

Advanced Imaging Task Group



Daniel Sullivan, MD



Michael McNitt-Gray, PhD



**NATIONAL
LUNG CANCER
ROUNDTABLE**

Advanced Imaging Task Group

NLCRT 4th Annual Meeting
December 8, 2020
Virtual

Advanced Imaging Task Group Charge

To identify imaging technology needs and potential solutions (e.g., hardware, software or interoperability methods or procedures), and strategies to further their use and transition into all clinical points along the multi-disciplinary care pathway of lung cancer including lung cancer screening, early detection, diagnosis and management.



Advanced Imaging Task Group Leadership and Members



**Task Group Chair
Daniel Sullivan, MD
Duke University**



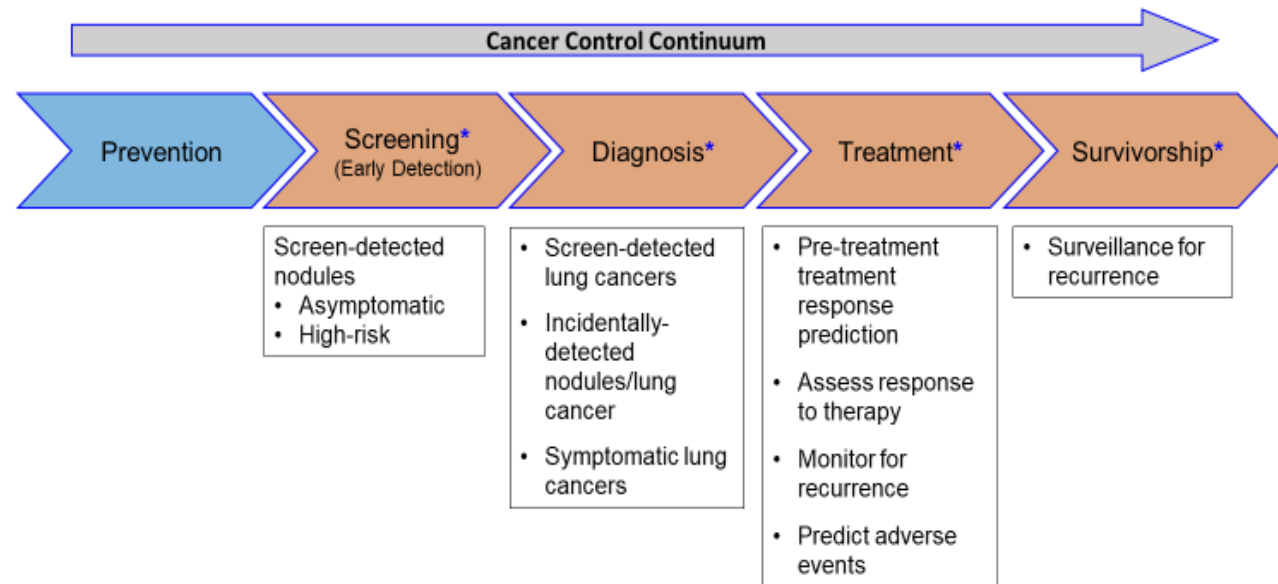
**Task Group Vice Chair
Michael McNitt-Gray,
PhD UCLA**

- ❖ Denise Aberle, MD, University of California Los Angeles
- ❖ Samuel Armato III, PhD, University of Chicago
- ❖ Rick Avila, MS, Accumetra
- ❖ Paul Bergstrom, PhD, National Institute for Standards and Technology
- ❖ Maria Chong, MD, RADIA Imaging (Washington)
- ❖ Laura Coombs, PhD, American College of Radiology
- ❖ Richard Frank, MD, PhD, Siemens Healthineers North America
- ❖ Robert Gillies, PhD, Moffitt Cancer Center
- ❖ Jonathan Goldin, MD, PhD, University of California Los Angeles
- ❖ Jayashree Kalpathy-Cramer, PhD, Athinoula A. Martinos Center for Biomedical Imaging
- ❖ Ella Kazerooni, MD, MS, University of Michigan
- ❖ Paul Kinahan, PhD, University of Washington
- ❖ Nicholas Petrick, PhD, Food and Drug Administration
- ❖ Matthew Schabath, PhD, Moffitt Cancer Center
- ❖ David Yankelevitz, MD, Mount Sinai

The NLCRT Advanced Imaging Task Group Strategic Plan

Opportunities in Advanced Imaging Across the Lung Cancer Care Continuum

Imaging Biomarkers in the Lung Cancer Control Continuum



**Relevant areas of image-based biomarkers in the continuum*

Report Goals:

- **Improve our ability to identify patients at risk of developing cancer (tailor screening eligibility);**
- **Improve and advance lung cancer screening technologies;**
- **Predict the probability of lung cancer in CT-detected nodules;**
- **Assist in developing best practices for patient management; and**
- **Develop methods to better assess response to therapy and monitor for recurrence.**



Report: High-priority Advanced Imaging Technologies needing targeted focus and resources from relevant organizations:

- **Develop novel technologies (for screening, staging, and/or monitoring)**
- **Optimize quantitative imaging (QI) methods to create objective image biomarkers**
- **Create systems and infrastructure for sharing image data and/or algorithms.**
- **Facilitate imaging-related artificial intelligence (AI) solutions**

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Recommendations re: Technology Development:

- **Additional financial investment is needed. Although many academic, non-profit and commercial groups are working on these technologies, the pace of technology development and evaluation is significantly hampered by lack of funding.**
- **Workshops could be convened by NIH and professional organizations to define lung-cancer-relevant high-priority clinical problem “challenges”, followed by “brainstorming” to define the biological/physical/engineering/technical specifications which innovators could try to address.**



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Recommendations re: Quantitative Imaging Development:

- ACR should strengthen programs that encourage or require the use of QI QA protocols, procedures and phantoms into clinical practice
- AAPM should provide lung cancer CT acquisition protocols for implementing *quantitative* imaging tools
- AAPM, QIBA, NIST and Industry should collaborate on implementation of QI assessment methods
- CMS should create relevant metrics for effective QI measures, tools and protocols for lung cancer.
- FDA should create additional QI Guidance documents.
- Improved funding is needed from government, non-profit and for-profit sources for QI research projects.

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Recommendations re: Data Sharing development:

- **Distributed-learning infrastructure and Open Image Archives need to be developed (by government, academic and commercial institutions) to make available an expanded number of extensive and unbiased training sets.**
- **The ACR-CMS-approved registry should be expanded to create a large image archive.**
- **Templates for data sharing agreements are needed.**

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Recommendations re: Artificial Intelligence development:

- Vendors and researchers should develop improved techniques to mitigate brittleness of algorithms.
- Professional organizations and regulatory agencies should develop standards around good ML practices and clarify algorithm validation pathways.
- Vendors and researchers should expand development of “interpretable AI” (AI that can explain the reasoning that led to its decision).

Summary Recommendations re: Implementation:

- The “users”, or beneficiaries, of these advances (e.g., treating clinicians, patient advocacy groups) must demand implementation of these advanced imaging techniques.
- Radiology professional organizations should develop incentives for radiology practices to fast-track adoption and integration of technology advancements.

NCLRT Co-sponsored workshop:

QUANTITATIVE IMAGING WORKSHOP XVII:

*Leveraging CT to Accelerate Detection of Lung
Cancer, COPD and Cardiovascular Disease*

October 28-30, 2020 | Virtual

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WORKSHOP  prevent
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NCLRT Co-sponsored workshop:

Session Two: Value of Metrology

This session is being held in collaboration with Quantitative Imaging Biomarkers Alliance and the American Cancer Society/National Lung Cancer Roundtable.

Co-Chairs & Moderators:

- Daniel C. Sullivan, MD, *Quantitative Imaging Biomarker Alliance and Duke University Department of Radiology*
- Robert A. Smith, PhD, *American Cancer Society and National Lung Cancer Roundtable*

**QUANTITATIVE IMAGING
WORKSHOP XVII:**

*Leveraging CT to Accelerate Detection of Lung
Cancer, COPD and Cardiovascular Disease*

0:00 / 2:11:35

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NCLRT Co-sponsored workshop:

- **Clinical Perspective: What are the Challenges and Hurdles Hindering the Implementation of Advanced Image Analysis Tools for CT Screening?**

Topic Overview: Gregory Sorensen, MD, *DeepHealth, Inc.*

Panelists: Ronald Summers, MD, PhD, *National Institutes of Health Clinical Center*
Eliot Siegel, MD, *University of Maryland and VA Maryland Healthcare System and National Cancer Institute's Cancer Image Archive*
Ella Kazerooni, MD, MS, *Michigan Medicine/University of Michigan Medical School*
Curtis Langlotz, MD, PhD, *Stanford University Medical Center*

- **Metrology and Quality Assurance Perspective: What are the Challenges and Hurdles Hindering the Validation and Regulatory Approval of AI Algorithms for CT Screening?**

Topic Overview: Maryellen L. Giger, PhD, *The University of Chicago*

Panelists: Nancy Obuchowski, PhD, *Cleveland Clinic Foundation*
Ricardo Avila, MS, *Accumetra LLC*
Anthony P. Reeves, PhD, *School of Electrical and Computer Engineering, Cornell University*
Timor Kadir, DPhil, MEng, *Optellum (United Kingdom)*
Robert Ochs, PhD, *Center for Devices and Radiological Health, US Food and Drug Administration*

Summary comments from PCF QIW Metrology Panel - October 2020

Challenges and Hurdles that impede development and/or implementation of AI for CT Lung Cancer Screening

- Inertia (Physician and system resistance to change)
- Lack of studies showing beneficial impact on outcome
- Quality image data acquisition
- Limited datasets for training
- Lack of ground-truth diagnosis
- How to get multi-institutional data?
- How to annotate data more efficiently?
- Rapidly Changing Imaging Technology
- Insufficient diversity of data
- Domain shift (Applying AI to population different from training set population)
- Robustness in presence of other diseases
- Need better and more collaborations between academic researchers/developers and industry
- Need clear understanding of clinical task and how AI will be used in the clinic
- Inadequate integration into workflow

Summary comments from PCF QIW Metrology Panel - October 2020

Wish lists

❖ **Clinical decision support tools**

- Identify patients for Screening (Tailored eligibility)
- EMR/HIS Ordering Template for Initial and Subsequent Annual LDCT lung cancer Screenings and Documentation in Beneficiary Medical Records
- Software for total screening process (include CAD, COPD, etc.)
- Need to provide level of certainty and benign vs. malignant
- Track change over time
- Software to follow up to determine whether recommendations have been followed
- Automatic ACR registry reporting

❖ **Technology**

- Need clinical performance measurements and metrics
- Integration with PACS and/or reporting workflow process
- Optimize texture by using Deep Learning reconstruction rather than IR
- Consider reconstruction at higher matrix sizes, at least for clinical decision support
- Access to Software (both locally and in the cloud)
- A continuous, automated, quality-controlled, and global data collection/curation system
- Publication standards are needed (for AI papers)

Advanced Imaging Task Group: Next Steps

- *Prioritize the QIW lists of challenges and wishes.*
- *Obtain input from workshop at SPIE meeting.*
- *Coordinate with Strategic Plans from other NLCRT TG's.*

Advanced Imaging Task Group: Next Steps

SPIE. MEDICAL
IMAGING

Town and Country Resort and Convention Center
San Diego, California, United States

14 - 18 February 2021

Session WK4: Workshop: Advanced Imaging for the Early Detection, Diagnosis and Treatment Evaluation of Lung Cancer: Challenges and Future Opportunities

Session Chair: [Michael F. McNitt-Gray](#), Univ. of California, Los Angeles (United States)

Advanced Imaging Task Group: Next Steps

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Session WK4: Workshop: Advanced Imaging for the Early Detection, Diagnosis and Treatment Evaluation of Lung Cancer: Challenges and Future Opportunities

Workshop Outline

- Introduction to ongoing clinical problems in Lung Cancer. Deni Aberle, MD, UCLA
- Opportunities for Advanced Imaging and Novel technologies – Paul Kinahan, PhD, U. Washington
- Optimizing quantitative imaging (QI) methods to create image biomarkers – Nick Petrick, PhD, FDA
- Facilitating imaging-related artificial intelligence (AI) solutions – Jayashree Kalpathy-Cramer, PhD, MGH
- Creating systems and infrastructure for sharing data and/or algorithms - Laura Coombs, PhD, ACR
- Funding Opportunities related to Advanced Imaging in Lung Cancer - Behrouz N. Shabestari, Ph.D., NIBIB

Thank You

