QIBA Quarterly

Quantitative Imaging Biomarkers Alliance RSNA

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QIBA MISSION
Improve the value and practicality of quantitative imaging biomarkers by reducing variability across devices, patients and time.

QIBA CONNECTIONS

Quantitative Imaging Biomarkers Alliance (QIBA)

QIBA Wiki

Contact us
Comments & suggestions welcome

Daniel C. Sullivan, MD
RSNA Science Advisor

IN MY OPINION

QIBA Collaborates with Imaging Manufacturers

By ANDREW J. BUCKLER, MS

Efficient, valid methodologies are required that use imaging biomarkers as surrogate endpoints for changes in the health status of patients. These methods can be applied in clinical research, optimal patient care, and development of new therapies, such as pharmaceuticals.

The deployment of qualified imaging biomarkers has not kept pace with the advances in technology that allow manufacturers to fulfill demand for them. Large scale deployment has been limited by variation across manufacturers and lack of consensus about which biomarkers need to be used and validated.

Efforts by individual manufacturers to qualify quantitative imaging biomarkers are cost-prohibitive and make it more difficult to establish the standards needed by the healthcare community.

QIBA Models Profiles after IHE®

As a collaborative alliance, QIBA's goal is to establish a methodology by which multiple stakeholders test various hypotheses about the technical feasibility and medical value of imaging biomarkers, starting with volumetric CT, fluorodeoxyglucose (FDG) PET/CT, and dynamic contrast material–enhanced MR imaging.

This process benefits the imaging device industry by providing a mechanism to share the cost of qualifying mature biomarkers to increase utilization while also encouraging the development of new, innovative markers. Broad use of qualified biomarkers to assess treatment response in clinical practice helps clinicians and patients, while industry stakeholders such as interventional device companies—including radiation therapy and minimally-invasive devices for prevention and therapy—and biopharmaceutical companies benefit from cost-effective development programs and more effective use of imaging.

QIBA Technical Committees are developing Profiles to organize their activity and capture the results. Adapted from the Integrating the Healthcare Enterprise (IHE®) model, a Profile is a document that specifies claims—which tell a user what can be accomplished by following the Profile—and details, which tell vendors what is required for their products to comply with the Profile.

After key scientific questions and concepts requiring validation have been identified and refined, QIBA coordinates the research and other groundwork needed to resolve these questions so the Profile definition can proceed.

It is envisioned that manufacturers will seek to comply with completed Profiles in response to the demand of clinical users for Profile-compliant equipment. Users will be motivated to require Profile-compliant devices based on the result of clinical trials that used Profile-compliant equipment to improve their effectiveness. Increasingly the standard of care in the clinic will call for these benefits as well.

It is anticipated that this method will be robust enough to be recognized as a regulatory pathway for the registration of such products with the FDA. For manufacturers, qualification data accepted by regulatory bodies could be used in 510(k) applications (or premarket notifications) more cost effectively

than if companies pursued the qualification individually.[1]

Future Coordination
Future development and implementation of quantitative imaging relies on coordination among industry players, regulatory organizations and practicing clinicians. Patients and the entire healthcare industry will benefit from the appropriate use of imaging in the diagnosis and management of disease, which can be supported by validation, standardization, and comparative effectiveness research.

While manufacturers must remain attuned to development cost and time-to-market, every stakeholder will benefit from technological, commercial, and utilization advances in imaging biomarkers.

Reference:
[1] *Why QIBA is a Good Thing for Radiology in General, and the Imaging Manufacturers in Particular.* Medical Imaging & Technology Alliance (MITA), February 2009.

Andrew J. Buckler, MS, is an imaging analytics specialist who has worked in the medical device manufacturing sector for over 20 years. He serves as co-chair of the QIBA Volumetric-CT Technical Committee.

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ANALYSIS TOOLS & TECHNIQUES

Calculating PET SUV from DICOM Images

By PAUL KINAHAN, PhD, and DAVID CLUNIE, MBBS, FRACR

Although PET/CT imaging of cancer has recently become a standard component of oncology diagnosis and staging, it does not necessarily require assessment of numeric pixel values.

Meanwhile, pharmaceutical companies are using quantitative PET/CT imaging to evaluate potential therapies even though the FDA has yet to accept the modality as a qualified or validated biomarker for surrogate endpoints.

At the clinical level, the relative tracer uptake by a lesion is now routinely reported, which creates compelling reasons to understand and improve the quantitative accuracy of PET/CT imaging.

The use of PET/CT to determine response to therapy is highlighted in the May 2009 supplement to the *Journal of*

Nuclear Medicine, which includes a comprehensive survey of the factors that affect the bias and variance of PET/CT imaging. [1]

Factors Impact Calculation of SUVs

Numerous factors impact the calculation of uptake values from Digital Imaging and Communications in Medicine (DICOM) images.

To account for variations in the injected dose and patient size, generally preferred units for image interpretation are standardized uptake values (SUVs) defined as $SUV=R/(D/W)$ where R (kBq/ml) is the activity concentration at each point, D (kBq) is the decay-corrected injected dose, and W is the patient weight.

Patient weight is typically used as a surrogate for the volume of distribution, although the estimated lean body mass or body surface area is sometimes used instead of weight. Proper calculation of SUVs, therefore, requires knowledge of several parameters encoded in the image “header” in addition to the spatially varying activity concentration encoded in the image pixel data. A partial list of these parameters includes injected dose, radionuclide half-life (to account for radioactive decay of the isotope), time of injected dose, time of scan, patient weight, scanner calibration factors, sex (for lean body mass calculations), height, as well as image scaling methods and scale factors.

Parameters are encoded in DICOM header elements of PET images by the scanner as specified by the DICOM Standard. Some variation exists between scanner manufacturers in how these values are stored and in which elements they are stored. In principle, the *DICOM Conformance Statement* published by the manufacturer should describe these details and the DICOM Standard defines how different elements should be interpreted. However, experience has shown that there is room for misinterpretation, ambiguity, error, and suboptimal choice. For example, the time to be used for decay correction is potentially stored in several different data elements, while only one may be appropriate for a given scanner operated in a particular manner.

A relatively large number of important data elements are needed for correct calculation of SUVs, which is further complicated by the need to interpret DICOM images on display station systems not manufactured by the original scanner provider. Also, the original scanner provider’s workstation may be limited and have the capability to implement fewer variations in the use of DICOM Standard elements, not support legitimate variations from other vendors, and consequently

may display incorrect SUVs.

Further, a particular vendor may add features using private elements understood only by their own systems that modify the calculation of SUVs and result in different values from those computed strictly according to the DICOM Standard.

QIBA Studies DICOM Elements

To address these issues, the QIBA FDG-PET/CT Quantitation Computation subcommittee is evaluating the generation and interpretation of the DICOM data elements used by the PET/CT scanner manufacturers and display station vendors. The committee comprises representatives from scanner manufacturers, display station vendors, pharmaceutical companies, clinical research organizations, professional societies, physicians, and physicists.

In the first phase, the subcommittee used surveys to obtain a description of which DICOM data elements were populated and their expected use from manufacturers and display station vendors. In addition, a Digital Reference Object (DRO), a set of test DICOM images, is being constructed to compare SUV measurements on different display stations. Because the DRO—which has demonstrated known truth—is being used as the test object, results obtained on different display stations should ideally be identical.

Results of these surveys and studies are posted at qibawiki.RSNA.org along with meeting summaries and other information. Comments and participation are always welcome. The authors acknowledge helpful comments from Jeffrey Yap, PhD, of the Dana-Farber Cancer Institute.

Reference:

[1] Standards for PET Image Acquisition and Quantitative Data Analysis. J Nucl Med 2009 May; 50 (suppl1):11S-20S. Boellaard R., et al.

Paul Kinahan, PhD, is a professor of radiology, bioengineering and electrical engineering and director of PET/CT physics at the University of Washington in Seattle. He is chair of the American Association of Physicists in Medicine (AAPM)/SNM Task Group on Quantitative PET/CT Imaging and participates in SNM, AAPM, and RSNA initiatives on quantitative medical imaging as a biomarker.

David Clunie, MBBS, FRACR, is a neuroradiologist and chief technology officer at RadPharm, Inc, which specializes in independent review and core lab services for imaging clinical trials for regulatory approval of oncology drugs and biologics. He is editor of the DICOM Standard*, co-chair of the IHE Radiology Technical Committee, and a participant in the NCI initiative, In Vivo Imaging Workspace of the Cancer Biomedical Informatics Grid (caBIG®).*

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FOCUS ON

RSNA 2009: Quantitative Imaging/Imaging Biomarkers and QIBA Meetings and Activities

MARK YOUR CALENDAR

QI/IB Informational Meeting

An overview of imaging biomarkers, the QIBA process, and reports from QIBA Technical Committees and the Uniform Protocols for Imaging in Clinical Trials (UPICT).

- Monday, November 30, 3:00 PM–4:30 PM

QIBA Technical Committee Working Meeting

- Wednesday, December 2, 2:00 PM–4:00 PM

VISIT THE LAKESIDE LEARNING CENTER (HALL E)

QIBA Technical Committee posters, Meet the Expert sessions, and the QIBA kiosk will be featured in the Lakeside Learning Center (Hall E) near the Molecular Imaging Zone and the *Toward Quantitative Imaging: Reading Room of the Future* educational showcase.

The *Toward Quantitative Imaging: Reading Room of the Future* educational showcase will provide visual and experiential exposure to quantitative imaging and biomarkers through 15 exhibitor products that integrate quantitative analysis into the image interpretation process. Participants can learn through hands-on exhibits featuring informational posters, computer-based demonstrations, and Meet the Expert presentations scheduled throughout the week.

QIBA MEETING MARKS YEAR OF PROGRESS

Attendees of QIBA's May 2009 working meeting were welcomed by N. Reed Dunnick, MD, RSNA Liaison for Science, who emphasized the RSNA Board of Directors' commitment to QIBA's activities and future efforts. The May 19-20 workshop was held in Oak Brook, Ill.

Chaired by Daniel C. Sullivan, MD, RSNA Science Advisor, the meeting marked a year of progress towards QIBA's mission to improve the value and practicality of quantitative imaging biomarkers by reducing variability across devices, patients, and time.

About 70 stakeholders from the clinical community, imaging equipment manufacturers, the pharmaceutical industry, government and medical informatics companies, imaging societies, and RSNA leadership attended the discussions and Technical Committee breakout sessions that are highlighted in the meeting summary.

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QI/IMAGING BIOMARKERS IN THE LITERATURE

PubMed Search on the Imaging Industry and Biomarkers

Each issue of *QIBA Quarterly* will feature a link to a dynamic search in PubMed, the National Library of Medicine's interface to its MEDLINE database. Click here to view a PubMed search on the imaging industry and biomarkers.

Take advantage of the My NCBI feature of PubMed that allows you to save searches and results and includes an option to automatically update and e-mail search results from your saved searches. My NCBI includes additional features for highlighting search terms, storing an e-mail address, filtering search results and setting LinkOut, document delivery service and outside tool preferences.

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