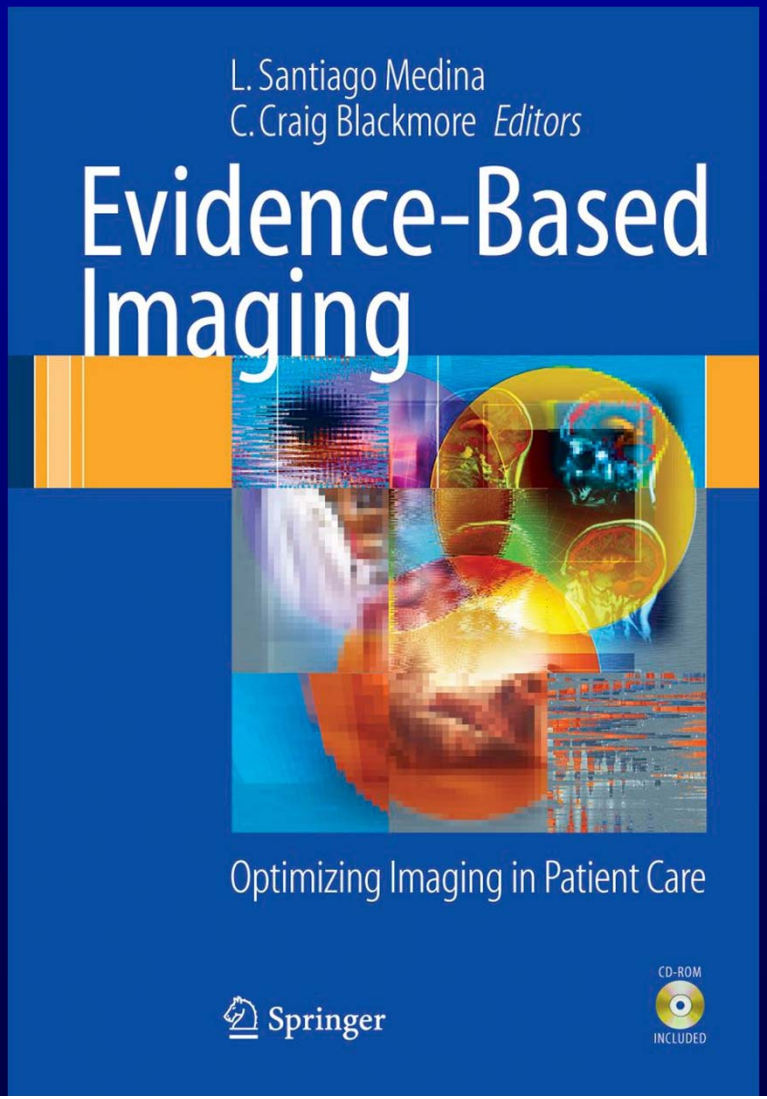
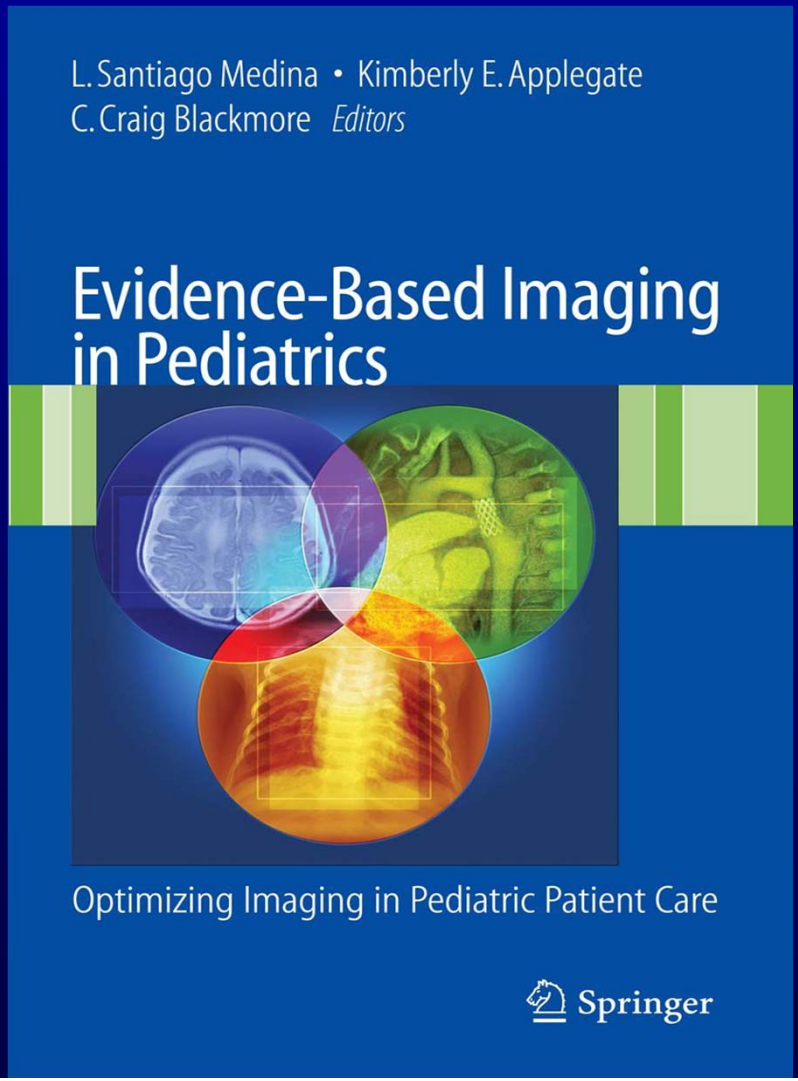
Top Ten Actions a Physician Can Take to Improve CT Dose Management

Kimberly E. Applegate, MD, MS
Emory University
Children's Healthcare of Atlanta
(CHOA)

Disclosures

AIM (American Imaging Management) radiation protection advisory board and…





Objectives

- Discuss Top Ten Things Physicians Can Do to Improve CT Dose Management
  - Team Effort
  - Image Gently: Ten Steps You Can Take to Optimize Image Quality and Lower CT Dose for Pediatric Patients. Strauss K et al. AJR 2010;194:868-873

Number 0: Prequel

Know Your "History" and Keep up with the Current Events

Number : Know Your History and Current Events

- Know the (medical and societal) culture we work within and why we have the policies, regulations, and beliefs we do
- Keep up with current media to understand what our patients and referring physicians know, don't know, are afraid of, and expect from us
- Communicate with referring colleagues and with patients—that is how we educate others about radiation safety and dose

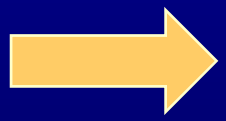
We can't measure patient dose

"The determination of ionizing radiation dose to a living human from an x-ray exam is very complex….."

At best, it is a "dose estimate"

JACR 2007 May 4(5) 272

Media attention has heightened awareness



www.usatoday.com THE NATION'S NEWSPAPER

LATE SPORTS

Super Bowl

Let the hype begin

Clock is ticking toward Sunday. Full report, 1-4C
- 10 years ago, war was on our minds, 1C
- Coming Friday: Bonus Section

USA TODAY

NO. 1 IN THE USA

'Gladiator' top film at Golden Glo

Julia Roberts takes best actress for *E Brockovich*; Georg Clooney gets come nod; Kate Hudson for *Almost Famou*
- The red carpet,

Monday, January 22, 2001

Newsline

CT scans in children linked to cancer later

By Steve Sternberg
USA TODAY

Each year, about 1.6 million children in the USA get CT scans to the head and abdomen — and about 1,500 of those will die later in life of radiation-induced cancer, according to research out today.

What's more, CT or computed tomography scans given to kids are typically calibrated for adults, so children absorb two to six times the radiation needed to produce clear images, a second study shows. These doses are "way bigger than the sorts of doses that people at Three Mile Island were getting," David Brenner of Columbia University says. "Most people got a tenth or a hundredth of the dose of a CT."

Both studies appear in February's *American Journal of Roentgenology*, the nation's leading radiology journal. The first, by Brenner and colleagues, is the first to estimate the risks of "radiation-induced fatal cancer" from pediatric CT scans. Until a decade ago, CT scans took too long to perform on children without giving them anesthesia to keep them still. Today's scanners spiral around the patient in seconds, providing cross sections, or "slices," of anatomy.

Doctors use CT scans on children to search for cancers and ailments such as appendicitis and kidney stones.

"There's a huge number of people who don't just receive one scan," says Fred Mettler of the University of New Mexico, noting that CT scans are used for diagnosis and to plan and evaluate treatment. "The breast dose from a CT scan of the chest is somewhere between 10 and 20 mammograms. You'd want to think long and hard about giving your young daughter 10 to 20 mammograms unless she really needs it."

Mettler recently published a study showing that 11% of the CT scans at his center are done in children under 15, and they get 70% of the total radiation dose given to patients. Children have more rapidly dividing cells than adults, which are more susceptible to radiation damage. Children also will live long enough for cancers to develop.

Researchers led by Lane Donnelly at Cincinnati's Children's Hospital found that children often get radiation doses six times higher than necessary. Cutting the adult dose in half would yield a clear image and cut the risk a like amount, Brenner says. "Radiologists genuinely believe the risks are small," he says. "I suspect they've never been confronted with numbers like this."

CT criticized for excessive radiation dose since 2001

How will we answer questions from this family?

The California radiologic technologist accused of operating the CT scanner that delivered a massive radiation overdose to a 23-month-old boy in 2008 testified that she only pushed the CT scan button a few times, and she doesn't understand how the toddler received 151 scans in a single imaging session…

October 1, 2010: California Tightens Oversight of CT Scans

WALT BOGDANICH NY Times

- California's governor has signed tough new legislation tightening oversight of diagnostic CT scans, largely in response to the overdosing of hundreds of patients who underwent brain scans for stroke in 2008 and 2009

Number 1:

Increase Awareness and Understanding of CT Radiation Dose Issues Among Radiologic Technologists

Number 1: Increase Awareness and Understanding of CT Dose Issues Among RTs

- Until 2007, physics of CT equipment not in RT curriculum
  - Provide further training if possible
  - ASRT CT Basics course
- CT technologists at minimum should be ARRT registered
- Encourage techs to become ARRT CT certified
- Encourage techs to take the Image Gently pledge and to take free CE online CT courses on Image Gently web

Number 2:

Enlist the Services of a Qualified Medical Physicist

Number 2: Enlist Services of QMP

- Complex CT technical aspects required to generate quality images at reasonable doses
  - Opportunity to learn and experiment
  - Opportunity to keep up to date
  - Opportunity to teach technologists, radiologists in training
- Medical physicist should be American Board of Radiology or American Board of Medical Physics certified

Collaboration

ACR® AMERICAN COLLEGE OF RADIOLOGY

IMAGE™ WISELY

RSNA® Radiological Society of North America

AAPM

asrt® American Society of Radiologic Technologists

Number 3:

Obtain Accreditation from the American College of Radiology for Your CT Program

Number 3: Obtain CT Accreditation

- Deemed status organizations include IAC, The Joint Commission
- ACR requires quality image review
- Certification of radiologists, technologists, physicists
- Radiologists must perform and document peer review
- ACR CT accreditation provides separate adult AND pediatric accreditation

Number 4:

When Appropriate, Use an Alternative Imaging Strategy That Does Not Use Ionizing Radiation

Number 4: Use Alternative, Non-ionizing imaging exams

- CT saves lives, decreases need for exploratory surgery, decreases morbidity and mortality
- Sometimes, however, other strategies may work as well or better:
  - Test of time (observation)
  - Ultrasound
  - MRI

The Simple Message:

Can CT use be reduced? Clinical Decision Rules

Some common CT scenarios where there is evidence that CT use could be reduced:

- CT for minor head trauma (observation)
- CT for VP shunt malfunction (fast MRI)
- CT for renal colic (U/A; US)
- CT for abdominal pain/appendicitis (US, MRI)
- CT for blunt abdominal and chest trauma (FAST*, observation)

*Focused Assessment with Sonography in Trauma

Number 5:

Establish Baseline Radiation Dose for Your Patients

Number 5: Establish Baseline Dose for Your Patients

- Compare your doses to Dose Reference Levels (DRLs)* from the ACR accreditation program
  - Work with your medical physicist to estimate output doses for routine abdominal and head CT exams
  - Your measured patient doses should be less than the DRLs

*Alternatives to the ACR DRLs exist, e.g., in europe ,and the National Council for Radiation Protection will be publishing new DRLs soon

Number 6:

Establish Radiation Doses for Pediatric Patients by "Child-Sizing" CT Scanning Parameters

Number 6: Establish Pediatric Doses—"Child-Size" It

- Start with doses from Number 5
- Adjust scanning field of view to smaller size of child
- Modify CT parameters to account for patient size—eg, start with Image Gently 'universal protocols' and reduce dose iteratively
  - See Number 7
  - Must balance image noise with image quality

Number 7:

Optimize (Pediatric) Examination Parameters—Part 1

Number 7: Optimize Exam Parameters

- Center patient in CT gantry
- Perform Scout PA rather than AP* to decrease dose to lens, thyroid, breast, testes
- Axial vs helical mode
  - Head CT
- Reduce detector size in z direction during acquisition

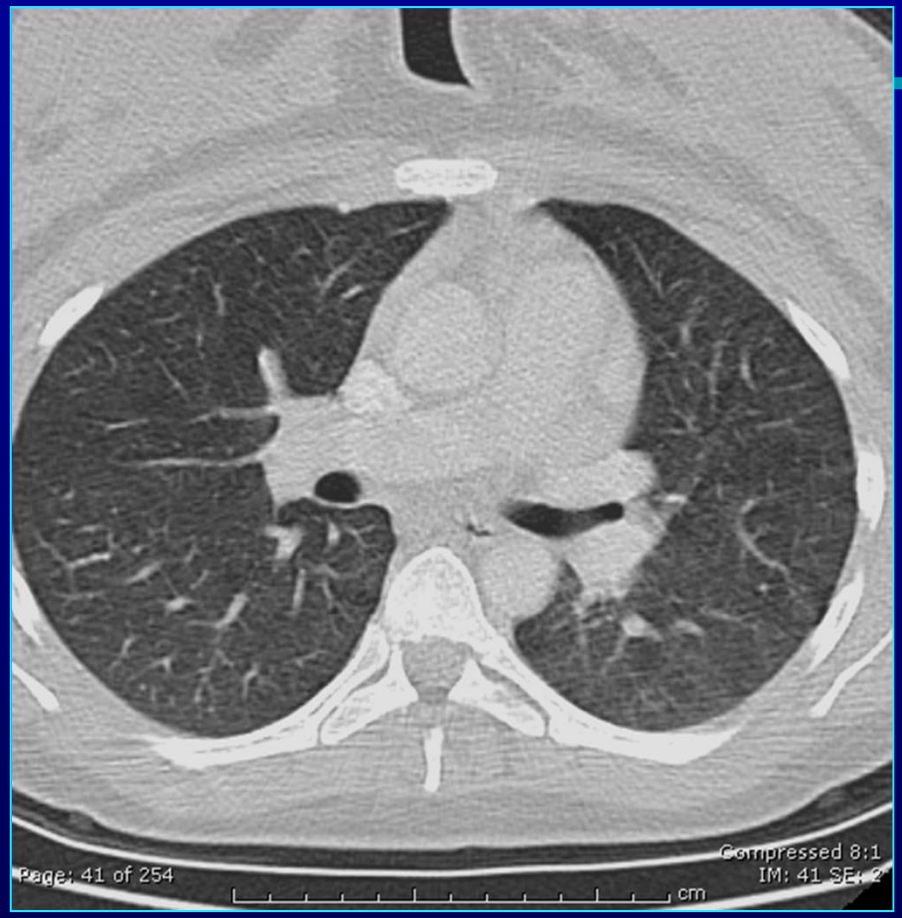
* Use AP for GE if using auto-mA

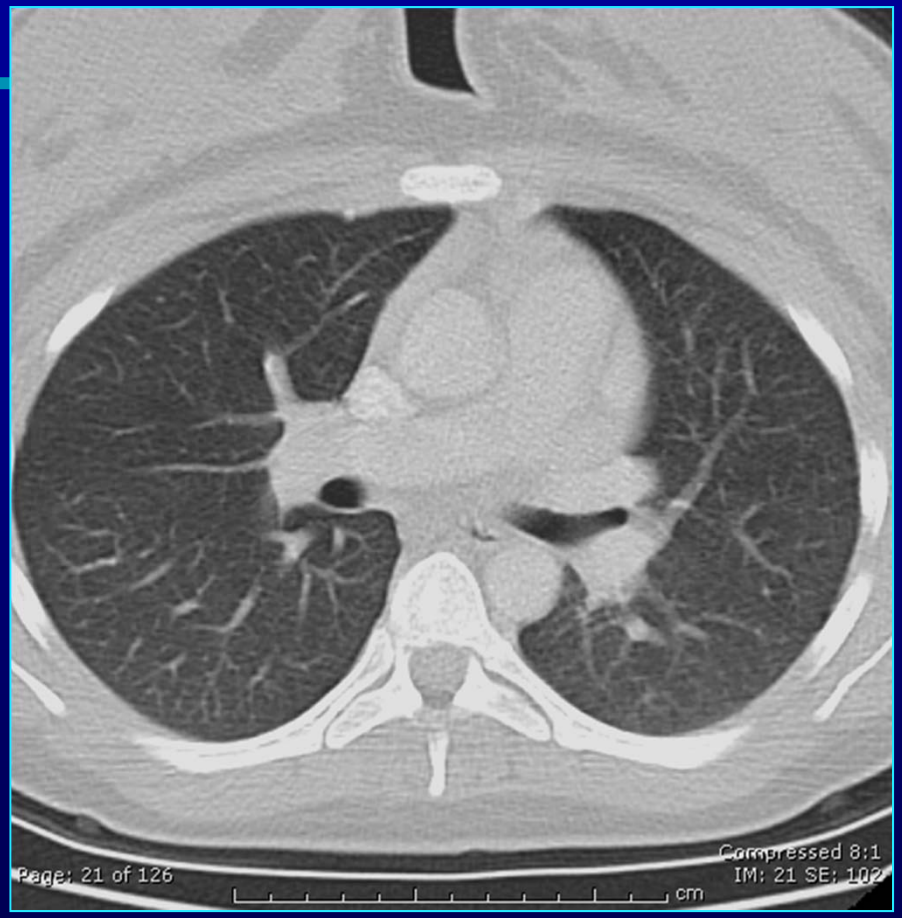
Number 8:

Optimize (Pediatric) Examination Parameters—Part 2

Number 8: Optimize Exam Parameters

- Adjust the product of tube current and exposure time
  - mA X rotation time (typically 0.5 seconds)
  - Depends on patient size and clinical indication
- Adjust the kVp
  - Chest lower kVp than abdomen
  - CT angiography allows lower kVp
  - Neonates: 80 Infants: 80-100; children 100-120 (weight and indication based) kVp





Normal exposure

Over exposure

Number 8: Optimize Exam Parameters

- Increase pitch
- Scan only the indicated area
  - Often coverage extends further than needed ‘to be safe’
  - Trauma ‘pan-scan’ of head, neck, chest, abd/pelvis
  - Pelvic CT vs limited to femoral head for closed reduction of developmental dysplasia of the hip
- Scan only one phase through the body part
  - Limited justification for unenhanced followed by contrast-enhanced CT imaging or delayed imaging in children

Number 9:

Participate in Lifelong Learning

Number 9: Participate in Lifelong Learning

- Considerations include:
  - American Board of Radiology-- Maintenance of Certification (every 10 yrs)
  - Quality Assurance and Improvement Projects
  - Multidisciplinary Conferences
  - Journal Clubs

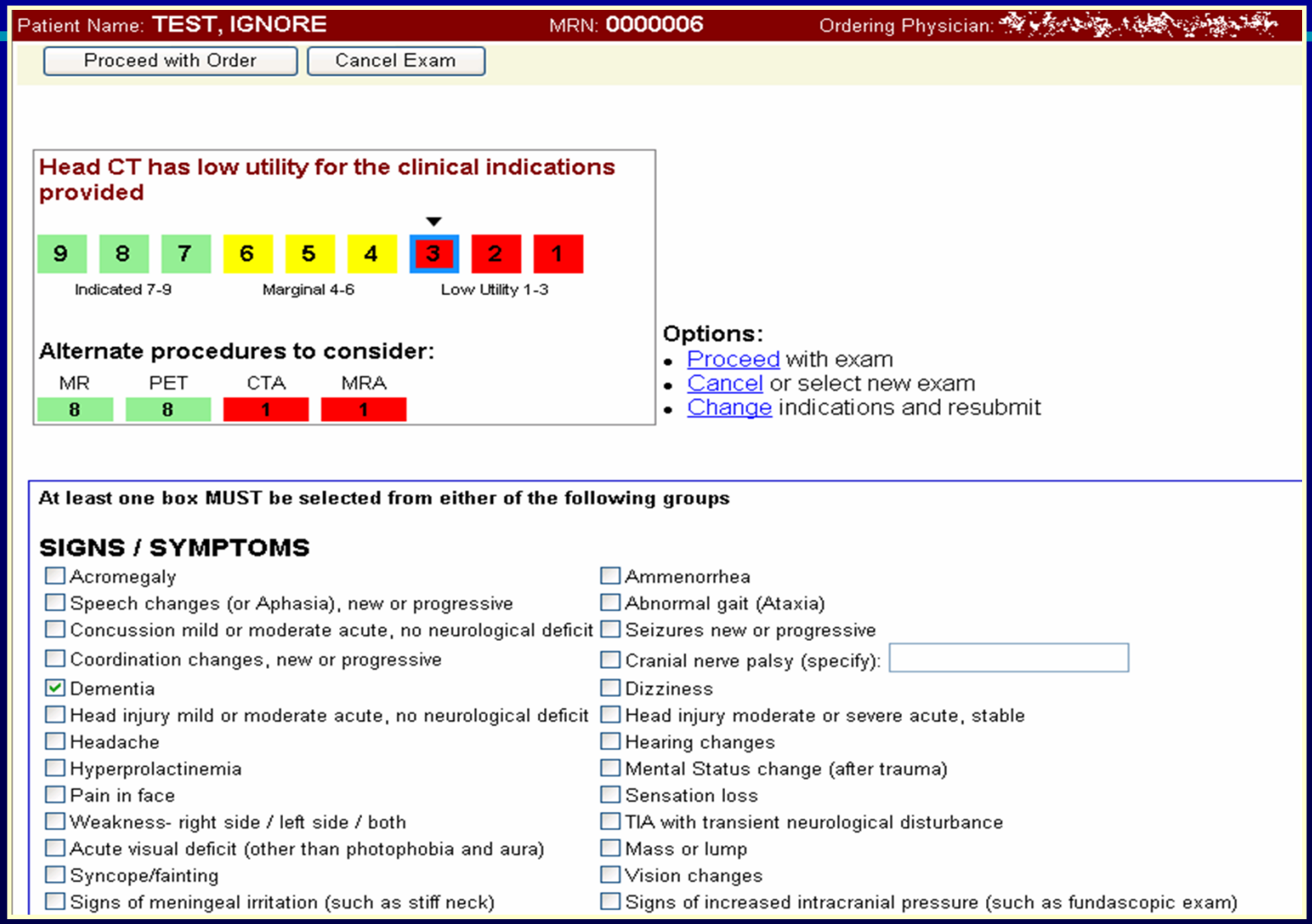
Number 10:

Obtain Decision Support for Your Health System's Computerized Physician Order Entry (CPOE)

Number 10: Obtain Decision Support for Your Health System's CPOE

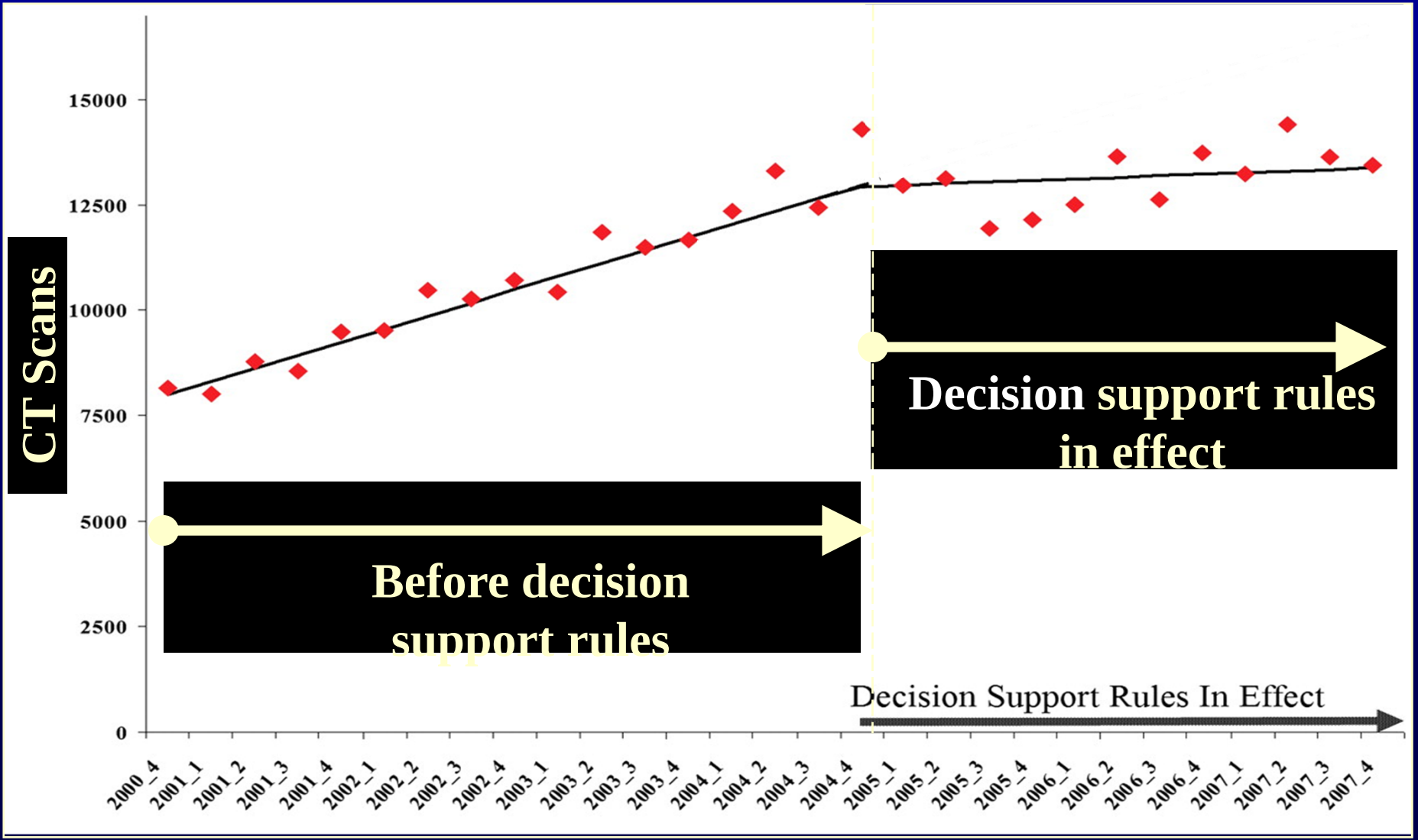
- This tool allows:
  - Use of the radiation protection principle of justification---where the patient benefit should outweigh the risk of the imaging test ordered
  - Evidence-based data at the point of care
- Example: use electronic ACR Appropriateness Criteria
  - Includes relative radiation doses
  - Free to all members of the ACR

MGH Radiology Order-Entry and Decision-Support System



Sistrom, C. L. et al. Radiology 2009;251:147-55

MGH Radiology Order-Entry and Decision-Support System: Effect on Outpatient CT Volume



Sistrom, C. L. et al. Radiology 2009;251:147-55

Summary: Improving CT Dose Management

- It is a team effort
- The medical physicist, technologist, and radiologist must work together to:
  - Advocate for patients to referring providers
  - Optimize image quality
- Decision support for CPOE systems will bring needed evidence to the referring provider to allow justification of CT imaging


Join with us.
Take the
image gently pledge.
Today.

Examples

- CATCH clinical prediction rule: high sensitivity, specificity for head CT need in minor pediatric head trauma
- Chest CT in blunt pediatric trauma
  - J Trauma 2009. TA Markel et al.
  - Significant drop in CXR use with sig increase in CT use
  - CXR identified all severe abnormalities
- Head CT for VP shunt malfunction evaluation
  - AJNR 2008. Udayasankar UK et al.
  - Same kVp, lowered mA from 220 to 80 without significant change in image quality