, research organizations and other entities announced their commitment to [endorse](#) or [adopt](#) these QIBA Profiles to improve the reliability of cancer imaging studies. These statements of support can be found here: <http://qibawiki.rsna.org/index.php/Profiles>.

Recognition of these QIBA Profiles by the Cancer Moonshot initiative will contribute significantly to improving the quality of cancer care — and to the development of more effective therapeutics in oncology.



Daniel C. Sullivan, M.D., is professor emeritus in the Department of Radiology at Duke University Medical Center, Durham, N.C. His areas of clinical and research expertise are in nuclear medicine and oncologic imaging, in particular focusing on improving the use of imaging as a biomarker in clinical trials. Dr. Sullivan participated in the formation of the Quantitative Imaging Biomarkers Alliance (QIBA), and currently serves as QIBA External Relations Liaison.



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PubMed Search on: "Cancer Moonshot Initiative Supports the Value and Need for Quantitative Imaging Standards."

Each issue of [QIBA Newsletter](#) features a link to a dynamic search in PubMed, the National Library of Medicine's interface to its MEDLINE database. Link to articles on: "Cancer Moonshot Initiative Supports the Value and Need for Quantitative Imaging Standards."

ANALYSIS TOOLS & TECHNIQUES

ADC Phantom Use in U.S. & European Clinical Trials

By THOMAS L. CHENEVERT, PhD

Incorporation of MR diffusion-based biomarkers, such as apparent diffusion coefficient (ADC), is becoming commonplace in clinical trials. ADC measures offer objective insight to tissue/tumor alteration secondary to effective cytotoxic therapy or disease progression [4, 10, 11]. To realize greatest scientific yield from any biomarker, however, all sources of variability must be identified, characterized and mitigated to the

degree possible. Little can be done to reduce biologic sources (e.g., patient- and tumor-based), whereas tighter control of technical sources regarding MRI system, technical staff, scan protocol and analysis procedure is feasible and a central focus of QIBA. Physical phantoms are essential to establish technical performance of an MRI system in terms of bias and variance relative to peer systems and, when available, measurement of ground truth quantities.

The QIBA-sponsored diffusion phantom [1, 2] was specifically designed to evaluate MRI systems in performing diffusion-weighted imaging (DWI) of media with known diffusion coefficients. This phantom is commercially available [6] and in use at over 60 sites worldwide. The QIBA DWI phantom contains an array of materials of precisely known diffusion properties due to temperature control by an ice water bath [2] and represents a significant extension to prior ice-water DWI phantom designs [3, 7, 8, 9]. The QIBA DWI phantom has been used for system testing in the European Union IMI-QulC-ConCePT [12] and an NIH-sponsored traumatic brain injury “TRACK-TBI” trial [13]. Quantitative DWI phantoms are also used for site certification in multiple clinical trials including ACRIN-6701, ACRIN-6702, ACRIN-6698, NRG-BN001, Brain Connectome and Neurodevelopmental Outcomes (SVR III) and the Pediatric Brain Tumor Consortium.

As noted above, variability in DWI analysis can unnecessarily confound multi-site/-platform clinical trials. To standardize analysis of QIBA DWI phantom data, the “QIBaphanR1” software package [5] was developed within the QIBA Groundwork Project mechanism to provide a vendor-agnostic phantom analysis platform. Despite obvious benefits of the DICOM standard, DWI and ADC DICOM results are generated and organized in a variety of ways across platforms. A key feature of the QIBaphanR1 software is the ability to import a wide range of DWI DICOM sort orders from multiple vendor sources for standardized ADC map generation and downstream processing. The software prompts the user for single click definition of ROI locations in target vials (Figure 1) and outputs statistics in multiple formats, as well as listing key acquisition parameters that were non-compliant with QIBA-recommended settings. As detailed in the QIBA DWI Phantom scan protocol, multiple identical sequential DWI acquisitions are collected to assess stability and signal-to-noise ratio (SNR) as a function of b-value. Results are tabulated in portable CSV format for optional import and analysis in other environments (Figure 2).

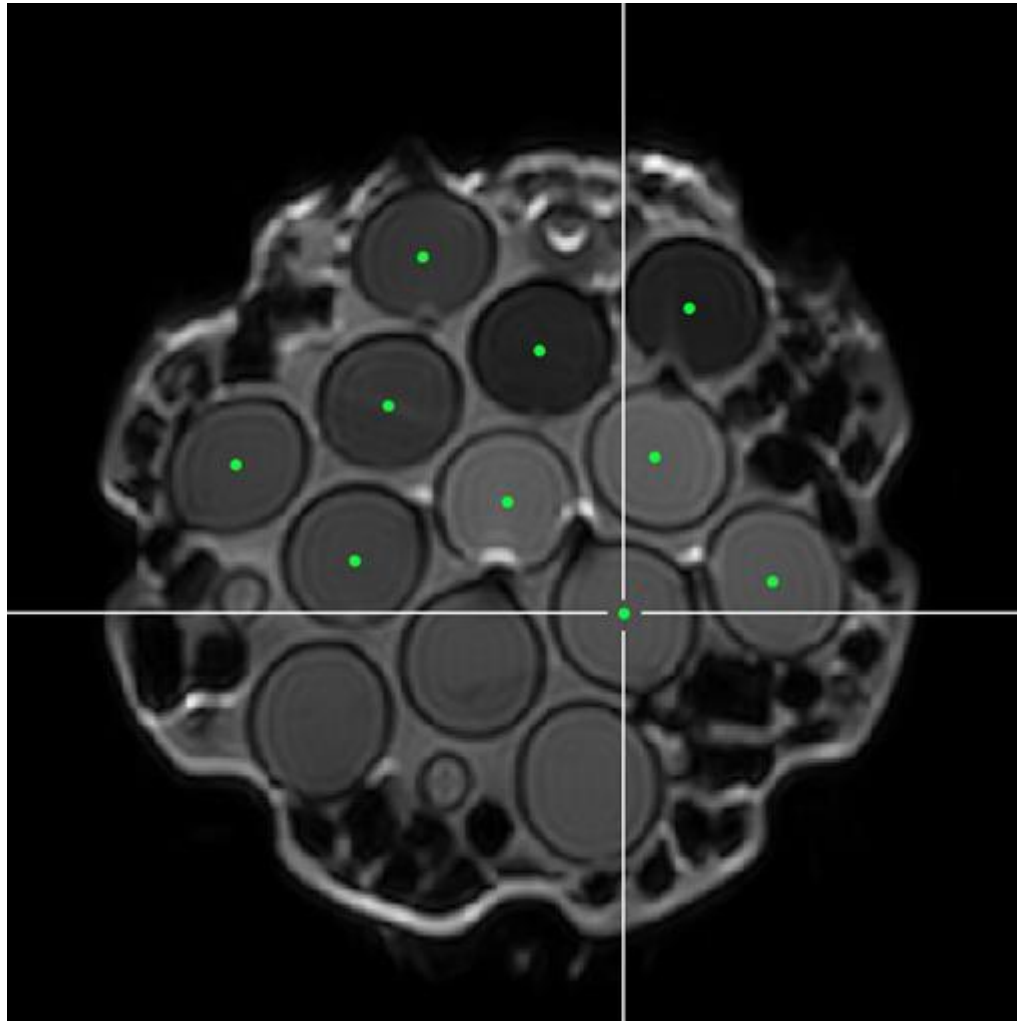


Figure 1: Illustration of QIBAphanR1 software-guided selection of centers of polyvinylpyrrolidone (PVP) vials of the QIBA DWI phantom. Selected loci coordinates define ROI centers mapped onto all associated DWI and ADC maps to extract statistics related to ADC bias, variance and DWI SNR.

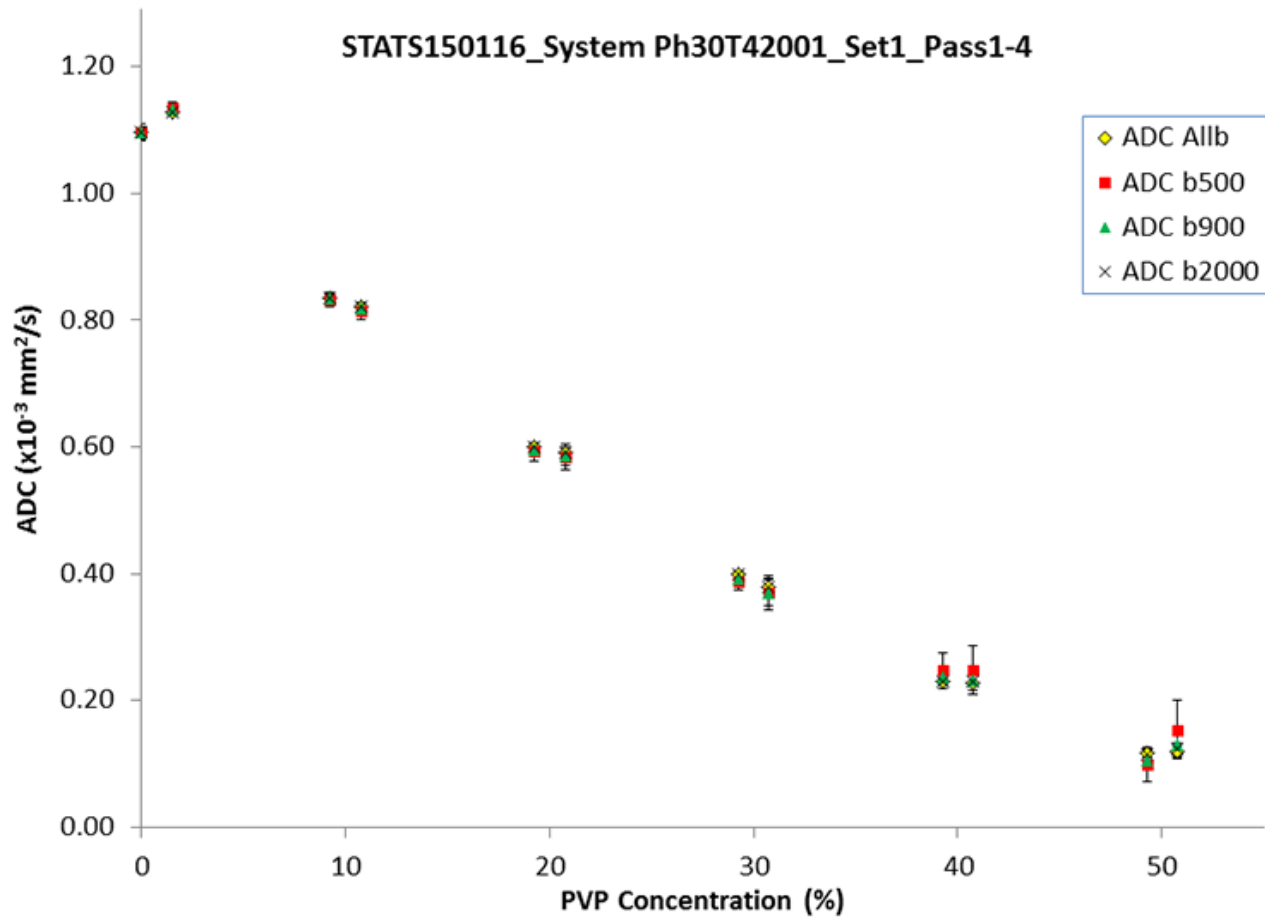


Figure 2: ADC vs. PVP concentration derived from statistics generated by QIBAphanR1 software using data from one 3T MRI system included in initial round-robin tests of the QIBA DWI Phantom [2].

Thomas Chenevert, PhD, is a professor at the University of Michigan, Department of Radiology, Ann Arbor. He is a senior MRI physicist and directs operations of the 3T MRI Human Research facility. His current research involves translation of MRI-based treatment response biomarkers to human clinical trials, efforts to standardize acquisition/processing methodologies and remove technical bias in diffusion MRI due to gradient nonlinearity.



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[QIBA and QI/Imaging Biomarkers in the Literature](#)

This list of references showcases articles that mention QIBA, quantitative imaging, or quantitative imaging biomarkers. In most cases, these are articles published by QIBA members or relate to a research project undertaken by QIBA members that may have received special recognition. New submissions are welcome and may be directed to QIBA@rsna.org.

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