

RSNA 2014 Quality Story Boards QSE004-b

*Radiation Dose:
Implementation of a Department Wide CT
Dose Monitoring and Reporting System:
Initial Experience and Results.*

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Background

- while dose reporting is required by state law in California (SB1237) since 2012, no off-the-shelf system currently allows comprehensive dose monitoring and comparison of CT exposures to reference standards.

Purpose

- to develop and implement an institution wide CT radiation dose standardization and monitoring system in a large academic setting

Challenges III

Dose reports by commercial software have

- Insufficient Depth
 - doses typically reported on a study level (protocol), rather than on a series level;
 - acceptable dose levels depend on the specific CT acquisition (series) within a CT study, however:
 - e.g. a CT stroke protocol includes non-contrast head, CTA head/neck, and brain perfusion, each with different acceptable dose levels
- Reference dose values do not exist for all CT acquisitions
(e.g.: pediatric cardiac, body perfusion, ..)

Strategy (Methods)

- Develop institutional CT dose limits based on ACR, and AAPM guidelines on a SERIES LEVEL
- Develop a system that correctly categorizes each exposure (series level) into the appropriate scan-type, age group, and body region
- Implement a system that automatically compares the measured exposures (in mGy CTDIvol) to the institutional reference values
- Implement a system that tracks and monitors all CT acquisitions at Stanford Healthcare, with monthly reports of scans exceeding the reference dose level (Institutional target exposure pass rate is > 99.5%)
- Implement policy to manually evaluate the outliers

Methods I (Development)

- Over a period of 7 months we collected the CT dose information (CTDIvol, DLP) and corresponding scan data from all CT scans obtained on nine CT scanners at our institution using commercial dose management software (DoseWatch, GE Healthcare). All data were exported into spreadsheet software (Excel, Microsoft). A set of filtration rules (Crystal reports, SAP) applicable to all scanners was developed to classify the dose information based on CTDIvol, reference phantom size, patient age, and text information extracted from study and series names to identify the type of the series within as CT acquisition (e.g. pediatric vs. adult, head vs. body, cardiac prospective and retrospective, body and neuro perfusion, etc.).

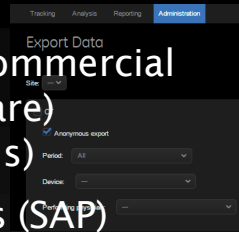
Institutional CT Dose Limits for each of 12 Categories of CT exposures

(Based on ACR and AAPM Recommendations) 2013,2014

Description of Series	Phantom	CTDI Threshold
Adult Neuro		
Adult Head	16cm	75 mGy
Adult Head	32cm	37.5 mGy
Head perfusion	16cm	600 mGy
Adult Body		
Adult body	16cm	70 mGy
Adult body	32cm	30 mGy
Body perfusion	32cm	300 mGy
Adult Cardiac		
Cardiac(Retrospective)	32cm	150 mGy
Cardiac(Prospective)	32cm	50 mGy
Cardiac(Flash mode)	32cm	50 mGy
Pediatric		
Pediatric head	16cm	35 mGy
Pediatric body	32cm	10 mGy
Pediatric body	16cm	20 mGy

Categorization of CT Dose Data

- all CT exposures recorded with commercial software (Dosewatch, GE Healthcare) → exported in raw data form (xls)
- data imported into CrystalReports (SAP) where a set of filtration rules were applied to categorize each acquisition (series level) into one of the 12 pre-defined categories
- filtration rules include age (pediatric/adult) phantom size (16cm, 32cm), anatomy (head, body, cardiac), scan type (standard, gated, perfusion)



Methods II (Implementation)

- The dose values were compared to institutional CTDIvol limits which are based on guidelines from the American College of Radiology and American Association of Physicists in Medicine. Actual dose values were reported and reviewed on a monthly basis. Exposures exceeding the predetermined dose limits were analyzed by a radiologist, a medical physicist, the chief- and the protocol technologist for medical necessity and categorized into one or more of three groups; protocol errors, technologist errors, and documentation errors.

Failure Analysis

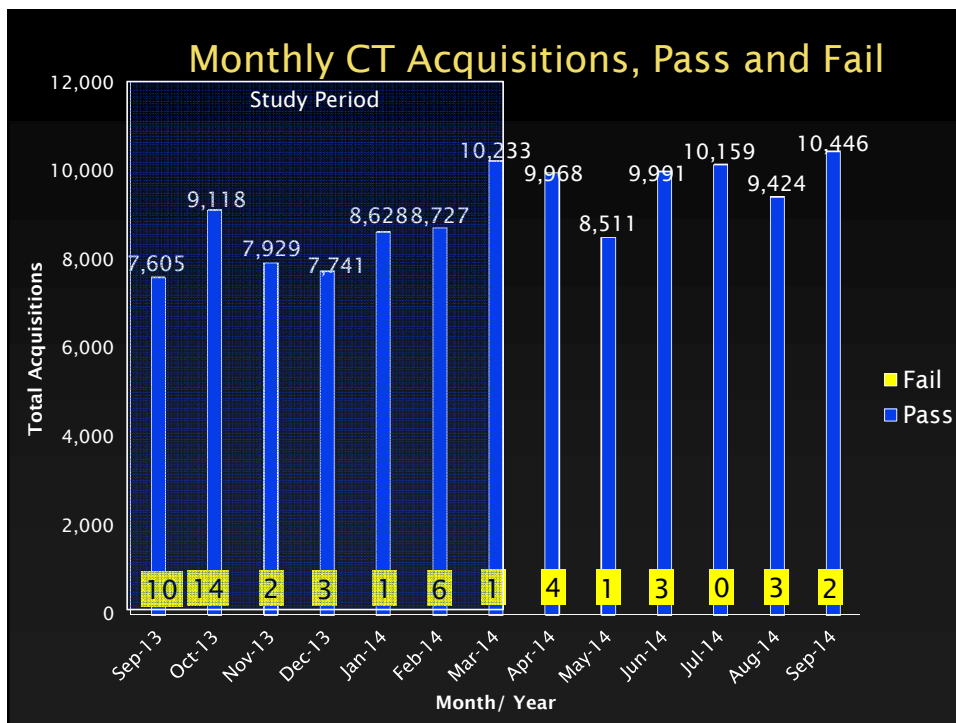
- Failures stratified into three categories
 - Documentation failures
 - ◆ exposure beyond institutional threshold may be appropriate in specific clinical settings (e.g. obesity)
 - ◆ adequate documentation includes reason for exceeding threshold and radiologist medical approval, exams meeting this criteria are excluded from failure count
 - Protocol Failures
 - ◆ Incorrect Noise Index or Quality Reference mAs setting in the Protocol
 - Technologist error
 - ◆ Failed to follow departmental imaging protocol without medical necessity;

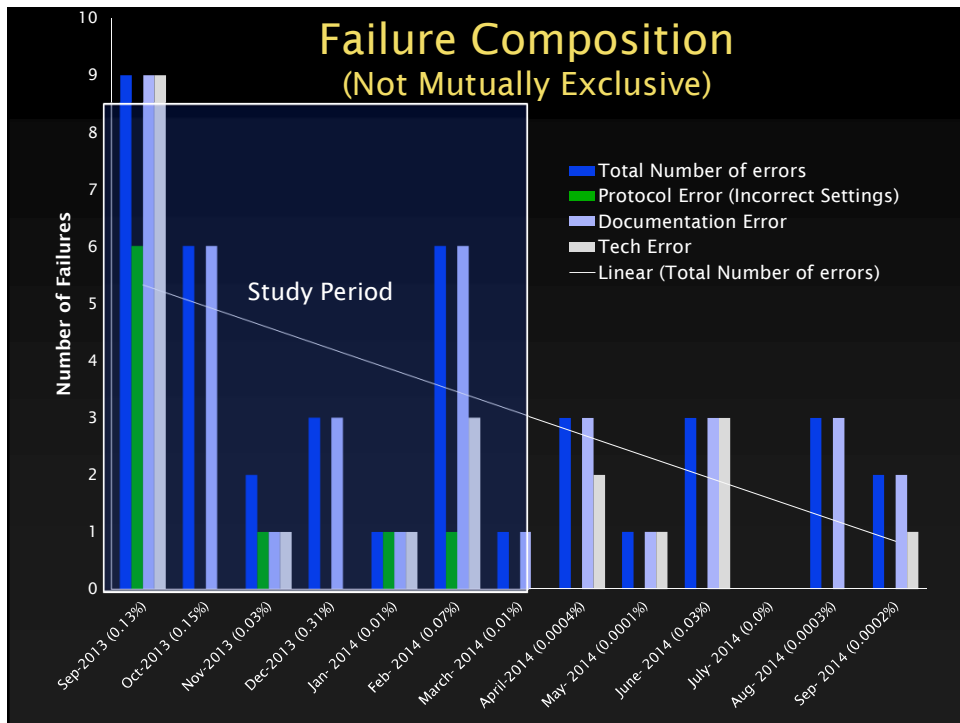
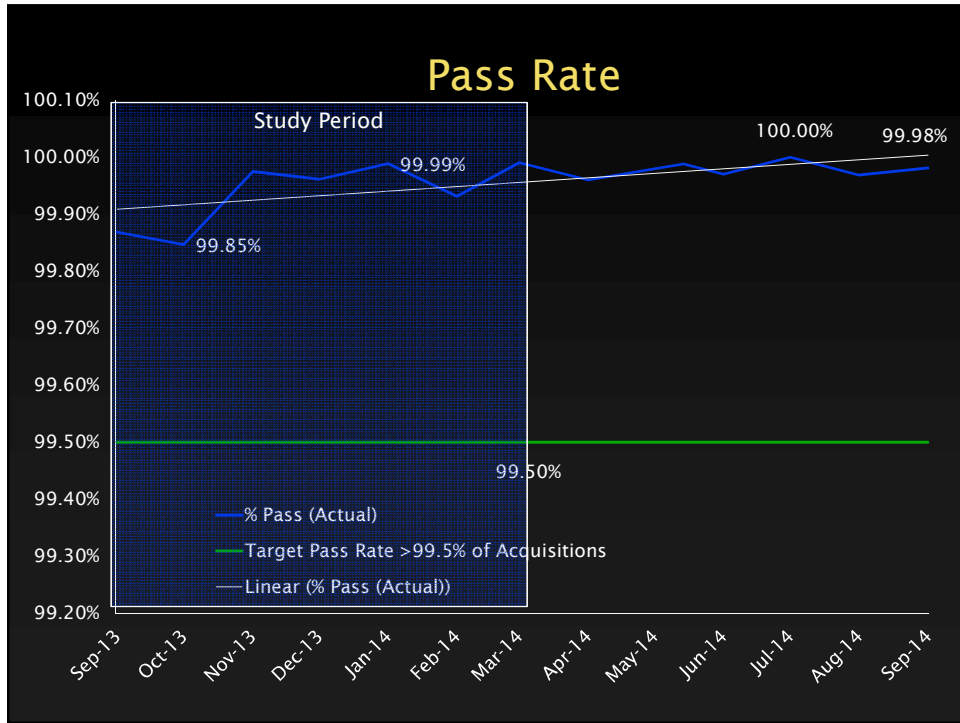
Results I

- A total of 59,981 CT scans were acquired during the study period. Of these acquisitions, 37/59,981 (0.062%) were found to be above the institutional dose limit.
- Overall, failure rate decreased over the seven months from 0.13% (n=10) in month one to 0.01% (n=1) in month seven
- 9/37 failures were due to errors in the settings of two protocols.
- 14/37 failures were technologist errors.

Results II

- 27 failures were due to technologist lack of documentation of medical necessity:
 9/27 of these documentation errors would have received medical authorization had they discussed the imaging procedure with a radiologist. Examples include obese patients, trauma patients with multiple arms positioned at their sides.
 Protocol setting errors were addressed, but recurred after scheduled maintenance service.





Conclusion

- Implementation of a comprehensive dose monitoring system may require several adaptations to institutional practice.
- The system allows reliable detection and analysis of possible overexposures which can be addressed in a timely manner and in a way that is consistent with institutional and regulatory guidelines.

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Thank You for your Interest



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