



THE AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE

Advancing the Science, Education and Professional Practice of Medical Physics

**CENTERS FOR MEDICARE & MEDICAID SERVICES
MEDICARE EVIDENCE DEVELOPMENT AND
COVERAGE ADVISORY COMMITTEE
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**LUNG CANCER SCREENING WITH LOW-DOSE
COMPUTED TOMOGRAPHY**

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Disclosures

Michael McNitt-Gray, PhD

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American Association of Physicists in Medicine (AAPM)

- Nothing to Disclose



American Association of Physicists in Medicine (AAPM)

- The mission of the AAPM is to advance the science, education and professional practice of Medical Physics; a broad-based scientific and professional discipline which encompasses physical principles with applications in biology and medicine.
- The AAPM supports the Medical Physicist community with a focus on advancing patient care through education, improving safety and efficacy of radiation oncology and medical imaging procedures through research, and the maintenance of professional standards.



**Q2: the harms of lung cancer screening
with LDCT (avg. effective dose 1.5 mSv)
if implemented in the Medicare population
will be minimized
(a) harms from the LDCT itself**



Radiation Dose to Average Participant

- 1.5 mSv
- Estimated average whole body effective dose to participants in the NLST was 1.4 mSv
 - Fig. 2 from Larke, Am. J. Roent, 2011
 - Based on data from 33 sites nationwide, 97 CT scanners, used to image 26,724 participants in trial
- Average scanner output (**CTDI_{vol}**) was **2.9 mGy**
 - Radiation dose value measured in a standard test object and reported on the scanner



NLST CT Scan Protocol

- NLST CT Scan Protocol Chart
 - Cagnon, Acad Radiol, 2006
 - Technical settings for 14 different scanner models from 4 manufacturers used in the trial
 - Scanner output values (**CTDI_{vol}**) for a standard sized participant were **≤ 3.0 mGy** with one exception (3.1 mGy)



NLST CT Scan Protocol

- NLST CT Scan Protocol Chart
 - Was Developed in 2002
 - Used “Low Dose” techniques at that time
 - Since then, CT scanners all have technologies to substantially reduce radiation dose
 - Automatic Exposure Control methods
 - Tube current modulation, kV selection and patient size adjustment
 - Advanced reconstruction methods
 - Reducing image noise which allows even lower doses
 - More efficient detectors



NLST CT Scan Protocol

- NLST CT Scan Protocol Chart
 - Did NOT require any specialized CT scanner
 - Can be achieved with the vast majority of scanners purchased within the past 15 years.



CT Scan Protocol

- 1.5 mSv: readily achievable for average patient
- Does not require specialized equipment
- Likely to be substantially lower due to advances in radiation dose reduction technology widely available since beginning of NLST



Professional Society Activities

- ACR Practice Guideline
 - Will recommend a minimum CT technology level
 - Will recommend technical factors set to yield CTDI_{vol} of ≤ 3 mGy for a standard sized patient.
- ACR Designated Lung Screening Centers
 - Will **REQUIRE** a minimum CT technology level.
 - Will **REQUIRE** CTDI_{vol} be ≤ 3 mGy for a standard sized patient.



Professional Society Activities

- AAPM
 - Developed, with participation from CT scanner manufacturers, “Reasonable CT Protocols” for typical CT exams (routine chest, routine head)
 - Publicly Available, link:
<http://www.aapm.org/pubs/CTProtocols/>
 - Is developing protocol for Lung Cancer Screening
 - First version expected to be available May 2014
 - Will update NLST protocol for advanced dose reduction technologies

AAPM Routine Chest CT Protocol

link: <http://www.aapm.org/pubs/CTProtocols/documents/AdultRoutineChestCT.pdf>

Adult Routine Chest CT Protocols Version 1.0 11/20/2012

ADULT ROUTINE CHEST CT (Selected GE scanners)

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SCOUT: AP S60-I400; scan from top of shoulder through mid-liver, if automatic exposure control is used. PA scout if manual mA is used.

LightSpeed BrightSpeed BrightSpeed 16 LightSpeed LightSpeed Discovery

Lung Screening Protocol will provide similar information but with Low Dose Screening techniques: lower mA, thinner image thickness, etc.

(ave mA)	No SmartmA	(160)	(260)	(270)	(500)	(500)
NI*	mA = 300	11.57	11.57	11.57	13.0	13.0
SFOV	Large	Large	Large	Large	Large	Large

RECON 1

Plane	Axial	Axial	Axial	Axial	Axial	Axial
Algorithm	Std	Std	Std	Std	Std	Std
Recon Mode	Full	Full	Full	Full	Full	Full
Thickness (mm)	5.0	5.0	5.0	5.0	5.0	5.0
Interval (mm)	5.0	5.0	5.0	5.0	5.0	5.0

RECON 2

Plane	Axial	Axial	Axial	Axial	Axial	Axial
Algorithm	Lung	Lung	Lung	Lung	Lung	Lung
Recon Mode	Full	Full	Full	Full	Full	Full
Thickness (mm)	5.0	5.0	5.0	5.0	5.0	5.0
Interval (mm)	5.0	5.0	5.0	5.0	5.0	5.0

RECON 3

Plane	Axial	Axial	Axial	Axial	Axial	Axial
Algorithm	Std	Std	Std	Std	Std	Std





1.5 mSv Effective Dose

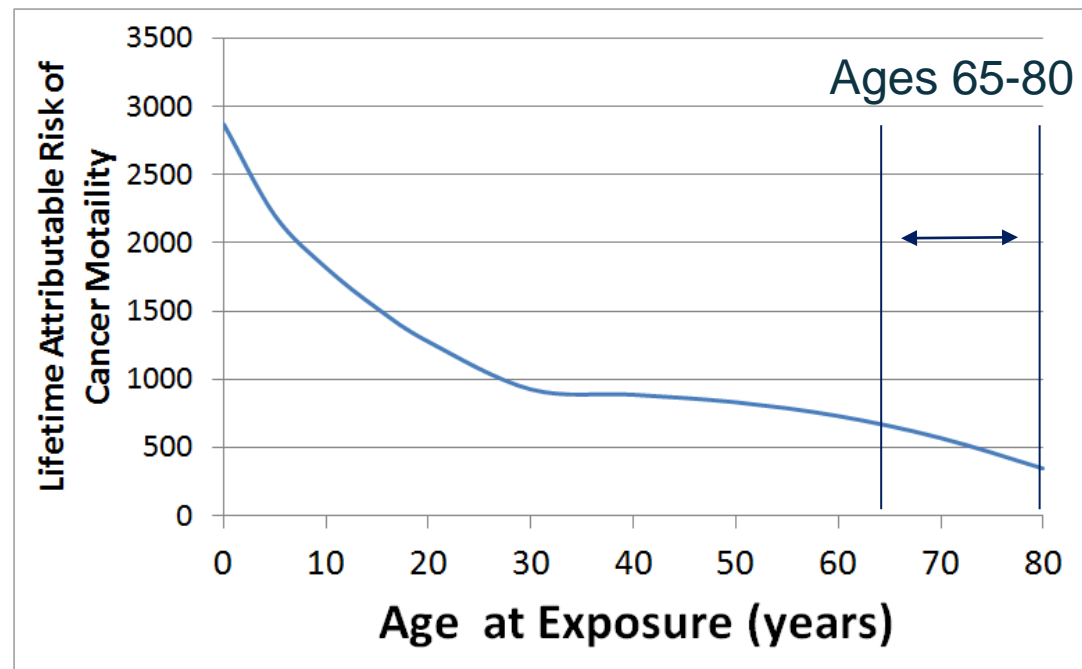
- Some context:
 - Average whole body effective dose in US from natural sources: 3.0 mSv
 - Radiation workers (radiologists, radiologic technologists) are allowed up to 50 mSv per year
 - Assumes a 40 year working history



Radiation Exposure and Risk

- Some context:
 - Age at Exposure makes a difference
 - Risk DECREASES w/age

Lifetime Attributable Risk of Cancer Mortality as a function of age (Number of deaths per 100,000 persons for single 100 mGy dose)
(from BEIR VII, Table 12D-2)





Conclusions

- Outstanding chance of achieving 1.5 mSv for average participant.
- Excellent to outstanding chance that doses will be substantially lower.
- Vast majority of CT scanners available now can achieve this; no special equipment is required.
- ACR and AAPM efforts will require and/or reinforce low dose techniques.



Conclusions

- 1.5 mSv is 50% of what average person in US receives from natural sources each year.
- 1.5 mSv is 3% of what radiologists, radiation technologists are allowed on an annual basis for their entire working life.
- Radiation risks decrease steadily with age.



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Thank you. Questions?