The physicist's to-do list: Benchmarks, alerts and reports

Ingrid Reiser, PhD DABR
The University of Chicago

AAPM 2018 BEYOND THE FUTURE!

Outline

Tasks of medical physicists in the dose review process

1. Institutional benchmarks
2. External benchmarks
3. Identifying outliers and generating alerts
4. Generating reports

Task 1: Institutional benchmarks

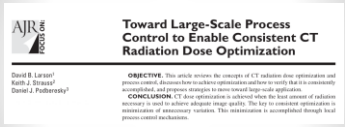
Joint Commission

Elements of Performance

PC.01.03.01 A 25: Establish diagnostic CT imaging protocols … which address key criteria including … expected radiation dose index range

PI.02.01.01 A 6: Review and analyze incidents where dose from diagnostic CT examination exceeds expected dose level

Principles of CT Radiation Dose Process Control



AJR:204, June 2015

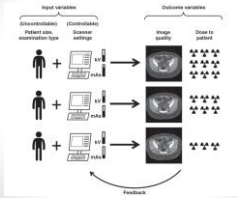
Toward Large-Scale Process Control to Enable Consistent CT Radiation Dose Optimization

David B. Larson[1]
Keith J. Strauss[2]
Daniel J. Podberesky[3]

OBJECTIVE. This article reviews the concepts of CT radiation dose optimization and process control, discusses how to achieve optimization and how to verify that it is consistently accomplished, and proposes strategies to move toward large-scale application.

CONCLUSION. CT dose optimization is achieved when the least amount of radiation necessary is used to achieve adequate image quality. The key to consistent optimization is minimization of unnecessary variation. This minimization is accomplished through local process control mechanisms.

Principles of CT Radiation Dose Process Control



D. Larson et al. Toward Large-Scale Process Control to Enable Consistent CT Radiation Dose Optimization. AJR 204:959–966 (2015).

Principles of CT Radiation Dose Process Control at the Local Level

- *Principle 2: Consistent Optimization Requires a Target Outcome ("set point")* i.e., institutional benchmark

D. Larson et al. Toward Large-Scale Process Control to Enable Consistent CT Radiation Dose Optimization. AJR 204:959–966 (2015).

Principles of CT Radiation Dose Process Control at the Local Level

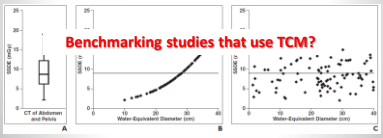
- *Principle 3: CT Image Quality, Not Patient Dose, Constrains the Optimization Problem and Determines the Target Outcome*

The first step is to determine what is meant by "adequate diagnostic image quality."

D. Larson et al. Toward Large-Scale Process Control to Enable Consistent CT Radiation Dose Optimization. AJR 204:959–966 (2015).

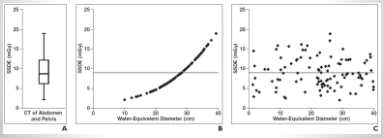
Principles of CT Radiation Dose Process Control at the Local Level

- *Principle 8: Verification of Process Control Is Greatly Enhanced by Proper Framing and Graphical Display*



D. Larson et al. Toward Large-Scale Process Control to Enable Consistent CT Radiation Dose Optimization. AJR 204:959–966 (2015).

Order or imaging protocol?!?



D. Larson et al. Toward Large-Scale Process Control to Enable Consistent CT Radiation Dose Optimization. AJR 204:959–966 (2015).

Task 2: Comparing to external benchmarks

Joint Commission

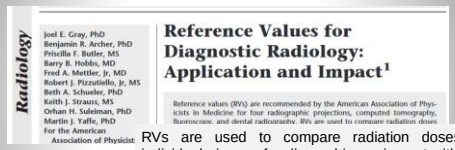
Element of Performance for PI.02.01.01 A6:

Review and analyze incidents where dose from diagnostic CT examination exceeds expected dose level

Compare these incidents to external benchmarks

J. Gray et al. Reference Values for Diagnostic Radiology: Application and Impact. Radiology 235:354–358 (2005).

External benchmarks


Radiology

Joel E. Gray, PhD
Benjamin R. Archer, PhD
Priscilla F. Butler, MS
Barry B. Hobbs, MD
Fred A. Mettler, Jr, MD
Robert J. Pizzutiello, Jr, MS
Beth A. Schueler, PhD
Keith J. Strauss, MS
Orhan H. Suleiman, PhD
Martin J. Yaffe, PhD
For the American Association of Physicist

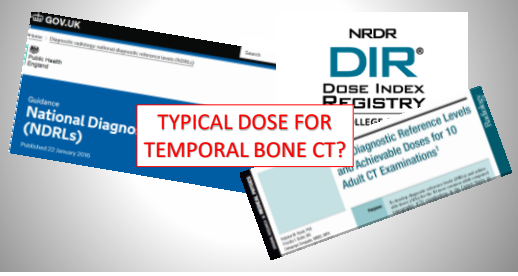
Reference Values for Diagnostic Radiology: Application and Impact[1]

Reference values (RVs) are recommended by the American Association of Physicists in Medicine for four radiographic projections, computed tomography, fluoroscopy, and dental radiography. RVs are used to compare radiation doses

RVs are used to compare radiation doses from individual pieces of radiographic equipment with doses from similar equipment assessed in national surveys.

J. Gray et al. Reference Values for Diagnostic Radiology: Application and Impact. Radiology 235:354–358 (2005).

External benchmarks



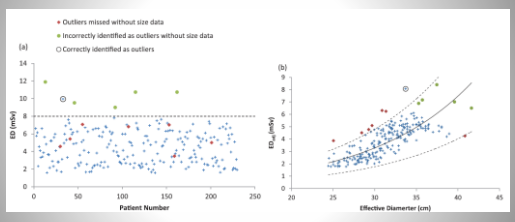
TYPICAL DOSE FOR TEMPORAL BONE CT?

Monitoring and reporting CT dose

Monitoring CT doses

- Effective tools needed
  - Graphics?
  - Automated reporting?
  - Action criteria/thresholds?

Task 3: Identifying outliers



O. Christianson et al. Automated size-specific CT dose monitoring program: Assessing variability in CT dose. Med. Phys. 39:7131-7139 (2012)

Alerts

- When?
- Who?
- What?

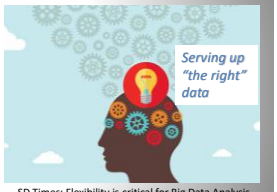
Task 4: Creating reports

- KPI?
- Templates?

SD Times: Flexibility is critical for Big Data Analysis

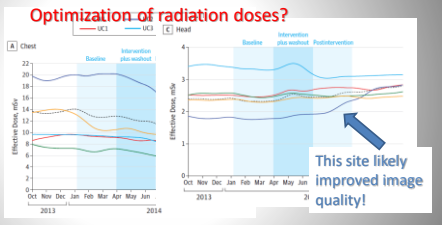
Task 4: Creating reports

- Example uses:
  - Internal dose monitoring
  - Auditing



SD Times: Flexibility is critical for Big Data Analysis

Auditing and sharing of best practices

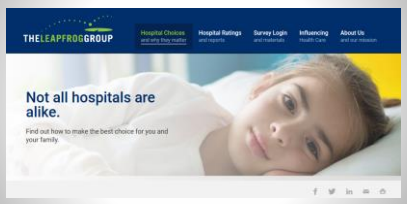


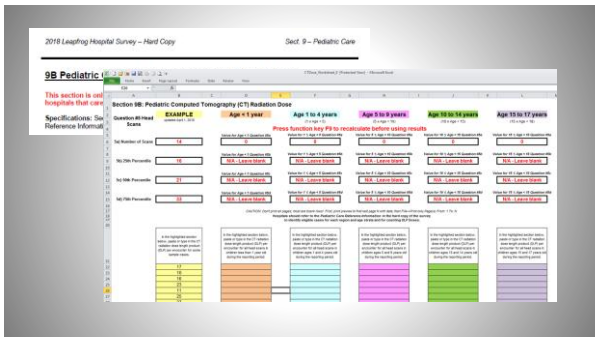
J. Demb et al: Optimizing Radiation Doses for Computed Tomography Across Institutions: Dose Auditing and Best Practices. JAMA Intern Med. 177:810-817 (2017)

Task 4: Creating reports

- Example uses:
  - Internal dose monitoring
  - Auditing
  - Hospital ranking (leapfrog 2018)

SD Times: Flexibility is critical for Big Data Analysis





Task 4: Creating reports

- Example uses:
  - Internal dose monitoring
  - Auditing
  - Hospital ranking (leapfrog 2018)
  - Next?

SD Times: Flexibility is critical for Big Data Analysis

Thank you

Hands-on workshop: Dose monitoring software

Hands-on workshop

Demonstrations of

1. Creating institutional benchmarks
2. Comparing against external benchmarks
3. Identifying outliers and generating alerts
4. Generating reports

Hands-on workshop

Presenters:

1. GE dose watch (Dave Miller)
2. IMALOGIX (Dan Steigerwalt)
3. PACSHealth (Steve Massey)
4. QAELUM DOSE (Niki Fitousi)
5. Radimetrics Enterprise Platform by Bayer Radiology (Carolyn Hohenberger)
6. SIEMENS teamplay (Peter Shen)