Optimizing Radiation Dose for Scanograms for Low Dose Chest CTs for Lung Cancer Screening

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Authors will be available for discussion on Teams meeting, via the following links:

-Sun 11/28/21 1:00-1:30pm (CST): Click here to join the meeting **Or call in** +1 347-566-4838,,67342457#

-Mon 11/29 12:15-12:45pm (CST): Click here to join the meeting **Or call in** +1 347-566-4838,,591938268#

-Tues 11/30 7:30-8:00am (CST): Click here to join the meeting **Or call in** +1 347-566-4838,,879634300#

-Wed 12/1 12:15-12:45pm (CST): Click here to join the meeting **Or call in** +1 347-566-4838,,10245194#

-Thurs 12/2 7:30-8:00am (CST): Click here to join the meeting **Or call in** +1 347-566-4838,,113080506#

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OBJECTIVE

- To reduce radiation dose to patients getting LDCTs for lung cancer screening (LCS) by ~20% by reducing the dose used for the scanogram portion of the exam by ~5x
- Could not have been possible without the help of many people, including
  - Erin A, Michael C, Asad K, Radu L, Julia M, Rudolf P, Jagjeet P, Luis P, Esfandiar S, Ronald S, Robert S, Bozena W, Anthony W

INTRODUCTION

- Low dose chest CTs are now routinely used to screen for lung cancer. During this exam, scanograms or scout AP and lateral views of the chest are first obtained, as shown on slide 5, where original factory presets were used. These scout views are used by the CT technologist to define the boundaries for the subsequent helical portion of the CT scan, just above the lung apex to just below the posterior costophrenic angles. The scout views are also used to obtain an approximate AP and lateral size of the patient, which is used for automatic mAs dose modulation at each slice in the helical portion.

RATIONALE

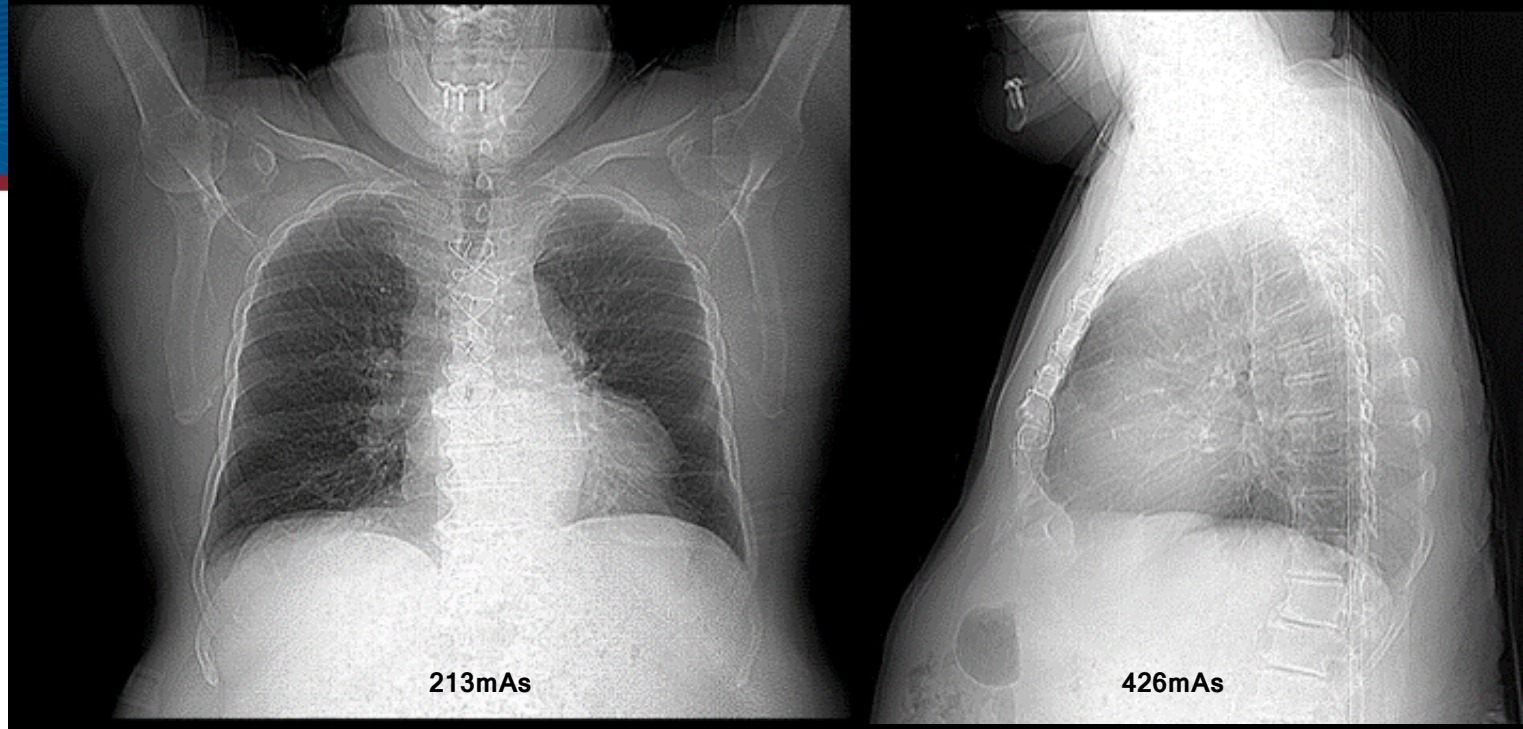
- Given:
  1. the marked contrast difference between the low density air-filled lungs compared to the higher density soft tissues,
  2. prior studies using phantoms demonstrating that dose reduction to the scanograms by 5x had no affect on the automatic dose modulation, and
  3. that scanograms are never used to detect pulmonary nodules

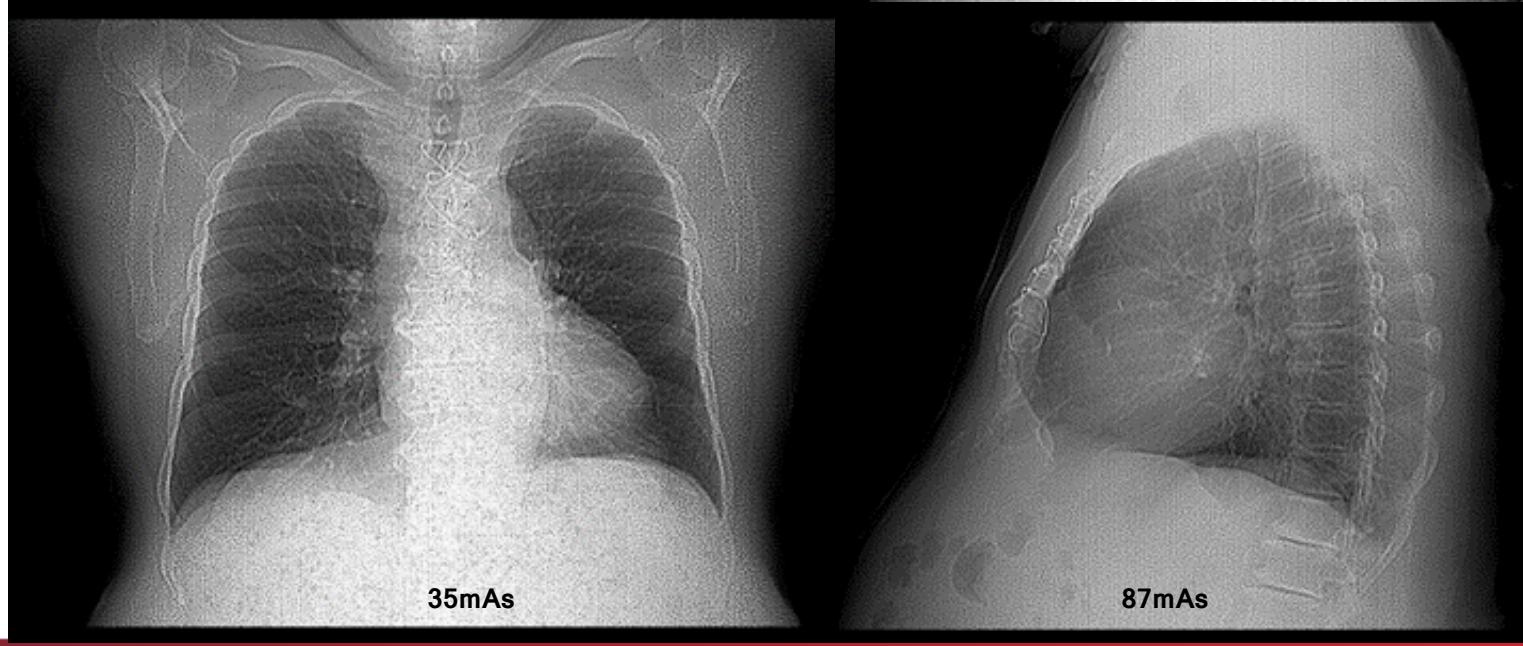
- We postulated that:
  - reducing the dose to the scanograms by 5x (as shown in the second set of images on slide 5) will not affect the study, and can only reduce the dose to the patient (by on average ~ 20% for the overall study)

Scanograms from LDCTs from same patient done on

12/29/2020

4/5/2021
(about 3 months later)





INTERVENTION – PHASE ONE

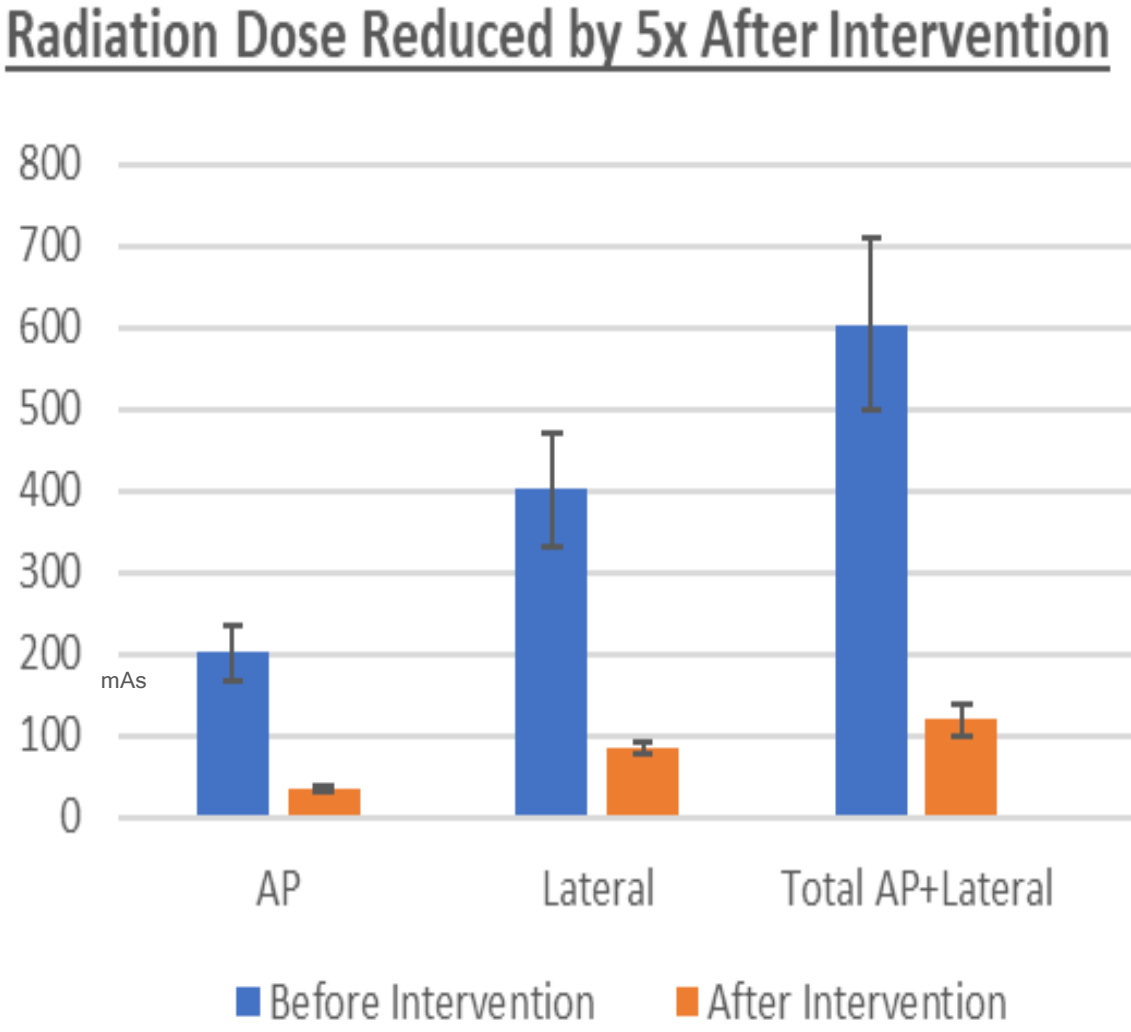
- The mA was incrementally decreased from the factory presets of 50/100 to 10/20 mA for the AP/lateral scanograms.
- At each incremental decrease, both the technologist and radiologist determined whether there was any adverse affect on:
  1. setting up the anatomical boundaries just above the lung apex and just below the posterior costophrenic angles
  2. automatic dose modulation and image quality of the subsequent helical portion of the exam

INTERVENTION – PHASE TWO

- Then, 30 consecutive patients who had a prior low dose chest with the original scanogram factory settings within the past 4 years on a 64-detector CT scanner were scanned with AP/lateral scanograms where the radiation dose was reduced 5x on that same scanner.
- The mAs for the scanograms, and the CTDIvol & dose-length products (DLPs) for the helical portion of the chest CTs for these 30 patients were analyzed.
- Statistical analysis was performed using paired t-test.

RESULTS

- The average mAs for the scanograms for the AP, lateral, and total mAs for 30 patients before and after intervention were 35±4, 84±6, and 119±19, compared with 201±35, 401±70, and 603±105, respectively, resulting in an approximate dose reduction of 5x (shown in the graph to the right).



RESULTS

- Were CT technologists able to use the reduced dose scanograms to define boundaries for the subsequent helical portion?
  - Yes! All of the lungs were included on the helical portion.
- Did the reduced dose scanograms affect the automatic dose modulation used during the subsequent helical portion?
  - No! The average CTDIvol for the helical portion of the CT was 3.4 ±1.2 mGy for both CTs done with scanograms with and without the dose reduction (p value=0.68).
- The average DLP for the 30 CTs done with the reduced dose scanograms was 126 ± 46 mGy cm, which was lower compared with the 139 ± 48 mGy cm for those done with regular dose scanograms; this was unexpectedly statistically significant (p value=0.002), suggesting an additional benefit of this quality improvement initiative from improved technique used by the CT technologists from scanning less of the abdomen or neck.

IMPACT ON PATIENT CARE

- The radiation dose reduction to the patient is significant, particularly as the scanogram portion with the original factory presets can constitute up to ~ 25% of the overall dose of these screening studies and up to 0.4 mSv for just one study.
- Given the recent expanded guidelines of the US Preventive Services Task Force for lung cancer screening, this is particularly important, as patients can now potentially be screened at least annually for up to thirty years.