

CT scanning

THE GOOD  
AND THE BAD  
AND THE UGLY

ICRP Symposium

Oct. 25, 2011

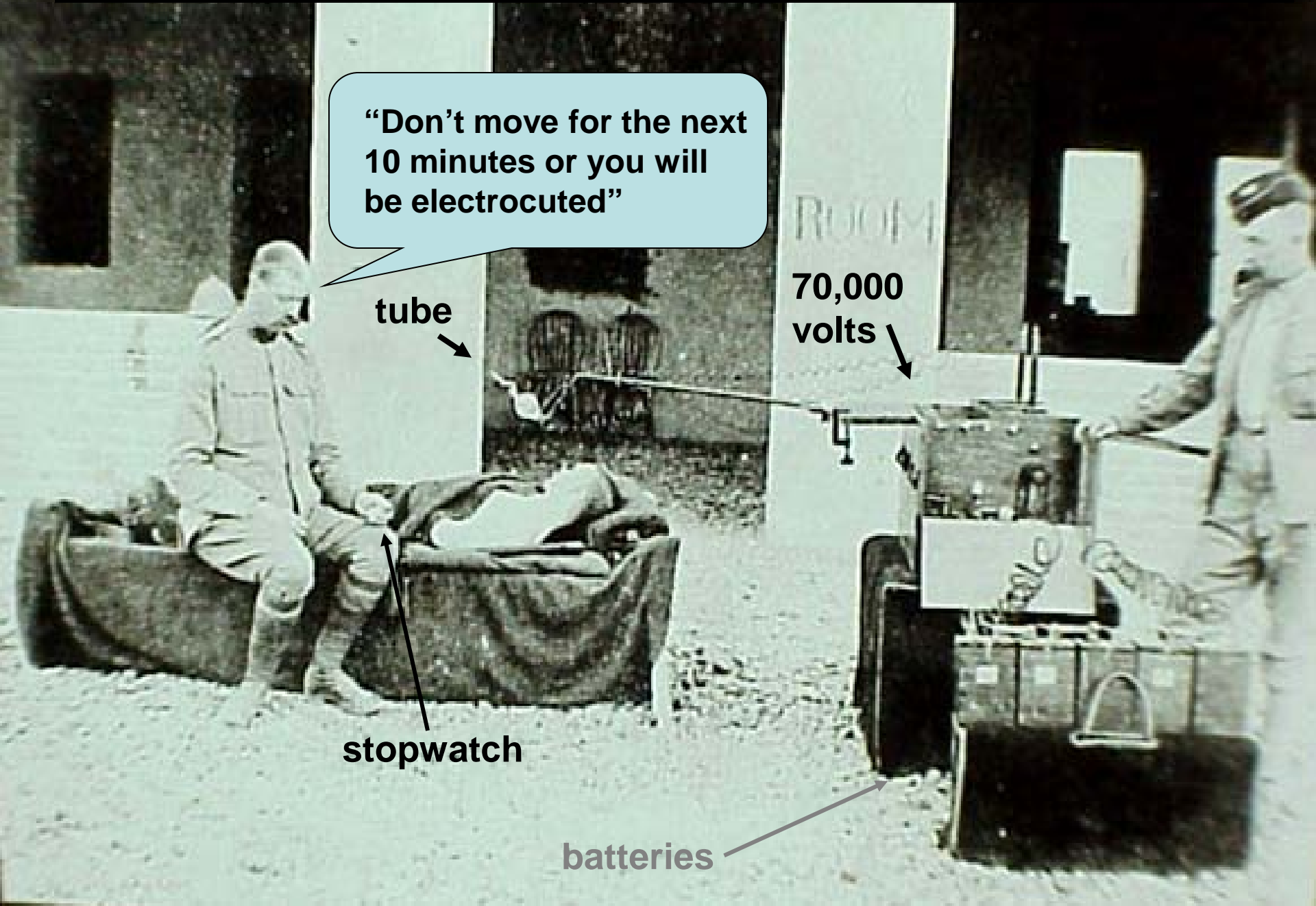
Bethesda, MD

Fred Mettler

NM VAHCS

Albuquerque NM

# Things are not as ugly as they used to be



“Don't move for the next 10 minutes or you will be electrocuted”

tube

70,000 volts

stopwatch

batteries



3 million 1982





1995 21 million

4CT9

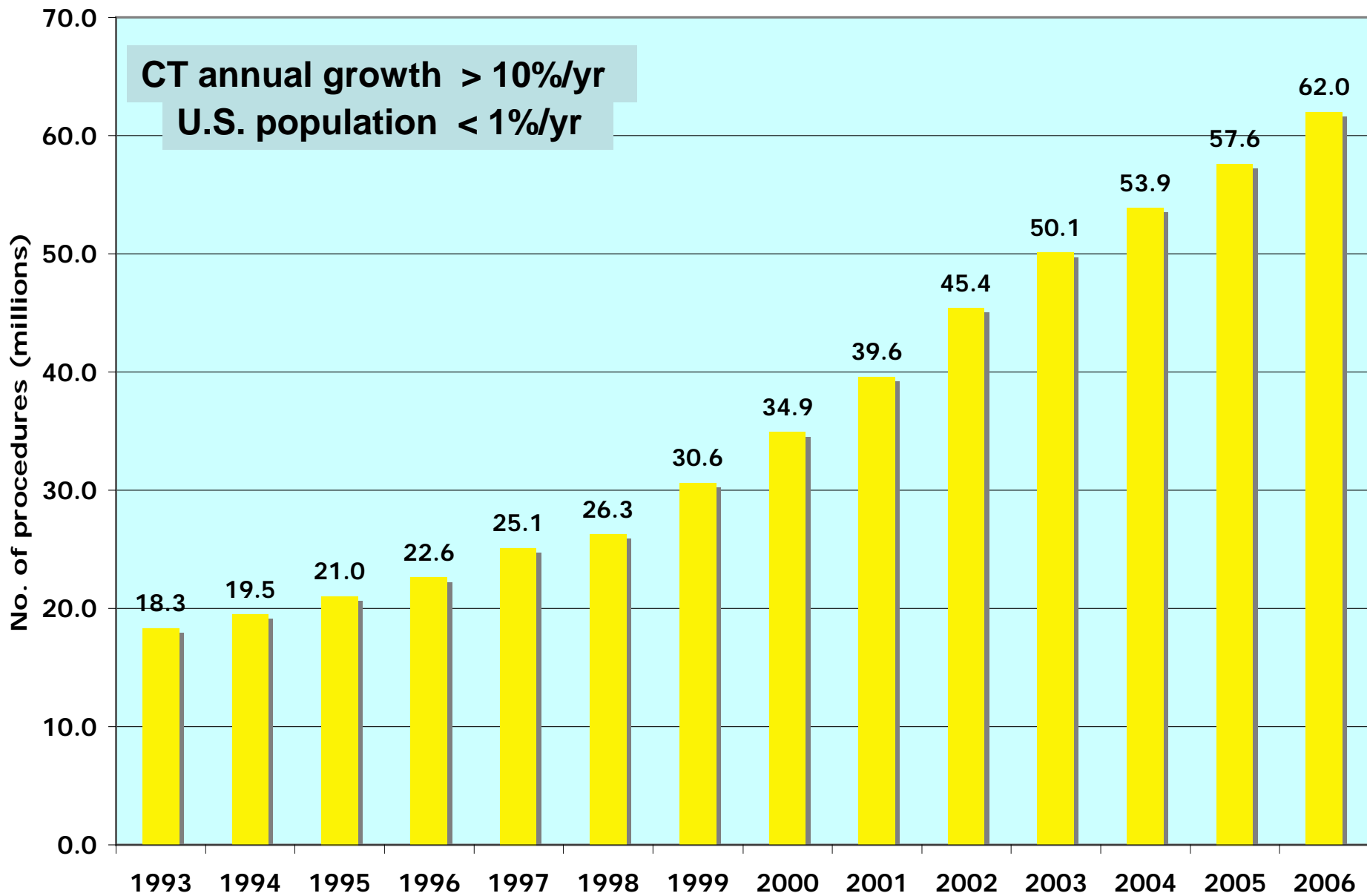


2007 70 million

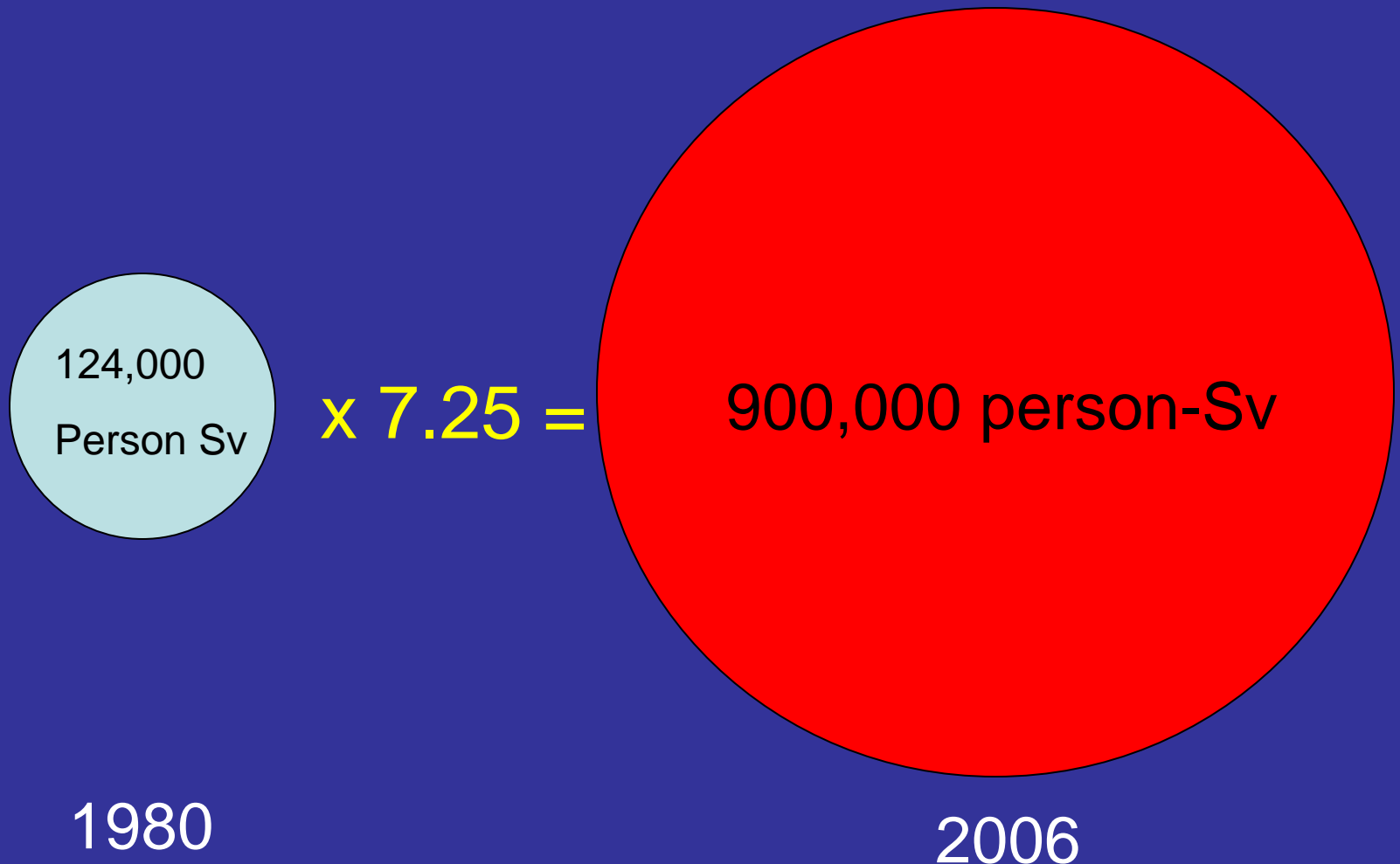
# CT scans by year in U.S. (millions)

**CT annual growth > 10%/yr**

**U.S. population < 1%/yr**



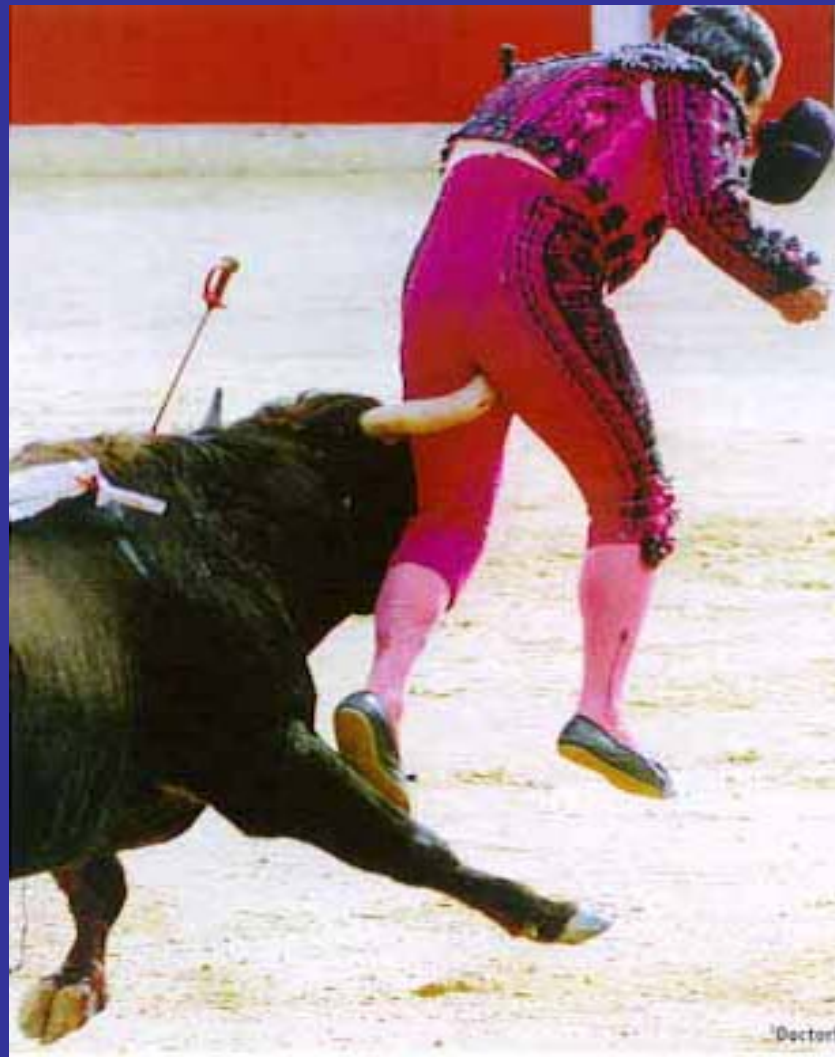
# Collective annual population dose from medicine has increased over 700 percent



These results have not been reviewed and approved by Council.  
Not to be disseminated or referenced

# Bad

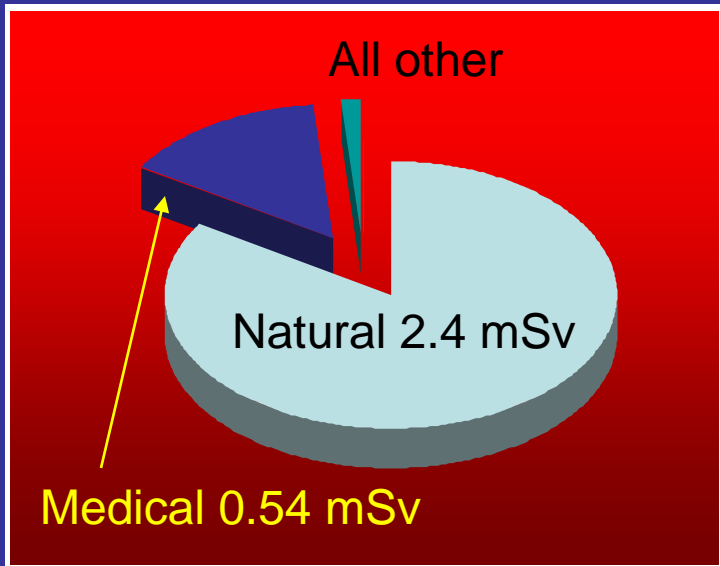
Regarding dose we were pretty much caught off guard





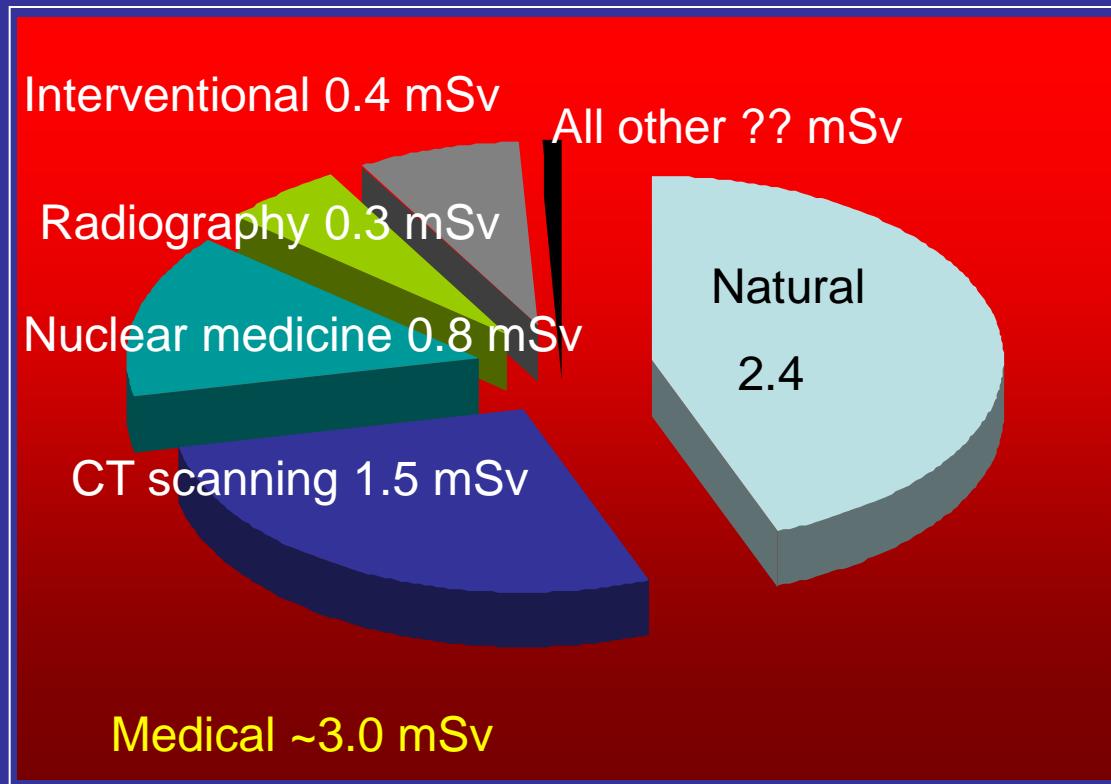
# Good or bad ?

U.S. 1980



Total 3.0 mSv per capita

U.S. 2006



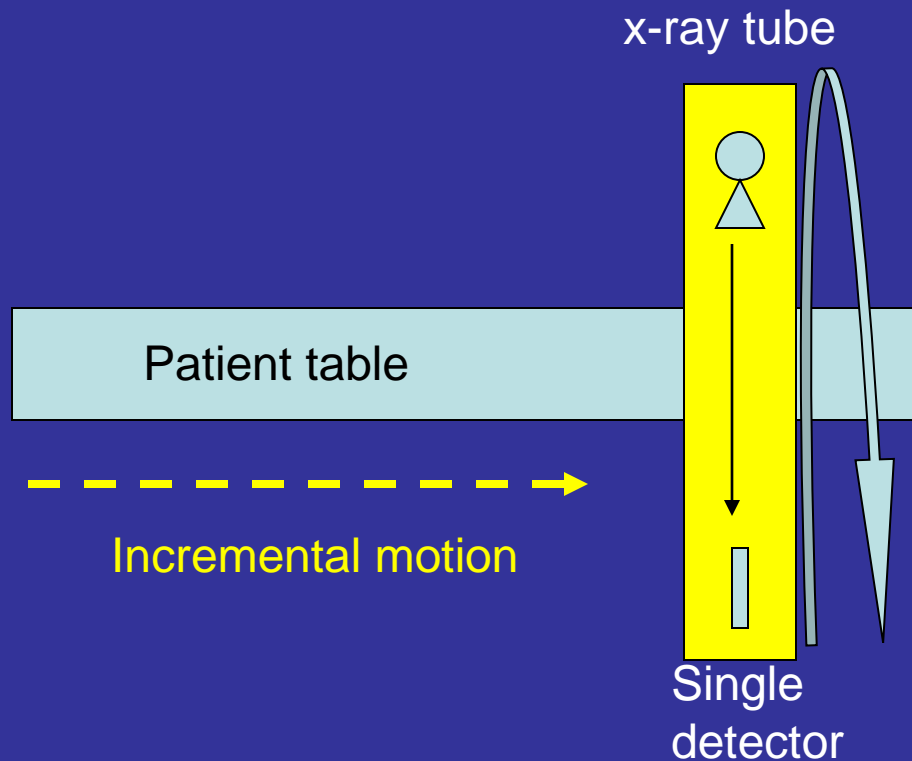
Total ~ 5.4

# Computed tomography (CT scan)



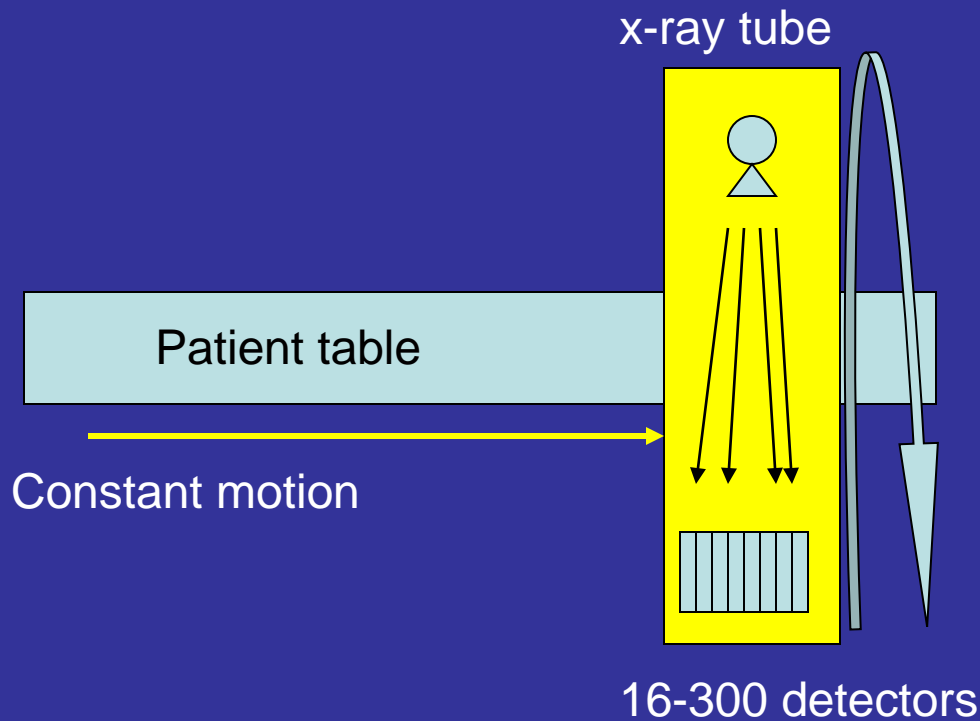
Recent advances in machine technology have led to more applications and markedly increased usage

# Single slice CT scanner



**Scan time ~ 10-20 minutes**

# Multislice multidetector helical CT scanner (new scanners are 1000x faster)



**Now 300 slices/images in 0.3 second**

**Good**

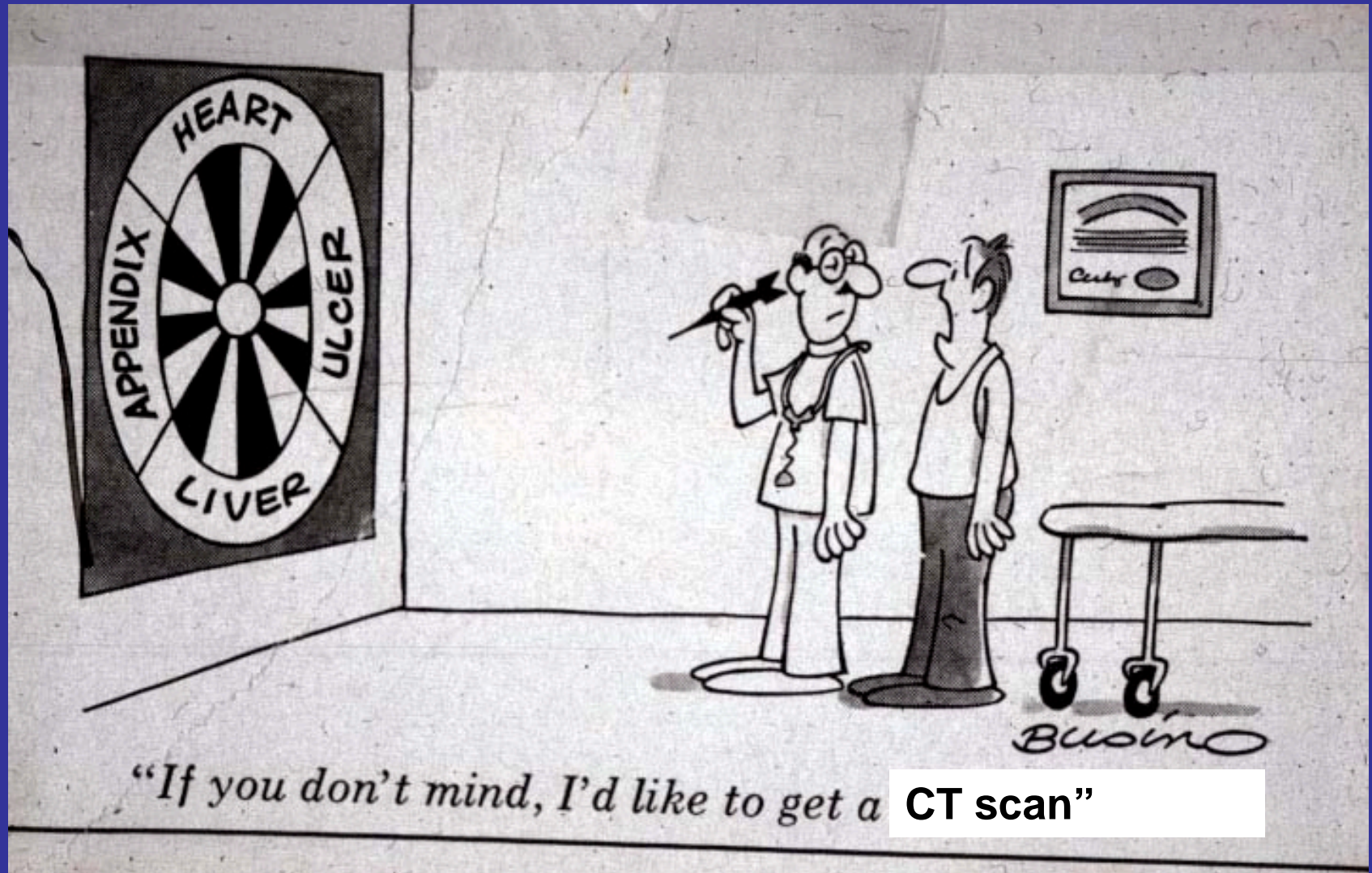
Uncertainty reduced for patient  
and physician



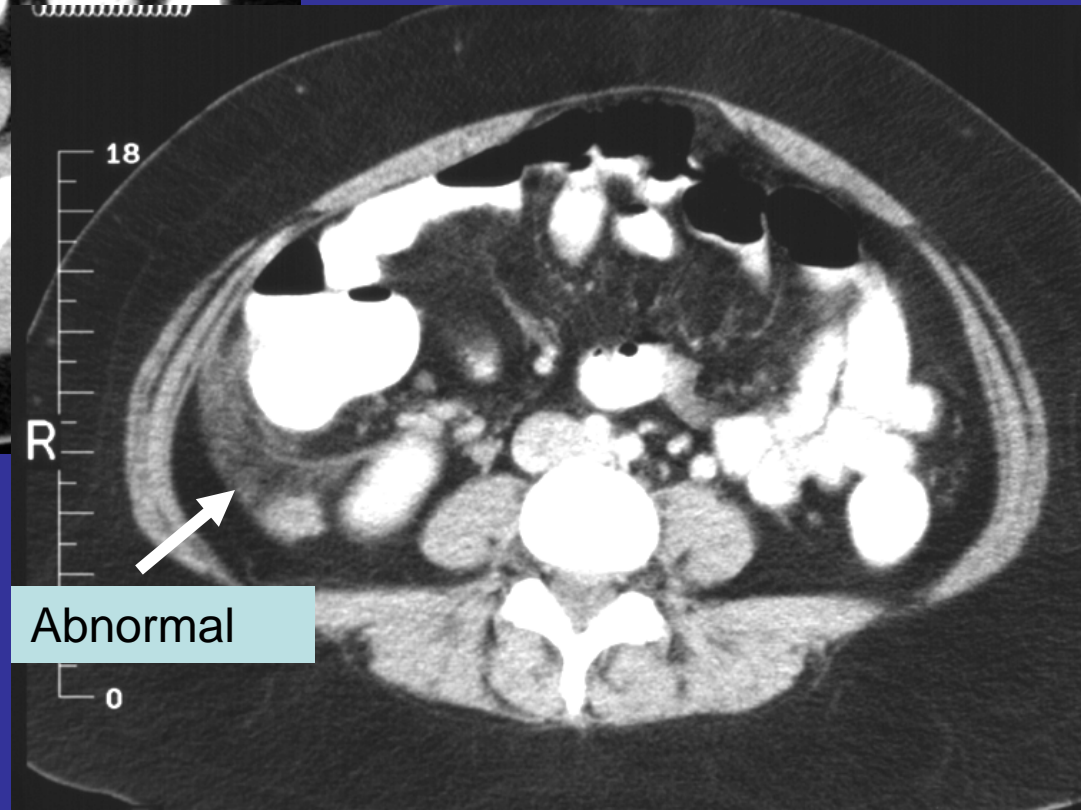
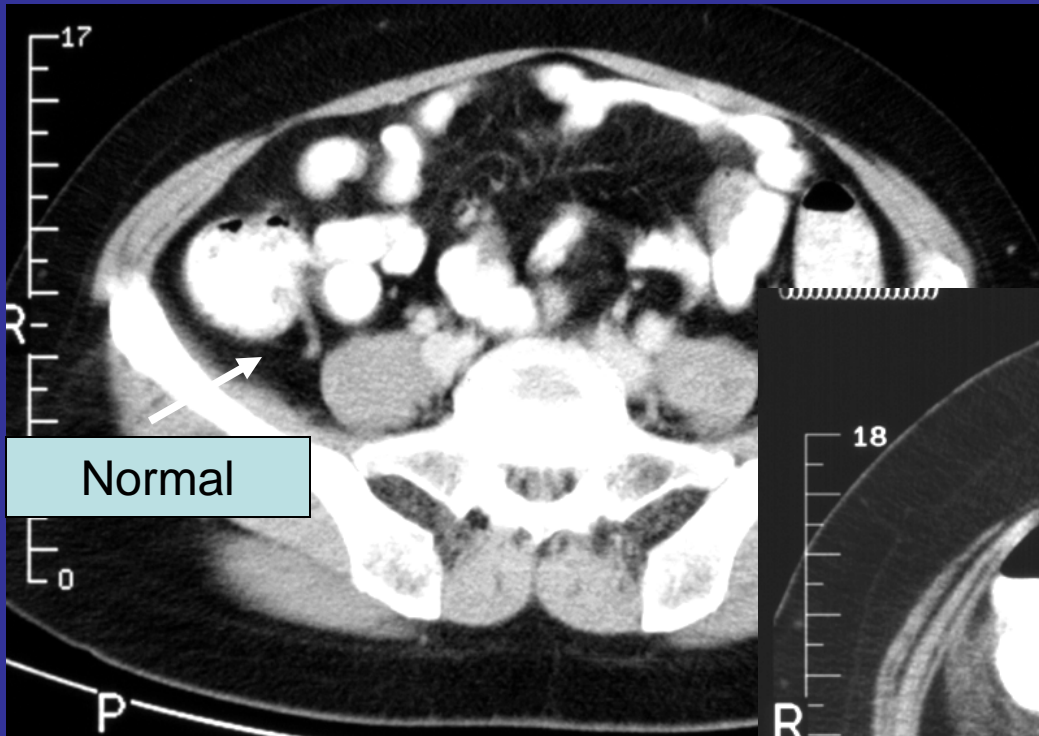


**Good**

Uncertainty reduced for patient  
and physician



# Good Appendicitis

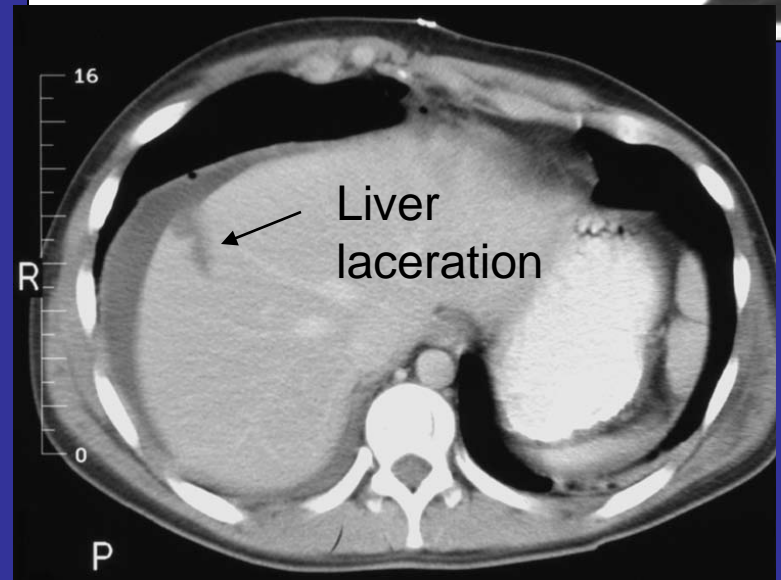
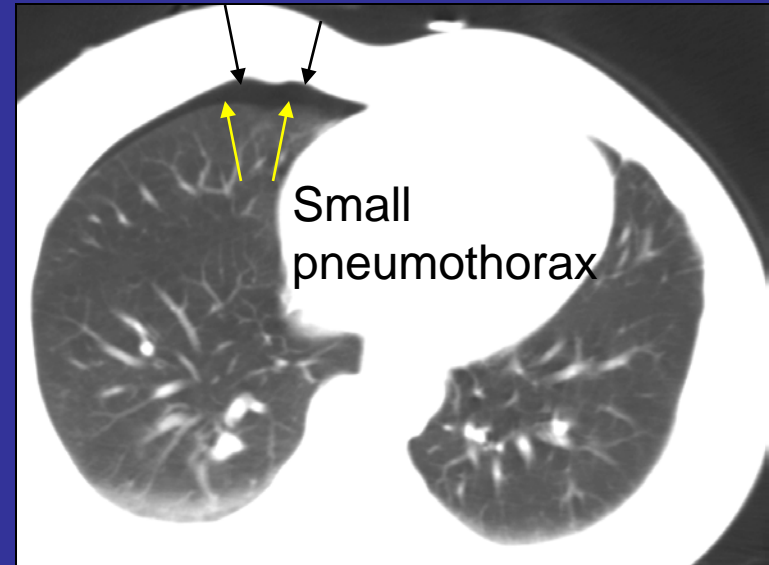


# Good Trauma

CT scan of head, neck,  
chest, abdomen and pelvis

10-30 seconds

Many significant findings are  
seen such as brain  
hemorrhage, liver  
lacerations which are difficult  
or impossible to see on plain  
x-rays





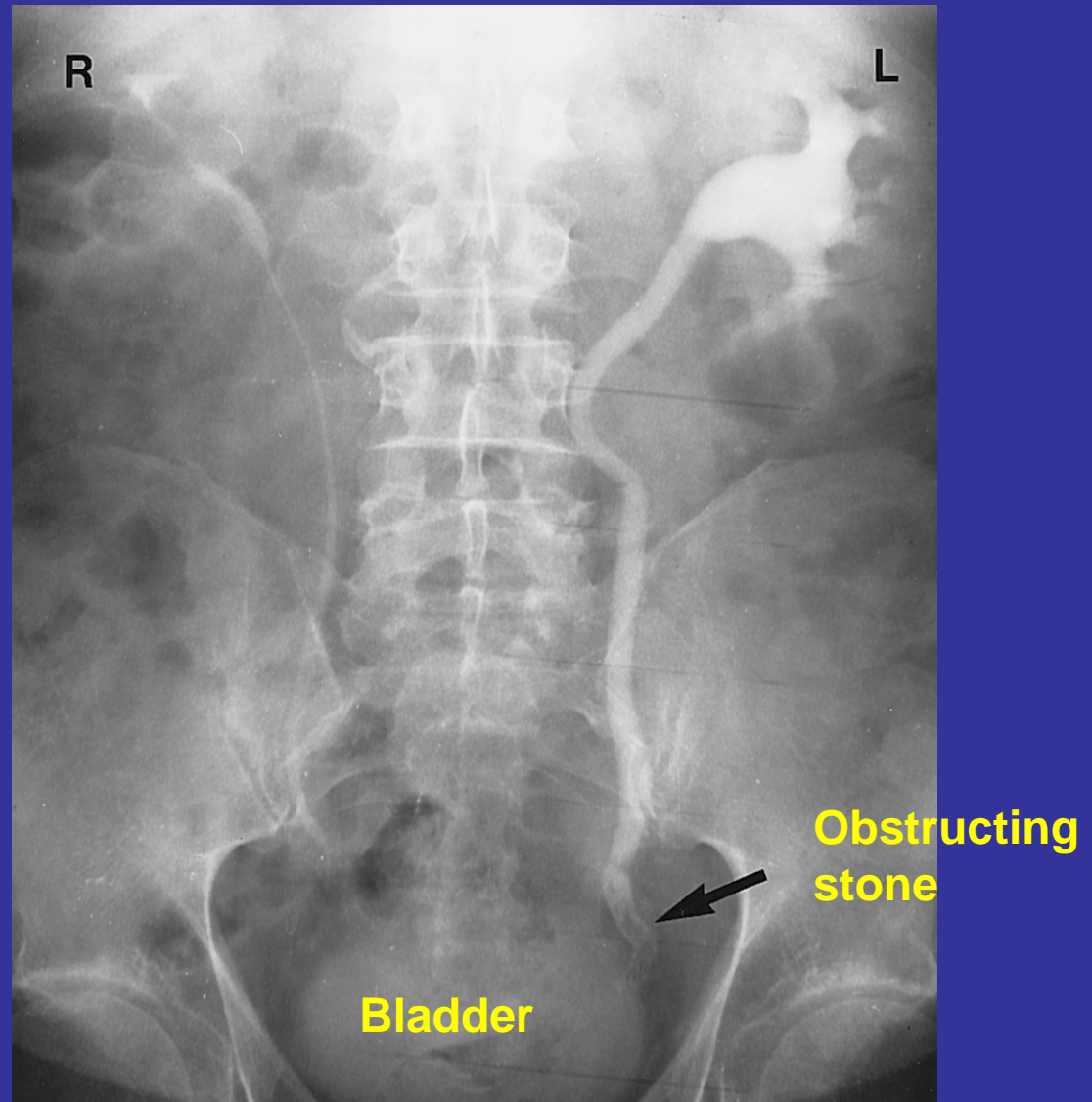
# Good replacement of IVPs

Intravenous urogram (IVP)

Requires injection of intravenous contrast

Contrast reactions in 5% of patients

30 minutes



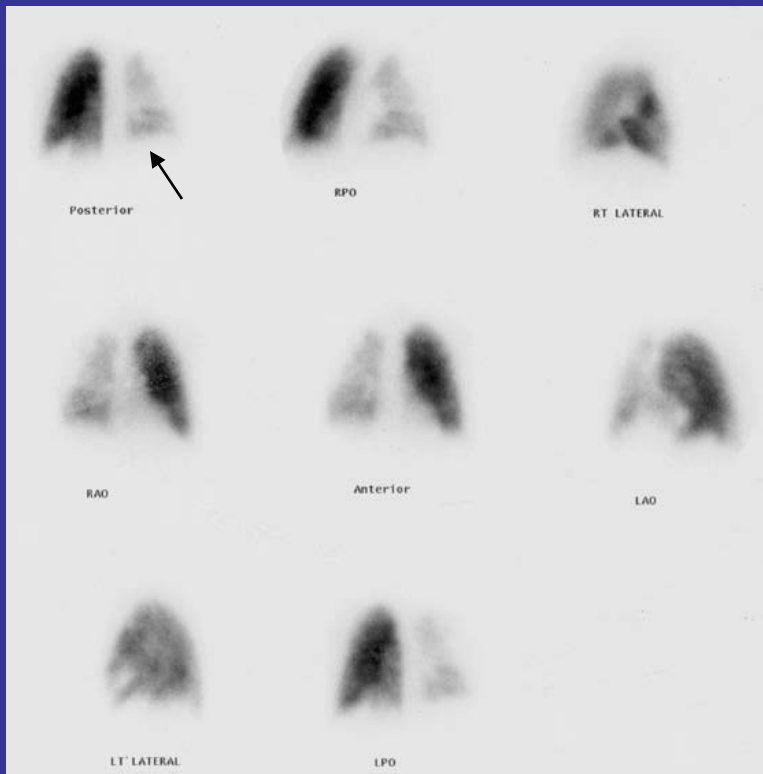
CT scan 30 seconds.  
No intravenous contrast



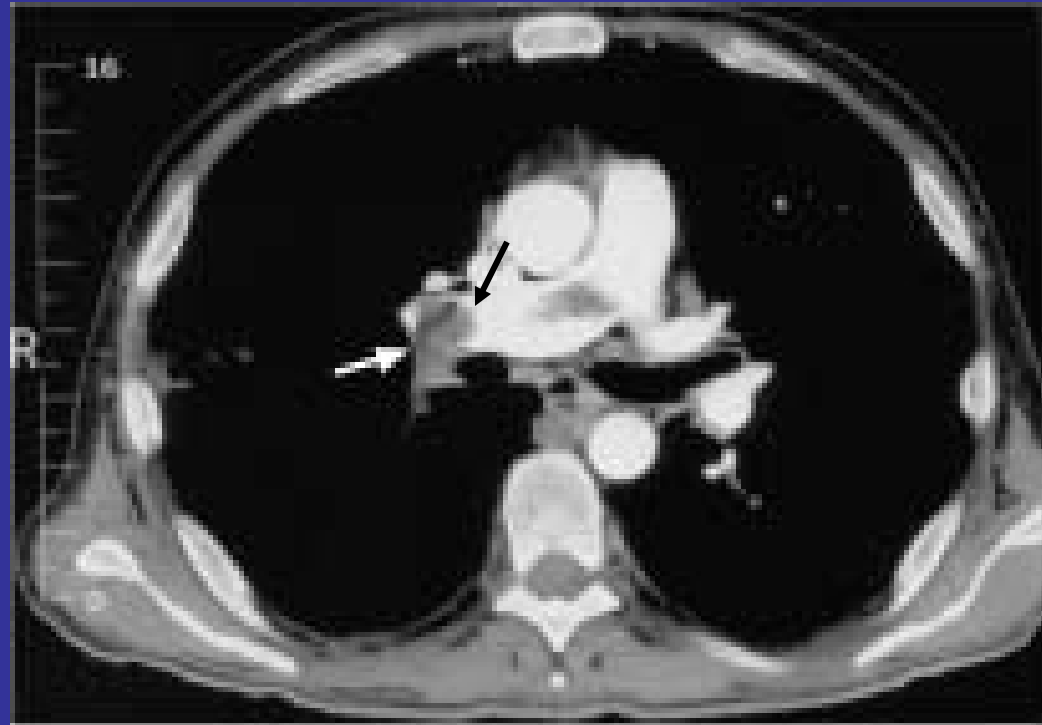
4mm stone in  
distal ureter



**Good** replacement of other techniques with improved accuracy



Reduced blood flow to one lung- nonspecific



Large clot in right main pulmonary artery – clear diagnosis

# Bad confusion in the literature

JAMA March 7, 2007

 EDITORIALS

Editorials represent the opinions of the authors and JAMA and not those of the American Medical Association.

## CT Screening for Lung Cancer Spiraling Into Confusion?

William C. Black, MD

John A. Bressan, MD

planations for these discordant results deserve some consideration.

Bach PB et.al. JAMA 2007

144 cancers found 44 expected

**No reduction in mortality**

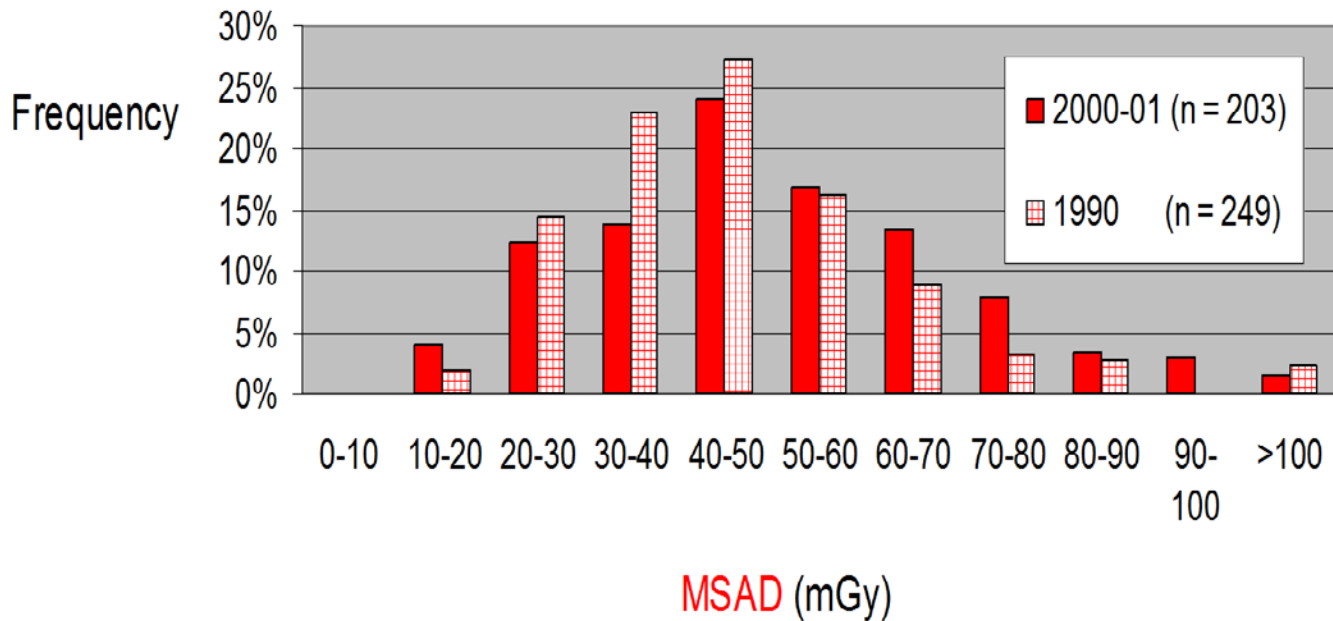
38 deaths vs 38.8 expected

Henschke et.al. NEJM 2006

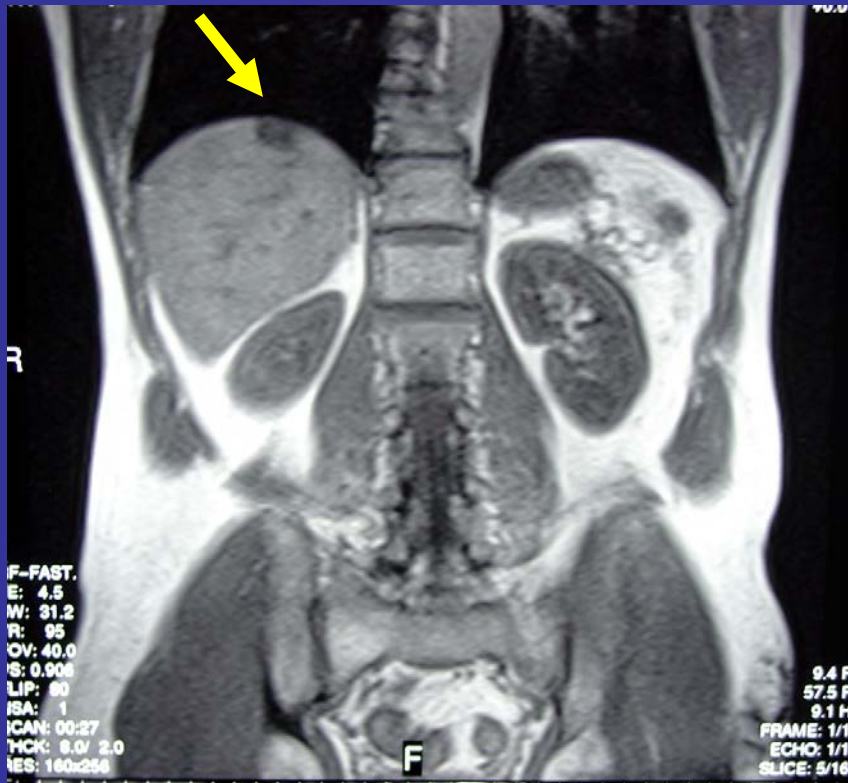
**CT scanning can prevent  
80% of lung cancer deaths**

# Ugly Variation in CT scan doses among institutions and by scanner model

## Multiple Scan Average Dose

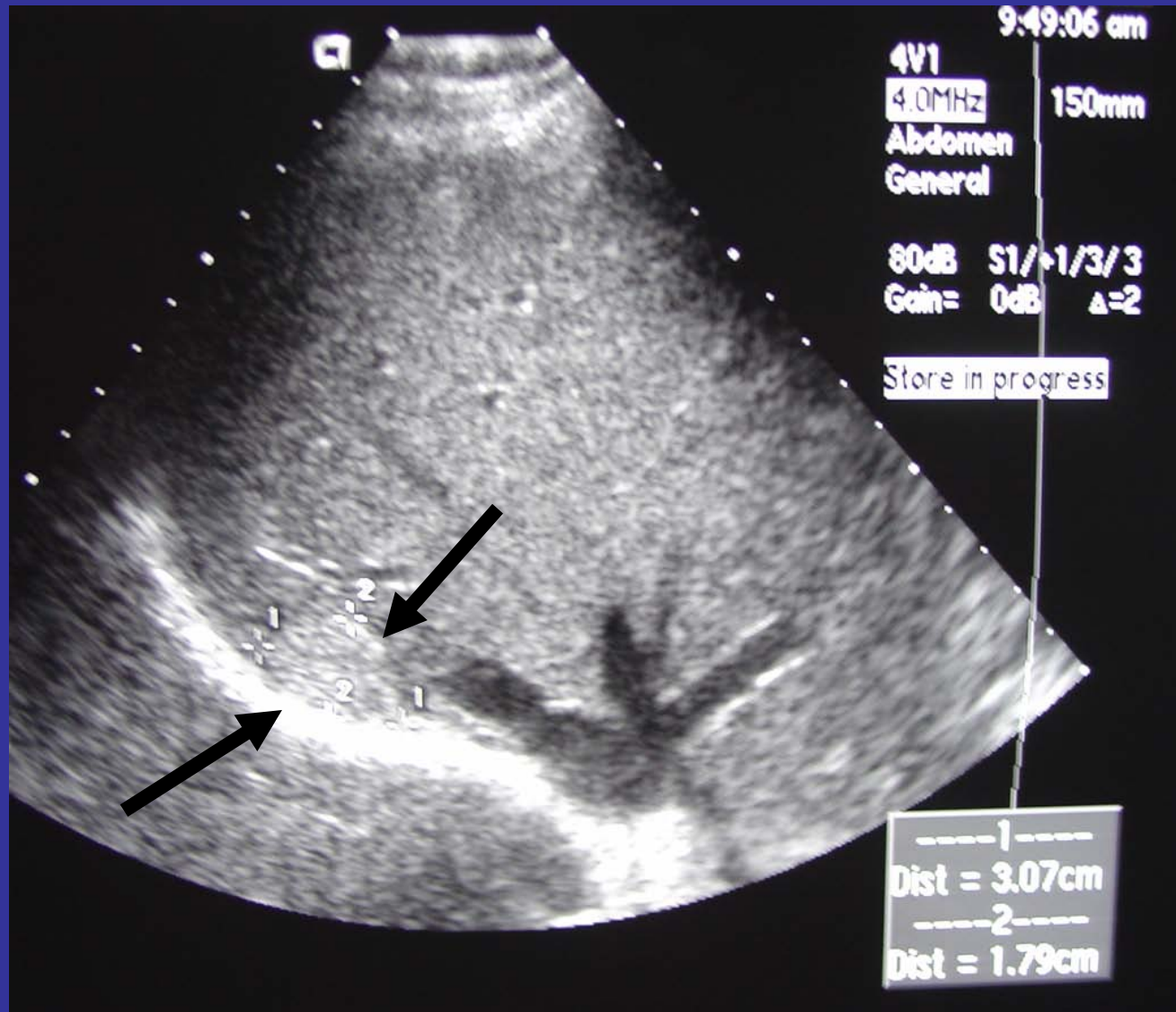


# Bad Radiologist's repetitive hedging



2005 MRI to “evaluate liver lesion”

**2004** Ultrasound shows characteristic hemangioma





# Surprise 4 prior CT studies

DATE	EXAM	ACR INDEX
8/16/03	Abd Pelvis	

C.T.  
UNIT NUMBER **2002**  
PATIENT NAME \_\_\_\_\_  
DATE OF BIRTH 8/19/49  M  F

DATE	EXAM	ACR INDEX
4-2-03	Abd - CT	

C.T.  
UNIT NUMBER **2003**  
PATIENT NAME \_\_\_\_\_  
DATE OF BIRTH // //  M  F

DATE	EXAM	ACR INDEX
20 SEP 2004		

C.T.  
UNIT NUMBER **2004**  
PATIENT NAME \_\_\_\_\_

DATE	EXAM	ACR INDEX
14 DEC 2004	Abd - CT	

C.T.  
UNIT NUMBER **2004**  
PATIENT NAME \_\_\_\_\_  
DATE OF BIRTH // //  M  F

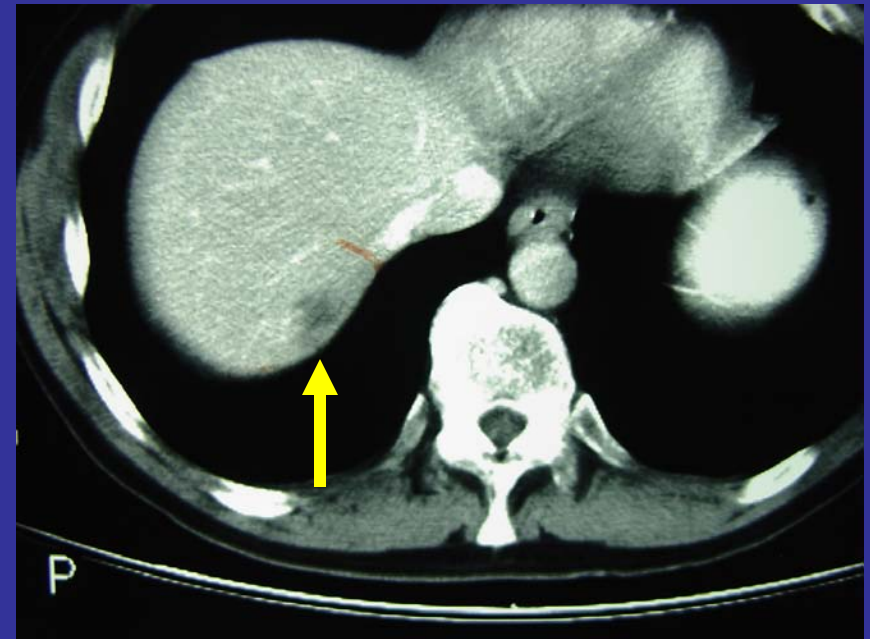
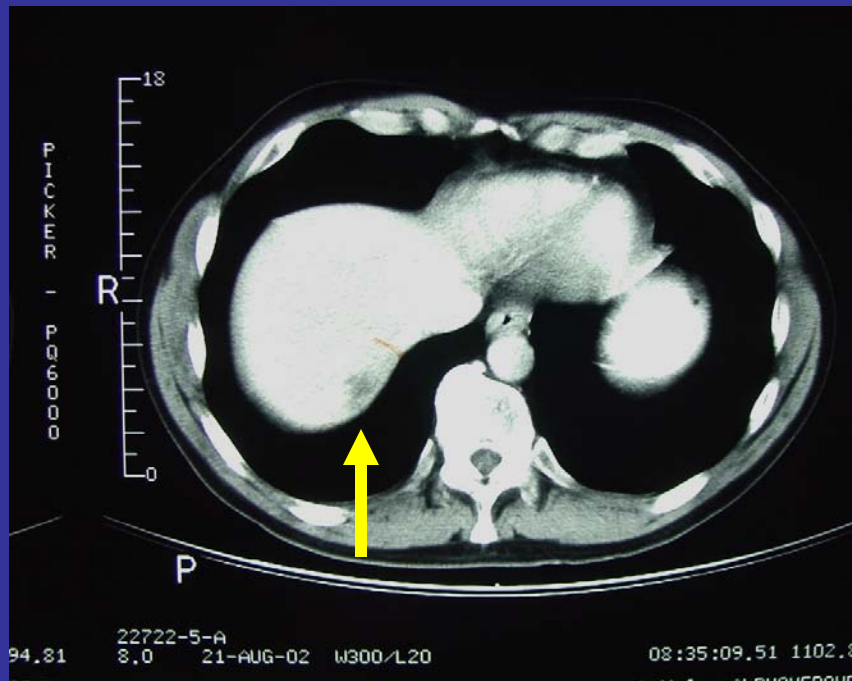
DATE	EXAM	ACR INDEX
2-6-05	Abd - CT	

C.T.  
UNIT NUMBER **2005**  
PATIENT NAME \_\_\_\_\_  
DATE OF BIRTH // //  M  F

# C. T.

# CT scan 2002

No change over any scans in prior 3 years but  
“cannot entirely r/o neoplasm”



© Original Artist

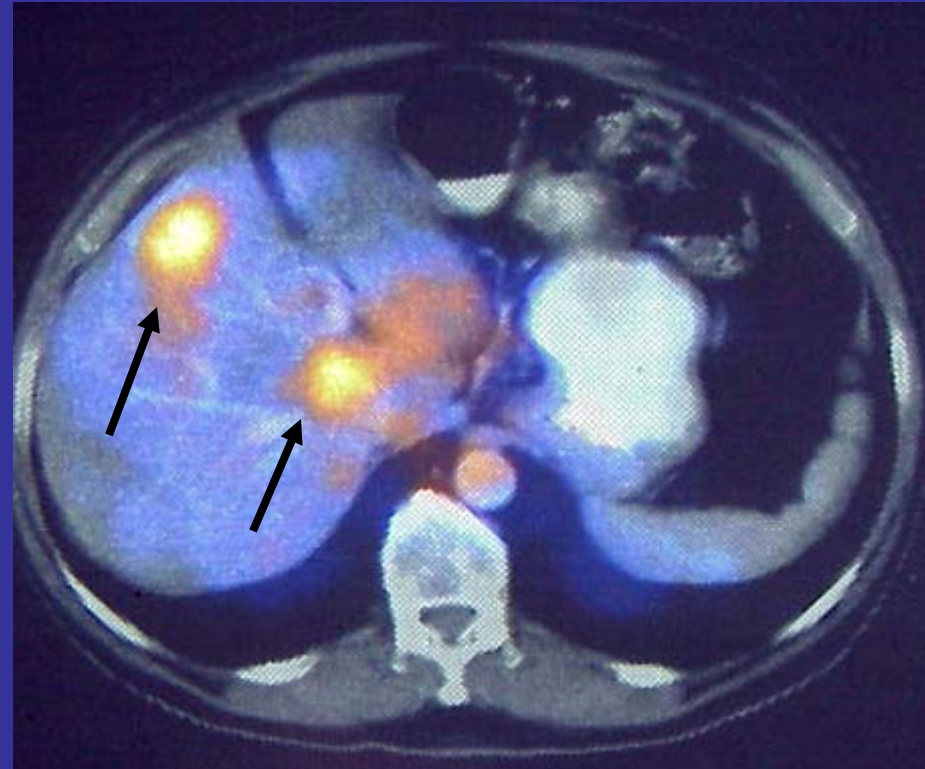
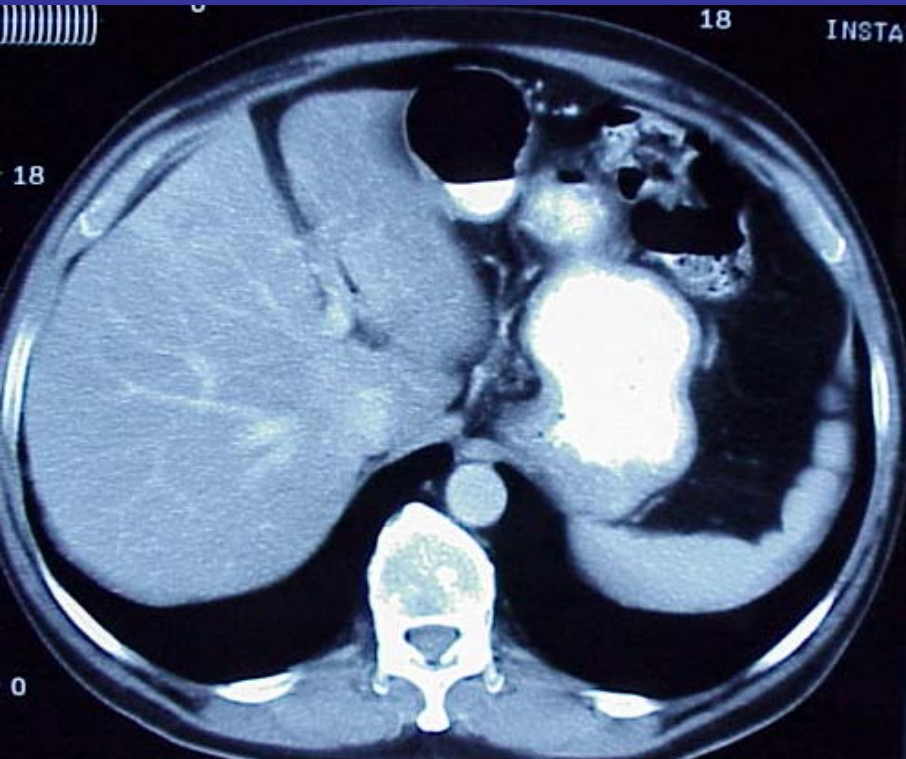
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"Judging by your X-rays, I'd say you've been  
exposed to too much radiation."

**Good**

Hybrid imaging





# Bad Self-referral financial incentives



Imaging Opportunities for Urology Physician Practice  
Affordable In-Office Computed Tomography Solution

Procedures Per Day	Days Per Month	Average CPT	Income	FMVL Cost	ROI* Per Month	ROI for 5 Years
1.8	20	\$220	\$7,950	\$7,950	Break Even	Break Even
5	20	\$220	\$22,000	\$7,950	\$14,050	\$843,000
10	20	\$220	\$44,000	\$7,950	\$36,050	\$2,163,000

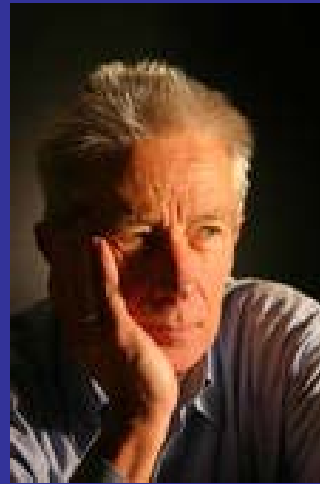


Sample computation – Basic SOMATOM Spirit configuration, based on a 5-year Fair Market Value Lease (FMVL). Prices will vary with additional options. Please consult your Siemens Account Executive for details.  
\*Return on Investment.



Ugly

Uncertainty over Obamacare, taxes and the Federal budget has stifled investment and planning



# Bad Gift certificates for screening CT scans

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**RADIOLOGY**  
DIAGNOSTIC & INTERVENTIONAL SPECIALISTS

DIAGNOSTIC RADIOLOGY SERVICES | INTERVENTIONAL RADIOLOGY SERVICES

**CT Scan**

**Procedure Name:**  
Computed Tomography

**Description:**  
A CT scan, or CAT scan, is a common term for computerized spiral tomography, a painless diagnostic imaging test that displays two-dimensional images of internal structures of the body on a computer screen. It takes less than 30 minutes to perform. Patients can receive a CT scan on an outpatient basis or as part of an inpatient hospital stay.

**Basic Facts:**

- Computed tomography (CT) scanners are diagnostic testing devices used to obtain horizontal and vertical cross-sectional views of internal body structures. In addition to creating diagnostic images, the CT scanner can be used for biopsy, needle or catheter placement.
- The CT scanner consists of a gantry, a control console, and a patient table. Images are displayed on a monitor.
- CT scans have a fine degree of detail.

**WHAT'S NEW?**

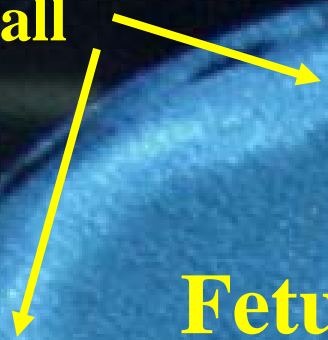
Are you at risk for stroke, aneurysm or peripheral artery disease? Artery Health Screening gift certificates are available now. [More »](#)

**Good** Rapid accurate diagnoses especially in the ER



PHOTOGRAPH / 000000

**Uterine wall**

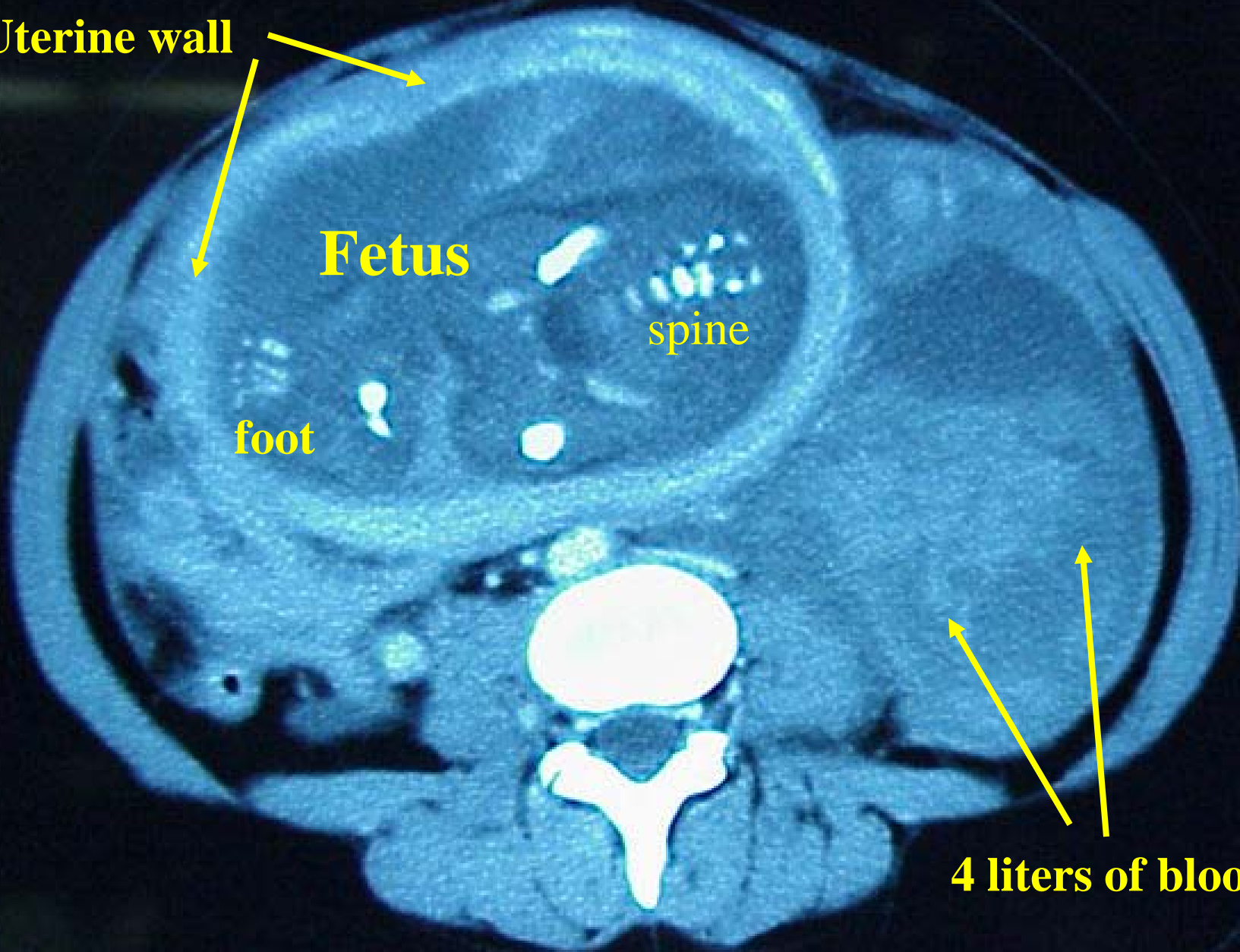
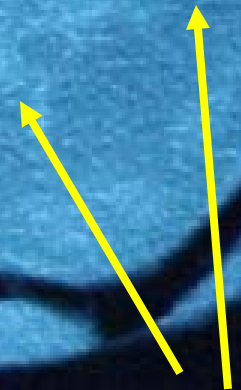


**Fetus**

**spine**

**foot**

**4 liters of blood**



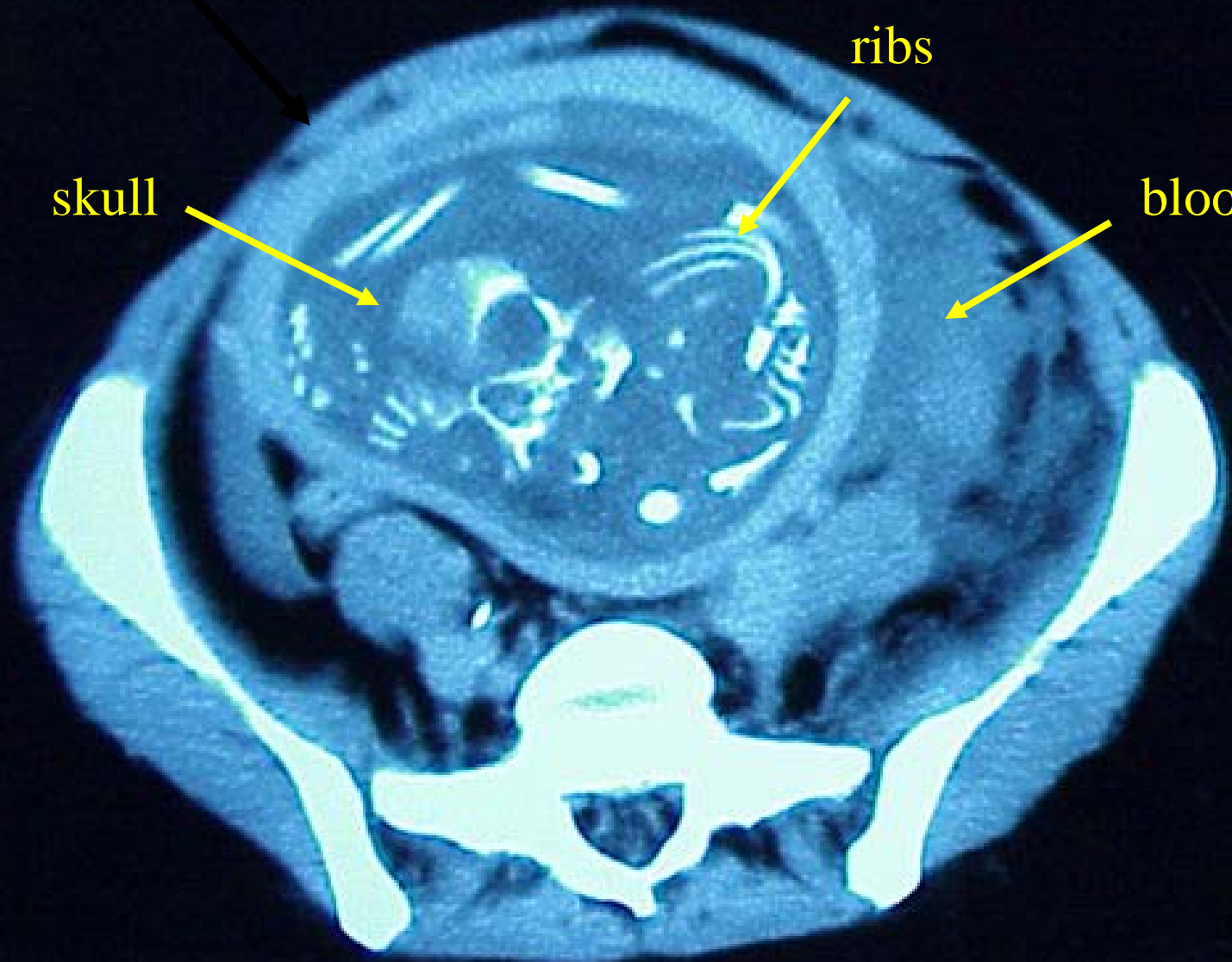
# CT scan results

Fetus

ribs

skull

blood

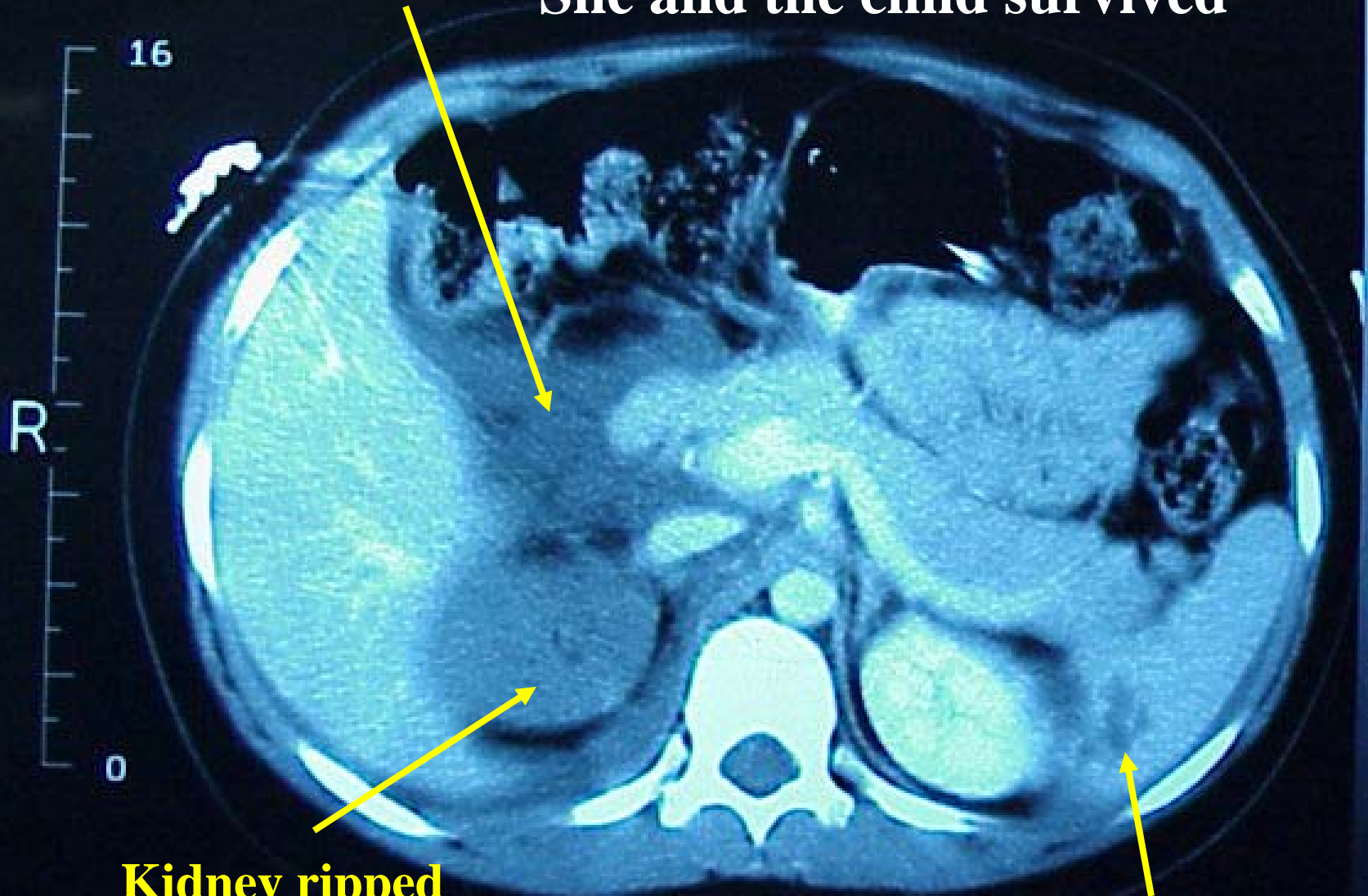




3 min exam and off to the OR<sup>16</sup>

She and the child survived

Free blood



Kidney ripped  
off aorta (no contrast in it)

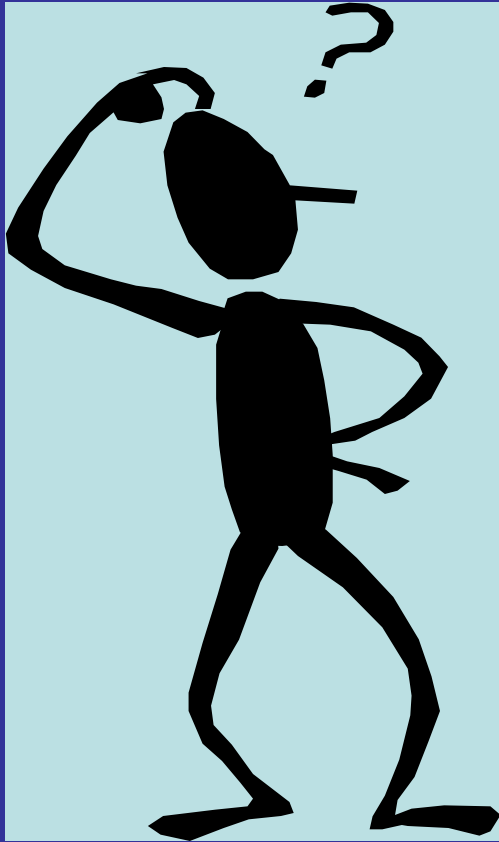
Splenic laceration

**Bad**

Potential overuse



What does “ABC” stand for

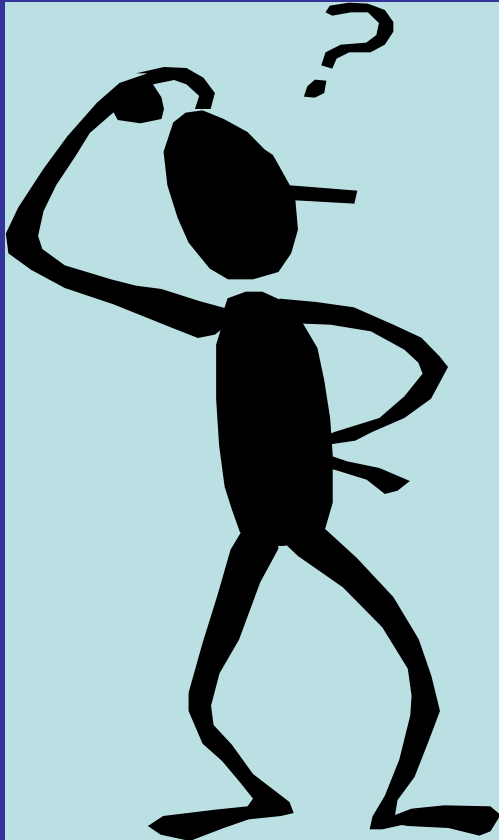


Airway

Breathing

Circulation

What does “ABC” stand for



Airway

Breathing

CT

# Ugly

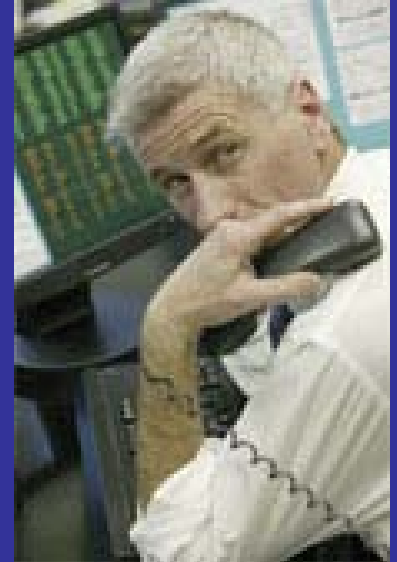
- The urologist or surgeon refuses to come see the renal stone patient until a CT is ordered





# Good and Bad Radiology consultation

- We don't have time to discuss all CT scans
- A typical department doing 35,000 CT scans per year = 5-6 phone calls per hour for CT alone
- Some have 24 hour availability



Good  
Bad

Computer systems  
Limited use

ACR Appropriateness Criteria® October 2008 Version - Microsoft Internet Explorer

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RADIOLOGY

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## ACR Appropriateness Criteria® October 2008 Version

The ACR Appropriateness Criteria® are evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision. By employing these guidelines, providers enhance quality of care and contribute to the most efficacious use of radiology.


The guidelines are developed by expert panels in diagnostic imaging, interventional radiology, and radiation oncology. Each panel includes leaders in radiology and other specialties. There are currently 159 topics with over 800 variants. For more information on the background and development process, [click here](#).

Personal use of the ACR Appropriateness Criteria® is permitted for research, scientific, and/or informational purposes only. Those with other interests in the ACR Appropriateness Criteria® should contact the ACR at [acr\\_ac@acr.org](mailto:acr_ac@acr.org) or (703) 648-8900 for permission and licensing information.

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- Relative Radiation Level Information
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- Anytime, Anywhere™ PDA Application
- Terms and Conditions
- Citation Information

start 2:17 - QuickLink Mobile ACR Appropriateness... Microsoft PowerPoint ... 9:37 AM

# Warning - Similar Names

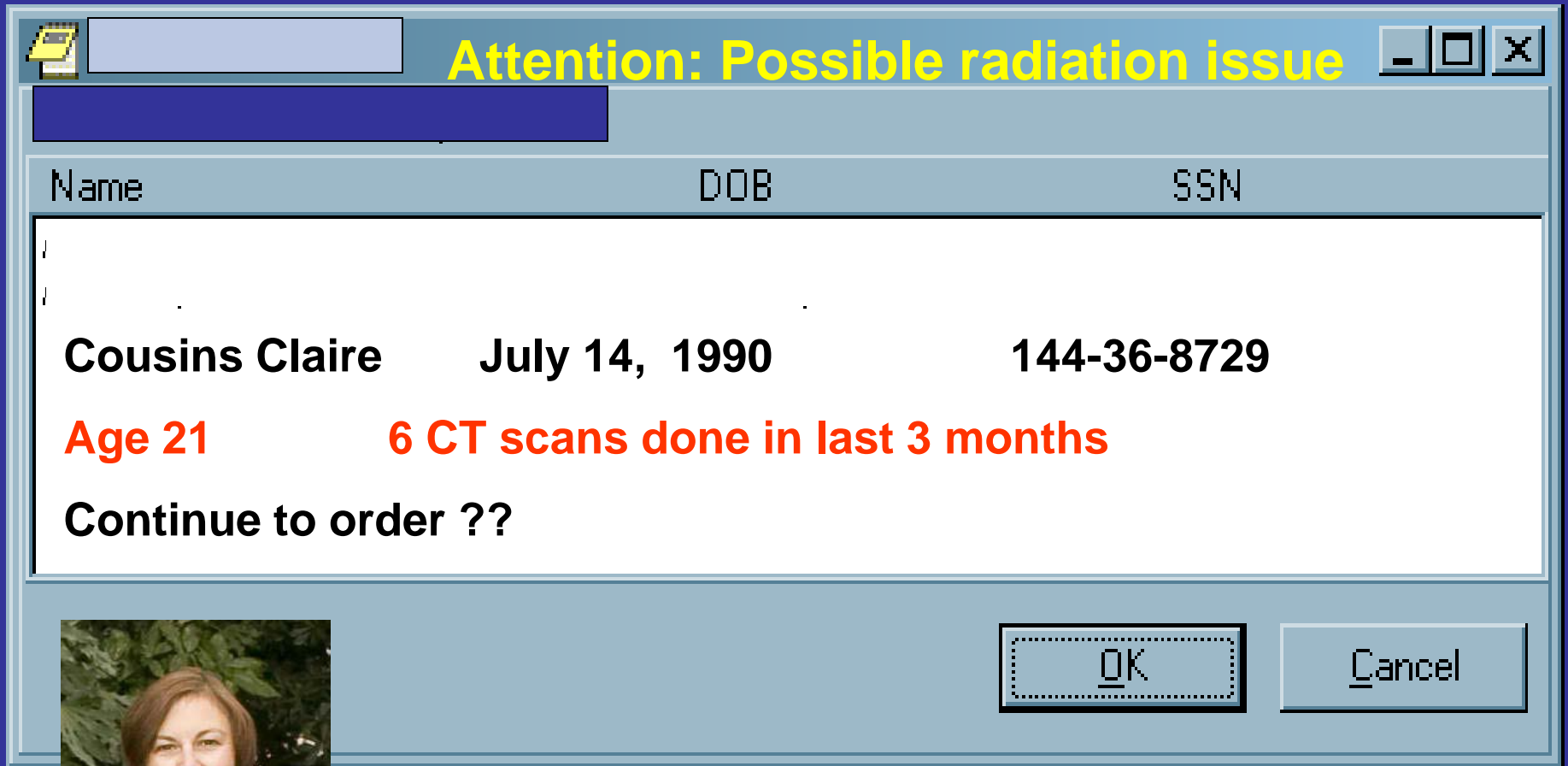
 **Similar Patients** \_ □ ×

Please select the correct patient:

Name	DOB	SSN
Vano El Gato	July 23, 1930	144-45-6929
Vano E	July 14, 2008	144-36-8729



# Good Computer generated warnings



The screenshot shows a Windows-style dialog box with a yellow title bar. The title bar contains a printer icon, a text box, and the text "Attention: Possible radiation issue" in yellow. Below the title bar is a blue header bar. The main content area has a table with three columns: "Name", "DOB", and "SSN". The table contains one row of data: "Cousins Claire", "July 14, 1990", and "144-36-8729". Below the table, the text "Age 21" and "6 CT scans done in last 3 months" is displayed in red. At the bottom of the dialog box, there are two buttons: "OK" and "Cancel".

Name	DOB	SSN
Cousins Claire	July 14, 1990	144-36-8729

Age 21      6 CT scans done in last 3 months

Continue to order ??

OK      Cancel



# Machine generated warnings

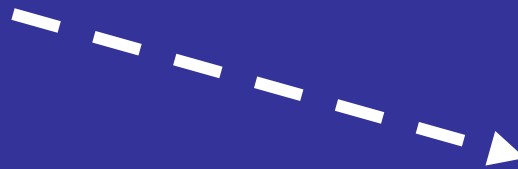


“ The CT protocol you have chosen has CTDI over the ACR accreditation limit !!”

**Bad**

Inadequate knowledge of dose and risk

What does a dose of 13 mSv  
and a DLP of 500 really  
mean ????



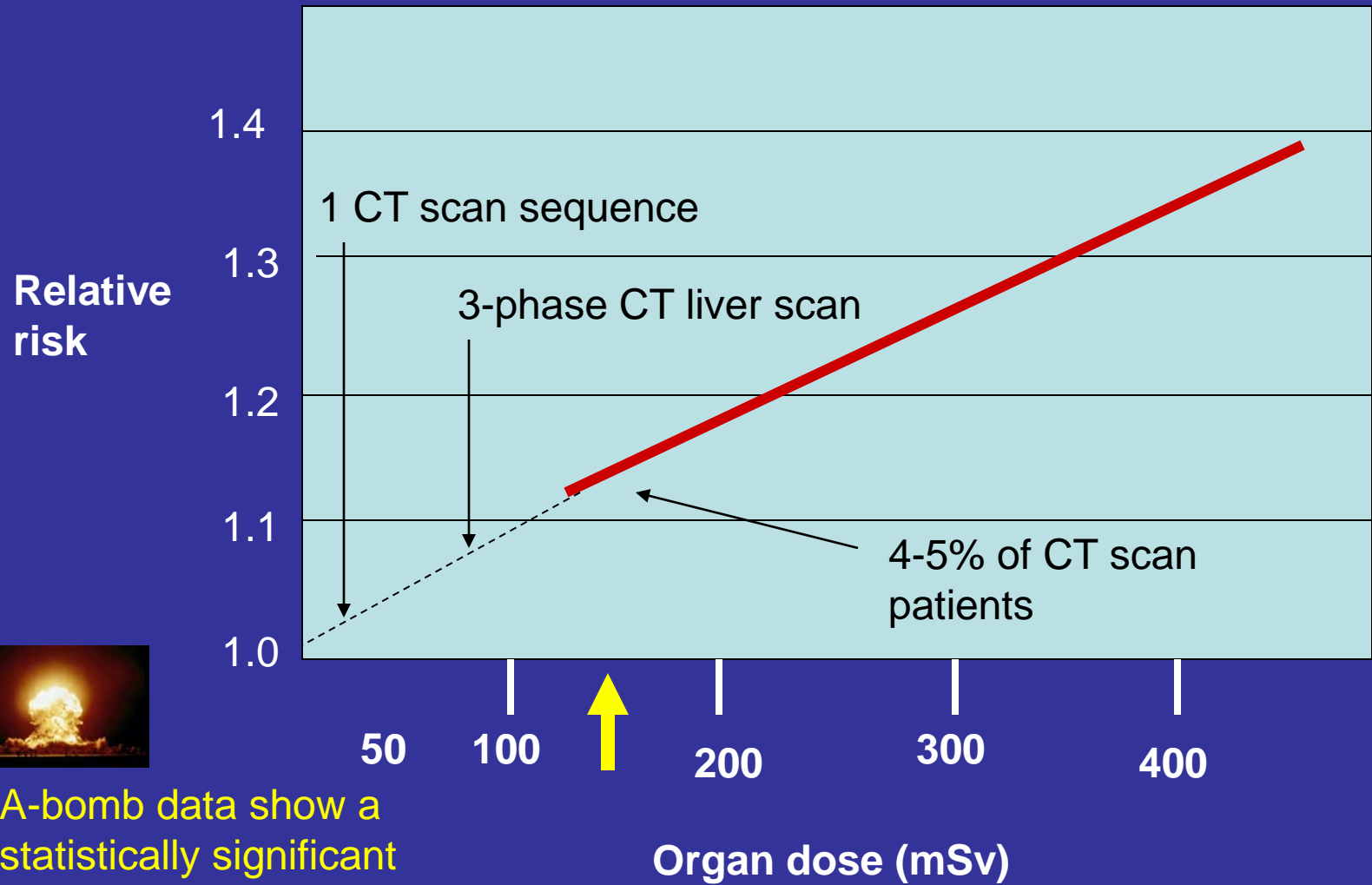
Radiology resident





# Bad

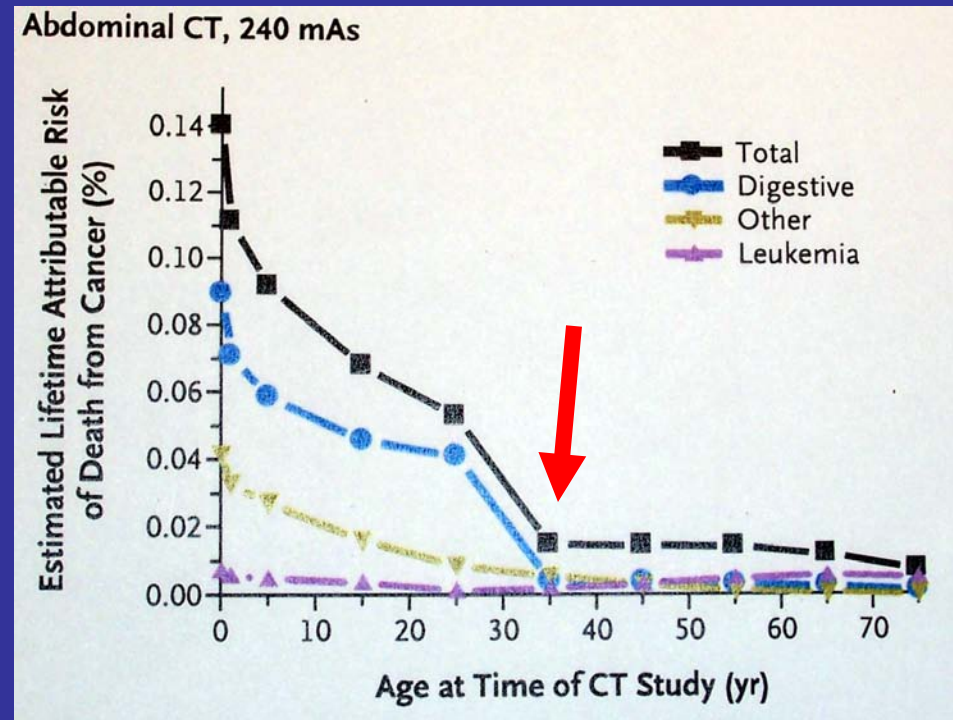
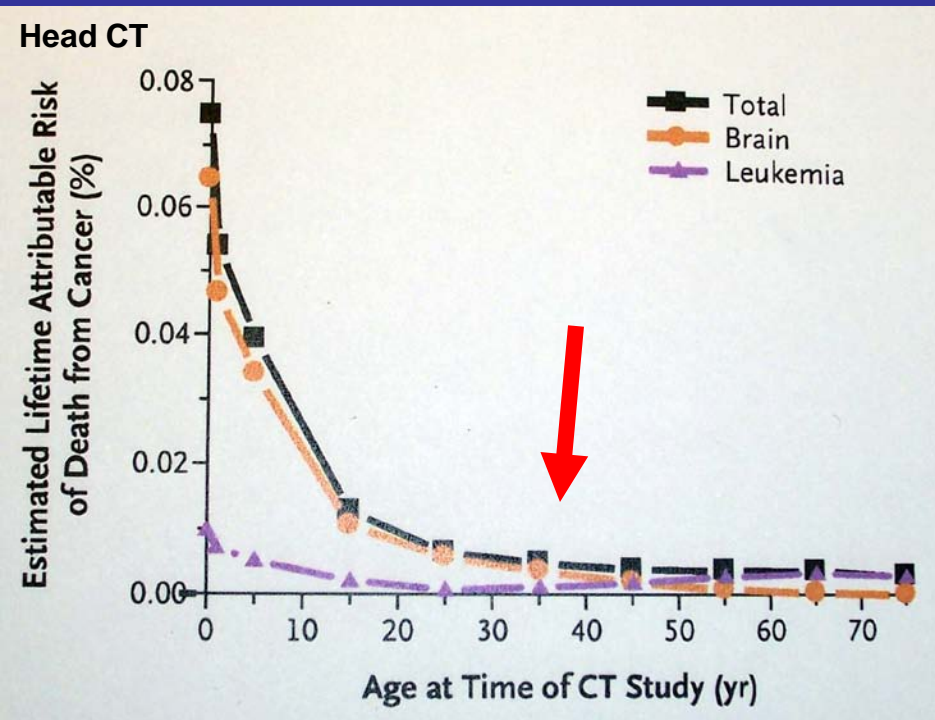
There probably is a cancer risk from CT



A-bomb data show a statistically significant increase at > 150 mSv

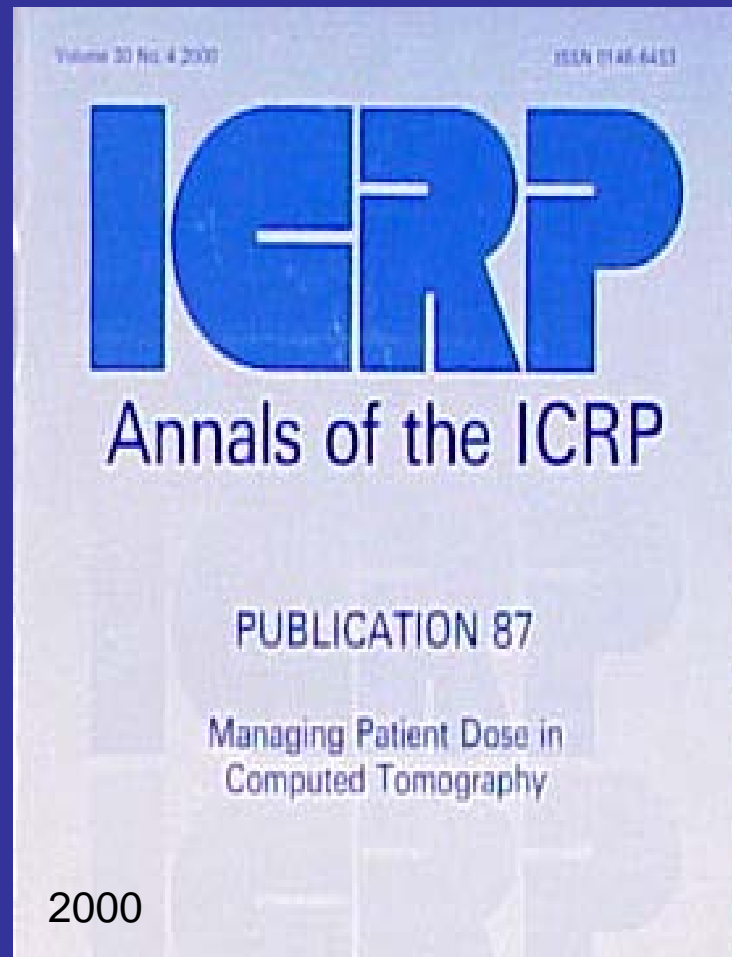
# Good and Bad

## Age dependence of risk from a CT scan



# Good

Some groups noticed the issues in the late 1990's



# Bad

It really took media attention to accelerate changes

## CT scans for young kids raise concerns

from PAGE C1

1930 to 1959.

Because 95 percent of Swedish men ages 18 and 19 are tested before military service, researchers were able to track information about the education and cognitive test results of these former pediatric patients.

The researchers found that the proportion of boys who attended high school decreased in relation to increasing doses of ionizing radiation — the type that penetrates the body — to the front and back of the brain.

The more radiation they were exposed to, the more impaired their learning ability and logical reasoning. Spatial recognition was unaffected. Because the dosages overlap those of CT scans, the findings raise questions about the long-term developmental effects of CT scans, which increasingly are used to assess minor head injuries, Swedish researchers wrote. Although they had data only about

radiation exposure before the age of 18 months, they said the findings raised questions about exposure and young children in general.

But Nelson said the types of radiation used then are different from today's CT, and that there are differences in the way various types of radiation are absorbed by the brain.

"If the child has significant head trauma as determined by the examining physician would not hesitate to do a CT," Nelson said "The benefits far outweigh the risks."

CT is the preferred test when a doctor suspects that a child has sustained a brain injury. The signs are unequal eye pupil size, weakness or lack of movement in the extremities and abnormal reflexes or unconsciousness for several minutes.

But it's not always required. If a child knocked out briefly, he or she should be observed and usually won't need a CT scan, Nelson said.

If a CT is recommended, Nelson suggests that parents ask the doctor or

ray technician "whether the CT facility is using the proper reduced-dose protocols for children based on the size of the child."

He noted that many hospitals and medical facilities use radiation dosing guidelines for adults, which "deliver two to three times more radiation than is needed for a proper pediatric CT."



# Good Dialogue



## Safety Features Planned for Radiation Machines

By WALT BOGDANICH  
Published: June 9, 2010

GAITHERSBURG, Md. — Manufacturers of [radiation therapy](#) equipment said at a patient-safety conference here Wednesday that within the next two years their new equipment and the software that runs it would include fail-safe features to help reduce harmful radiation overdoses and other mistakes.

The absence of these fail-safe features contributed to the fatal radiation overdose of a New York City patient, whose death was the centerpiece of a [lengthy article](#) in The New York Times early this year that examined radiation accidents and how complex new technology

- RECO
- TWIT
- SIGN MAIL
- PRIN
- REPE
- SHAR

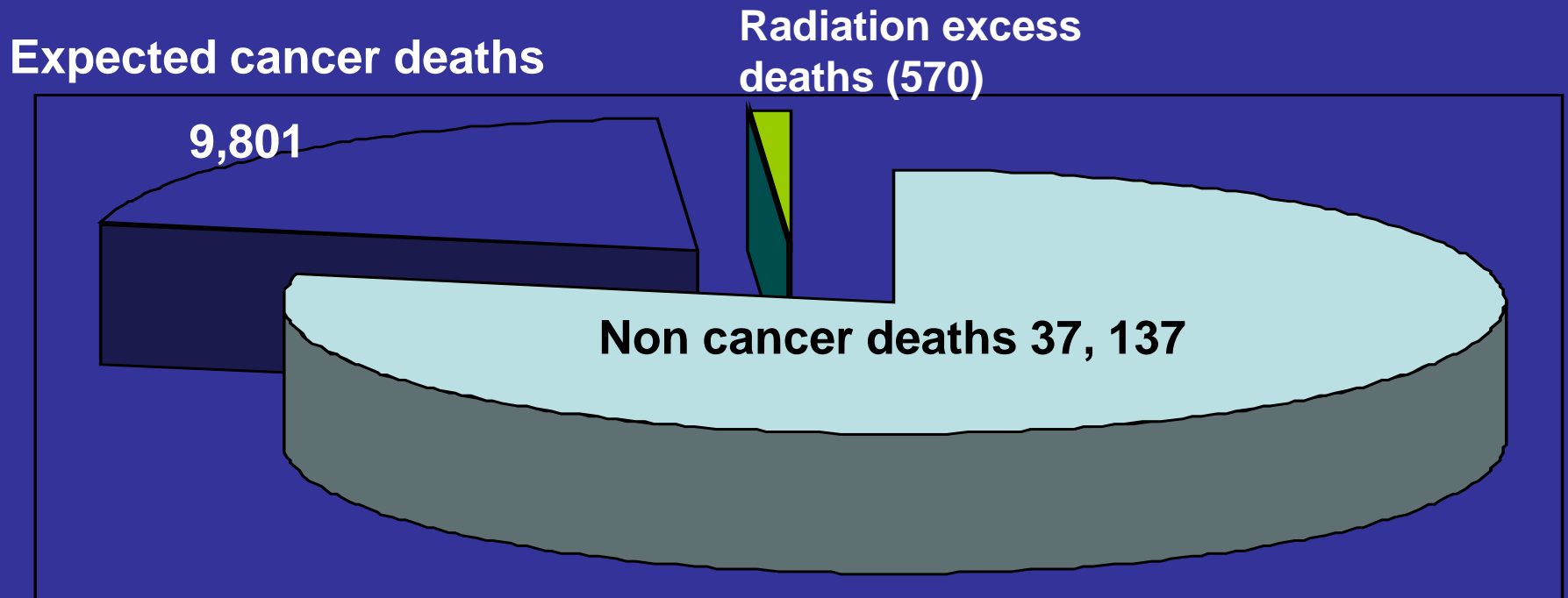


# Good

Radiation is quite a weak carcinogen and the cancers usually take years to arise, if they arise at all

**Good** Radiation is a weak carcinogen and cancers generally take decades to occur

Causes of death in atomic bomb survivors (2001)



~ 1% excess deaths due to radiation-induced cancer

**Bad** Even a low risk multiplied by 70 million is a large number

# Ugly

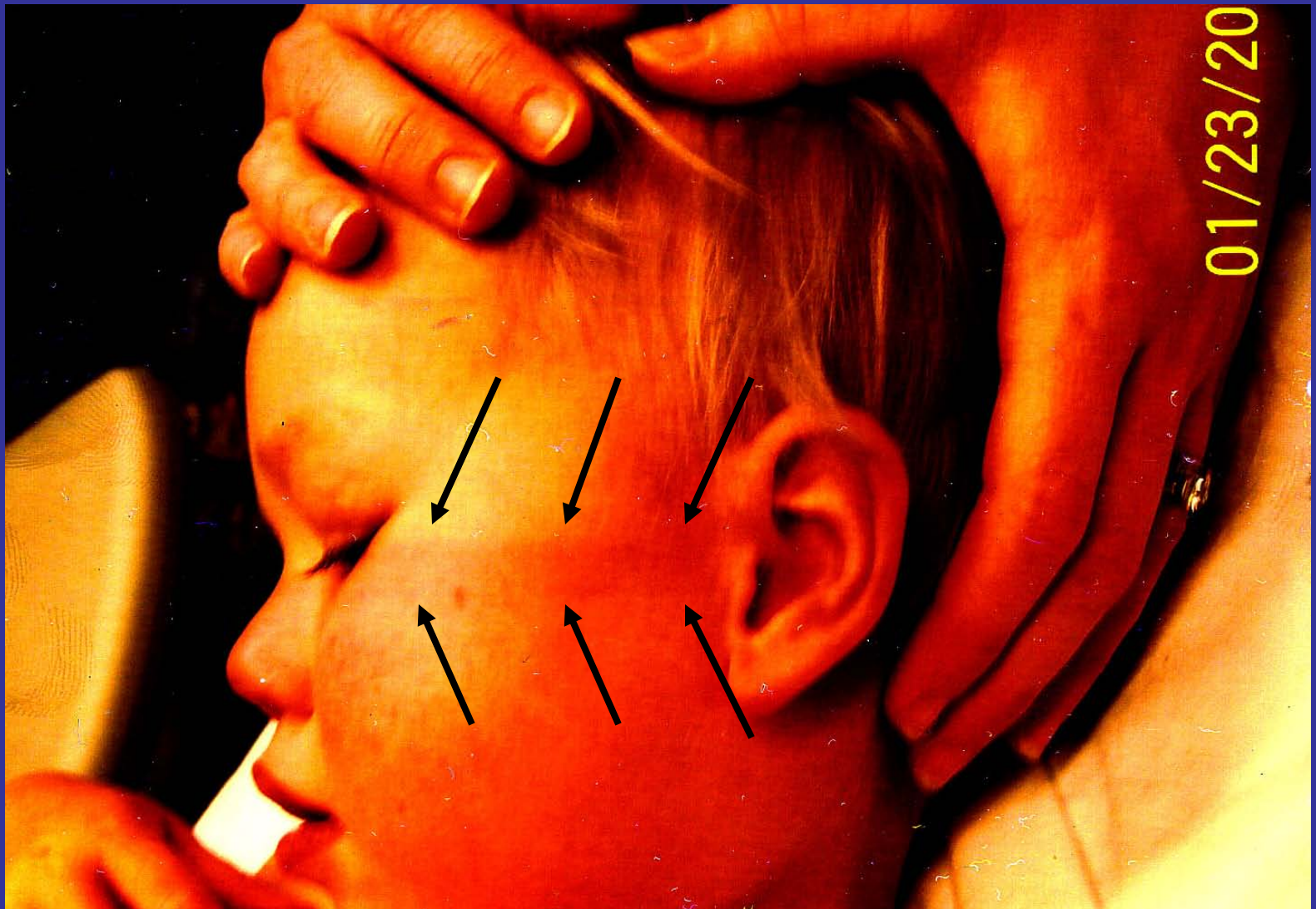
CT scanning was reported to cause epilation and erythema over 10 years ago and has continued



Hair loss from excessive dose of a CT angiogram

# Ugly

Erythema from recent accidental overexposure



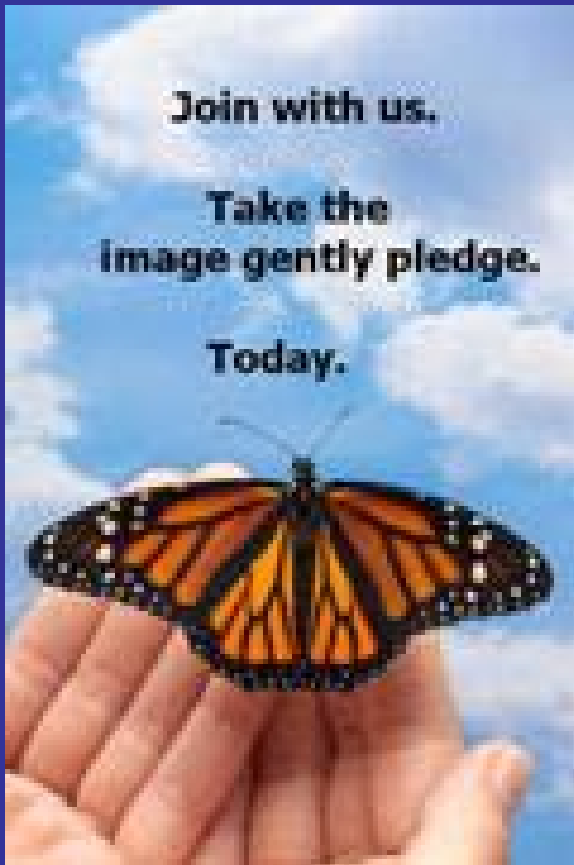


# Things that should be in our sights

Lower dose, better aim



# Good



# Good translation and outreach



父母須知：  
關於兒童的醫用輻射安全

image  
gently™

[www.imagegently.org](http://www.imagegently.org)



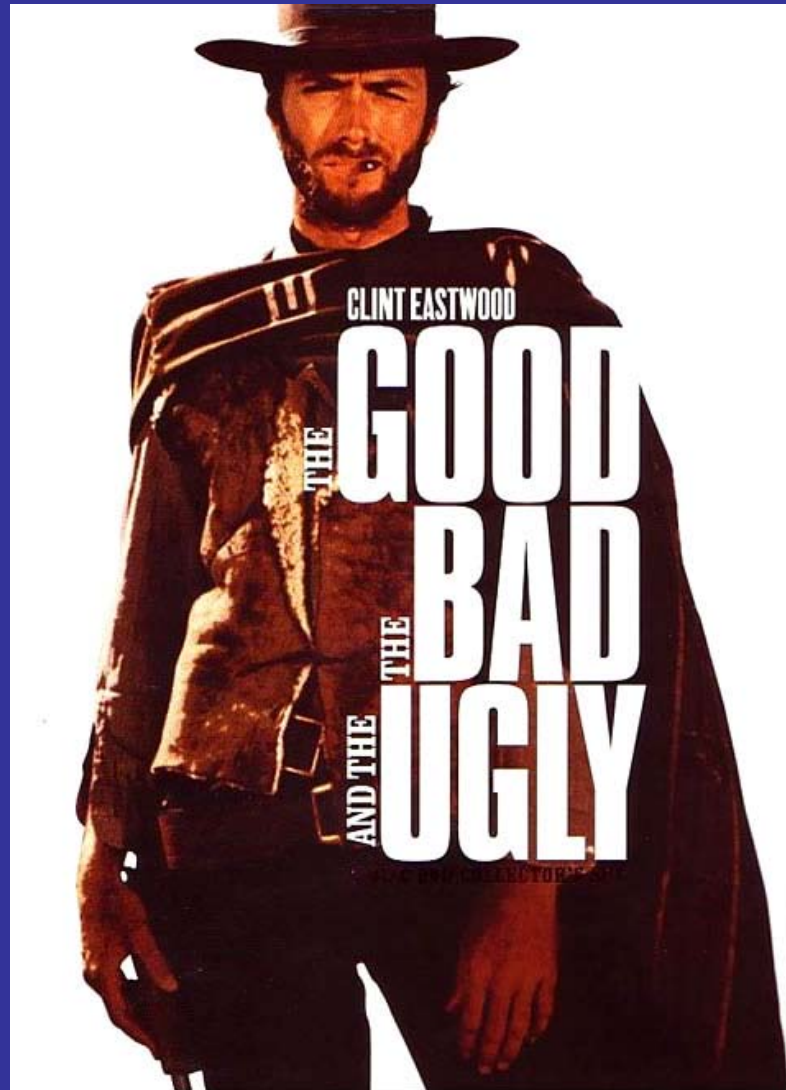
Anne-babaların Radyolojik Görüntüleme  
Yöntemleri ve Radyasyondan Korunma  
Konusunda Bilmesi Gerekenler

image  
gently™

Konuyla İlgili Sorularınız İçin  
Bizi Arayın: 0850 300 00 00

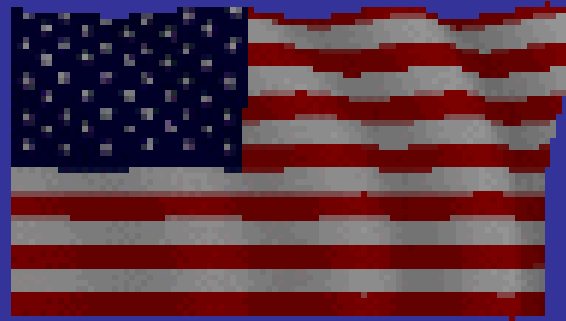


Coming soon.....





Thank you



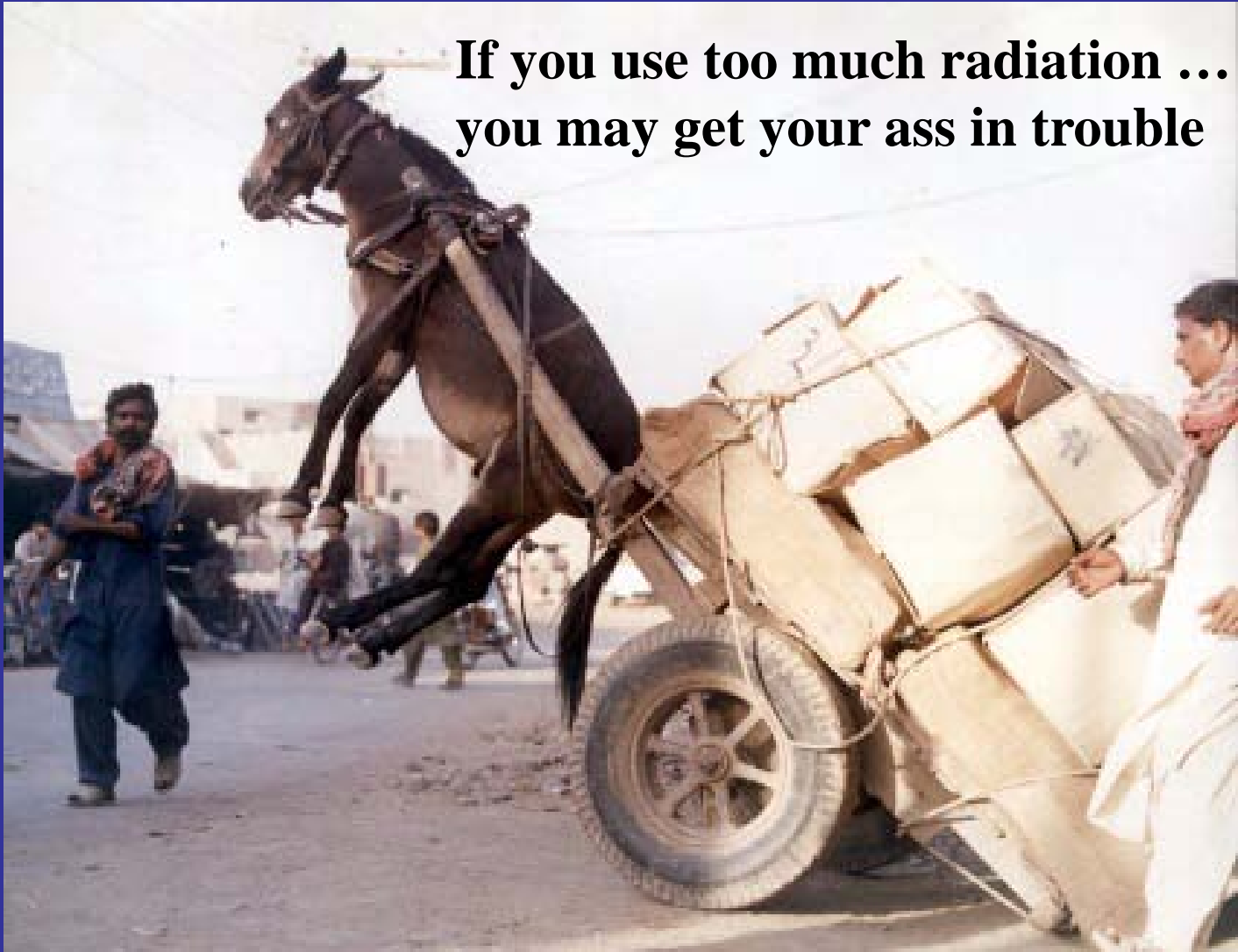
HERMAN



"I'd say it's your gall bladder, but  
if you insist on a second opinion,  
I'll say kidneys."

**Always remember.....**

**If you use too much radiation ...  
you may get your ass in trouble**



# Ugly

Going through the learning process



"This is all pretty experimental stuff, you know  
... all we're really certain of is that it's going to  
cost you \$2,500 ..."

NATIONAL ENQUIRER

