DATE: June 22, 2017

TO: Small lung nodule profile leadership

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SUBJECT: Small nodule performance conformance requirement

Initiated at the QIBA annual meeting in May 2017, a physics group was convened to seek feedback on the conformance requirements currently under consideration for the QIBA small lung nodule profile. The following is a summary of the consensus that our committee reached in its deliberations.

The QIBA small lung nodule profile is understood to propose the following items that were the focus of discussion:

* using a new phantom (described in Section 4.1)
* adding several requirements that were all based on this new (non-standard) phantom, including:
  + changing requirements on voxel noise to meet standard deviation targets in four materials rather than one (described in Section 3.4.2)
  + changing requirements on resolution to use 3D PSF standard deviation and z-axis PSF standard deviation rather than MTF50 (described in Section 3.4.2)
  + adding requirements on voxel bias, edge enhancement, and spatial warping (described in Section 3.4.2)

Three principles that came up during discussion were:

* QIBA and QIBA profiles, as a reflection of the consensus of the scientific community, should strive to adapt techniques that have independent endorsement of the scientific establishment, which includes peer-review publication, professional guidelines, and consensus standards.
* To minimize having to acquire additional materials, and to learn additional procedures, it is desirable to re-use phantoms and procedures already in common use, as long as they are adequate to meet the profile claims. For example, use of the ACR phantom is required for ACR CT Accreditation, which is one of the ways to achieve the accreditation required for CMS reimbursement (which will include reimbursement for lung cancer screening). There is familiarity with the associated medical physics protocols, so a compelling, evidence-based case should be made for deviating from the use of this or other widely used and accepted phantoms.
* Demonstration of the methodology across scanners, technologies (e.g. conventional and iterative reconstructions), various segmentation algorithms and even lesion types (spherical and non-spherical), etc. is highly desirable.
* Automated tools that support QIBA conformance procedures are highly desirable (although their use should not be a mandatory pre-requisite for conformance to the profile). However, these tools should not be sole-sourced and their calculations and capabilities should be externally validated.

To further consider the proposed methodology it would be helpful to establish broader evidence, validation, and endorsement. To facilitate that, the following would help judge the potential benefits of the proposed changes:

1. Explanation of how the noise requirements in the three additional materials would be expected to improve overall volume quantification performance (e.g. segmentation performance and beyond) compared to protocols constrained by only a single material noise requirement.
   1. Supporting experimental data would be helpful
2. Justification for reflecting resolution in terms of PSF as opposed to the MTF50, and for use of a 3D metric and an in-plane-vs-z-axis ratio
3. Explanation of how requirements on each of voxel bias, edge enhancement, and spatial warping would be expected to improve volume quantification (e.g. segmentation performance and beyond) compared to protocols where only noise and resolution were constrained.
   1. Supporting experimental data would be helpful
4. Demonstration of the effects of these parameters on volume quantification under a variety of acquisition and reconstruction conditions (eg, pitch, recon filters, slice thickness, dose) using current state-of-the-art scanners.