Quality and Safety Analytics as a Pathway to Evidence Based Imaging Practice

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References
Introduction

Opportunity: DICOM image headers have always offered a wealth of information related to practice safety, quality, and efficiency, but only recently have significant efforts been made to leverage these data.

Drivers:
- Radiation dose concerns, especially in CT
- Cost pressures on radiology practices
- Challenges managing increasingly complex, multi-platform, geographically distributed, imaging practices

Logistics: How to capture & utilize the data

DICOM images, headers, structured reports (SR)

DICOM Images, Headers, Structured reports (SR) to imaging analytics infrastructure

Image routing

RIS / DICTATION / REPORTING  PACS  ARCHIVE  CLINICAL VIEWING
Logistics: How to capture and utilize the data

Data Base
Website GUI
Automated Reports
Real Time Alert System

DIT GATEWAYS: Receive / Buffer / Parse / Standardize

DICOM Index Tracker (DIT)

- Standardize protocols and average doses across exam types, practitioners, system models, vendors and radiology practices
- Example: Exam-specific dose indices and protocol optimization
- DIT-facilitated estimations of appropriate z-axis coverage using an artificial neural network
  - Network inputs: Age, Gender, Weight, Height, Width, Thickness, CTDI, DLP
  - Example: Alert for excessive CT Z-axis coverage
• CT perfusion examination alerts
• Single exam with excessive exposure parameters
• Multiple exams on same patient within a predetermined time period
• Dose-area product alerts
  • Single exam with DAP > threshold
  • Multiple exams with DAP > threshold
• Excessive SAR alerts for higher-risk MRI exams

Example: Real-time patient exposure alerts

Example: MRI exam times, inter-series times, and inter-exam (“idle” or “gap”) times

Example: Ultrasound exam statistics

Where are the best opportunities for improving practice efficiency?
Example: Ultrasound exam statistics

Abdomen exam %’s = 21%

Can also do a similar analysis of utilization of added-cost imaging features, e.g. shear wave elastography, image fusion, panoramic imaging, contrast media imaging, …

Example: Ultrasound probe utilization

Do we have enough shared probes at each practice location?

Example: Ultrasound scanner utilization

Breast ultrasound

Where are the best options for adding exam capacity to the practice?

10-hour days? Add a room/scanner? Add a tech?
Example:

Tech Workflow

Exam scanning times

• Breast ultrasound
  Ultrasound = 72.4%

Example:

Tech Workflow

Interstudy "gap" times

• Breast ultrasound
  Are there workflow best practices that can be shared?

Example: Ultrasound image quality optimization

• US image analytics data can facilitate image quality optimization work...

• Use DICOM SR to define the clinical task being studied, e.g.
  target lesion sizes, depths, echogenicity

• Observe the usage rates of new and old presets, and identify sonographer patterns of use

• Analyze the image-to-image control changes made by sonographers to optimize the presets
Conclusions

- Imaging analytic techniques can now provide significant value for:
  - Ensuring patient safety
  - Improving standardization and quality in the clinical practice
  - Optimizing practice efficiency and management of resources
  - Improving image quality

- Challenges are still present:
  - Consistent naming conventions for scanners & exams
  - Limitations of public DICOM image headers
  - Acquisition of image analytics data, without impact to existing electronic practice workflow
  - Need for robust electronic environment and infrastructure for production data analysis and reporting
  - Optimizing data analysis and presentation for each clinical application is critical to avoid data overload
  - Need for specialized tools and expertise to investigate new problems and develop and validate new production metrics and reports

- These challenges represent great opportunity for medical physicists:
  - Our diverse skill set makes us uniquely suited to lead development in this area
    - Imaging physics, technology and standards
    - Clinical data flow and IT infrastructure
    - Radiology practice workflow
    - General problem solving, data analysis and data interpretation
    - Statistics and data presentation