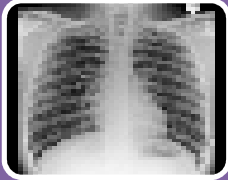


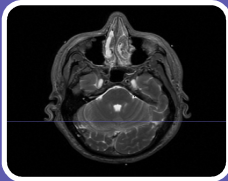
Computed Tomography Scanning

Jared Leichner

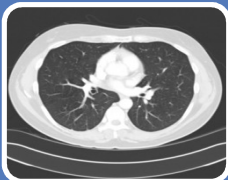
Advantages



Elimination of Superposition



Soft Tissue Differentiation



Multiplanar Reformatted Imaging



Reduction of Need for Exploratory Surgery

Elimination of Superposition



VS



* Note the fine details that become apparent

[http://imaging.consult.com/image/chapter/Chest?title=Silicosis%20and%20Coal%20Workers%27%20Pneumoconiosis&image=fig10&locator=gr10a&pii=S1933-0332\(08\)73235-X](http://imaging.consult.com/image/chapter/Chest?title=Silicosis%20and%20Coal%20Workers%27%20Pneumoconiosis&image=fig10&locator=gr10a&pii=S1933-0332(08)73235-X)

Soft Tissue Differentiation

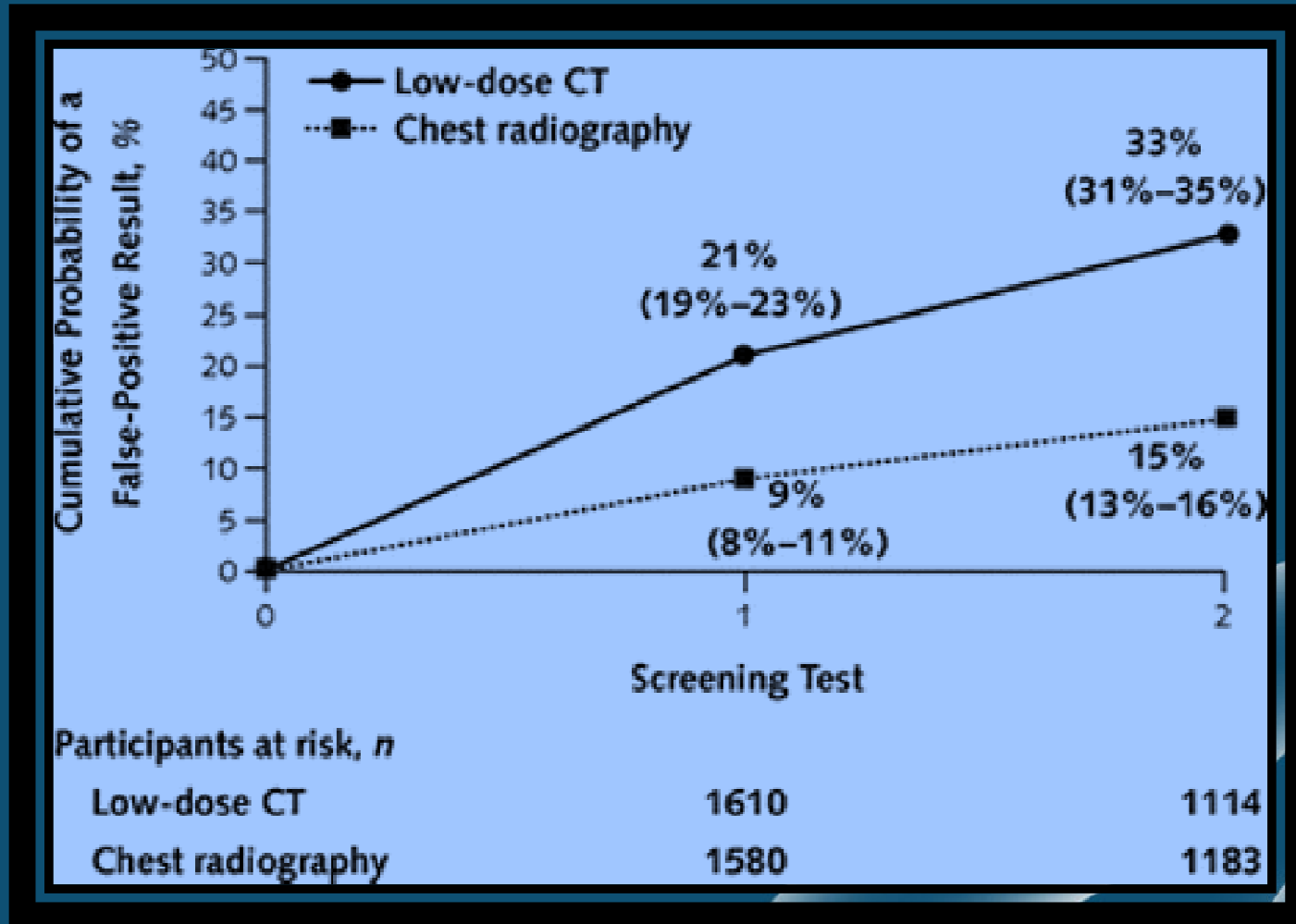


<http://www.sciencephoto.com/media/302798/>

<http://www.sciencephoto.com/media/302800/>

<http://www.sciencephoto.com/media/302802/>

Unnecessary Surgery



Disadvantages



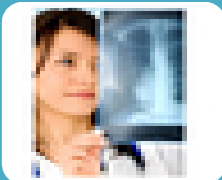
Radiation Dosage



Potential For Unnecessary Use



Allergic Reactions to Contrast Agents



Misconceptions of Radiologists

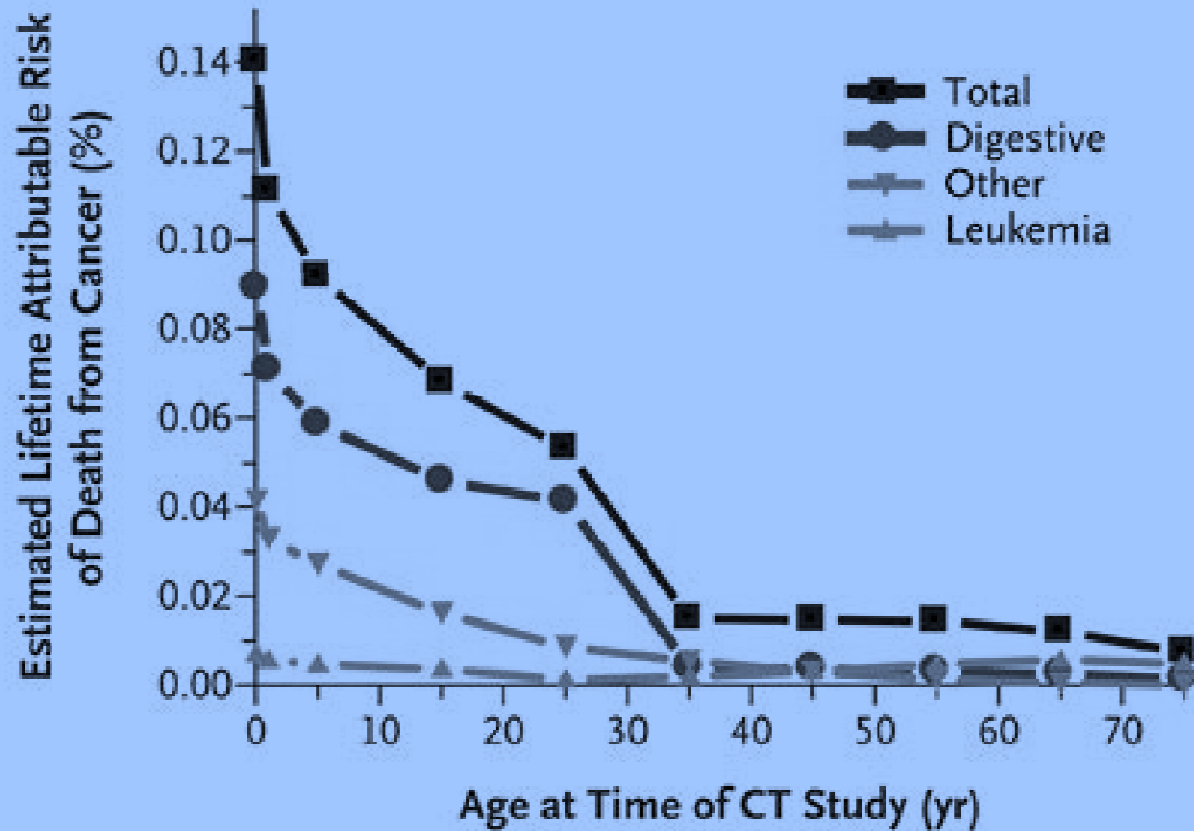
Large Radiation Dose

Typical Organ Radiation Doses From Various Radiologic Studies

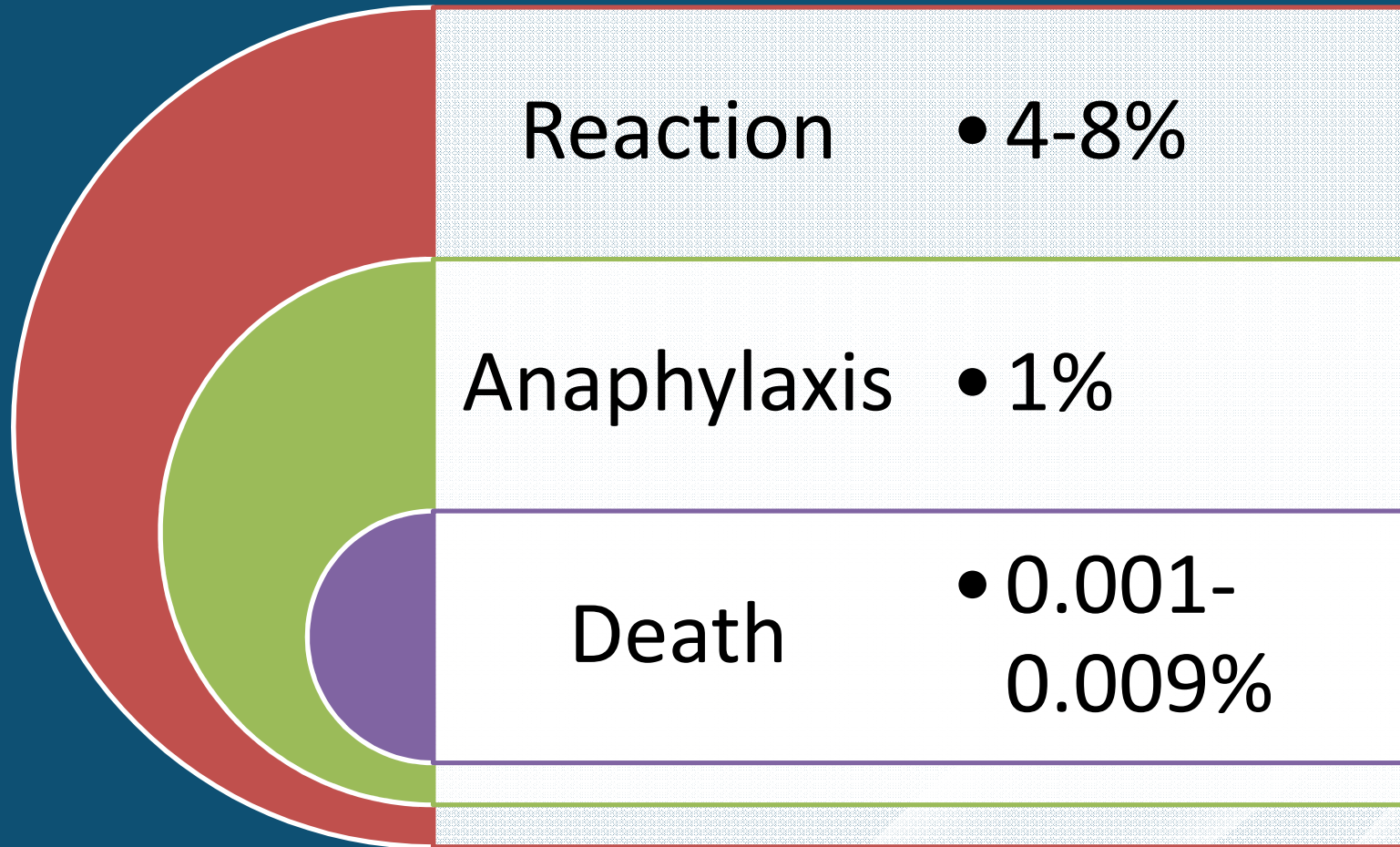
Study Type	Relevant Organ	Relevant Organ Dose (mGy)
Dental Radiography	Brain	0.005
P/A Chest Radiography	Lung	0.01
Lateral Chest Radiography	Lung	0.15
Screening Mammography	Breast	3
Adult Abdominal CT	Stomach	10
Neonatal Abdominal CT	Stomach	20

Large Radiation Dose

Abdominal CT, 240 mAs



Allergic Reactions

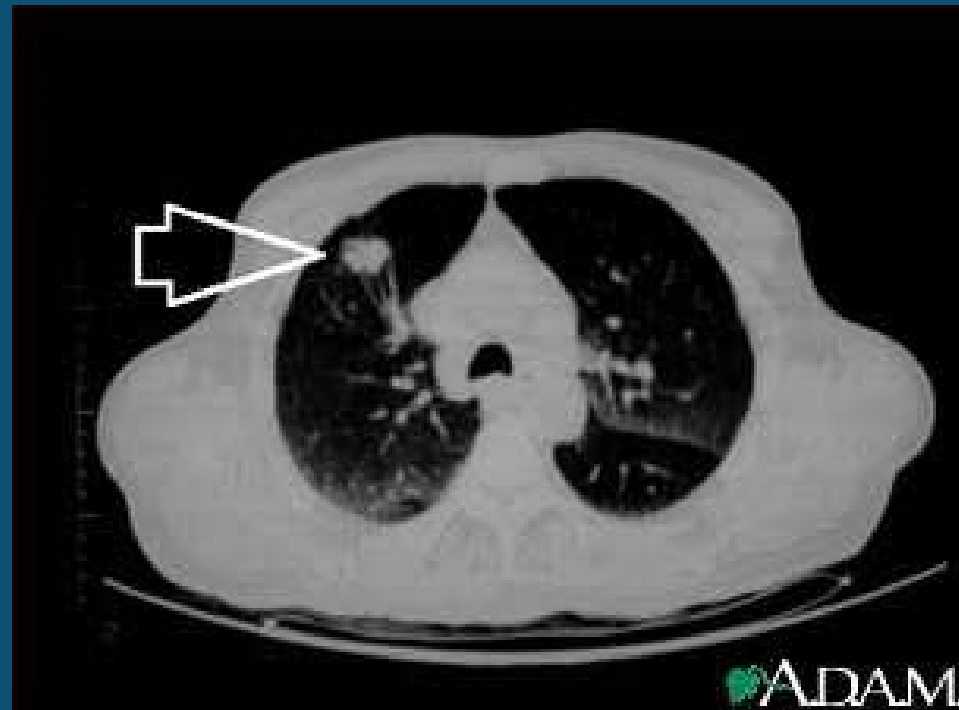


Internal Misconceptions

- Survey of Radiologists & ER Physicians
 - 75% Significantly Underestimated Radiation Dose
- Do CT Scans Increase the Lifetime Risk of Cancer?
 - 53% of Radiologists said No.
 - 91% of ER Physicians said No.

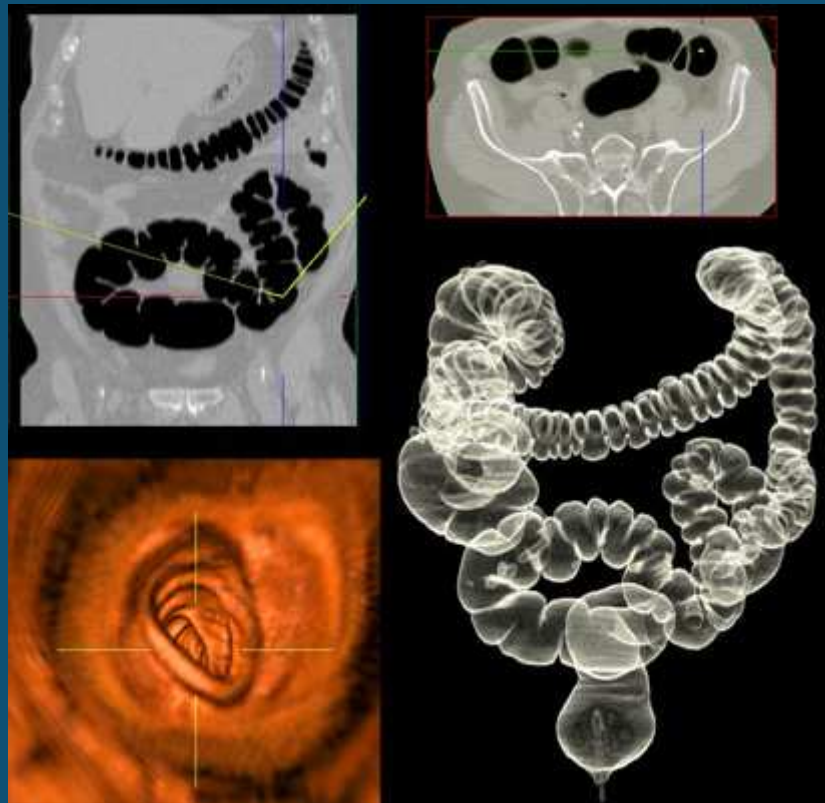
Common Medical Applications

- Screening of Lungs of a Smoker



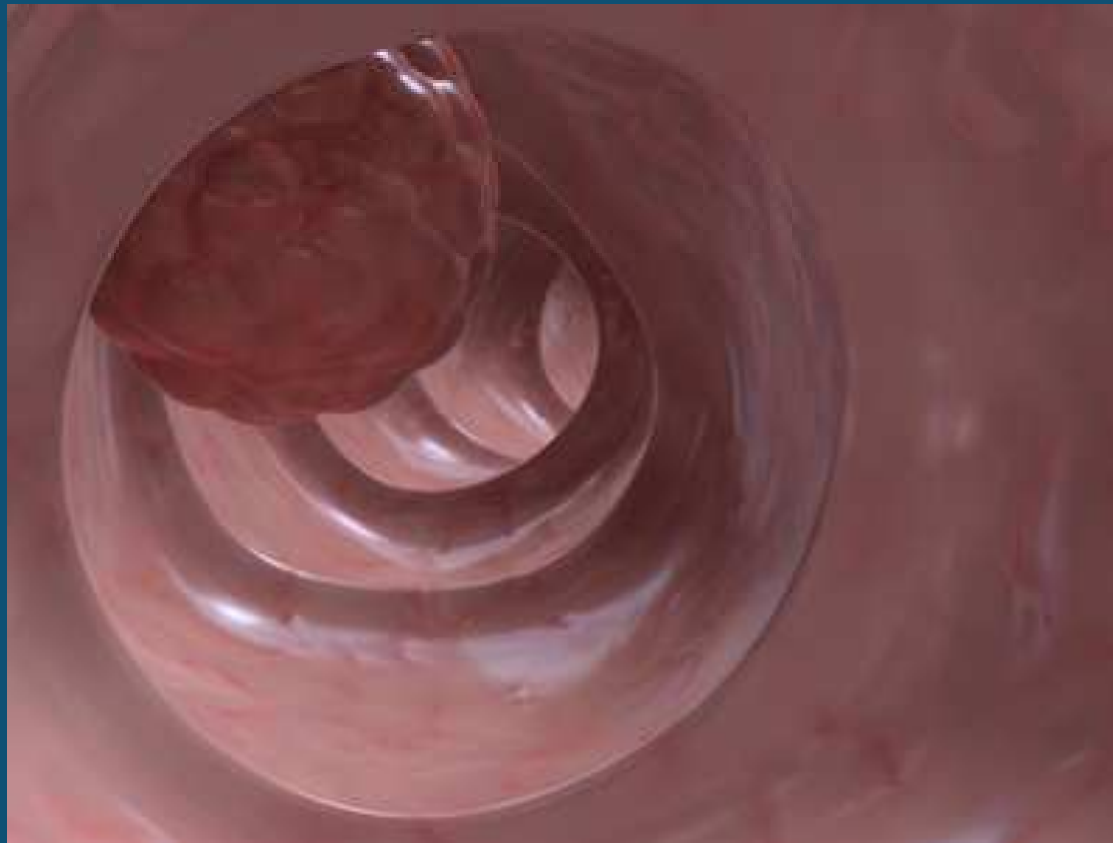
Common Medical Applications

- Virtual Colonoscopy



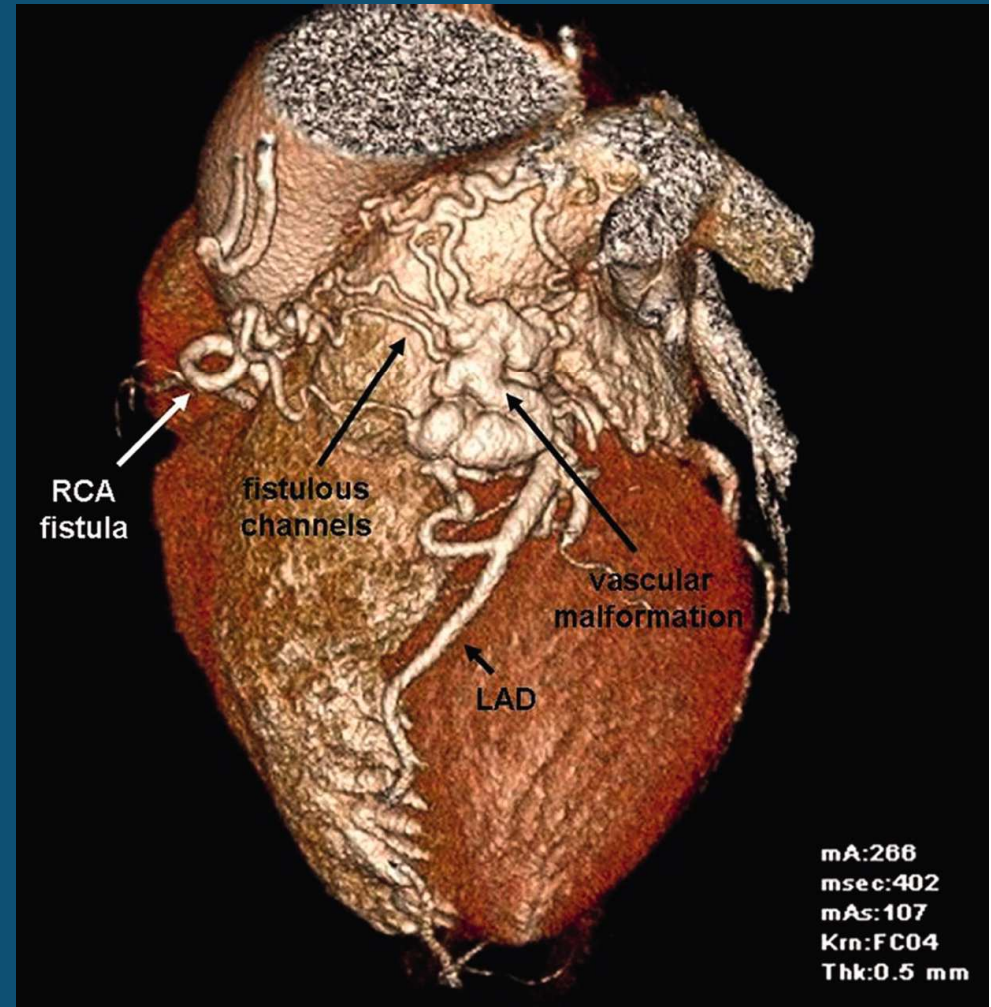
Common Medical Applications

- Virtual Colonoscopy



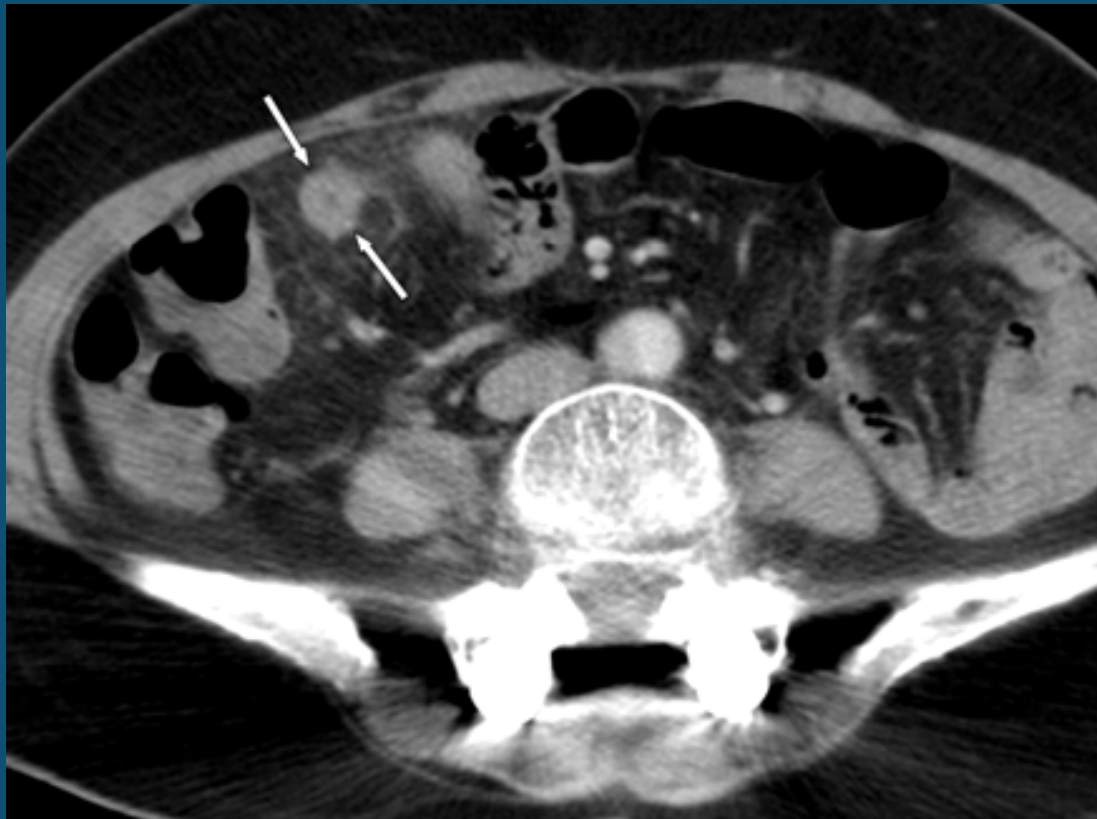
Common Medical Applications

- Cardiac Screening



Common Medical Applications

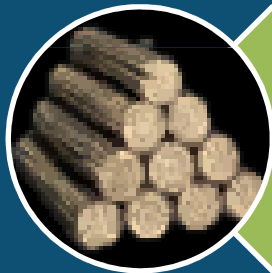
- Appendicitis Diagnosis



Non-Medical Applications



Thermodynamics of
porous mixtures



Evaluation of Timber
Quality

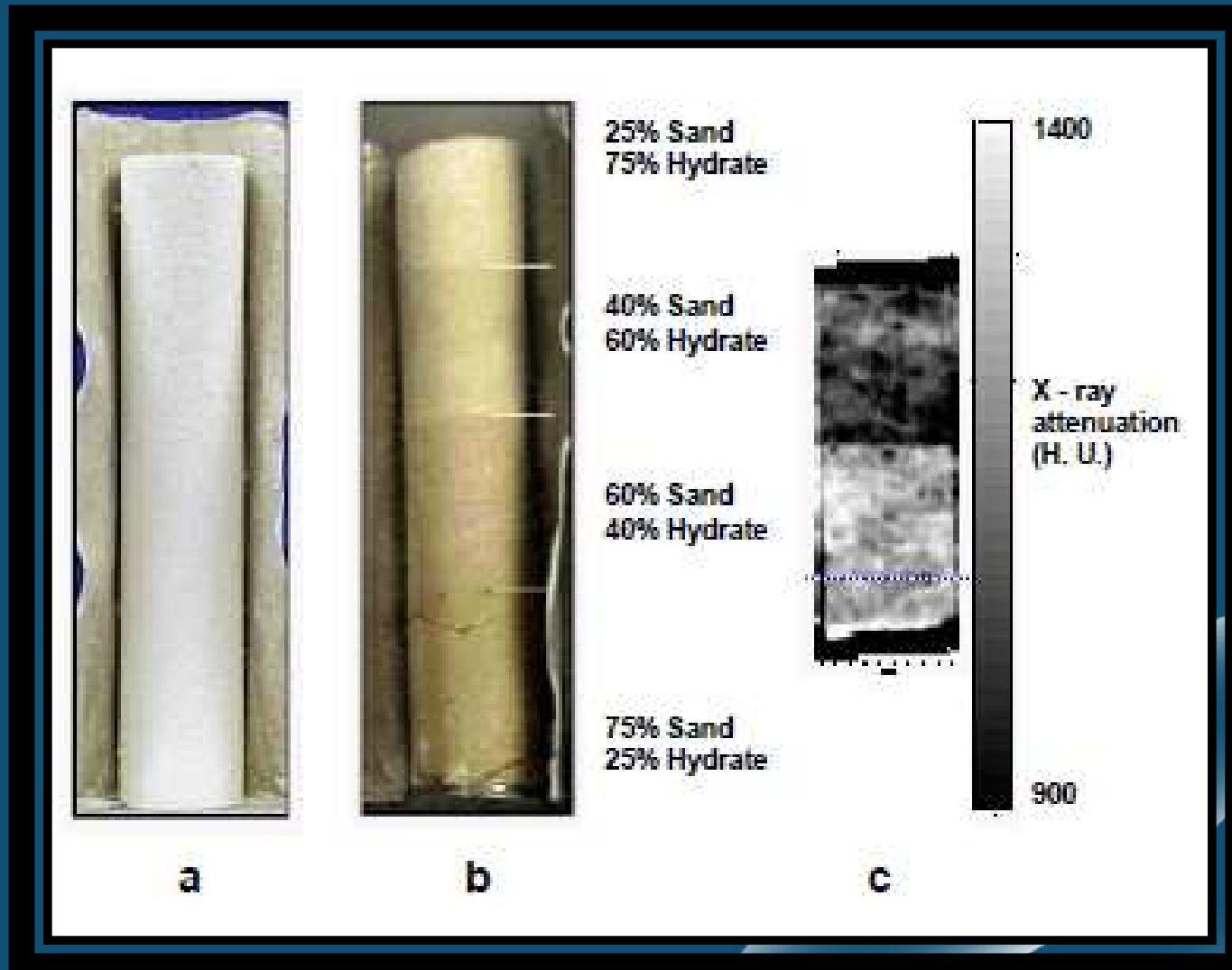


Analyzing Soil Fertility

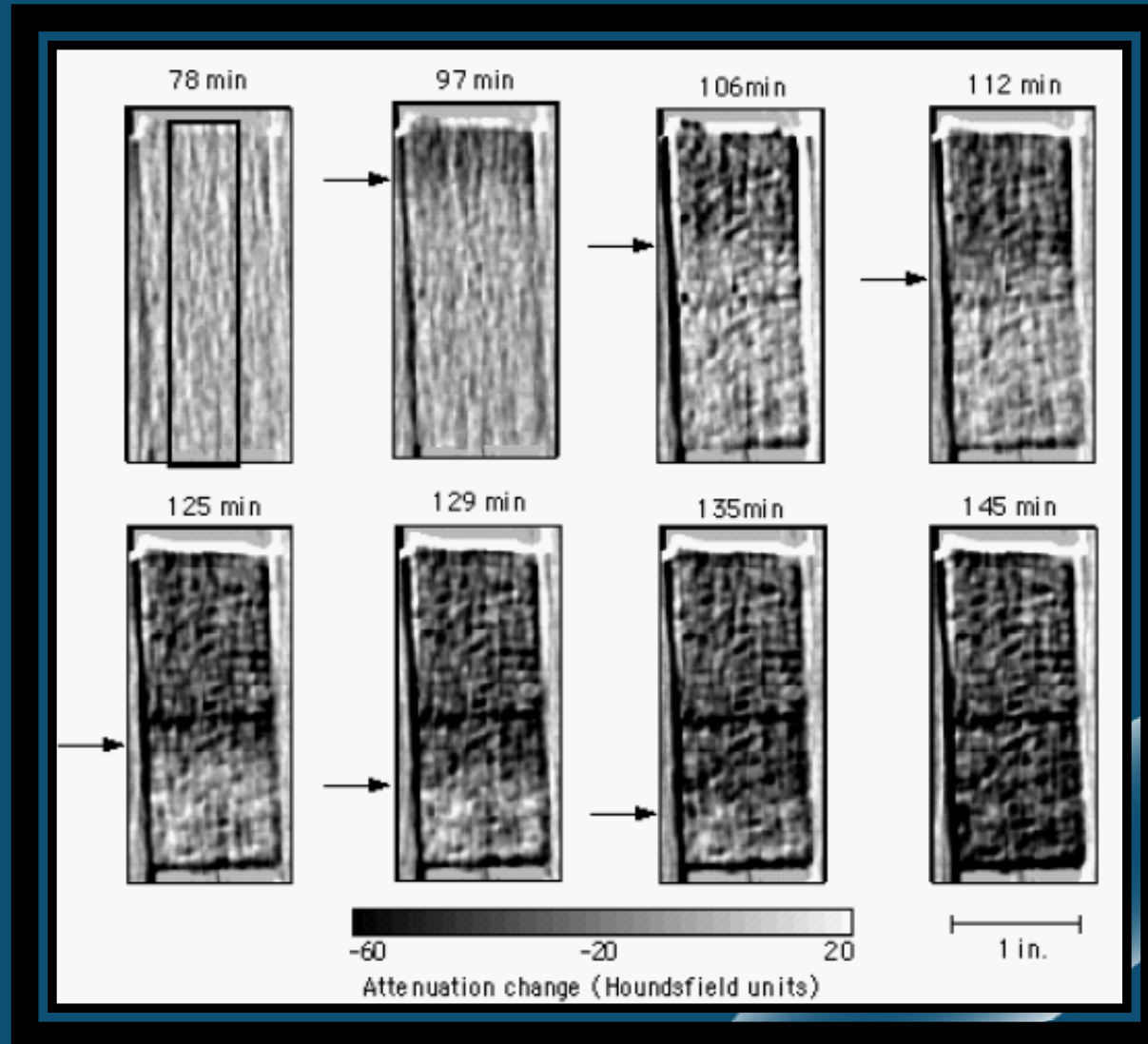
http://findarticles.com/p/articles/mi_hb3387/is_1_74/ai_n28947474/

<http://www.osti.gov/accomplishments/documents/fullText/ACC0256.pdf>

Mixture Thermodynamics



Mixture Thermodynamics



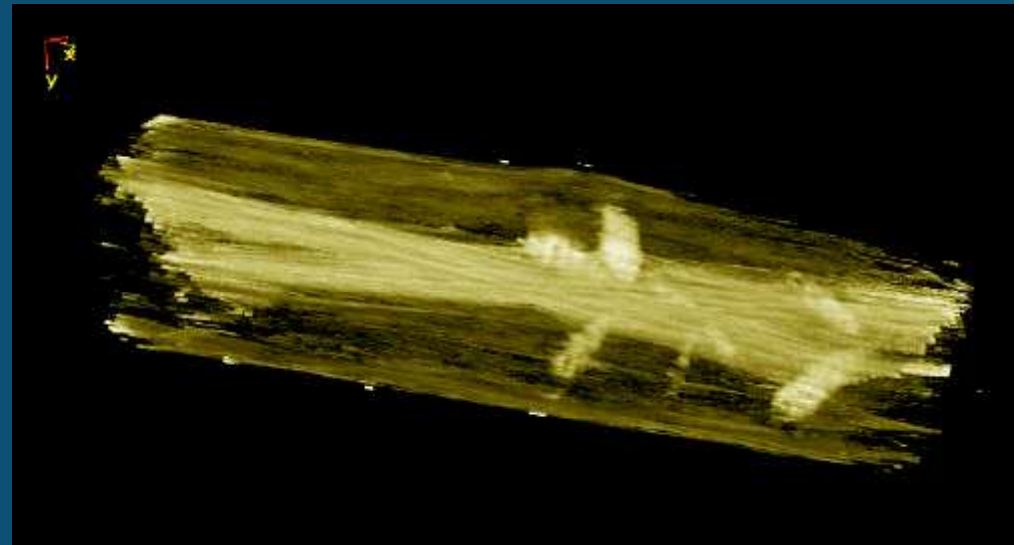
Timber Quality Control

X-Ray

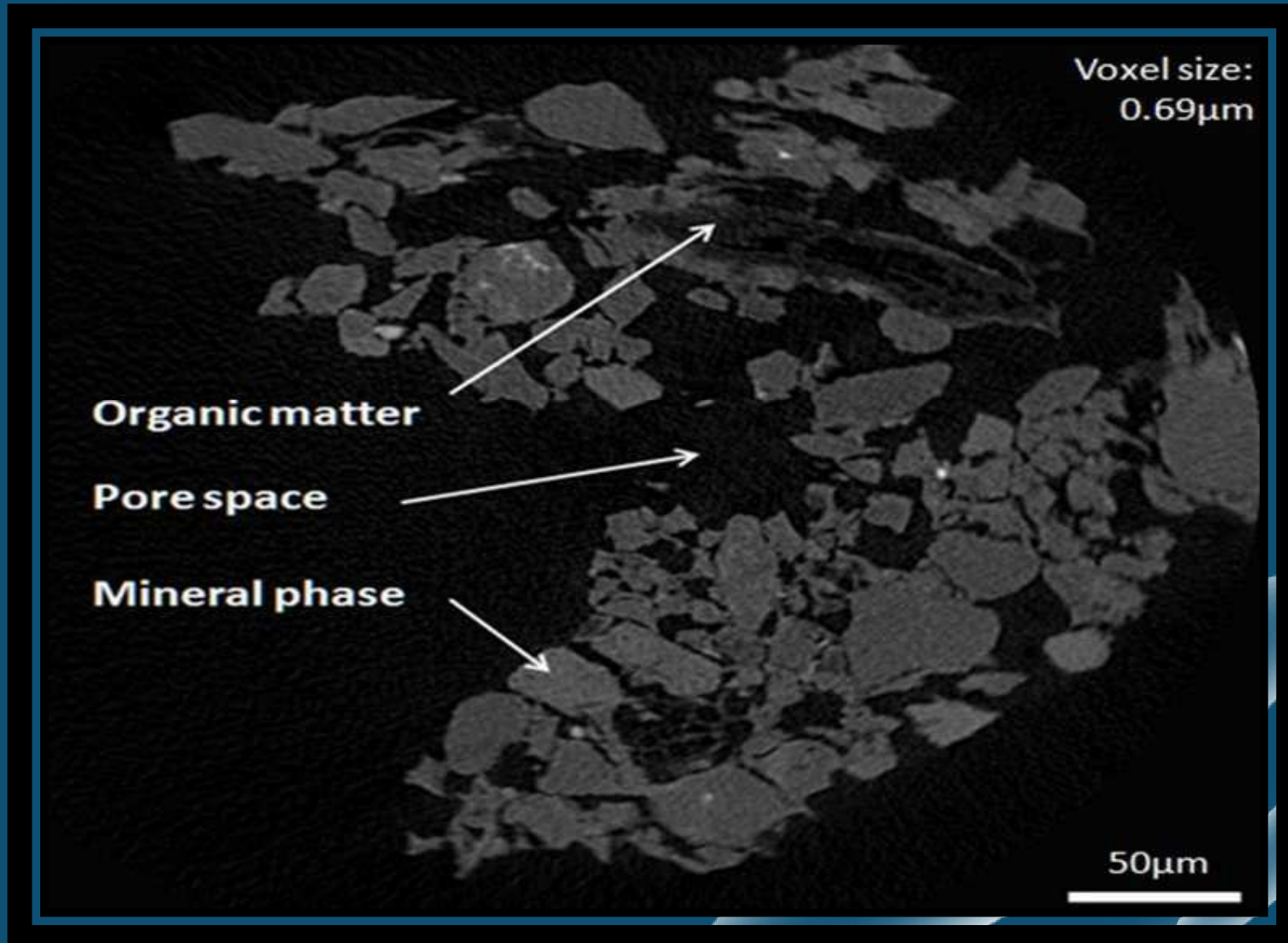


VS

CT Scan



Soil Fertility

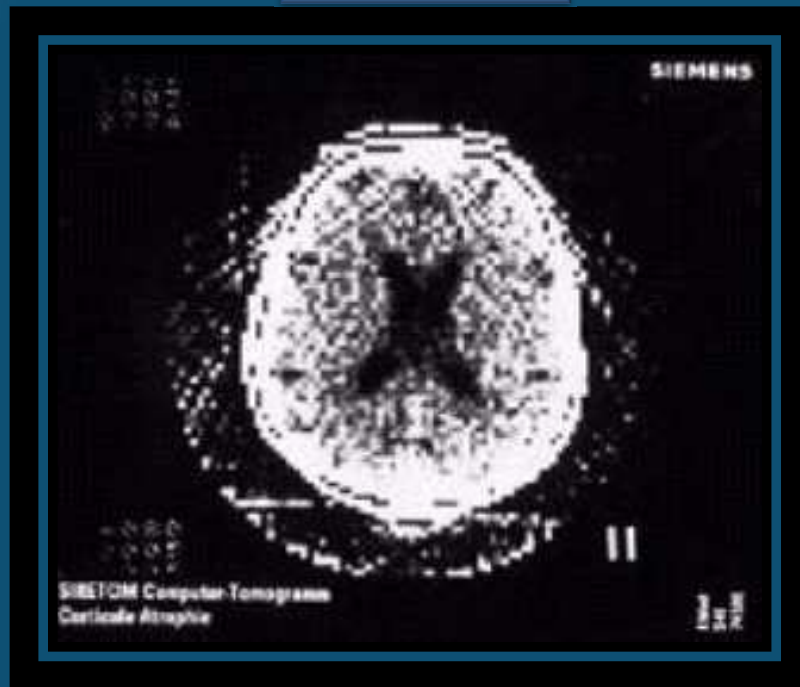




Progression of the Technology

A Brief Comparison

1975 Scan



2006 Scan

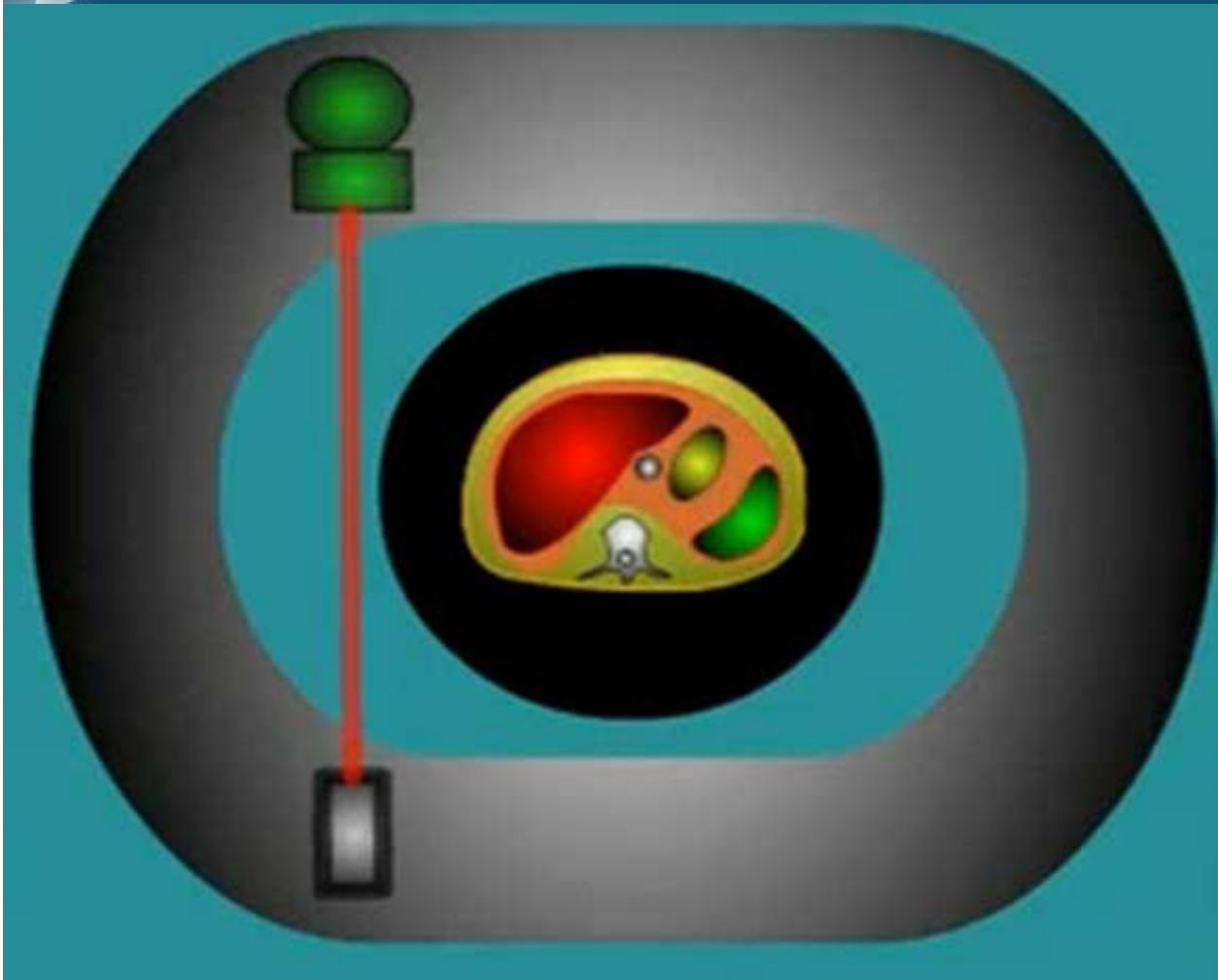


VS

1972 - Inception

- Invention by Godfried N. Hounsfield
- Non-Superimposed Images of a Cross-Section
- Several Hours / Slice
- Several Days / Reconstructed Image

1st Generation



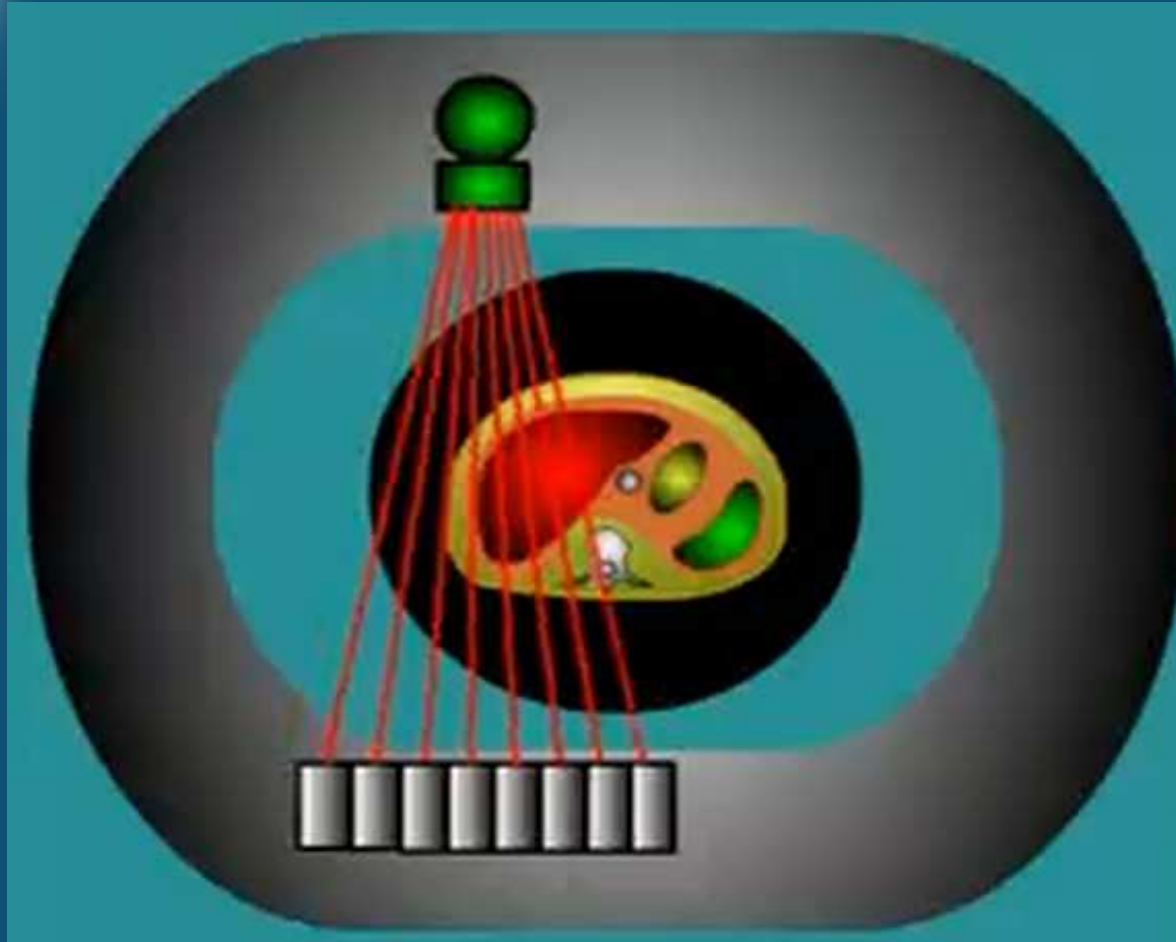
Highly Collimated Pencil Beam

Excellent Scatter Rejection

Long Scan Times (5 min)

<http://www.youtube.com/watch?v=fNaCxhhhZTE>

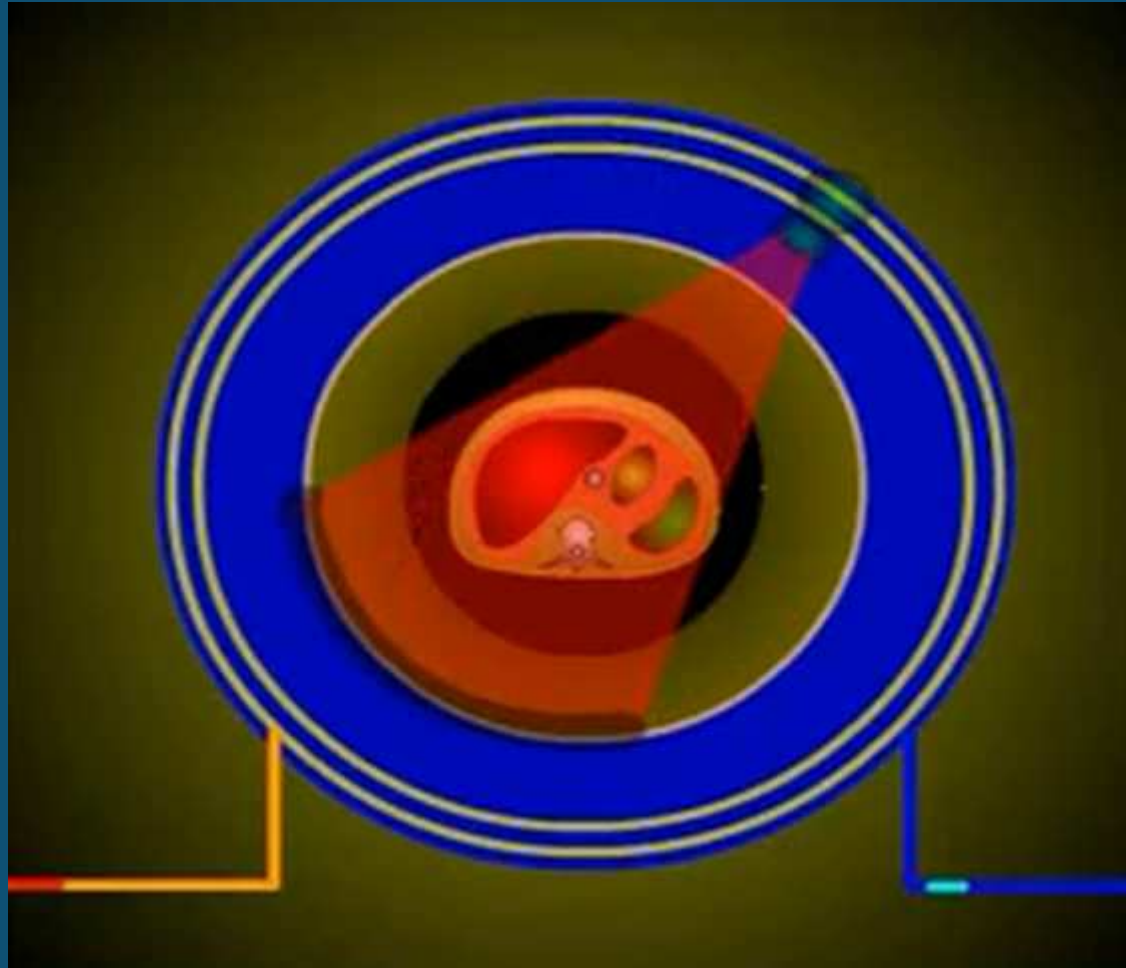
2nd Generation



Shorter Scan Time
(Faster Angular Component)

Complicated Reconstruction

3rd Generation



Full Rotation

No Translation

1 Second Scan

<http://www.youtube.com/watch?v=bdf0kXn5Eeg>

4th Generation

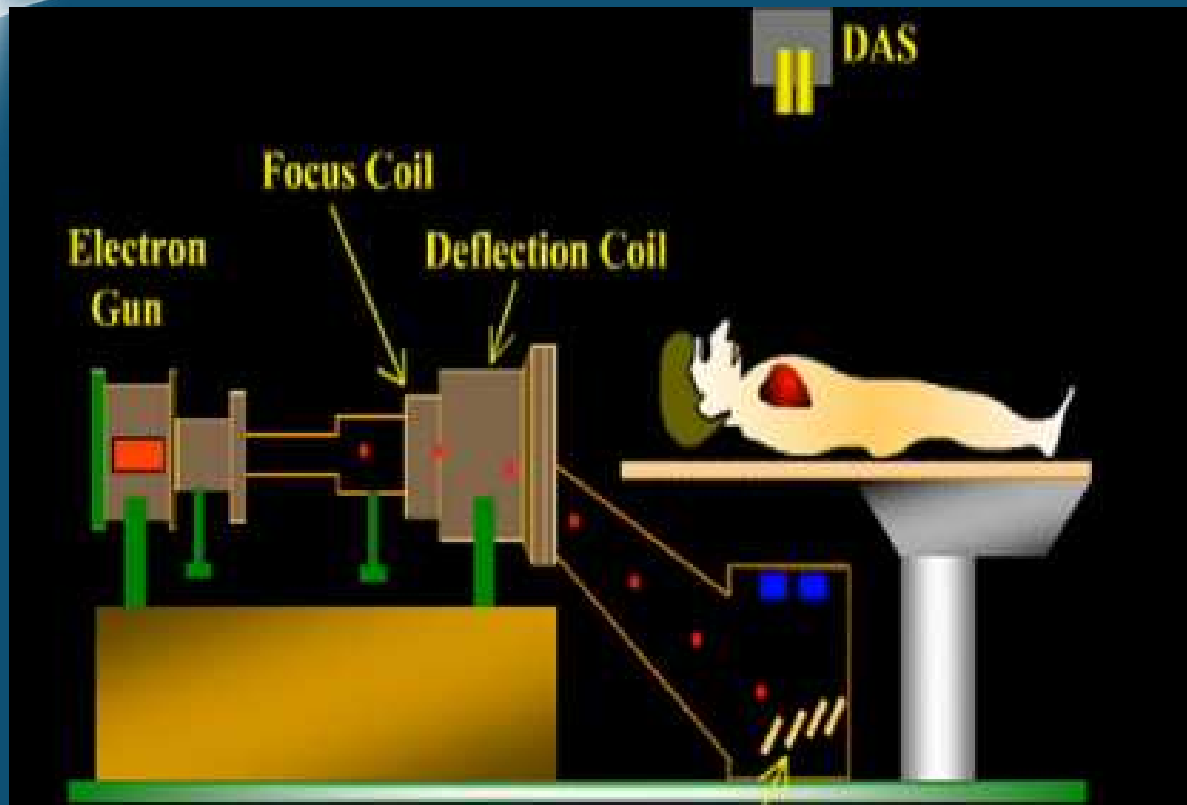


600-4800 Fixed Detectors

Rotating Fan Beam

http://www.youtube.com/watch?v=AWVz3yke_bY

5th Generation



No Moving Parts

Subsecond Scan Time

Stationary Detector Array

<http://www.youtube.com/watch?v=ww2TZBagDc&feature=related>

1974 - Commercialization

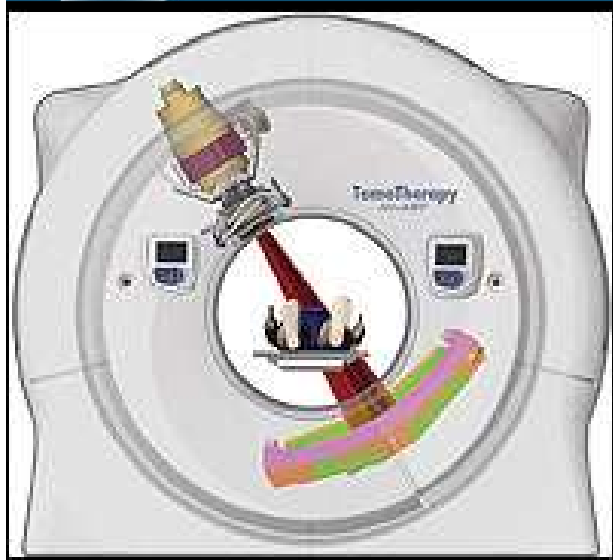
SIRETOM

- Dedicated to Head Imaging
- Only Two Sold



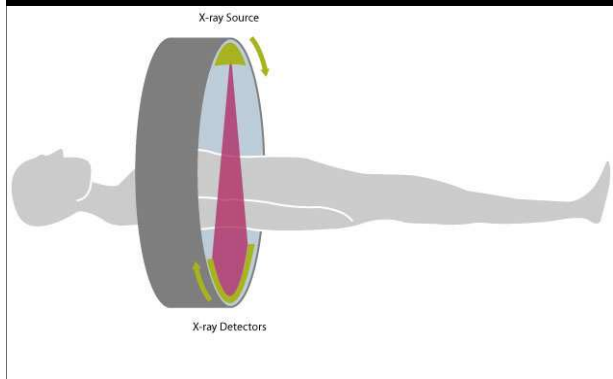
http://www.medical.siemens.com/siemens/en_GB/rg_marcom_FBAs/files/brochures/magazin2_2004/P8-9_CoverStory_CT-History.pdf

1976 – Full Body Scans



SOMATOM

- Introduction of a Gantry
- 5s Scan Time/Slice



[http://www.medical.siemens.com/siemens/zh_CN/gg_ct_FBAs/files/brochures/CT_History and Technology.pdf](http://www.medical.siemens.com/siemens/zh_CN/gg_ct_FBAs/files/brochures/CT_History_and_Technology.pdf)

1978-1983

Somatom II - 1978

- ECG Synchronized CT Image

Somatom DR III - 1983

- 3s Scan Time/Slice
- 1 mm Slice Width

Somatom DRH - 1985

- 25 Degree Gantry Tilt Angle
- Integrated Multi Planar Reformatting

1988-1994

Somatom Plus - 1988

- Continuous Rotation of Tube and Detector
- 1s Scan Time/Slice

Somatom AR - 1991

- Windows User Interface
- Spiral CT Scanner

Somatom Plus 4 - 1994

- 0.5s Scan Time / Slice

1998-2002

Somatom Volume Zoom - 1998

- 125ms Temporal Resolution during Cardiac Surgery
- 'Sureview' Reconstruction Algorithm

Somatom Sensation - 2002

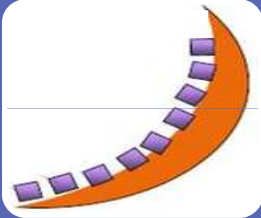
- Multislice Scanning – 16 per Rotation
- 105ms Temporal Resolution during Cardiac Surgery

State of the Art CT



Scanner

- X Ray Tube – Various Focal Spot Sizes
- Shielding – Grids, Collimators, Filters



Detector

- Single Row Detectors
- Multi Row Detectors

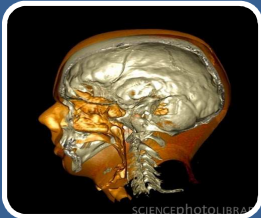
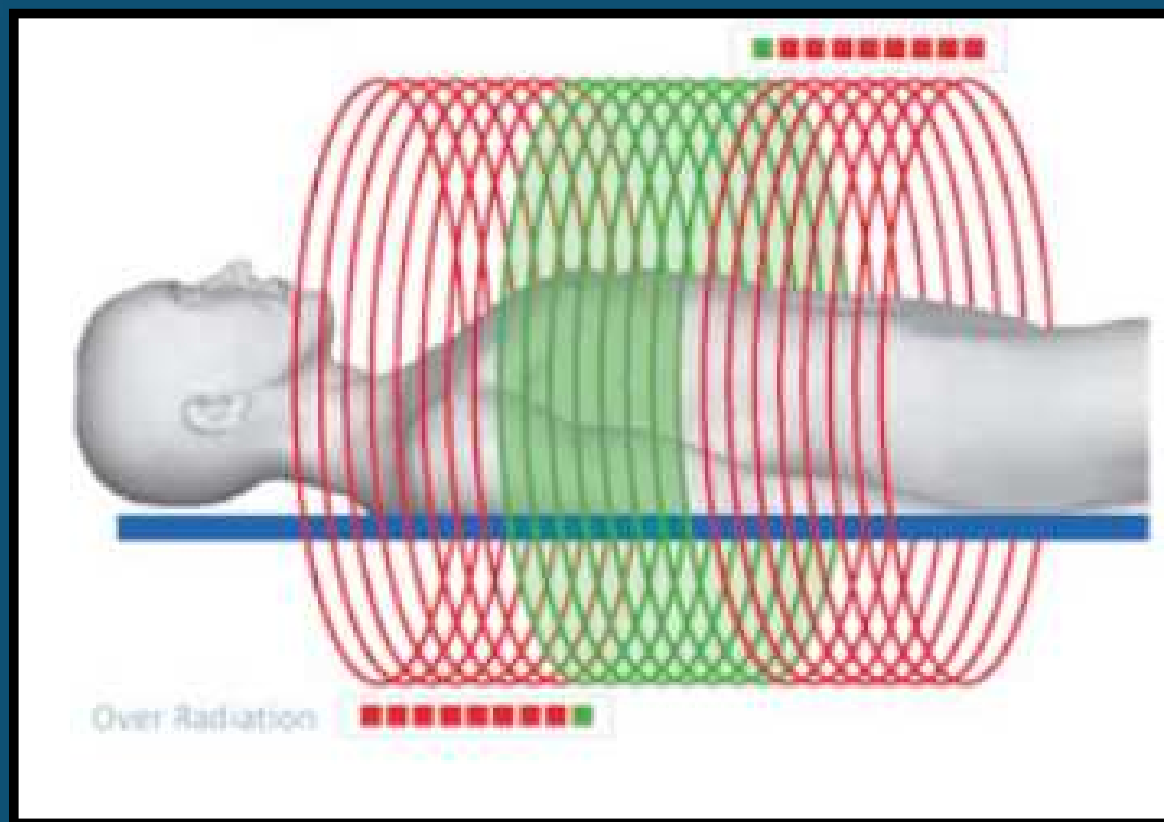


Image Reconstruction

- Volume Rendering

Most Recent Challenge

Reducing Unnecessary Radiation From Spiral Scans



Red Zone – Unnecessary Radiation

Solution: 'Breathing' Tube Side Collimator

Typical Device Cost

- 1992 Somatom AR.T (4.5k)
- 2000 Somatom+ 4 (45k)
- 2002 Somatom Sensation 16 (850k)
- 2005 Somatom Sensation 64 (650k)
- 2008 Somatom Definition (380k – 580k)

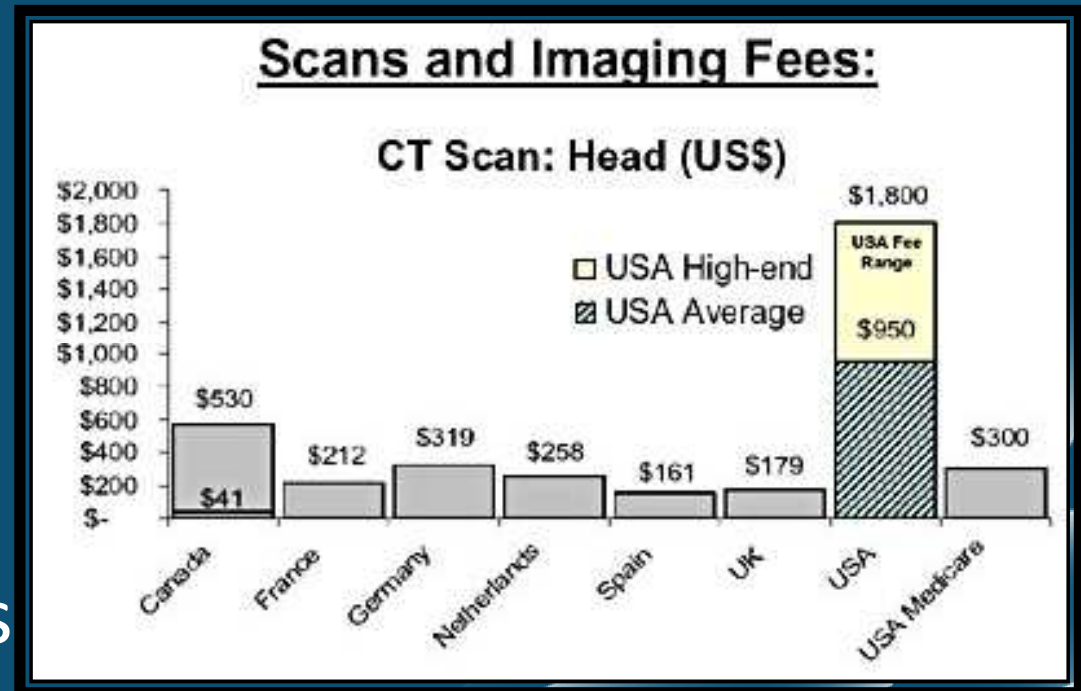
- 2011 Somatom AS+ (3 Million)
 - Two x-ray sources

<http://www.medwow.com/used-ct-scanner-equipment/210.med>

http://www.forbes.com/2005/11/17/cat-scanners-cardiac_cx_dal_1118CAT.html

Typical Scan Cost

- (\$600-\$3000)
- (\$300-\$1500)
- \$3000
- 40% Discount for Uninsured Patients & Payment Plan



<http://www.comparecatcancost.com/>

http://blog remakehealth.com/blog_Healthcare_Consumers-0/bid/7499/How-much-does-a-CT-Scan-cost

<http://answers.yahoo.com/question/index?qid=20061006104857AAXgwOx>

<http://answers.yahoo.com/question/index?qid=20080224095624AA1PFHh>

<http://motherjones.com/kevin-drum/2009/11/cost-technology-revisited>

Annual Use in the USA

