Establishing a Technical Guidance Document for COPD and Lung Cancer Image Acquisition Protocol: Topic Overview

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University of Michigan
RSNA QIBA Lung Density Committee
The goal of a QIBA Profile is to help achieve a useful level of performance for a given biomarker.

QIBA Profile:
Small Lung Nodule Volume Assessment and Monitoring in Low Dose CT Screening

QIBA Profile:
Computed Tomography: Lung Densitometry
QIBA guidance: Computed tomography imaging for COVID-19 quantitative imaging applications

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Table 1. Logistic regression results. Odds ratios (ORs) are displayed as 95% confidence intervals. The ORs for %HAA-200 and age are applied to unit increases in percentage and years, respectively.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>ICU admission</th>
<th>Intubated</th>
<th>Intubated &gt; 7 days</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>%HAA-200</td>
<td>(1.07, 1.17), p&lt;0.001</td>
<td>(1.09, 1.19), p&lt;0.001</td>
<td>(1.08, 1.19), p&lt;0.001</td>
<td>(1.00, 1.11), p&lt;0.052</td>
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<tr>
<td>Age</td>
<td>(0.99, 1.03), p=0.242</td>
<td>(0.98, 1.02), p=0.978</td>
<td>(0.98, 1.02), p=0.907</td>
<td>(1.05, 1.12), p&lt;0.001</td>
</tr>
<tr>
<td>Sex (male=0, female=1)</td>
<td>(0.56, 1.57), p=0.810</td>
<td>(0.40, 1.27), p=0.247</td>
<td>(0.48, 1.68), p=0.866</td>
<td>(0.36, 1.31), p=0.254</td>
</tr>
</tbody>
</table>
2,212 studies

“With no standardization, AI algorithms for COVID-19 have been developed with a very broad range of applications, data collection procedures and performance assessment metrics. Perhaps as a result, none are currently ready to be deployed clinically. Reasons for this include: (1) the bias in small datasets; (2) the variability of large internationally sourced datasets; (3) the poor integration of multistream data, particularly imaging data.”

“It is now so much easier to design and conduct a radiology AI experiment. The only prerequisite seems to be possession of a large data set.”

“It is time to move beyond studies showing that AI can detect opacities at CT or chest radiography—this is now well established.”
"We found that among the 52,726 asymptomatic participants, emphysema was identified on baseline LDCT in 12,542 (23.8%) participants. Of the 12,542 participants with emphysema, 9595 (76.5%) had no prior COPD diagnosis and 2947 (23.8%) had a prior COPD diagnosis."

Need to establish feasibility of screening for *automated quantitative* COPD/emphysema

Need to establish use cases for *automated quantitative* COPD/emphysema
10009Y_Njc_Copd, You have an excellent opportunity to quit smoking now, before things get worse:

- **3%** more likely to die in the next 6 years.
- **2%** more likely to be diagnosed with lung cancer in 5 years.
- **4x** more likely to have a heart attack than a nonsmoker.
- **2x** more likely to have a stroke than a nonsmoker.

Because of your lung health and smoking status you are up to...

10009Y_Njc_Copd, your body starts healing the minute you quit smoking.

- **20 MINUTES**
  - Carbon monoxide levels in your blood drops to normal.
- **12 HOURS**
  - Your circulation and lung function improve.
- **2 WEEKS - 3 MONTHS**
  - Your risk of coronary heart disease and heart attack drops significantly.
- **1 YEAR**
  - Your risk of stroke can fall to that of a nonsmoker.
- **5 YEARS**
  - Your risk of dying from lung cancer is about half that of a smoker.
- **10 YEARS**
  - Your risk of dying from heart disease drops to that of a nonsmoker.

**HELP**

QUITTING CAN BE VERY DIFFICULT. BUT PEOPLE WHO KEEP TRYING ARE VERY LIKELY TO SUCCEED. PLEASE CALL 444-555-8888.

We want to support you no matter how many times you have tried to quit in the past. It is never too late to improve your health by quitting smoking. At the number above, you will find someone ready to listen to you and connect you with smoking cessation counseling, nicotine replacement products, and prescription non-nicotine medications.
“Systematic literature review shows emphysema detected visually on CT to be independently associated with increased odds of lung cancer. This association did not hold with automated emphysema detection.”
Quantitative Emphysema on Low-Dose CT Imaging of the Chest and Risk of Lung Cancer and Airflow Obstruction: An Analysis of the National Lung Screening Trial

Part of this article has been presented in abstract form at the American Thoracic Society International Conference, May 18-23, 2018, San Diego, CA.

Wassim W. Labaki MD, Meng Xiu PhD, Susan Murray ScD, Charles R. Hall PhD, Abdullah Al-Abba MD, Michael C. Ferreira MD, Catherine A. Medrano PhD, BN, Lauren A. Keith PhD, Craig J. Galvin PhD, Douglas A. Azenberg MD, Jeffrey L. Curtis MD, Fernando J. Martinez MD, Ena A. Kazzaz MD, Nan Lin, Yuan Han MD
Comparison of CT Lung Density Measurements between Standard Full-Dose and Reduced-Dose Protocols

- LDCT lung density measurements can easily be harmonized with standard dose measurements
- Ability of lung density to predict COPD and exacerbations is not diminished with LDCT.
Normalizing computed tomography data reconstructed with different filter kernels: effect on emphysema quantification.

All-cause mortality

Raw

Normalized

Lung cancer mortality
Head-to-head Comparison of Qualitative Radiologist Assessment With Automated Quantitative Computed Tomography Analysis for Bronchiolitis Obliterans Syndrome After Hematopoietic Cell Transplantation

Husham Sharifi, MD, MS,* Zachary D. Guenther, MD,†
Ann N.C. Leung, MD,† Laura Johnston, MD,‡ Yu K. Lai, MD,*
Joe L. Hsu, MD, MPH,* and H. Henry Guo, MD, PhD†

<table>
<thead>
<tr>
<th>TABLE 4. Diagnostic Performance for Consensus Radiologist Interpretation for the Diagnosis of BOS*</th>
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<tbody>
<tr>
<td>Inspiratory Phase</td>
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<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Sensitivity</td>
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<tr>
<td>Specificity</td>
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<tr>
<td>PPV</td>
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<td>NPV</td>
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<td>Accuracy</td>
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<td>AUC (95% CI)</td>
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*N = 76.
CI indicates confidence interval; NPV, negative predictive value; PPV, positive predictive value.
Questions for panelists

• How can we accommodate Radiologist preference in scanning parameters while maintaining standards for quantitative protocol requirements?

• What are the clinical application targets of a combined CT image acquisition protocol for COPD and Lung Cancer?

• What studies will be necessary to demonstrate effectiveness of a combined protocol?
  • How do we move beyond statistically significant associations between biomarkers and disease, and demonstrate concrete examples how the biomarkers can be used clinically?

• Do we have enough data to support the role and impact of doing expiratory imaging in LCS?

• What is the best way to disseminate and achieve acceptance of such a document?