

QUANTITATIVE IMAGING WORKSHOP XIX:

Utilizing Quantitative Thoracic Imaging
to Optimize Population Health

November 3-4, 2022 | Virtual

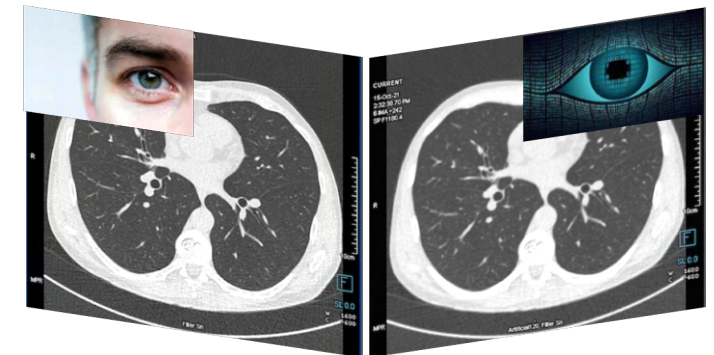
Session Five: Exploring New CT Imaging & Artificial Intelligence Technical Opportunities

New CT Technologies: Opportunities and Challenges

Mario Silva, MD, PhD

University of Parma (Italy)

UMass Chan Medical School, Worcester (MA, USA)

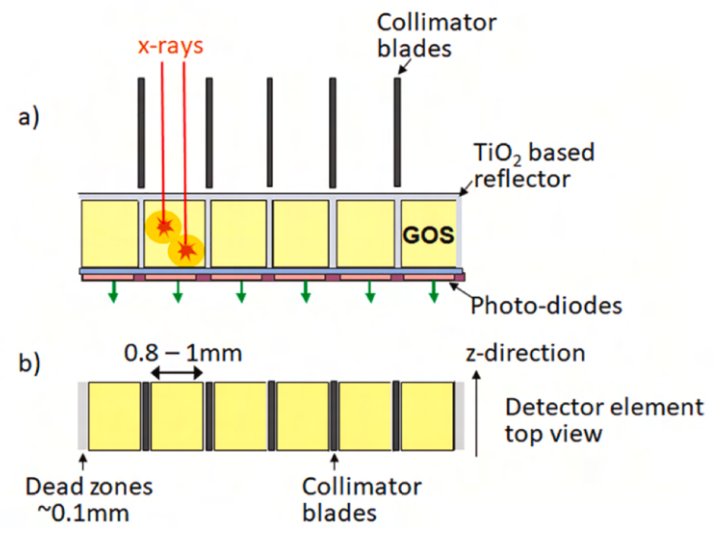


Disclosure:

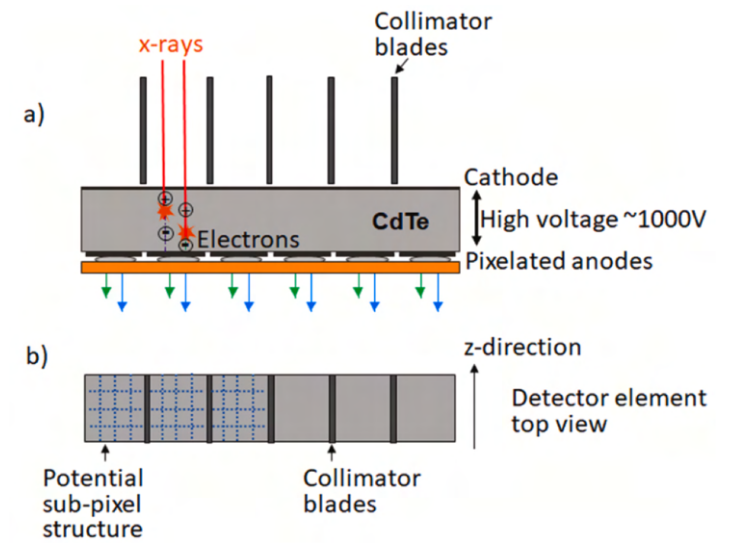
- *Speaker* Coreline
Astra Zeneca
Roche

- Same energy-signal...what characterization?

TAKE IT ALL!!!



Energy-integrated detector (EID)



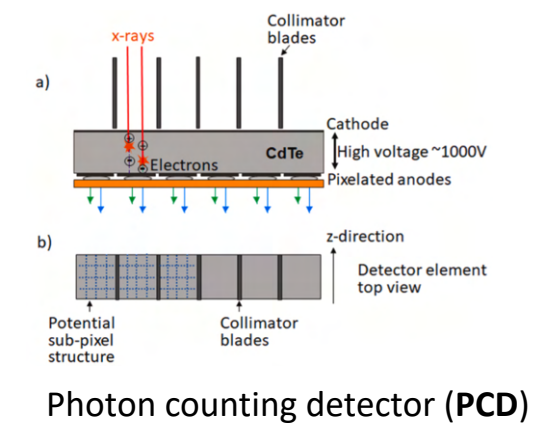
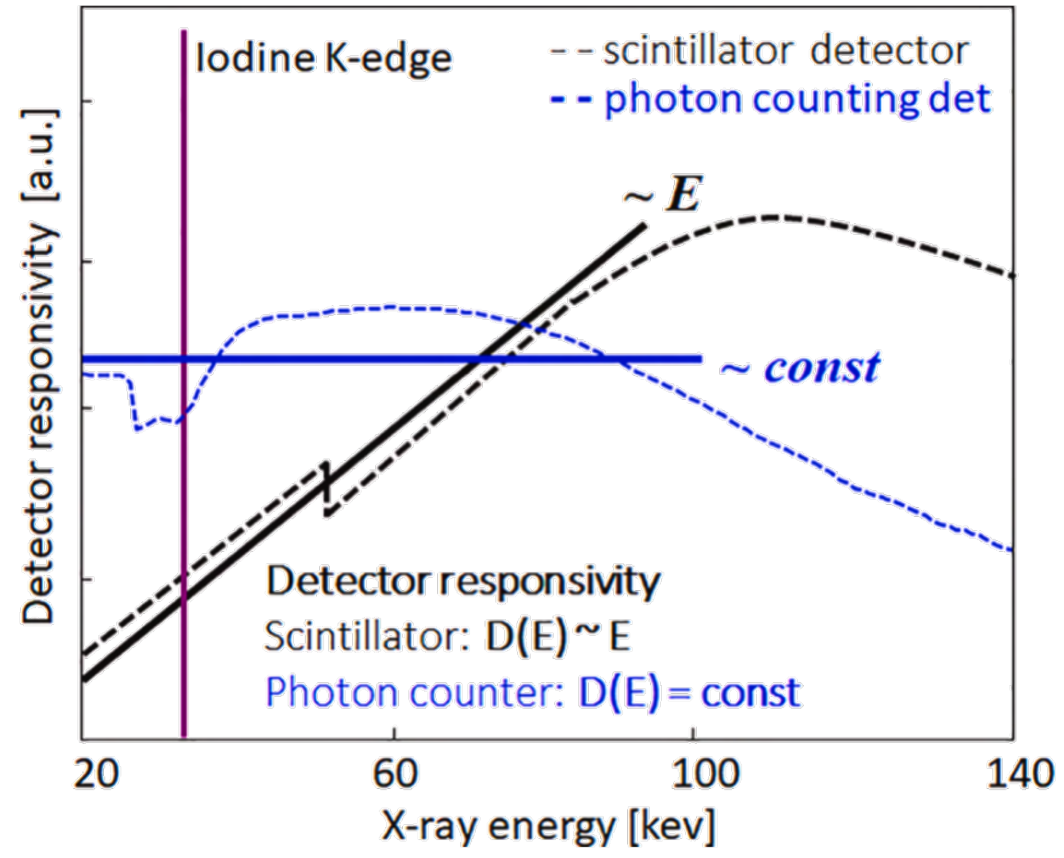
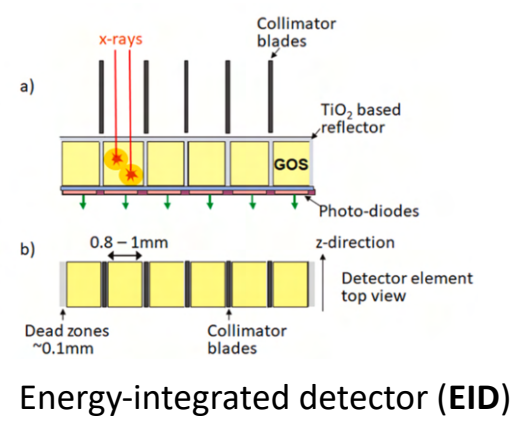
Photon counting detector (PCD)

Energy-The absorbed x-rays produce **electron-hole pairs** which are separated and drift to the anodes where they **induce short current pulses**.

Geometry-Each “**macro pixel**” confined by collimator blades can be divided into **smaller sub-pixels** which are read-out separately to increase spatial resolution

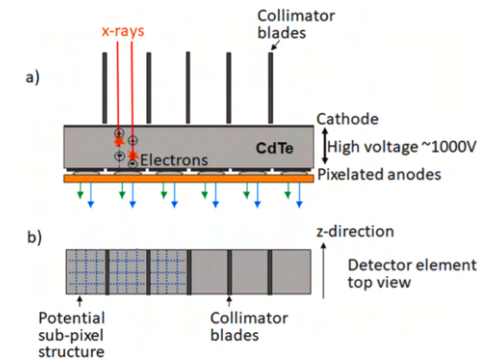
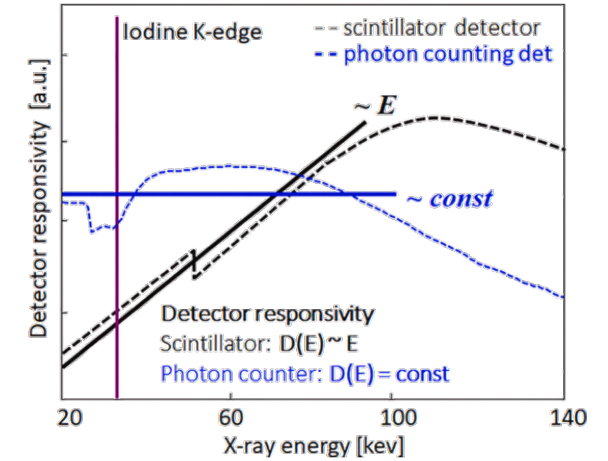
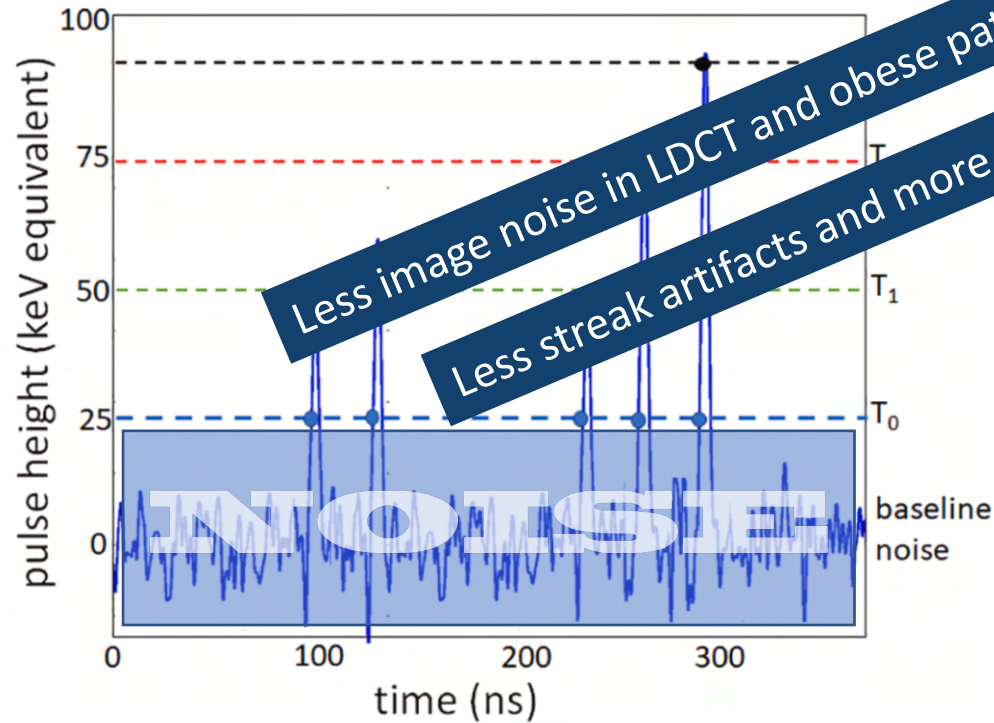
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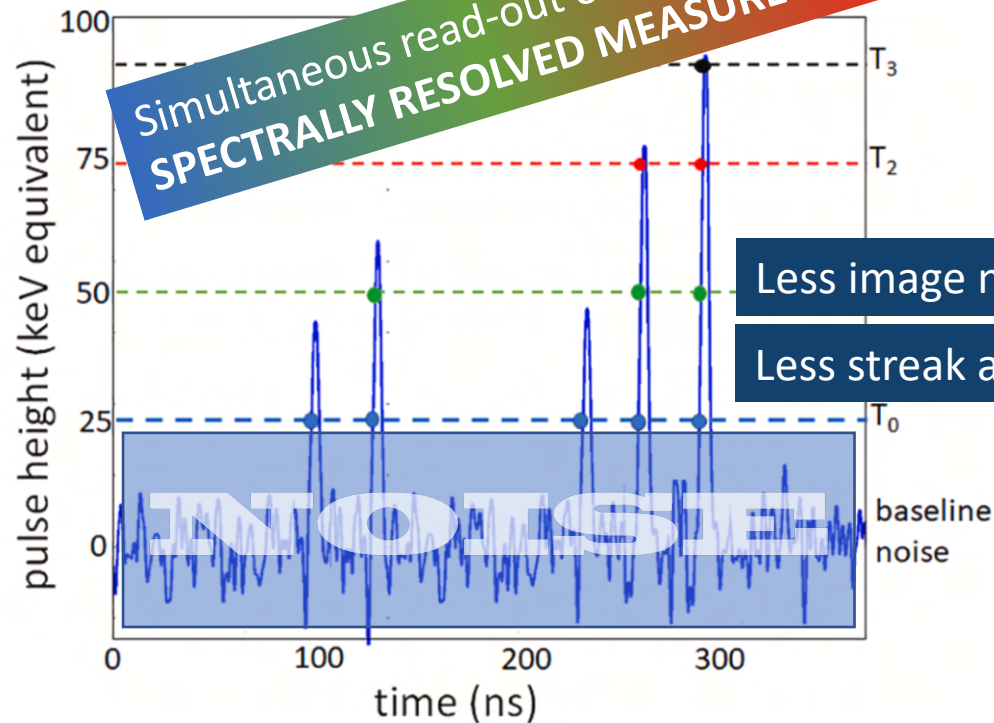


Photon counting detector (PCD)

All current pulses produced by absorbed x-rays are counted as soon as they exceed a threshold energy T_0 .

In a photon-counting detector for medical CT, T_0 is about 20–25 keV.

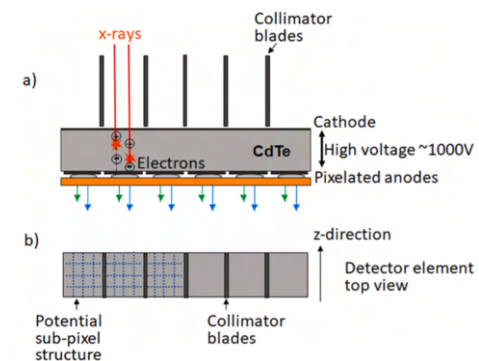
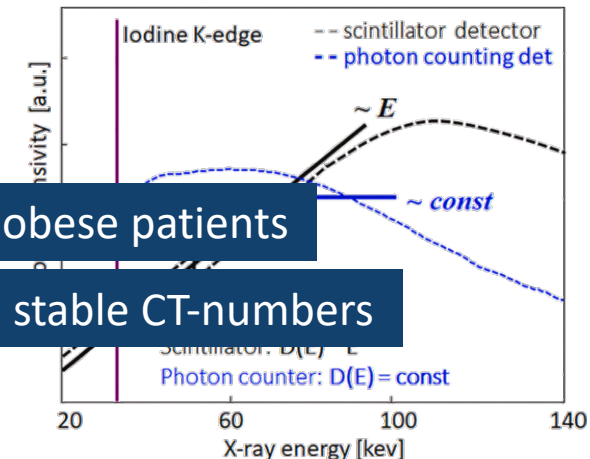
- Same energy-signal... what about noise?



TAKE IT ALL!!!

Less image noise in LDCT and obese patients

Less streak artifacts and more stable CT-numbers



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Simultaneous read-out of CT data in different energy bins:
SPECTRALLY RESOLVED MEASUREMENTS



Article

Low-Dose High-Resolution Photon-Counting CT of the Lung: Radiation Dose and Image Quality in the Clinical Routine

Matthias Michael Woeltjen ^{*}, Julius Henning Niehoff, Arwed Elias Michael, Sebastian Horstmeier ,
Christoph Moeninghoff, Jan Borggreffe and Jan Robert Kroeger

ORIGINAL ARTICLE

Potential of Photon-Counting Detector CT for Radiation Dose Reduction for the Assessment of Interstitial Lung Disease in Patients With Systemic Sclerosis

Lisa Jungblut, MD, ^{*} André Euler, MD, ^{*} Jochen von Spiczak, MD, ^{*} Thomas Sartoretti, ^{*} Victor Mergen, MD, ^{*}
Vanessa Englmaier, MD, ^{*} Anna Landsmann, ^{*} Carmen-Marina Mihai, MD, [†] Oliver Distler, MD, [†]
Hatem Alkadhi, MD, MPH, EBCR, FESER, ^{*} Thomas Frauenfelder, MD, ^{*} and Katharina Martini, MD^{*}

ORIGINAL ARTICLE

Estimating the Clinical Impact of Photon-Counting-Detector CT in Diagnosing Usual Interstitial Pneumonia

Akitoshi Inoue, MD, PhD, ^{*} Tucker F. Johnson, MD, ^{*} Darin White, MD, ^{*} Christian W. Cox, MD, ^{*}
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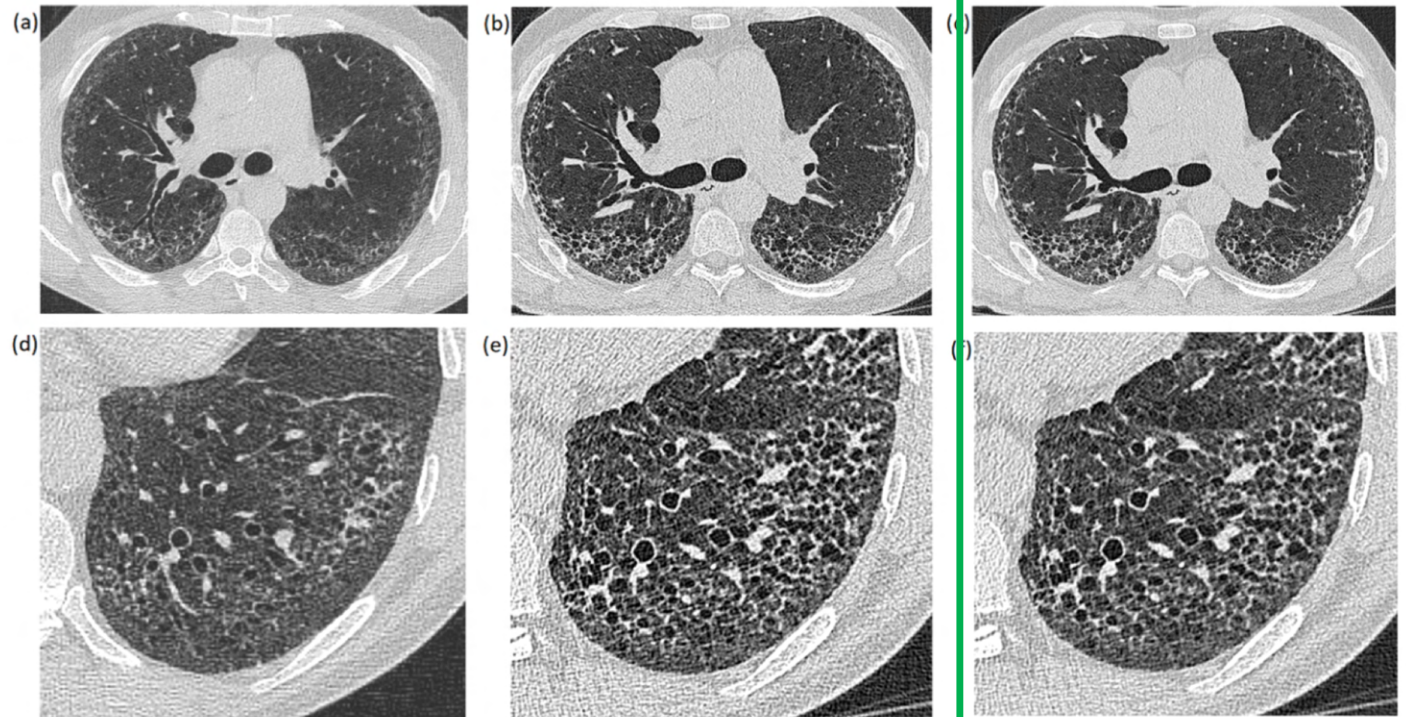
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Lower dose, higher image quality

PCCT (QIR+)

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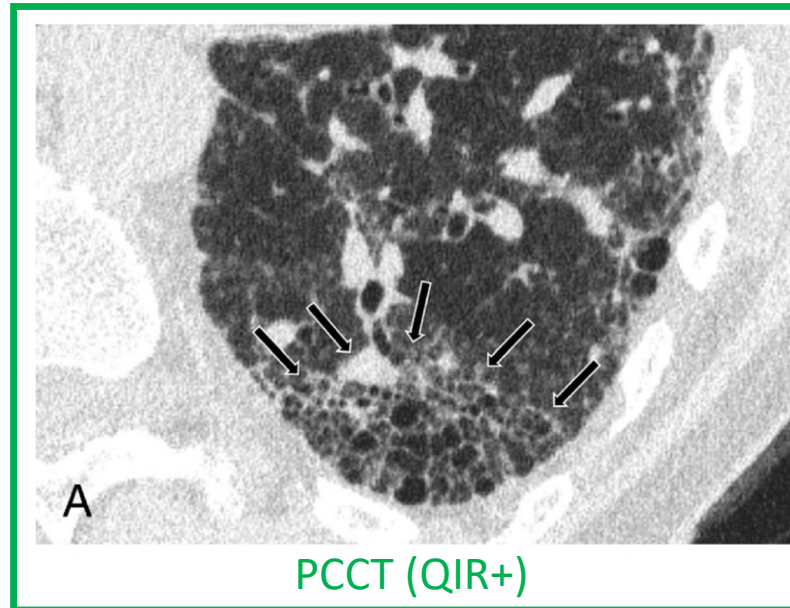
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Improved the reader confidence for

- reticulation,
- GGO
- mosaic pattern

Improvement in confidence in UIP presence.



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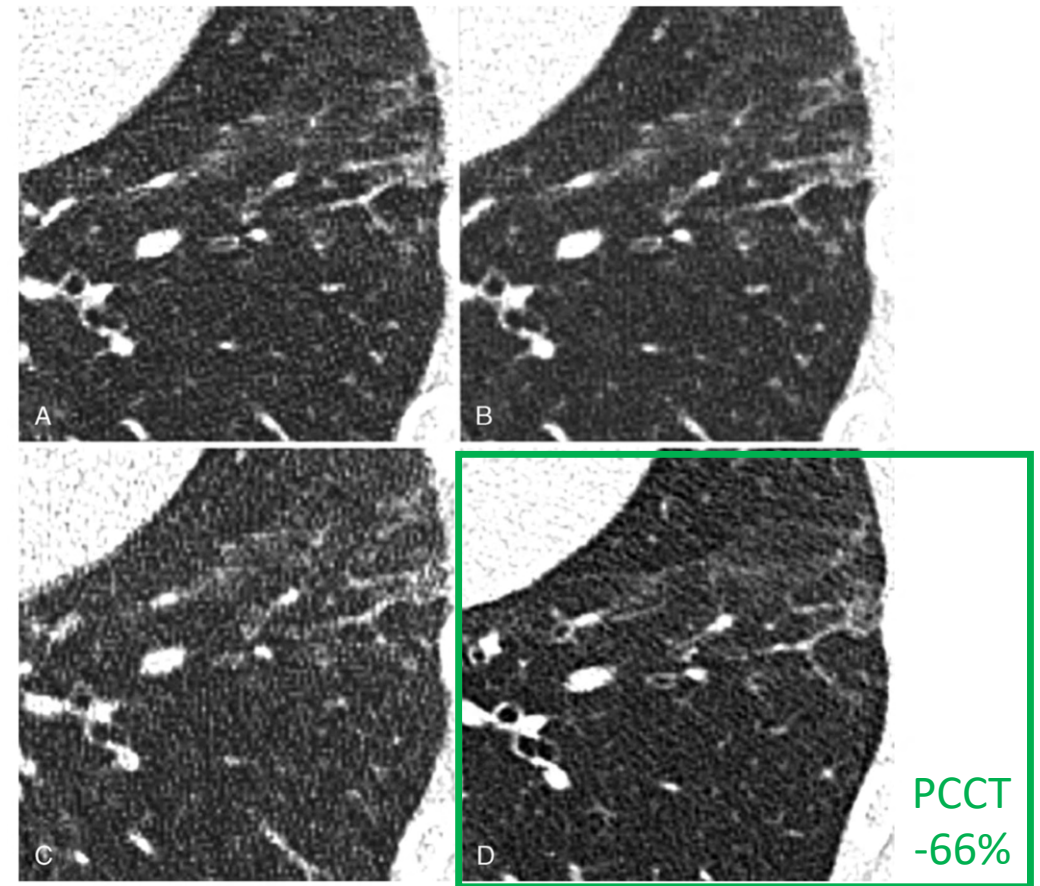
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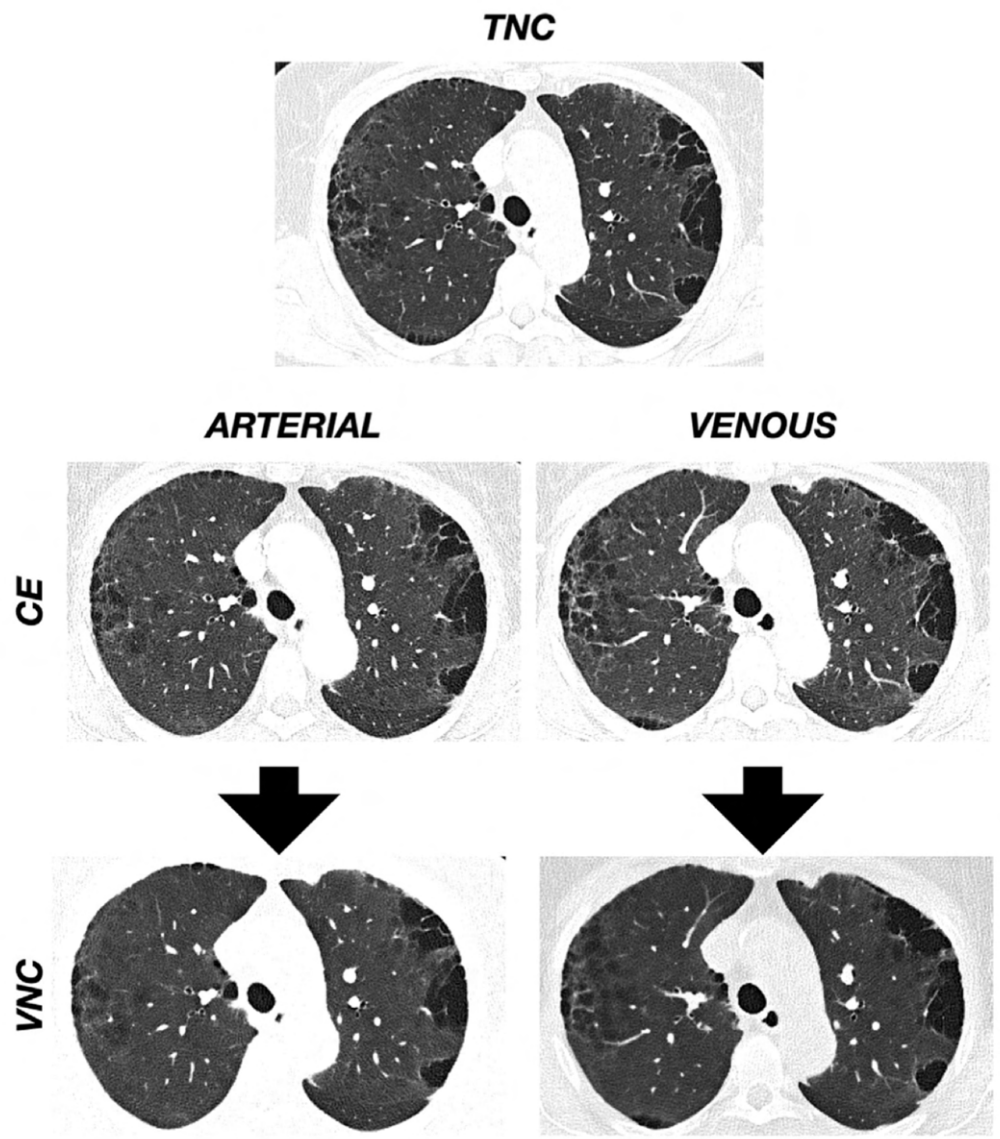
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Radiation dose reduction of 66% compared with EID-CT is feasible, without penalty in image quality and diagnostic performance for the evaluation of ILD.



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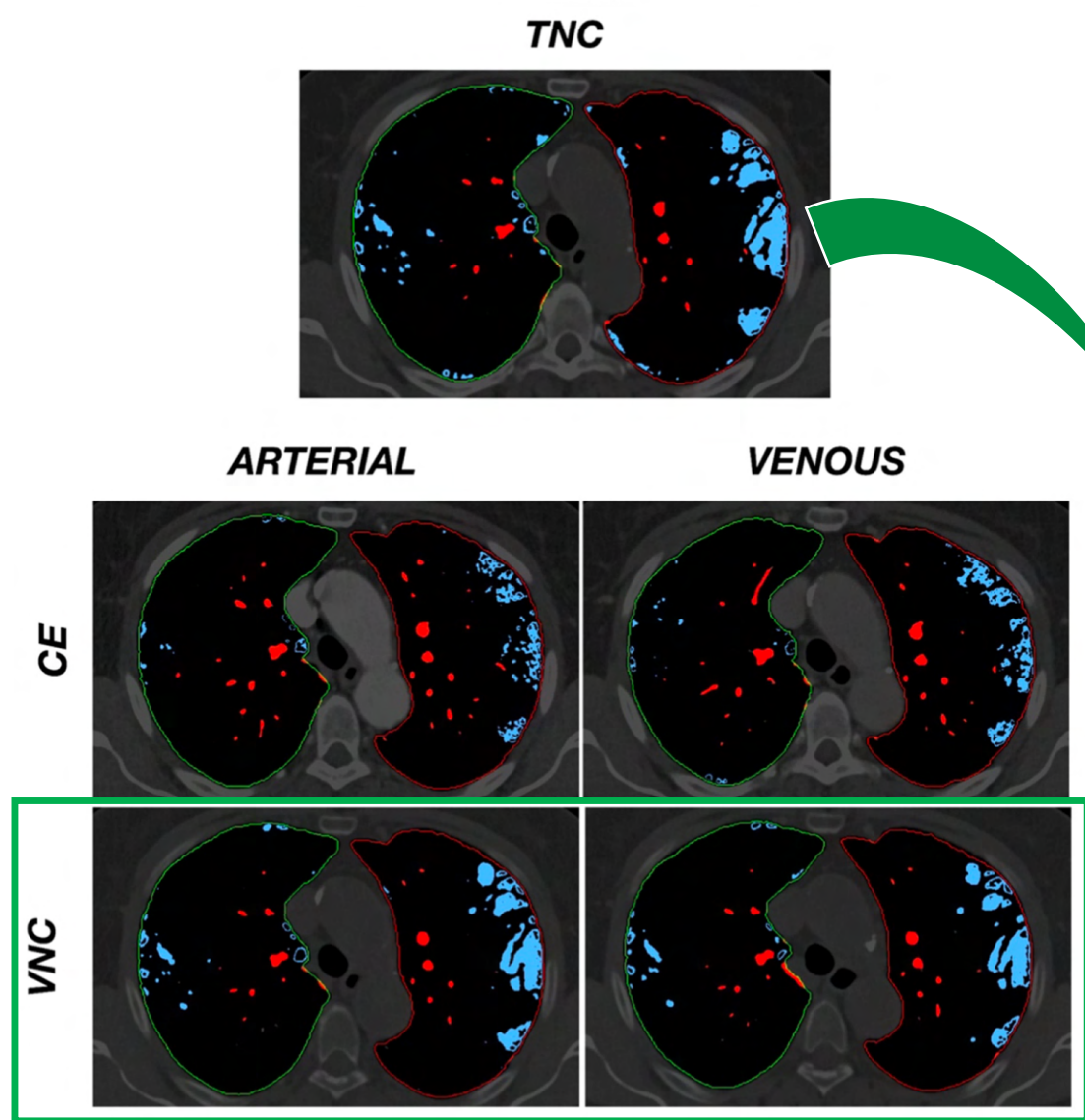
FULL PAPER

Performance of virtual non-contrast images generated on clinical photon-counting detector CT for emphysema quantification: proof of concept

¹LISA JUNGBLUT, MD, ¹THOMAS SARTORETTI, ¹DANIEL KRONENBERG, ¹VICTOR MERGEN, MD, ¹ANDRE EULER, MD, ²BERNHARD SCHMIDT, ¹HATEM ALKADHI, MD, MPH, EBCR, FESER, ¹THOMAS FRAUENFELDER, MD and ¹KATHARINA MARTINI, MD

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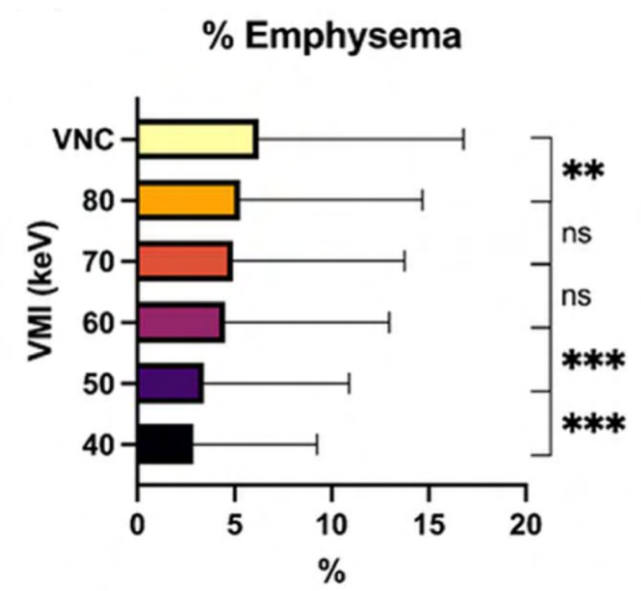
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Computed tomography emphysema quantification was **significantly affected by intravenous contrast administration and VMI-energy level** (80 keV yielded most comparable results to VNC)
 The **best trade-off** in qualitative as well as in quantitative image quality evaluation was determined at **60/70 keV**.



Jungblut L, Invest Radiol 2022

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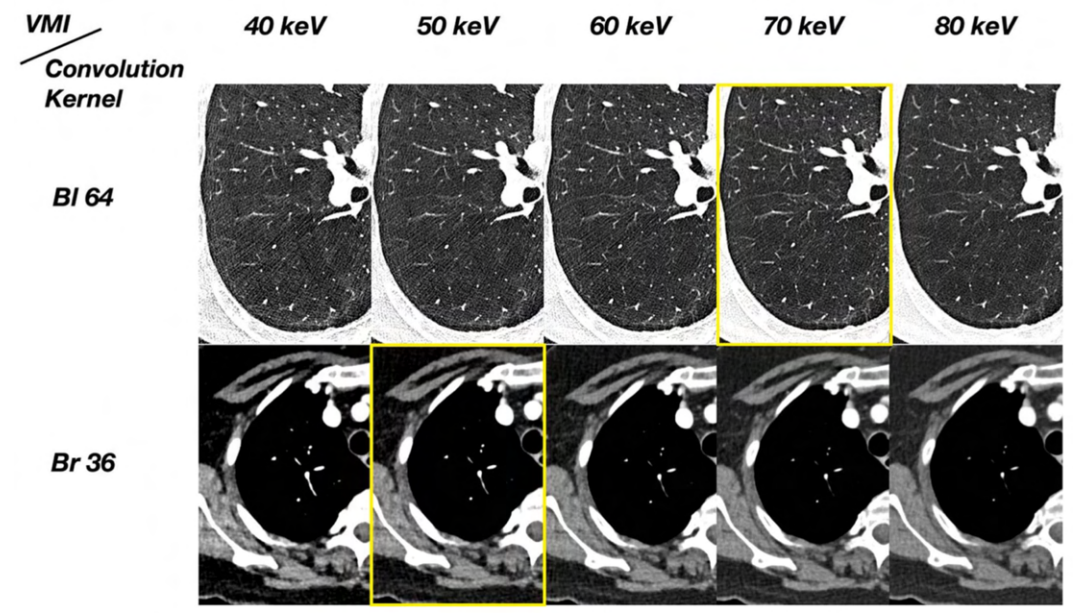
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ORIGINAL ARTICLE

Impact of Contrast Enhancement and Virtual Monoenergetic Image Energy Levels on Emphysema Quantification
 Experience With Photon-Counting Detector Computed Tomography

Lisa Jungblut, MD,* Daniel Kronenberg, MD,* Victor Mergen, MD,* Kai Higashigaito, MD,* Bernhard Schmidt,† Andre Euler, MD,* Hatem Alkadhi, MD, MPH, EBCR, FESER,* Thomas Frauenfelder, MD,* and Katharina Martini, MD*



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