CT scanning
Things are not as ugly as they used to be

"Don’t move for the next 10 minutes or you will be electrocuted”
3 million 1982
CT scans by year in U.S. (millions)

- CT annual growth > 10%/yr
- U.S. population < 1%/yr

Year | CT Scans (millions)
--- | ---
1993 | 18.3
1994 | 19.5
1995 | 21.0
1996 | 22.6
1997 | 25.1
1998 | 26.3
1999 | 30.6
2000 | 34.9
2001 | 39.6
2002 | 45.4
2003 | 50.1
2004 | 53.9
2005 | 57.6
2006 | 62.0
Collective annual population dose from medicine has increased over 700 percent.

1980: 124,000 Person Sv

2006: 900,000 Person-Sv

124,000 Person Sv \times 7.25 = 900,000 Person-Sv

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
- Natural 2.4 mSv
- Medical 0.54 mSv
- Total 3.0 mSv per capita

U.S. 2006
- Natural 2.4 mSv
- Medical ~3.0 mSv
- CT scanning 1.5 mSv
- Nuclear medicine 0.8 mSv
- Radiography 0.3 mSv
- Interventional 0.4 mSv
- All other ?? mSv
- Total ~ 5.4

Medical ~3.0 mSv
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

“If you don’t mind, I’d like to get a second opinion.”
Good

Uncertainty reduced for patient and physician

“If you don’t mind, I’d like to get a CT scan”
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

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
Variation in CT scan doses among institutions and by scanner model

Multiple Scan Average Dose

MSAD (mGy)

Frequency

S. Stern, USFDA
Bad: Radiologist’s repetitive hedging

2005 MRI to "evaluate liver lesion"
2004 Ultrasound shows characteristic hemangioma
Surprise  4 prior CT studies
CT scan 2002

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

<table>
<thead>
<tr>
<th>Procedures Per Day</th>
<th>Days Per Month</th>
<th>Average CPT</th>
<th>Income</th>
<th>FMVL Cost</th>
<th>ROI* Per Month</th>
<th>ROI for 5 Years</th>
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<tbody>
<tr>
<td>1.8</td>
<td>20</td>
<td>$220</td>
<td>$7,950</td>
<td>$7,950</td>
<td>Break Even</td>
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<td>5</td>
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<td>$220</td>
<td>$22,000</td>
<td>$7,950</td>
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<tr>
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<td>20</td>
<td>$220</td>
<td>$44,000</td>
<td>$7,950</td>
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</table>

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
Good  Rapid accurate diagnoses especially in the ER
4 liters of blood

Uterine wall

Fetus

spine

foot

4 liters of blood
CT scan results

Fetus

- skull
- ribs
- blood
Free blood

Kidney ripped off aorta (no contrast in it)

Splenic laceration

3 min exam and off to the OR

She and the child survived
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

Computer systems

Bad

Limited use
Warning - Similar Names

<table>
<thead>
<tr>
<th>Name</th>
<th>DOB</th>
<th>SSN</th>
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<tbody>
<tr>
<td>Vano El Gato</td>
<td>July 23, 1930</td>
<td>144-45-6929</td>
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<tr>
<td>Vano E</td>
<td>July 14, 2008</td>
<td>144-36-8729</td>
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</table>
**Good Computer generated warnings**

**Attention: Possible radiation issue**

<table>
<thead>
<tr>
<th>Name</th>
<th>DOB</th>
<th>SSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cousins Claire</td>
<td>July 14, 1990</td>
<td>144-36-8729</td>
</tr>
<tr>
<td>Age 21</td>
<td>6 CT scans done in last 3 months</td>
<td></td>
</tr>
<tr>
<td>Continue to order ??</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

Head CT

Abdominal CT, 240 mAs
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 x-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.”
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
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)

- Expected cancer deaths: 9,801
- Radiation excess deaths: 570
- Non cancer deaths: 37,137

\[ \text{~1\% excess deaths due to radiation-induced cancer} \]
Bad Even a low risk multiplied by 70 million is a large number
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

Join with us.
Take the image gently pledge.
Today.
Good translation and outreach
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken leg</td>
<td>Shoot</td>
</tr>
<tr>
<td>Infected eye</td>
<td>Shoot</td>
</tr>
<tr>
<td>Splayed hoof</td>
<td>Shoot</td>
</tr>
<tr>
<td>Runny nose</td>
<td>Shoot</td>
</tr>
<tr>
<td>Fever</td>
<td>Shoot</td>
</tr>
<tr>
<td>Open sores</td>
<td>Shoot</td>
</tr>
<tr>
<td>Closed sores</td>
<td>Shoot</td>
</tr>
<tr>
<td>Wobbling lower lip</td>
<td>Shoot</td>
</tr>
<tr>
<td>Ornery</td>
<td>Shoot</td>
</tr>
<tr>
<td>Swayback</td>
<td>Shoot</td>
</tr>
<tr>
<td>Erratic heart</td>
<td>Shoot</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>Shoot</td>
</tr>
<tr>
<td>Red breath</td>
<td>Shoot</td>
</tr>
<tr>
<td>Mange</td>
<td>Shoot</td>
</tr>
</tbody>
</table>

*7-24*
Coming soon.....
Thank you
"I'd say it's your gall bladder, but if you insist on a second opinion, I'll say kidneys."

9-25
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