Good, Bad and Ugly of Patient Exposure and Dose Tracking: Experience at UCLA in dose tracking and implications

Michael McNitt-Gray, PhD, DABR, FAAPM FACR
Professor, Department of Radiology
Director, Physics and Biology in Medicine Graduate Program
David Geffen School of Medicine at UCLA
mmcnittgray@mednet.ucla.edu

Radiation Dose Tracking

- In summer of 2011, the State of California passed a law that required all sites performing diagnostic CT
- "**115111.** (a) Commencing July 1, 2012, subject to subdivision (e), a person that uses a computed tomography (CT) X-ray system for human use shall record the dose of radiation on every diagnostic CT study produced during a CT examination in the patient's record …"

Radiation Dose Tracking

- "(e) The requirements of this section shall be limited to CT systems capable of calculating and displaying the dose.
- (f) For the purposes of this section, dose of radiation shall be defined as one of the following:
- (1) The computed tomography index volume (CTDI vol) and dose length product (DLP), as defined by the International Electrotechnical Commission (IEC) and recognized by the federal Food and Drug Administration (FDA).
- (2) The dose unit as recommended by the American Association of Physicists in Medicine.

Dose Reporting

- To comply, we used Radimetrics to:
  - Send CTDI and DLP information from scanner to Radimetrics server
  - Convert that information to an HL-7 message
  - Import that message into our Radiology reporting system
  - Include that information in all radiology reports

Dose Tracking

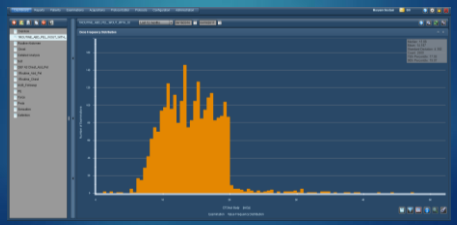
- Our primary purpose was to provide tools that allowed us to comply with CA state law
- Radimetrics has MANY more capabilities that we are using and still exploring

Dose Tracking

- Track doses by protocol and by scanner
- Track individual patient doses
- Organ doses
- Radimetrics is REALLY GOOD at organizing, querying, displaying data (they are outstanding at database issues)

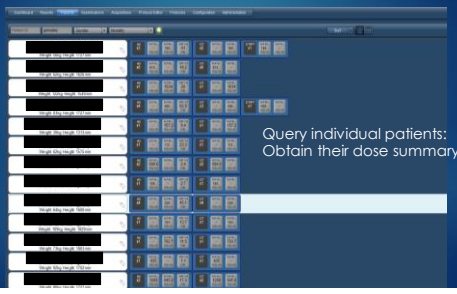
Dashboard

- Personalized overview of doses, # of exams, etc

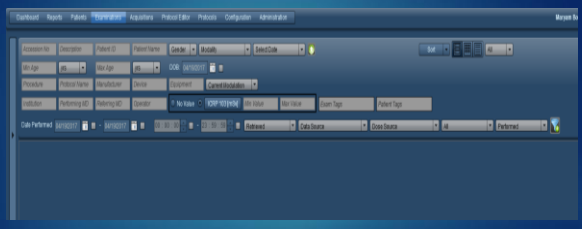


Patients

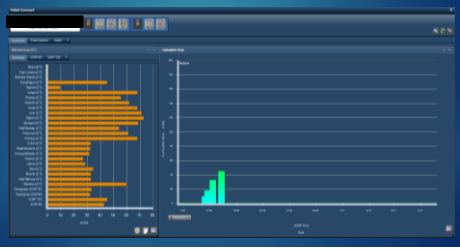
- Search option by patient name, all CT examinations performed (Physics testing here)



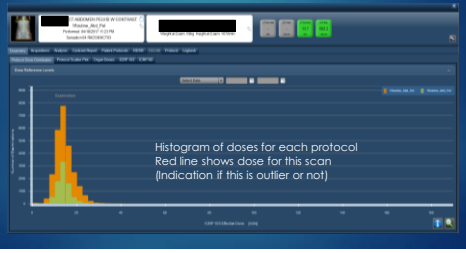
Many Parameters/Fields to Query On



Dose History for an Individual Patient



Even Investigate an Individual Scan



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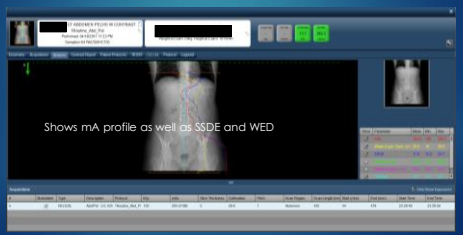
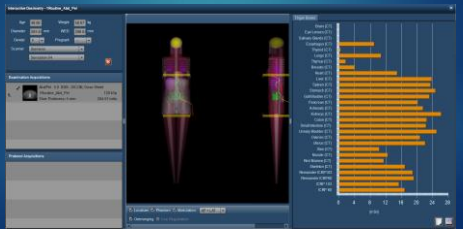
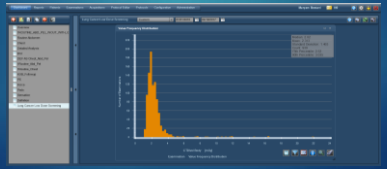


Interactive Dosimetry (like ImPACT) – can vary parameters



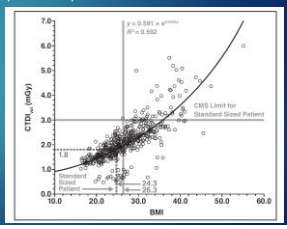
Some Examples and Cautions

- Review Dose distribution for a specific protocol
  - Lung Cancer Screening



Some Examples and Cautions

- Review Dose distribution for a specific protocol
  - Lung Cancer Screening
  - CTDIvol as a function of BMI
  - Fujii et al, AJR 2016



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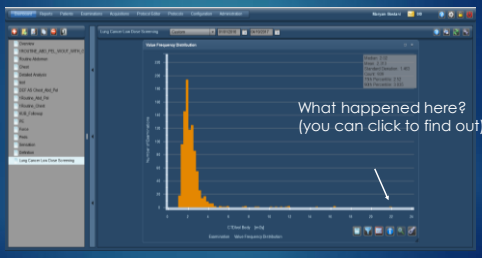

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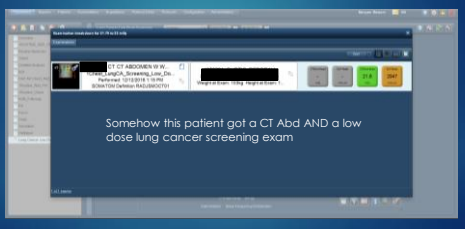

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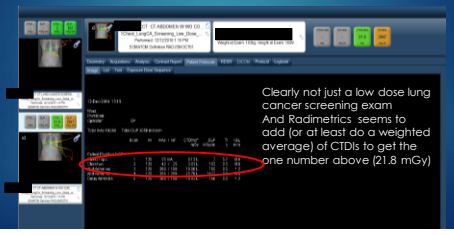

Clearly not just a low dose lung cancer screening exam
And Radimetrics seems to add (or at least do a weighted average) of CTDIs to get the one number above (21.8 mGy)

Some Examples and Cautions

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Individual Dose History

ACR Dose Index Registry (DIR)

- Activity sponsored by ACR (fee)
- Send Dose Reports (patient dose reports or RDSR) from scanner to ACR
  - Have to provide some mapping from your exam names ("Routine Adult Brain") to standard names

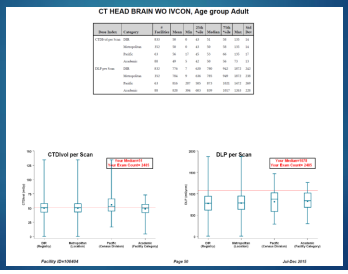
ACR Dose Index Registry (DIR)

- Report back to site: Dose Index Values
  - CTDIvol, DLP and SSDE
  - By protocol
  - By age group (adult and several peds categories)
  - Provide comparisons to "similar" practices:
    - By practice type (academic/community/etc.)
    - Geographic Region (Pacific)
    - Location (Urban/Suburban/Rural)

ACR Dose Index Registry (DIR)

- DOES:
  - Allow comparisons to national and regional averages by protocol
- Does NOT:
  - Track individual patient doses
    - Data is anonymized when it is submitted
    - Therefore, NO cumulative doses
  - Allow detailed queries by patient scan
    - Though individual exposure events can be queried

ACR Dose Index Registry (DIR)



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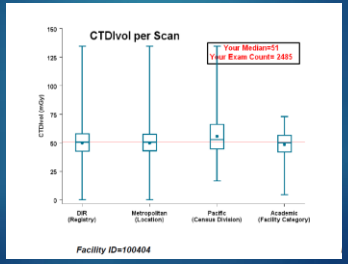

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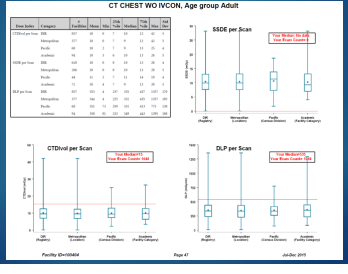

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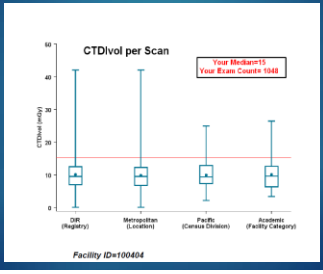

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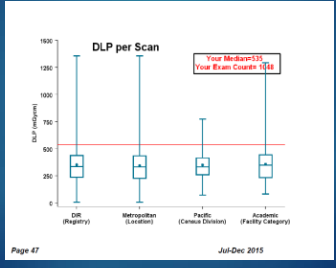

Summary for Tracking Systems

- Bad/Ugly:
  - Track patient exposure history for stochastic risks
    - What will you DO with that data? Not perform next exam?
    - Estimates of effective dose are within XX%??
    - No real way to deal with the effects of time except assume risks are linear and cumulative
      - 50 mSv over one week = 50 mSv over 50 years?
  - Non-standard reporting of CTDIvol
    - Weighted average across studies
    - Cute idea, but not standard. Leads to confusion

Summary for Tracking Systems

- Good/Bad?
- Query individual patients' dose history
  - Great from QC perspective
  - Also will be good for tissue effects (effect formerly known as "Deterministic effects") from fluoro/angio

Summary for Tracking Systems

- Good:
  - Help us comply with Legal Requirements (CA law)
  - Perform internal audits
  - Query individual cases
  - Ability (ACR DIR) to make meaningful comparisons against national, regional and type of practice
  - Ability to do these by protocol

David Geffen School of Medicine | UCLA Health