Sunday, December 01, 2013
10:45-12:15 PM • SSA11 • Room: S403A • ISP: Informatics (Education and Research)
10:45-12:15 PM • SSA19 • Room: S403B • Physics (CAD I)
11:00-12:30 PM • ICIA11 • Room: S401CD • Quantitative Medical Imaging for Clinical Research and Practice: Hands-on Workshop
11:00-12:30 PM • ICII11 • Room: S501ABC • IHE Clinical Solutions for Interoperability - Imaging and Beyond
11:00-12:30 PM • ICIW11 • Room: S401AB • National Library of Medicine PubMed: Find Articles You Need: Searching PubMed/MEDLINE Efficiently
12:30-01:00 PM • LL-INS-SUA • Room: Lakeside Learning Center • Informatics - Sunday Posters and Exhibits (12:30PM - 1:00PM)
01:00-01:30 PM • LL-INS-SUB • Room: Lakeside Learning Center • Informatics - Sunday Posters and Exhibits (1:00pm - 1:30pm)
02:00-03:30 PM • RC126 • Room: S103AB • Health IT Tools to Improve Quality and Safety in Radiology (An Interactive Session)
02:00-03:30 PM • RC130 • Room: S403A • Standardized Terminology in Radiology: Applications and New Developments
02:00-03:30 PM • RC153 • Room: S401CD • Introduction to Social Media (Hands-on Workshop)
02:00-03:30 PM • RC154 • Room: S401AB • Introduction to Workflow Engines, Hands-on with an Open-source Platform
04:00-05:30 PM • ICIA12 • Room: S401CD • Structured Annotation and Image Markup (AIM) Template and Toolsets: Hands-on Workshop
04:00-05:30 PM • ICII12 • Room: S501ABC • Ergonomics
04:00-05:30 PM • ICIW12 • Room: S401AB • The RSNA Image Share Network - How It Operates and How to Put It into Your Office

Monday, December 02, 2013
07:15-08:15 AM • SPSC20 • Room: E350 • Controversy Session: Radiology Reporting: Is Structured Reporting the Answer?
08:30-10:00 AM • RC230 • Room: S102D • Technologies for Creating Educational Content and Teaching Files
08:30-10:00 AM • RC253 • Room: S401CD • Introduction to Social Media (Hands-on Workshop)
08:30-10:00 AM • RC254 • Room: S401AB • Introduction to Workflow Engines, Hands-on with an Open-source Platform
08:30-12:00 PM • VSIN21 • Room: S404CD • Radiology Informatics Series: Mobile Computing Devices
10:30-12:00 PM • ICIA21 • Room: S401CD • DtiStudio/MriStudio: Integrated Software Resource for White Matter Mapping and Quantitative Image Analysis
10:30-12:00 PM • ICII21 • Room: S501ABC • Practical Informatics for the Practicing Radiologist: Part One (In conjunction with the Society for Imaging In...
10:30-12:00 PM • ICIW21 • Room: S401AB • Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC®: A Hands On Course
10:30-12:00 PM • SSC09 • Room: S402AB • ISP: Informatics (Enterprise Integration)
12:15-12:45 PM • LL-INS-MOA • Room: Lakeside Learning Center • Informatics - Monday Posters and Exhibits (12:15pm - 12:45pm)
12:30-02:00 PM • ICIA22 • Room: S401CD • Using myRSNA®: Hands-on Workshop
12:30-02:00 PM • ICII22 • Room: S501ABC • Practical Informatics for the Practicing Radiologist: Part Two (In conjunction with the Society for Imaging In...
12:30-02:00 PM • ICIW22 • Room: S401AB • National Library of Medicine PubMed: There's More to PubMed/MEDLINE: The Free My NCBI Tool
12:45-01:15 PM • LL-INS-MOB • Room: Lakeside Learning Center • Informatics - Monday Posters and Exhibits (12:45pm - 1:15pm)
02:30-04:00 PM • ICIA23 • Room: S401CD • Mobile Computing for Decision Support and Learning While You Work
02:30-04:00 PM • ICII23 • Room: S501ABC • 3-D Printing: Bridging the Gap between Theory and Practice
02:30-04:00 PM • ICIW23 • Room: S401AB • Optimizing PowerPoint Slides
03:00-04:00 PM • SSE13 • Room: S402AB • Informatics (Workflow and Displays)
03:00-04:00 PM • SSE22 • Room: S403A • Physics (CAD II)
04:30-06:00 PM • ICIA24 • Room: S401CD • Using IHE Profiles to Plan for Medical Imaging
04:30-06:00 PM • ICII24 • Room: S501ABC • Meaningful Use for Radiology IT Vendors: What Your Customers will Demand, and Your Competition will Provide
04:30-06:00 PM • ICIW24 • Room: S401AB • Using RSNA Clinical Trial Processing (CTP) Software for Clinical Trials and Research Applications

Tuesday, December 03, 2013
08:30-10:00 AM • RC326 • Room: N229 • Quantitative Imaging: A Revolution in Evolution (In Association with the Society for Imaging Informatics in Me...
08:30-10:00 AM • RC353 • Room: S401CD • Hands-on HL7 Data Manipulation (Hands-on Workshop)
08:30-10:00 AM • RC354 • Room: S401AB • Next-Generation Educational Content Creation: Screencasting and Video Editing (Hands-On)
08:30-12:00 PM • VSER31 • Room: E352 • Emergency Radiology Series: Leveraging Technology for State-of-the-Art Practice
08:30-12:00 PM • VSIN31 • Room: S502AB • Radiology Informatics Series: Natural Language Processing: Extracting Information from Text Radiology Reports ...
10:30-12:00 PM • ICIA31 • Room: S401CD • Using myRSNA®: Hands-on Workshop
10:30-12:00 PM • ICII31 • Room: S501ABC • The RSNA Reporting Initiative: Developing a Library of Best-Practices Radiology Report Templates
10:30-12:00 PM • ICIW31 • Room: S401AB • Overview of RSNA's Teaching File Software (MIRC®)
10:30-12:00 PM • SSG08 • Room: S402AB • Informatics (3D, Quantitative and Advanced Visualization)
12:15-12:45 PM • LL-INS-TUA • Room: Lakeside Learning Center • Informatics - Tuesday Posters and Exhibits (12:15pm - 12:45pm)
12:30-02:00 PM • ICIA32 • Room: S401CD • 3D Interactive Visualization of DICOM Images for Radiology Applications: Hands-on Workshop
12:30-02:00 PM • ICII32 • Room: S501ABC • Meaningful Use: Experience from Private Radiology Practices
12:30-02:00 PM • ICIW32 • Room: S401AB • Display Technology
12:45-01:15 PM • LL-INS-TUB • Room: Lakeside Learning Center • Informatics - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
01:30-03:00 PM • MSAS33 • Room: S105AB • Process Engineering to Optimize Work Flow Processes in Radiology: A Case Study Approach (Sponsored by the Asso...

02:30-04:00 PM • ICIA33 • Room: S401CD • Monitoring Radiation Exposure: Standards, Tools and IHE REM
02:30-04:00 PM • ICII33 • Room: S501ABC • Decoding the Alphabet Soup (IHE®, MIRC®, RadLex®, Reporting): Whirlwind Tour of RSNA Informatics P...
02:30-04:00 PM • ICIW33 • Room: S401AB • Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC®: A Hands On Course
03:00-04:00 PM • SSJ14 • Room: S402AB • Informatics (Business Analytics)
03:30-05:00 PM • MSAS34 • Room: S105AB • Social Media and Medical Imaging Management: What You Do Not Know Can Destroy Your Practice (Sponsored by the ...
04:30-06:00 PM • RC426 • Room: S404CD • Next Generation Infrastructure for Medical Imaging (In Association with the Society for Imaging Informatics in...
04:30-06:00 PM • RC430 • Room: S403A • Impact of Legislative Policy and Regulations on Imaging Informatics
04:30-06:00 PM • RC453 • Room: S401CD • Hands-on DICOM Metadata Manipulation (Hands-on Workshop)
04:30-06:00 PM • RC454 • Room: S401AB • Next-Generation Educational Content Creation: Screencasting and Video Editing (Hands-On)

Wednesday, December 04, 2013
08:30-10:00 AM • RC526 • Room: E351 • Cool Technologies for Radiologists
08:30-10:00 AM • RC530 • Room: S404AB • Managing Radiology IT in the EHR World
08:30-10:00 AM • RC553 • Room: S401CD • Hands-on DICOM Metadata Manipulation (Hands-on Workshop)
08:30-10:00 AM • RC554 • Room: S401AB • Using RADIANCE for Dose Monitoring and Quality Assurance: A Hands-on Course
10:30-12:00 PM • ICIA41 • Room: S401CD • Open Access Imaging Data Resources: NIH Cancer Imaging Archive: Hands-on Workshop
10:30-12:00 PM • ICII41 • Room: S501ABC • Next Generation IT Requirements for Improving Quality and Safety for Radiology
10:30-12:00 PM • ICIW41 • Room: S401AB • Creating Radiology eBooks for the iPad: A Hands-on Introduction to iBooks Author
10:30-12:00 PM • SSK11 • Room: S405AB • ISP: Informatics (Quality and Safety)
12:15-12:45 PM • LL-INS-WEA • Room: Lakeside Learning Center • Informatics -Wednesday Posters and Exhibits (12:15pm - 12:45pm)
12:30-02:00 PM • ICIA42 • Room: S401CD • Correlating Imaging with Human Genomics
12:30-02:00 PM • ICII42 • Room: S501ABC • Meaningful Use: Experience from Radiology Practices in Hospitals and Health Systems
12:30-02:00 PM • ICIW42 • Room: S401AB • Optimizing PowerPoint Slides
12:45-01:15 PM • LL-INS-WEB • Room: Lakeside Learning Center • Informatics - Wednesday Posters and Exhibits (12:45pm - 1:15pm)
02:30-04:00 PM • ICIA43 • Room: S401CD • Using myRSNA®: Hands-on Workshop
02:30-04:00 PM • ICII43 • Room: S501ABC • RadLex®: Overview of a New Lexicon for Radiology
02:30-04:00 PM • ICIW43 • Room: S401AB • National Library of Medicine PubMed: Find Articles You Need: Searching PubMed/MEDLINE Efficiently
03:00-04:00 PM • SSM11 • Room: S403A • Informatics (Image Sharing)
04:30-06:00 PM • ICIA44 • Room: S401CD • Rapid Application Development with XIP™ - the eXtensible Imaging Platform
04:30-06:00 PM • ICII44 • Room: S501ABC • IHE Workflow Efficiency from Acquisition to the Report Attendees
04:30-06:00 PM • ICIW44 • Room: S401AB • National Library of Medicine PubMed: Free Online Databases: Images and More

Thursday, December 05, 2013
08:30-10:00 AM • RC626 • Room: E451A • Latest Developments in Meaningful Use: Ask the Experts
08:30-10:00 AM • RC630 • Room: S403B • Cloud Computing for Radiologists: A Primer
08:30-10:00 AM • RC653 • Room: S401CD • Hands-on HL7 Data Manipulation (Hands-on Workshop)
08:30-10:00 AM • RC654 • Room: S401AB • Advanced Data Analysis with Excel for Research and for Practicing Quality Improvement (Hands-on Workshop)
10:30-12:00 PM • ICII51 • Room: S501ABC • Breast Imaging: Interoperability Challenges and Solutions
10:30-12:00 PM • ICIW51 • Room: S401AB • Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC®: A Hands On Course
10:30-12:00 PM • SSQ02 • Room: E450A • Breast Imaging (CAD/Quantitative Imaging)

10:30-12:00 PM • SSQ11 • Room: S403A • ISP: Informatics (Results and Reporting)
12:15-12:45 PM • LL-INS-THA • Room: Lakeside Learning Center • Informatics - Thursday Posters and Exhibits (12:15pm - 12:45pm)
12:30-02:00 PM • ICIA52 • Room: S401CD • Using myRSNA®: Hands-on Workshop
12:30-02:00 PM • ICIW52 • Room: S401AB • National Library of Medicine PubMed: There's More to PubMed/MEDLINE: The Free My NCBI Tool
12:45-01:15 PM • LL-INS-THB • Room: Lakeside Learning Center • Informatics - Thursday Posters and Exhibits (12:45pm - 1:15pm)
01:30-02:45 PM • ICIX51 • Room: E350 • RadioGraphics' Publication Information for Potential Authors
03:00-04:00 PM • SPSH55 • Room: S403A • Hot Topic Session: From Irene to Sandy: How to Keep a Digital Department Running during a Natural Disaster
04:30-06:00 PM • RC721 • Room: N229 • Medical Physics 2.0: Information Management and Display
04:30-06:00 PM • RC725 • Room: E352 • Quantitative Imaging: Informatics
04:30-06:00 PM • RC726 • Room: N226 • Decision Support in Clinical Practice
04:30-06:00 PM • RC730 • Room: S103AB • Leveraging Imaging Informatics to Improve Radiology Education: Beyond the Teaching File (An Interactive Sessio...
04:30-06:00 PM • RC753 • Room: S401CD • Advanced Image Analysis, including Applications such as Automated Stent Planning and Multimodality Image Fusio...
04:30-06:00 PM • RC754 • Room: S401AB • Using RADIANCE for CT Dose Monitoring and Quality Assurance: A Hands-on Course

Friday, December 06, 2013
08:30-10:00 AM • RC826 • Room: E350 • The Use of Business Analytics for Improving Radiology Operations, Quality, and Clinical Performance (In Associ...
08:30-10:00 AM • RC830 • Room: S403A • Current and Next Generation Health IT Tools To Enable Radiation Exposure Reduction - A Practical Guide
08:30-10:00 AM • RC853 • Room: S401CD • Advanced Image Analysis, including Applications such as Automated Stent Planning and Multimodality Image Fusio...
08:30-10:00 AM • RC854 • Room: S401AB • Basic Tools and Tricks for Data Collection and Organization for Practice Quality Improvement Projects and for ...
10:30-12:00 PM • ICIW61 • Room: S401AB • National Library of Medicine PubMed: Find Articles You Need: Searching PubMed/MEDLINE Efficiently
10:30-12:00 PM • SST08 • Room: E353A • Informatics (Segmentation, Measurement and CAD)

Image Quality Characterization of Handheld Devices for Medical Image Display

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LL-INE3167

Asumi Yamazaki , MS
Peter J Liu
Aldo Badano , PhD *

PURPOSE/AIM
Recent studies suggest that the imaging performance of handheld display devices can be comparable to that of medical workstation displays. We exhibit the main image characteristics in handheld devices and compare the results obtained via physical measurements in relation to measurements performed on medical workstation displays.
CONTENT ORGANIZATION
For a selection of phones and tablets with liquid-crystal (LCD) and organic light-emitting diode (OLED) displays, we report results of a comprehensive image quality characterization with respect to spatial resolution, noise, contrast response, and reflection coefficients.
SUMMARY
We compare the image quality of phone- and tablet-size LCDs and OLEDs handheld display devices for medical image viewing. All handheld display devices have better or equivalent spatial resolution and noise characteristics compared to medical diagnostic workstation displays. The reflection properties of handhelds exhibit large variation among devices, since the intrinsic luminance responses are not calibrated to comply with the grayscale standard display function (GSDF). Our image quality characterization highlights performance areas for which different technologies outperform others and identifies areas where there exists large variation among devices.

Polling-based Workflow Notification System at a Community Hospital - A Resident Perspective

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LL-INE3169

Alok A Anand , MD

PURPOSE/AIM
1. To present a web application system which provides a simple rules-based framework that enables radiology residents to monitor worklists in real time for incoming studies and receive alerts via text page. 2. To discuss benefits and impact on the resident experience both on-call and during 'offsite' rotations.
CONTENT ORGANIZATION

1. Challenges of monitoring worklists during resident call in a community hospital
2. Demonstration of the basic interface, illustrating the use of simple rules to create custom worklists, which update dynamically and alert users of changes, both on-screen and via text page.
3. Exploring advanced features, utilizing complex rules, regular expressions, and wildcard matching to enable further refinement of worklists and alerts.

SUMMARY
On-call responsibilities in a community hospital may require residents to step away from the reading room, limiting their ability to effectively watch for incoming studies. Current solutions, including worklist 'dashboards' are focused on traditional workflow paradigms, only enabling interaction with users sitting at a workstation. A simple, polling-based notification system meets the needs of on-call residents to step outside the department in order to evaluate patients, speak with clinicians, or perform charting duties, with the assurance that they will know immediately when new studies arrive.

Educational Patient-specific Bio-elastic Organ Manufacturing by Multi-material 3D Printer

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LL-INE3170

Maki Sugimoto , MD, PhD

PURPOSE/AIM
Our new technology of Bio-Texture Modeling by multi-material 3D printing system enabled manufacturing patient-specific bio-elastic 3D organ models by simultaneous jetting of different types of model materials and compounding the PVA, which is a water-soluble synthetic resin that was first industrially produced in Japan. Such organ models can be soaked in water to look and feel closer to real organs. We evaluated its feasibility in education.
CONTENT ORGANIZATION
Based on MDCT and MRI, after generating STL-files, the inkjet 3D printer created a 3D organ model. This enabled the simultaneous use of two different materials to form 3D organ textures and structures. The patient individual 3D printed models were used to plan and guide the successful therapeutic procedure. The 3D objects using combination of transparent and soft materials allowed creation of translucent models that show visceral organs and other details. The actual size transparent organ model with vessels and tumor could be manufactured and be handled. This enabled each composite material to provide specific values of organ bio-texture for tensile strength and elongation to break for training of pre-surgical dissection and suturing procedures.
SUMMARY
Our personalized bio-elastic organ manufacturing could help younger, less experienced surgeons practice with accurate copies before surgery.

Information Overload

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LL-INE3171

Sundip D Udani , MBChB
Kevin R Haylett

PURPOSE/AIM
This article highlights the exponential growth in medical publications. Quantifying this growth it predicts that the numbers of these publications will double every 16 years with an annual increase approaching 5%. By 2014, over 1.5 million articles will be published each year, an astonishing figure. Important questions are raised about the practicality of current approaches to literature reviews and a useful example is given. The relationship between this increase and statistical results is examined and finally the impact on evidence based medicine is considered. The relatively low profile this information explosion receives in the literature raises many questions and suggests that is now time to take action and focus the attention of the medical research councils and other funding bodies on this important matter.
CONTENT ORGANIZATION
Standing on the bridge between the worlds of medicine and engineering it is interesting to reflect on the relationship between changes in technology and medicine. Considering Moore's Law, a question comes to mind: is there a medical equivalent?
SUMMARY
There is an explosion of medical literature happening on our watch. This has been briefly examined here and a growth law determined which shows publication rates doubling every 16 years at just under 5% each year. Important educational points will be discussed.

Educational System for Radiologist and Radiological Technologist Using Optical CT Understanding of Interest Mechanism of CT

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LL-INE3172

Chika Murata
Atsushi Teramoto , PhD
Hiroshi Fujita , PhD

PURPOSE/AIM
Currently, X-ray CT plays an important role in clinical practice, and understanding the principle of CT are required for radiologist and radiological technologist. However, understanding of the principles and properties of CT are difficult for them. Therefore, we developed an optical CT system for education of radiologist and radiological technologist. The purpose of this exhibition is to show how much we can learn from our educational system.
CONTENT ORGANIZATION
SUMMARY
The major teaching points of this exhibit are:

1. Acquiring the projection data without radiation exposure.
2. Intuitive understanding of a principle of image reconstruction.
3. Origin of artifact and its behavior in CT image.

University of Colorado Hospital Adult Contrast Reaction Guide Smartphone App: Design and Implementation

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LL-INE3177

Theodore B Jennermann , MD
Thomas D Suby-Long , MD
Peter B Sachs , MD
Nicole Restauri

PURPOSE/AIM
Recently, researchers in the Department of Radiology at University of Colorado Hospital sought to improve patient care by adopting a standardized practice for handling adverse reactions to intravenously administered contrast. One step in this process was to create a paper pamphlet, called the University of Colorado Radiologist Adult Contrast Reaction Smartcard, which outlines the steps in responding to an adverse reaction to contrast. To make the process and standards more accessible to faculty and residents, we designed an application (app) for Apple iPhones and iPads. The presentation will briefly demonstrate the process by which an application is created, tested and disseminated.
CONTENT ORGANIZATION
CONTENT ORGANIZATION A. Purpose B. Obstacles C. Resources D. Design and Creation E. Distribution F. Implementation
SUMMARY
After viewing the exhibit, attendees will be able to understand the basic process of designing and distributing a radiology-specific iOS application, and its potential benefits to quality and safety within a radiology department.

Slice Dropping in Clinical Image Interpretation with Stack-mode Viewers: How to Cope with This Problem

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LL-INE3178

Masahiro Yakami , MD, PhD
Akira Yamamoto , MD, PhD
Morio Yanagisawa
Hiroyuki Sekiguchi
Takeshi Kubo , MD
Kaori Togashi , MD, PhD *

PURPOSE/AIM
Some of the PACS viewers examined in a study have confirmed to omit showing considerable percentage of image slices in stack-mode. Slice omission is a serious problem because it may lead to misdiagnosis. A major cause lies in the drawing functions in the major operating systems. This suggests that most PACS viewers may be involved in the problem. This exhibit shows the causes of slice omission, the possible effects on clinical image interpretation, and how to cope with the problem.
CONTENT ORGANIZATION
1. A review on investigation of slice omission with a high-speed movie camera.
2. Risks of missing lesions by slice omission.
3. Other possible effects on clinical image interpretation.
4. The possible causes of slice omission.
4.1. Viewer programs
4.2. Operating systems
4.3. Graphics boards
4.4. Displays such as cathode ray tube (CRT) and liquid crystal display (LCD) including In-Place-Switching (IPS) and virtical alignment (VA) type.
5. Conditions on which slice omission occurs.
6. How to prevent slice omission.
7. How to prevent missing lesions in spite of slice omission.
SUMMARY
Certainly slice omission may be a serious problem in clinical image interpretation, but several countermeasures against it are available to radiologists.

Reconsider the Size of the Matrix in CT Images: The Image Diagnosis by High Resolution CT with Wide Field of View

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LL-INE3182

Masahiro Suzuki
Shiho Gomi
Hirobumi Nagasawa , RT
Tomohiko Aso , RT
Ryutaro Kakinuma , MD, PhD
Noriyuki Moriyama , MD, PhD
Shinsuke Tsukagoshi , MS

PURPOSE/AIM
CONTENT ORGANIZATION
SUMMARY
In the course of evolution of CT until now, there has been no change in the matrix size. With the appearance of ultra-high-resolution CT in the future, lager reconstructed matrix size will be an indispensable element in order to establish a new microscopic image diagnosis. The difference between new ultra-high-resolution CT images and conventional high-resolution CT images are revealed, and the scanning technology of microscopic image diagnosis is learned.

Cone Beam CT Image Processing in Dental Office: Acceleration by GPGPU Machine for Metal Artifact Reduction, 3D-filtering and Region Growing Methods for High-quality 3D Visualization

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LL-INE3184

Jian Dong
Dai Miyanaka
Xinyuan Zhang
Yoshihiko Hayakawa
Cornelia Kober , PhD

PURPOSE/AIM
CT scans in dental are often performed to observe bone morphology. Metallic prosthetic appliances cause unavoidable streak artifacts, thus the bone morphology is overlapped or damaged. Successive iterative methods, 3D filtering and region growing were examined to improve accuracy of bone morphology in CBCT. Multi-planar reconstruction (MPR) images were got as an evaluation standard of image quality improvement. To reduce processing time, we assembled the top level computer 'general purpose graphic processing unit (GPGPU)'.
CONTENT ORGANIZATION

Metal-induced streak artifacts appear gradually on CT images and we focus on that adjacent images often depict similar anatomical structures. Solution 1: we developed the statistical iterative method for artifact reduction. Solution 2: 3D filtering of averaging, Gaussian smoothing and Laplacian sharpening following with Gaussian sharpening were applied for image quality improvement. MPR images at midsagittal plane on the maxilla were presented to evaluate the effect. Since both solutions are too time-consuming to meet the clinical appliance, we assembled a top level GPGPU machine to shorten the processing time.
SUMMARY
Both solutions were effective in improving quality of X-ray CT images. Also increased the concerned anatomical structures for diagnosing. Moreover, GPGPU application realized dozens of times time reduction.

Re-thinking the Role of the Radiologist: Enhancing Visibility through Both Traditional and Non-traditional Reporting Practices

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LL-INE3192

Andrew J Gunn , MD
Mark D Mangano , MD
Brian S Pugmire , MD
Garry Choy , MD, MS
Dushyant V Sahani , MD

PURPOSE/AIM
To review the literature regarding reporting practices, highlighting current ideas such as expanding the role of the radiologist in delivering results directly to patients, and discuss future topics in radiology reporting, including the establishment of radiology consultation clinics.
CONTENT ORGANIZATION
1. Review of current literature: the radiology report in patient care, components of the radiology report, reporting errors, and methods for peer review. 2. Current topics in radiology reporting: structured reporting, radiologist outreach to patients and referring physicians for feedback on reporting practices, and expanding the role of the radiologist in delivering examination results directly to patients. 3. Future of radiology reporting: expanding the peer-review process to include referring physician and patient feedback and the establishment of diagnostic radiology consultation clinics.
SUMMARY
Traditional reporting practices do not provide the radiologist with sufficient opportunity to interact with patients or referring physicians, limiting their ability to practice "patient-centered" radiology or form effective partnerships with referring physicians. While an understanding of current reporting practices is essential, the radiologist should aim to increase his or her visibility through the use of non-traditional reporting practices.

Using a Free DICOM Header Extraction Tool to Create a Data Warehouse of DICOM Data Elements for Data Mining Purposes in Research and Clinical Use

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LL-INE3193

Pattanasak Mongkolwat , PhD
Alexandr Kogan
Skip Talbot , BS
Ann B Ragin , PhD
Godwin I Ogbole , MBBS
Vladimir Kleper

PURPOSE/AIM
The DICOM header of a DICOM file contains information about acquisition and imaging parameters, patient demographics and/or structured reporting. This information is stored in the DICOM file as data elements. Accessing each DICOM data element requires considerable DICOM expertise and access to imaging studies in order to separate out data elements. We created an imaging tool to extract DICOM data elements from a DICOM file and store the information in a relational database.
CONTENT ORGANIZATION
The exhibit consists of two parts. The first part demonstrates how to properly extract DICOM data elements and preserve the hierarchical structure of the DICOM contents. It depicts the database schema and examples of structure query language, needed in order to retrieve DICOM data. The second part is the software demonstration that recursively discovers DICOM files within a directory structure and extracts DICOM data elements from DICOM files into a relational database.
SUMMARY
Commercial and open source picture archiving and communication systems (PACS) can extract and store a limited number of DICOM data elements required to operate PACS. Many useful DICOM data elements remain in the DICOM files. Searching and retrieving these elements from PACS is not simple. We provide a free tool used to create a DICOM elements data warehouse for research and clinical use.

Understanding and Using National Cancer Informatics Program (NCIP) Annotation and Image Markup (AIM) Software Products

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LL-INE3194

Pattanasak Mongkolwat , PhD
Skip Talbot , BS
Norman Young , MSc *
Vladimir Kleper

PURPOSE/AIM
The exhibit describes how to use AIM software products from NCIP in clinical and research environments. AIM software tools reduce the effort needed to understand and use the AIM information model.
CONTENT ORGANIZATION
• AIM 4.0 overview
• Creating case report forms using AIM Template Builder 2.0
• Sharing and searching AIM templates using AIM Template Service
• Importing AIM templates in to an open source AIM enabled ClearCanvas workstation
• Creating AIM instances as AIM DICOM SR and/or AIM XML documents
• Storing, searching and retrieving AIM XML documents to/from AIM Data Service
SUMMARY
AIM defines a standard information model for collecting annotation descriptions, markup and computational results of image features using well-defined medical lexicons such as RadLex, SNOMED CT, etc. The participant will understand how to use AIM tools step-by-step. It starts with 1) preparing information for creating an AIM template; 2) storing and sharing the AIM template; 3) importing the AIM template in to an AIM enabled ClearCanvas workstation; 4) using the AIM template on the workstation and 5) storing resulting AIM instances on the local computer and AIM Data Service repository. Annotations stored in the AIM format can be searched to find recoded image findings using controlled vocabularies. This yields more accurate results than searching textual descriptions.

Extending Annotation and Image Markup (AIM) Enabled Imaging Workstation for Traumatic Brain Injury (TBI) Research

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LL-INE3195

Dzung Pham , PhD
Pattanasak Mongkolwat , PhD
Skip Talbot , BS
Vladimir Kleper
John A Butman , MD, PhD

PURPOSE/AIM
The National Cancer Informatics Program (NCIP) AIM enabled workstation provides fundamental features used to create AIM instances as DICOM SR objects or XML documents. Structured radiology reads, such as those described in the National Institute of Neurological Disorders and Stroke (NINDS) Common Data Elements, can be encoded as AIM templates and filled out electronically alongside viewed images. We extended the workstation capabilities to support annotation creation for TBI research.
CONTENT ORGANIZATION
The new capabilities include 1) creation of crosshair markups, which are useful in defining microhemorrhage locations, 2) improved handling of multiple markups, important in TBI patients with multiple lesions, and 3) the ability to save, reload, and edit existing AIM instances, a critical feature for collaborative studies involving multiple readers and extensive templates. The latter feature is particularly useful for consensus reads, as well as for when a read is interrupted, allowing radiologists to save and continue previous, partially completed work.
SUMMARY
TBI is a highly heterogenous and complex disease. AIM workstations enable rigorous descriptions of the types and locations of TBI lesions in a free, user-friendly software package. These new capabilities make AIM a more powerful research tool for TBI and other diseases.

Enhancing the Image Interpretation Process: Utilizing 3D Game Controllers for Efficiently Navigating through 2D, 3D and 4D CT, MR and PET Images

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LL-INE3198

Michael Teistler , PhD
Oliver J Bott , PhD
J. Anthony Seibert , PhD
James A Brunberg , MD
Pattanasak Mongkolwat , PhD
Jeremy D Collins , MD *
Uwe Zimmermann

PURPOSE/AIM
Recently developed game controllers allow for fast and accurate 3D human-computer interaction, with multiple degrees of freedom regarding the controller's position and orientation. The purpose of this exhibit is to demonstrate how these controllers can be used as input devices to efficiently navigate through medical images, thus enhancing the image viewing process.
CONTENT ORGANIZATION
A. Introduction of 3D game controllers as input devices that provide multiple degrees of freedom (DOF) for position and orientation as compared to conventional devices like mouse, touchpad or trackball B. Hands-On: Utilizing multiple DOF to efficiently perform:
- frequently used conventional viewing functions like scrolling, changing window level and width, and zooming into 2D images
- advanced 3D image viewing functions like creating oblique MPRs and rotating/zooming MIP or volume rendering views.
- special functions with regard to multimodality and 4D (3D+time) imaging, like PET/CT and cardiac CT C. Demonstration of clinical cases to assess the benefits of using a game controller as addition to / substitute for conventional input devices
SUMMARY
Based on recently developed 3D game controllers, a new interaction concept for viewing medical images is presented. Hands-on experience will be provided to let the attendee assess the benefits and drawbacks of this approach.

iBook vs Standard Publication: Is It Worth the Effort?

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LL-INE3209

Sara Raminpour , BS
Elliot K Fishman , MD *
Melissa R Rowell , MS
Siva P Raman , MD
Frank M Corl , MS

PURPOSE/AIM
To compare Apple iBook with standard publications including existing e-books and paper textbooks and discuss its pros and cons to help define whether development is worth the effort.
CONTENT ORGANIZATION
SUMMARY
After reviewing this exhibit the user will have a better understanding of the capabilities of a well-designed iBook. This will help the user in the future define whether than selection of educational material, should potentially be an iBook vs classic textbook.

Development and Use of RadStax: A Web-based Application as a Robust Radiology Teaching Tool for Medical Students

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LL-INE3210

Petro M Kostandy , MD
Philip Colucci
Elizabeth K Arleo , MD
Michele Fuortes , MD, PhD
Krishna Juluru , MD
Apostolos J Tsiouris , MD *

PURPOSE/AIM
For most medical students, their first exposure to Radiology occurs in Gross Anatomy. The primary goal in this setting is to use imaging to teach anatomy and normal studies with labels help achieve this goal. While multiple web-based anatomy programs exist, the level of detail is often beyond the appropriate scope for a medical student.
CONTENT ORGANIZATION
RadStax is a web-based application developed as an interactive resource for independent study. It allows creation of new learning modules to provide users with labeled multiplanar image sets, basic anatomical information, and a self-assessment feature. RadStax was offered to second-year students during their neuroradiology course. Student surveys support its efficacy with 91% of respondents wishing they had access to this tool during prior coursework. While many confounders could not be controlled for, exam scores showed a statistically significant increase from the previous year.
SUMMARY
RadStax is a robust interactive radiology teaching tool that provides faculty a feasible way to create an atlas of labeled studies that can be tailored to meet the specific needs of their school's curriculum. The introduction of RadStax into the second-year curriculum was met with positive subjective and objective feedback. RadStax has potential as a valuable tool for medical student education.

Social Media in Radiology Education

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LL-INE3212

Roland S Talanow , MD,PhD

PURPOSE/AIM
Social media is a fast growing phenomenon in many aspects of life. Initially used only for private connectivity purposes it has also started being used in medical sectors by professionals and trainees in support of education. The purpose of this exhibit is to provide an overview of social media sites involved in Radiology education, demonstrate how they are used and evaluate their usefulness in Radiology education.
CONTENT ORGANIZATION
We did a comprehensive internet search to identify available social media sites that are involved in Radiology education. We provide a list of sites that offer the most educational value to the user in regard to Radiology education. Criteria include types of offered contents, accessibility, security, connectivity, discussions and other 'social' features. We provide a snapshot of each of these sites with an introduction and list pros/strength and contras/weakness of each site. This gives the user a guide to find the right social network (or networks) to either gather or provide/share educational radiological information.
SUMMARY
In this exhibit we provide a spectrum of social media sites that are used for Radiology education and demonstrate how these resources apply solutions for Radiology education. Furthermore we evaluate these sites based on their usefulness in regard to enhancing the educational experience.

Measurement of Arterial Pulse Wave Velocity (PWV) Based on 4D Phase Contrast MR Flow Imaging (4D PC MRI)

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LL-INE3218

Hanieh Mirzaee
Johann Drexl
Anja Hennemuth , MS
Andreas Harloff *

PURPOSE/AIM
It is generally accepted that many cardiovascular disorders are associated with increasing stiffness of arterial wall due to arteriosclerosis. In this regard, higher pulse wave velocity indicates less compliance of the arterial wall.
The aim of this exhibit is to provide an overview of the major steps involved in a semi-automatic computation of arterial PWV based on 4D flow MRI within an interactive framework.
CONTENT ORGANIZATION
1. Introduction to 4D PC MRI flow imaging.
2. Explanation and demonstration of 4D PC MRI preprocessing steps (phase unwrapping and eddy current correction).

3. Vessel segmentation based on the magnitude image and interactive exploration of real example cases.
4. Vessel centerline extraction algorithm.
5. Computation of 4D flow curves:
5.1. Automatic placement of cross-sectional planes for through flow computation.
5.2. Measurement of PWV and application to real example cases. 6. Discussion and summary.
SUMMARY
Major steps in a semi-automatic computation of arterial PWV based on 4D PC MRI within an interactive framework are explained. In this exhibit we will review: • The principles of 4D flow MRI.
• Necessary preprocessing steps in order to acquire a suitable vessel mask for PWV computation.
• Correlation of PWV with arterial stiffness and aging through application to real example cases.

Visual Support for Interactive Assessment of Radiofrequency Ablation

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LL-INE3220

Christian Rieder
Benjamin S Geisler , MD
Hong-Sik Na , MD
Peter Isfort , MD
Philipp Bruners , MD
Andreas H Mahnken , MD *
Horst K Hahn , PhD *

PURPOSE/AIM
Thorough follow-up imaging is essential to evaluate therapy success of radiofrequency ablation. This presentation challenges conventional assessment using visual side-by-side comparison of pre- and post-interventional images. To objectify the verification of the treatment success, a novel software system allowing for fast and accurate comparison of tumor and coagulation is proposed.
CONTENT ORGANIZATION
The presentation is intended to demonstrate the functionality of the software system and explore the benefit compared with the conventional method. The system consists of three stages: (1) an interactive segmentation method allows to extract tumor and coagulation in the CT datasets; (2) an automatic rigid registration method facilitates alignment of both images in the target volume around the tumor; (3) a real-time visualization method of the spatial relations of tumor and coagulation combined with color overlays superimposed onto slice images support objective evaluation of the treatment success.
SUMMARY
In a retrospective clinical study, it is confirmed that the software-assisted method allows physicians to correctly identify local tumor recurrence with a higher percentage than the conventional method (sensitivity: 0.6 vs. 0.35), whereas the percentage of correctly identified successful ablations is slightly reduced (specificity: 0.83 vs. 0.89).

Medical Graphic Viewer Interface: Our Trial on Game Controller, Eye-tracking and Touch-less Gesture Motion Capture

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LL-INE3221

Dai Miyanaka
Jian Dong
Xinyuan Zhang
Yoshihiko Hayakawa
Takatoshi Onoue
Takahumi Ono

PURPOSE/AIM
We have developed the blink counter system. We applied it to the eye-tracking interface for the medical graphic viewer system. The system using a game controller as the pointing and tracking devices for the virtual 3-D space was also developed. By the way, touch-sensitive panels are used for contemporary mobile communication devices. But the touch panel operation is difficult for clinicians not only in surgical operation rooms but in medical and dental offices. Therefore, we developed the touch-less interface using two web-cameras. We present three trials.
CONTENT ORGANIZATION
OpenCV, free image processing and recognition algorithm libraries, were applied for the object detection, face recognition, hand recognition and the distance measurement and realized for the correspondence between clinicians' hand gestures and the pointing cursor motion. The face recognition was well worked. 7000 patterns of the hand motion were inputted as the pattern learning and the feature extraction. Applying the dynamic subtraction, etc., our touch-less interface showed the accuracy.
SUMMARY
Our trials to create alternatives for the medical graphic viewer interface are described. They are a game controller device, an eye-tracking system and a touch-less gesture motion capture. Such intuitive operations show potentials.

A System for Visual Information Retrieval in Images, Radiology Reports and the Medical Literature

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LL-INE3234

Dimitrios Markonis , MSc
Rene Donner
Thomas Schlegl
Markus Holzer
Georg Langs
Henning Muller , PhD

PURPOSE/AIM
The enormous amount of visual data in PACS and the medical literature grows exponentially, also with the appearance of new imaging methods. Most current information search tools in radiology do not fully exploit new technologies and often allow only patient-based access. In this study, the medical image search prototype of the KHRESMOI project is presented. The application aims to assist radiologists when an unknown pathology is met during clinical work and in searches related to teaching and research.
CONTENT ORGANIZATION
The system allows searching for visual information by combining content-based image retrieval (CBIR) and text retrieval using also semantics technology. It includes, among others, searching by marking ROIs in 3D images, relevance feedback and links between 3D results and 2D images published in medical articles. They are demonstrated on a set of radiology reports with 5TB of PACS images and articles of the biomedical literature with over 1.5 million images. Recent user tests reported that radiologists quickly adapted to the new tools and showed intention in using them in practice.
SUMMARY
The prototype of a novel medical image search system is demonstrated. The goal was to integrate state-of-the-art information retrieval techniques into a medical application to be used by radiologists to improve their visual information search possibilities.

An Open Source, Rich-client Web Application for Visualizing DICOM RT Data

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LL-INE3235

Brent J Liu , PhD
Ruchi Deshpande , MS
Jorge Documet
Wanwara Thuptimdang
John J Demarco , PhD
Patrick Kupelian , MD *
Daniel A Low , PhD *

PURPOSE/AIM
There is a lack of open source applications that allow users to work with complex DICOM RT data objects in a platform independent manner and are modular enough to allow easy integration into other web-based systems. We aim to develop open-source, web-based tools that allow users to visualize DICOM Radiation Therapy data in their web browsers as well as embed these functions in their web applications. This data includes CT images, Dose Volume Histograms, Region of Interest overlays and Isodose curves derived from CT Images, DICOM RT Structure Set, Dose and Plan objects. This tool-kit will be available for download on GitHub after validation by an expert in Radiation Oncology.
CONTENT ORGANIZATION
This computer exhibit will include a demonstration of: (1) Our DICOM RT visualization tools, including real-time user interaction with the system; (2) How to

download, install and utilize this tool-kit as a stand-alone application; and (3) How to effectively integrate relevant pieces of the tool-kit into other web applications.
SUMMARY
We have developed an open source JavaScript DICOM parser, which will be used in building web-based visualization tools for DICOM RT data. DICOM files are read and rendered directly from the user's file system, thus eliminating the need to send them to the server and ensuring patient privacy.

Improving Radiology Workflow with a Scriptable Automated Protocoller

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LL-INE3241

Rohit Ramanathan , MD
Sarfaraz Sadruddin , MD
Leonardo I Valentin , MD
Sean D Raj , MD
Naveen Garg , MD *

PURPOSE/AIM
Current and impending changes in reimbursement have changed the landscape of radiology and it is becoming increasingly important to abide by meaningful use of imaging studies. Emphasis on quality, safety and efficiency puts pressure back on the radiologist to protocol studies and tailor it to the right clinical situtation. Routinely, a radiologist protocol's on the order of 75-100 studies per day parsing through an extensive list of medications to reconcile, and lab results for creatinine. A mundane appearing task that should take less than one minute per protocol extends into a whole hour for protocols with disruptions in workflow. We offer a simple solution based on a scripting model to automate the protocolling process.
CONTENT ORGANIZATION
We implemented a scriptable program with AutoHotkey, and abstracted relevant patient information from EPIC EMR. We automatically parsed the data for reason for study, medications, most recent creatinine, and after a series of checks and balances for allergies, and normal GFR, our program goes through a hard-coded decision tree to arrive at a protocol. A GUI displays the final computed protocol and with one keystroke, protocol is complete for one patient.
SUMMARY
Scriptable automation is an easy way to improve workflow and future application will focus on machine learning adaptations to accomplish auto-protocol.

National Library of Medicine (NLM) Literature Searches Demonstration

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IN

LL-INE3251

PURPOSE/AIM
NLM Literature Searching Consultation Area offers demonstrations of the free resources of the National Library of Medicine (NLM) (http://nlm.nih.gov/) and the Neuroimaging Informatics Tools and Resources Clearinghouse (NITRC) (http://www.nitrc.org/). Search PubMed/MEDLINE, the premier citation database, on individual workstations with one-on-one assistance from health sciences librarians. Improve your searching skills and discover tools to keep up with the latest publications. Tour related free NLM databases including those focusing on images and drugs. View demonstrations of the NIH-funded free NITRC website including the Image Repository (NITRC-IR) and the collaboration environment NITRC-R, a Resources Repository. This site collects, points to, and enables the comparing of neuroimaging tools and software and offers user provided ratings and reviews. In addition to tutorial brochures, materials for the in-person classes on PubMed and on online databases taught by NLM librarians will be available; as well as assistance in several languages.

RSNA/IHE Image Sharing Demonstration

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LL-INE3252

PURPOSE/AIM
The IHE Image Sharing Demonstration will showcase developments in radiology informatics, standards-based interoperability and image sharing. The demonstration will include:

- Exchange of medical images and reports using personal health record (PHR) accounts as in the RSNA Image Share pilot project, funded by the National Institute of Biomedical Imaging and Bioengineering (NIBIB). The image exchange architecture is based on the IHE Cross-enterprise Document Sharing for Imaging (XDS-I) profile.
- Patient radiation dose monitoring in local and national settings based on DICOM Dose Structure Reports (SRs) and the IHE Radiation Exposure Monitoring (REM) profile.
- Ordering and scheduling of radiology procedures using procedure names from the RSNA RadLex Playbook.
- Generation of radiology diagnostic reports using structured templates developed by the RSNA Reporting Committee and including RadLex terminology.
- Exporting image data exported from PACS using the IHE Teaching File and Clinical Trial Export (TCE) profile and using this data to author teaching files and processing of images for clinical trials using the RSNA MIRC software.

RSNA/IHE Image Sharing Demonstration

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LL-INE3252

PURPOSE/AIM
The IHE Image Sharing Demonstration will showcase developments in radiology informatics, standards-based interoperability and image sharing. The demonstration will include:

- Exchange of medical images and reports using personal health record (PHR) accounts as in the RSNA Image Share pilot project, funded by the National Institute of Biomedical Imaging and Bioengineering (NIBIB). The image exchange architecture is based on the IHE Cross-enterprise Document Sharing for Imaging (XDS-I) profile.
- Patient radiation dose monitoring in local and national settings based on DICOM Dose Structure Reports (SRs) and the IHE Radiation Exposure Monitoring (REM) profile.
- Ordering and scheduling of radiology procedures using procedure names from the RSNA RadLex Playbook.
- Generation of radiology diagnostic reports using structured templates developed by the RSNA Reporting Committee and including RadLex terminology.
- Exporting image data exported from PACS using the IHE Teaching File and Clinical Trial Export (TCE) profile and using this data to author teaching files and processing of images for clinical trials using the RSNA MIRC software.

The Society for Imaging Informatics in Medicine (SIIM)

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LL-INE3253

Computer Assisted Radiology and Surgery (CARS)

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LL-INE3254

'Baptism By Fire': Challenges to Testing and Upgrading PACS, RIS and Voice Recognition Systems: Daily Issues and Practical Resolutions

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LL-INE4609

Perry S Gerard , MD
Michael Seiler , BS
Neil Kapadia , MD
Adele Brudnicki , MD
Zvi Lefkovitz , MD

PURPOSE/AIM

To define what systems are involved in the electronic radiology imaging.
To outline the important considerations of choosing new vendors and systems for RIS and PACS systems.
To define the practical issues, upgrading, testing, and integrating radiology information systems.
To recommend methods and solutions for the problems that may arise when switching to a new system.
CONTENT ORGANIZATION
HIS/RIS/PACS- What systems are involved?
Considerations when choosing a new system or switching vendors
• Networking
• Web vs client/server based
• User Interface/ Common logons
• Integration of HIS, RIS, PACS and Voice recognition systems
• Customizability
Testing utilizing dashboards and data mining
Adapting New Technology
• Cloud based solutions
• Mobile Radiology ViewersTraining staff for new features/tools
Maintenance Issues

SUMMARY
To learn various systems involved in electronic radiology imaging and the important aspects of choosing a RIS/PACS system.
To understand various methods for testing and maintaining RIS.
To be able to make informed decisions when evaluating new system choices.

From the Back of a Napkin to the App Store: How to Create and Submit an Educational iPad Application to the Apple App Store

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LL-INE4610

John D Bisges , MD *
Daniel T Hankins , MD

PURPOSE/AIM
To describe the process of building an educational application for the iPad or iPhone, from initial design to refining and updating the finished product as a living educational tool.
CONTENT ORGANIZATION
A. Conception and Design
B. Writing the Program Code
C. Initial Testing and Refinement of the Application
D. Submitting a Finished Application
E. Updating the Application.
SUMMARY
The advancement of smartphone and tablet technology is increasingly becoming a strong influence on the practice and teaching of radiology. We built a free educational iPad application describing a topic in musculoskeletal radiology. We submitted this application to the Apple iTunes Store, where it was approved and has been downloaded several hundred times worldwide since its release. We discuss the process of building an application for the iPad or iPhone, from conception to implementation to testing to refining and updating the finished product as a living educational tool.

The PET-CT Report: What Oncologists Want to Know

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LL-INE4611

Abigail V Berniker , MD
Oleg Teytelboym , MD

PURPOSE/AIM

- Summarize trends in radiology reporting
- Address the paucity of standardized reporting in PET-CT with a review of the literature/current guidelines
- Outline information oncologists need from a PET-CT report
- Propose better consistency in communicating tumor staging and tumor response assessment
- Share data analysis of PET-CT reports at our institution

CONTENT ORGANIZATION
Overview Radiology reporting

- Historical background and literature review
- Trends toward universal structure and better communication: RadReport, BI-RADS, LI-RADS

Need for standardized oncologic PET-CT reporting to better assist oncologists in patient management

- Communicate initial tumor staging based on AJCC 7th edition
- Characterize tumor response to treatment with formal criteria such as RECIST 1.1, PERCIST

Data analysis of PET-CT reports from our institution 2008-2012, before and after an effort to standardize reporting Summary
SUMMARY
Structured reporting is increasingly important in radiology. However, there remains little consistency in PET-CT reporting, leading to confusion among referring oncologists and patient mismanagement. Interpreting radiologists should construct clear reports that include formal tumor staging and treatment response assessment to better guide oncologists in the care of these complicated patients.

Alzheimerâ€™s Disease: Can Z-score Mapping Quantify Temporal Horn Volume of Lateral Ventricle on CT Images?

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LL-INE4612

Noriyuki Takahashi
Yongbum Lee , PhD
Du-Yih T Tsai , PhD
Eri Matsuyama , PhD
Toshibumi Kinoshita , MD, PhD
Tomomi Omura
Kiyoshi Ishii , MD

PURPOSE/AIM
Measuring the volume of temporal horn of lateral ventricle (THLV) is of importance for diagnosis of Alzheimer's disease (AD). Various automated segmentation methods for MR images have been developed for diagnosis of AD. However, segmenting THLV on CT images is considerably difficult due to low contrast in CT images. The purpose of this exhibit is to demonstrate a z-score mapping method for quantifying the volume of THLV on CT images.
CONTENT ORGANIZATION

- Importance of measurement of THLV for diagnosis of AD
- Review of segmentation methods on MR images
- Difficulty of segmentation of normally small THLV on CT images
- Details of the z-score mapping method based on voxel–by-voxel analysis for quantifying the volume of THLV on CT images.

SUMMARY
In general, the z score mapping is used to detect early CT sign of acute stroke on CT images. In this study, we applied this method to measure the volume of THLV. The proposed method calculates z score and uses it as an index of the volume of THLV. The performance of the proposed method was evaluated in 40 cases with various sizes of THLV. As a result, z-score value had a good correlation (r = 0.96, p

Patient Status Displays for Radiology Departments: Helping Us, Helping Our Clinicians

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LL-INE4613

Tim O'Connell , MD, MEng *
Jeremy R Wortman , MD
Aaron D Sodickson , MD, PhD
Ramin Khorasani , MD *

PURPOSE/AIM
Workflow in radiology departments can be complex and is often not well understood by our clinical colleagues. Through the creation of both interactive and kiosk-style displays, radiology departments can allow clinicians to see real-time patient status. A kiosk-style 'big board' display for use in the Emergency Radiology setting is reviewed to show ER clinicians the status of their patients, and an interactive 'patient tracker' tool is reviewed to display a patient's scheduled and recent examinations and their status. By providing status information to the clinical teams, radiologist and technologist interruptions may be reduced and referring clinician satisfaction may be improved.
CONTENT ORGANIZATION
A. Overview of real-time displays and visual control
B. Data sources and methods to create real-time displays
C. Kiosk-style display for the Emergency Radiology department
D. Interactive patient tracker
E. Description of workflow impact
SUMMARY
Techniques are presented to provide clinical teams with real-time information about their patients' status in the radiology workflow. The viewer should gain insight into:
1. How real-time displays can aid clinical workflow
2. Possible improvements in radiologist workflow with the use of real-time displays
3. Techniques used to create real-time radiology status displays

PrelimCheck: Software to Facilitate Follow-Up of Resident Preliminary Reports

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LL-INE4614
Phillip M Cheng , MD, MS

PURPOSE/AIM
At our academic medical center, residents make preliminary notes in PACS while on call duty. Although such independent radiologic interpretation is essential to resident training, its effectiveness requires feedback regarding the accuracy of the interpretations. The purpose of this exhibit is to illustrate an open source tool for follow-up of resident preliminary notes, allowing residents to rapidly evaluate their notes for discrepancies compared to final dictated reports.
CONTENT ORGANIZATION
A. Introduction 1. Preliminary radiologic interpretations on call 2. The problem of feedback: volume of cases and steps required for manual comparison of preliminary and final reports B. PrelimCheck 1. Usage with Fuji Synapse PACS a. Specification of interval and location for retrieval of preliminary notes and final reports b. Network performance 2. User interface features a. Multiword filtering of retrieval set by author and keywords b. Autoscroll of report text to impression c. Saving data sets as CSV files C. Evaluation - Survey Data, March 2013 1. Usage by residents by training year 2. Usability 3. Effectiveness 4. Comments on strengths and weaknesses
SUMMARY
PrelimCheck, an open source application, facilitates resident follow-up of independent preliminary reports on call.

Taking Radiology Education to the Next Level: Simple Approach on How to Create a Tablet Based Interactive Multimedia Teaching Module Using Apple iBooks Author Software

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LL-INE4615
Sanjay K Paidisetty , MD
Joseph J Budovec , MD
Rahul N Sawlani , MD
Scott J Erickson , MD

PURPOSE/AIM
Electronic books capitalize on tablet technology and address the need to efficiently maintain an up to date Radiology curricula. In 2012, Apple released iBooks Author, a free application, which greatly facilitates development and publication of electronic books containing interactive curricula. The degree of user interaction exceeds that of other electronic book formats and is highly desirable in image intensive academic radiology. With the demand of clinical and academic responsibilities, learning how to use new software can be daunting. This educational exhibit will familiarize the learner with the Apple iBooks Author software and provide a simple approach to create an interactive multimedia teaching module.
CONTENT ORGANIZATION
-Brief video based demonstration of the software's layout, key features, and organization of content. -Video based step-by-step instruction taking the learner from a blank template to a fully developed module containing: primary text; interactive image galleries; embedded PowerPoint presentations, articles, and videos; scrollable image stacks; hyperlinks to external sites; and quiz questions. -Instructions on how to distribute content.
SUMMARY
Apple's iBooks Author software is a very user friendly and free. Anyone can learn to use. It has significant potential to help take Radiology education to the next level.

Natural Language Processing: An Overview in Healthcare and Imaging Informatics and How It can Impact Your Practice

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LL-INE4616
Paras Lakhani , MD
Christopher G Roth , MD *
Raja Gali , MS
Richard E Sharpe , MD, MBA
Richard J Gorniak , MD
Vijay M Rao , MD
Adam E Flanders , MD

PURPOSE/AIM
The purpose of this exhibit is: To provide an overview of Natural Language Processing (NLP). To highlight the capabilities of NLP, both in radiology, healthcare informatics, and beyond. To provide examples of what has been done in informatics and NLP. To discuss future directions of NLP. To provide a roadmap for starting NLP-projects at your institution.
CONTENT ORGANIZATION
1. Overview of NLP a) Definition b) Basic Principles with examples 2. NLP and its use outside of healthcare a) Examples 3. NLP within Healthcare and Imaging Informatics a) NLP Solutions to Basic Problems in Imaging Informatics i.) Critical Results ii.) Structured Reporting iii.) Information Retrieval and Document Classification 4. Future Directions 5. Basic Steps on how to start using NLP at your institution a) Freely available NLP toolkits b) Online-resources and computer programming requisites.
SUMMARY
The major teaching points of this exhibit are: 1. Learn the capabilities and principles of NLP, both in imaging and healthcare informatics and beyond. 2. Understand current NLP solutions. 3. Learn about future directions of NLP within imaging informatics. 4. How to start an NLP project for quality assurance and performance improvement.

The Use of Infographics as a Means of Enhancing Patientsâ€™ Understanding of Their Imaging Results and Conditions, and in This Way Enhance Adherence to Treatment and Patient Cooperation

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LL-INE4617
Andres Vasquez , MD
Jorge A Abreu , MD
Juliana Ocampo , MD
Yenny A Moreno Vanegas , BSc
Alicia Londono , MSc
Javier A Romero , MD

PURPOSE/AIM
Radiological reports contain plain and complicated information for patients. Infographics consist in the use of graphic presentations with communicative ends.

Currently the use of infographics is expanding globally in many fields due to the fact that they permit communicating in an effective and graphic manner, enabling different groups to understand complex information. The purpose of this work is to present and review the use of infographics in radiological reports in order to facilitate the understanding of patients of their own study results and pathologies.
CONTENT ORGANIZATION
- Description of infographics - Implementing Infographics in radiology reports - Examples of radiological reports in which infographics can be useful in regards to patient education
SUMMARY
There are several radiological studies in which the implementation of infographics can help patient acquire a deeper understanding of their study results and conditions. This can in turn increase adherence to treatment and patient compromise. They represent a didactic mean of convening information to patients.

Abras 2: A Rapid Application Development Environment for Prototyping and Deploying Quantitative Imaging Software and Observer Study Interfaces

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LL-INE4618

Adam Starkey
William F Sensakovic , PhD
Samuel G Armato , PhD

PURPOSE/AIM
Medical imaging research often requires the development of many pieces of custom software over the course of a study. These software tools may be needed for tasks such as the initial collection of suitable scans, observer study interfaces, and for final QA. While many of these tools will be similar to tools used in other studies, it is rare that a one-size-fits-all solution can be applied, thus creating a need for new tools to be developed for each research study. In practice however, the development of such software is time consuming even for experienced programmers, and short lead times greatly increase the risk of software errors that, at worst could produce erroneous data. For this reason we have created a tool that allows even inexperienced programmers to quickly produce robust custom medical imaging applications.
CONTENT ORGANIZATION
* A step-by-step process for creating an observer study interface using Abras. * Examples of how Abras may be used to aid the development and tuning of CAD algorithms. * Examples showing how Abras can be used to develop software for large multi-site trials.
SUMMARY
The Abras software lowers the costs and risks associated with custom interface development. A development environment that is tightly focused on the specifics of medical imaging is expected to offer researchers a powerful and unique tool.

Advancement in Computer Aided Detection in the Diagnosis and Characterization of Pulmonary Nodules

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LL-INE4619

Luca Saba , MD
Michele Anzidei , MD
Jasjit S Suri
Mario Piga
Daniela Berritto , MD

PURPOSE/AIM
The purpose of this work is 1) To review the current indications for performing pulmonary nodule computer aided detection system) 2) To describe a pulmonary nodule CAD system and logical pathway to obtain the nodule detection and characterization. 3) To learn the CT technical parameters and the software to be used. 4) To understand the actual limits of CAD systems and with a focus on the “False Positive” problem.
CONTENT ORGANIZATION
1) Indications for performing pulmonary nodule CAD, underlining radiation exposure, cost, diagnostic efficacy, sensitivity and specificity. 2) Mathematical introduction about pulmonary CAD and principles of segmentation. 3) Logical pathway to obtain the nodule detection and its characterization (benign\malign) 4) CT technical parameters and the software to be used 4) Limits of CAD systems.
SUMMARY
Early detection of lung cancer may allow a more timely therapeutic intervention and a more favourable patient prognosis. The sensitivity of multi-detector-row CT is higher in the detection of lung cancer than chest radiography and the development of multi-detector-row CT technology has made possible to acquire data of lungs with unprecedented spatial resolution. The efficacy of CAD systems is very high by using it together with radiologist. In CT data analysis a problem to be solved is the high number of false positive.

So You've Created a Big Radiation Exposure Database. Now What?

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LL-INE4620

Luciano M Prevedello , MD,MPH
Tim O'Connell , MD, MEng *
Ramin Khorasani , MD *
Aaron D Sodickson , MD, PhD

PURPOSE/AIM
To describe the steps involved in extracting, cleaning and presenting aggregate radiation dose information to support quality improvement efforts.
CONTENT ORGANIZATION
Introduction
Overview of common techniques to mine PACS for radiation dose databases
-DICOM header information
-Optical character recognition of dose report screen captures
-DICOM structured reports
Data cleansing and visualization
-The Role of Business Intelligence
-Dealing with the inherent noise in the data
->Naming inconsistencies
->Topograms and Monitoring Scans
->Missing and Duplicate Data
->Incorrect data associations
-Representing the Data - what and how to aggregate
->Irradiation-event versus Encounter level data
->CTDIvol versus DLP
Useful techniques
-Linking to image viewer
-Protocol and scan-part groupings
-Outlier classification and resolution utility
Use cases
-Protocol cleanup
-Outlier detection and investigation
-Trend analysis
Summary
SUMMARY
This exhibit will review:
a. Common techniques to mine PACS for radiation dose extraction purposes.
b .Frequent issues that generate noise within the data.
c. How to solve database inconsistencies using Business Intelligence techniques.
d. Specific case examples in which analytical tools may be useful for monitoring radiation dose.

Turbocharge Your Academic Productivity: A Radiologist's Primer for Getting Things Done

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LL-INE4621

Amanda Lackey , MD
Tarun Pandey , MD, FRCR
Chandana G Lall , MD

Neeraj Lalwani , MD
Mariam Moshiri , MD
Puneet Bhargava , MD

PURPOSE/AIM
1. With increasing patient volume, decreasing reimbursement from healthcare reform and academic time the radiologist today feels more pressured than ever! 2. We analyze and illustrate the usefulness of productivity techniques and tools which when correctly implemented have the potential for dramatically improving work productivity.
CONTENT ORGANIZATION
1. Understanding concepts of Getting things done®, Pomodoro technique®, Inbox zero, serial monotasking, conveyer belt approach, file tickler system, team building, and collaboration 2. Optimizing your personal computer (software): indexing tools, text expanders, to do list manager, clipboard manager, bookmark sharing, note taking applications, password manager, reference manager, digital academic portfolio, mind mapping programs, voice dictation, advanced calendar applications 3. Hardware for paperless workflow: Sheet feed scanner, dual monitor set up, voice dictation microphone 4. Email ninja techniques: batching, automating, avoiding using inbox as a to do list, scheduling email time, decreasing use
SUMMARY
After viewing the exhibit, the viewer will be able to improve personal productivity by incorporating changes suggested and using technological tools which will help save valuable time and improve work flow.

TAG Bar Codes and Near Field Communication (NFC) Technology: A New Way to Empower Patient Education

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LL-INE4622

Andres Vasquez , MD
Yenny A Moreno Vanegas , BSc
Jorge A Abreu , MD
Sergio A Puentes , MS
Bibiana Pinzon , MD
Alfonso Esguerra , MD

PURPOSE/AIM
The use of QR codes in Diagnostic Imaging Departments has been previously explored. However, the concept and use of these codes can be complicated for many patients. With the evolution to the TAG bar code and Near Field Communication (NFC) technology, approaching patients can be easier due to the friendly design, ease of use and ease of follow up. The purpose of this work is to present and review the implementation of this technology in the field of patient education in radiology departments.
CONTENT ORGANIZATION
- Description of the TAG bar codes (what they are, characteristics, uses, Tag and Real Time Location, comparison with previous technologies "QR codes") - Near Field Communication (NFC) technology - How to implement this service in the field of patient education in radiology - How to use the analytics to identifying the patient needs in education. - Our experience in patient education
SUMMARY
TAG bar codes are an effective mean of communicating with patients, being able to provide valuable information regarding security, necessary preparations, studies and reports. They are easy to implement and can enable Diagnostic Imaging Departments.This technology can contribute to a closer understanding of patients' needs in regards to educational information in radiology in a low-cost, ecologic manner.

Inexpensive IT Solutions for Teaching of Clinical Anatomy and Radiology Correlation

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LL-INE4623

Jacqueline Alvarez , BA
Andre J Duerinckx , MD, PhD
James Wilson , PhD
Darah N Wright , MS
Jean Sebastien Rowe , BS
Sanmeet Singh
Faezeh Razjouyan
Chijindu R Nworgu , BS
James S Teal , MD
Kamyar Sartip , MD
Han Kim , MD
Bonnie C Davis , MD

PURPOSE/AIM
Medical schools are continuously struggling with ballooning IT budgets while trying to offer students access to computer based learning. Inexpensive DICOM viewers and anonymous HIPAA compliant radiology image data sets are widely available and provide low cost tools for first year medical student education in clinical anatomy and radiology correlation. Teaching of image interpretation and imaging software navigation is important to budding physicians. Initiating these skills early in medical training could have an important impact on patient safety, satisfaction, and medical care quality by enhancing effective communication between radiologists, referring physicians, and patients.
CONTENT ORGANIZATION
1. Review inexpensive IT solutions for computer based clinical radiology and clinical anatomy learning.
2. Report on two years of experience with our inexpensive IT solutions and the educational value of this teaching model (using computerized quizzes and surveys).
SUMMARY
Using these inexpensive IT tools, students are becoming more comfortable with multiple imaging modalities which enhance retention of clinical anatomy, and believe that future communication with radiologists will be improved. Future work will include a study of the impact of this early exposure to radiology on: medical licensing exam performance, clinical rotations, and residency experience.

Designing/Enhancing Patient Safety Initiatives with NEMA XR25 CT Dose Check: Stewardship through Active Mitigation of CT Radiation Dose Events

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LL-INE4624

Jenifer W Siegelman , MD, MPH
Alphonso Magri , PhD
Les R Folio , DO, MPH
Dustin A Gress , MS
Marie K MacGregor , MPH *
Vana M Derderian , BS
Julius Kocsondy , MBA
Mark P Supanich, PhD *

PURPOSE/AIM
Step-by-step approach to optimize patient safety through development of institution-specific scanner dose alerts and notifications (CT Dose Check) which can be effective across multiple scan types, multiple CT scanners and manufacturers. Graphically depict to radiology professionals basic and advanced concepts needed to take full advantage of the useful NEMA (National Electrical Manufacturers Association) /MITA XR25 Smart Dose Alerts and Notifications.
CONTENT ORGANIZATION
Historical Review

1. RDSR vs Dose Summary Page Extraction
2. Audit Method
3. Dashboard Method

Data Collection

1. Scanner Capabilities
2. Current Modulation
3. kVp Availabilty

Data Display

1. Spreadsheet Method
2. Histogram Compilation Method

Benchmark Comparison

1. Diagnostic Reference Levels (DRL)
2. ACR Dose Index Registry (DIR)

Special Considerations

1. Appropriate Threshold Choice
2. Timing Bolus
3. Alarm Fatigue
4. Legacy Equipment
5. Technologist Training

SUMMARY
Improvement of patient safety through effective implementation of dose alerts and notifications requires fastidious attention to scanner-specific and protocol-specific details, careful data collection, awareness of current practice and local and national benchmarks.

Transitioning to Electronic Books: Easier Than You Think

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LL-INE4625

Joseph J Budovec , MD
Sanjay K Paidisetty , MD
Scott J Erickson , MD

PURPOSE/AIM
Electronic books (e-books) are quickly becoming the preferred reading medium of residents. E-books provide a visually rich layout with color, imagery, multimedia, and interaction. Although a number of publishing platforms now exist for creating digital books, Apple's iBooks Author is currently considered to be the best option for publishing image rich interactive content. Transitioning previously created content to an e-book may be a time consuming endeavor. The purpose of this exhibit is to demonstrate how to transition static presentations, usually in the form of Microsoft PowerPoint slides, into dynamic, image-rich documents.
CONTENT ORGANIZATION
• Creating a template
• Importing PowerPoint slides
• Embedding video galleries
• Importing and embedding PACS images
• Creating interactive review questions
• Managing and distributing e-books
SUMMARY
E-books are revolutionizing education, permitting an interactive, media rich experience. As educators, we need to adapt our current static content to a more accessible media format. Transitioning previously created lecture material into dynamic, media and image rich documents is relatively easy and straightforward.

Feasibility of a Generalized Informatics Framework for Cohort Identification, Hypothesis Generation, and Retrospective Data Analysis for Radiology Research

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LL-INE4626

Cesar A Lam , MD
Christina Eldredge , MD, MS
Nadia Ahmad , PhD
Bradley W Taylor , BS
Charles E Kahn , MD, MS *

PURPOSE/AIM
Repositories of radiology reports and electronic health data provide opportunities to facilitate research. The i2b2 (Biology to the Bedside) project provides an open-source, scalable framework to link biomedical research datasets to clinical record systems. i2b2 has been developed to bridge the biological and clinical research domains to advance the study of genomics. The i2b2 software can be used to query a local institution's patient population to obtain de-identified data, identify cohorts, generate hypotheses, and analyze retrospective data. The purpose of this exhibit is to review i2b2 and its use in radiology research.
CONTENT ORGANIZATION
1. i2b2 overview, architecture and query capabilities
2. Clinical and radiological query examples
3. Benefits, limitations, and potential applications
SUMMARY
Electronic medical record systems store vast amounts of data for management of patients. Accessing and applying such information for research studies can be a daunting task. Powerful software such as i2b2 can be useful for pre-screening, power analysis, and feasibility testing of radiology research studies. Potential collaboration with other institutions with i2b2 capabilities would allow larger sample sizes. The ability to streamline and facilitate investigations has the potential to advance the quality of clinical and translational research in radiology.

How to Correctly Denoise PET and MRI-PET Images: Current Approaches, Constraints, and Future Trends

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LL-INE4627

Awais Mansoor , PhD
Ulas Bagci , PhD, MSc
Brent Foster
Ziyue Xu , PhD
Daniel J Mollura , MD

PURPOSE/AIM

1. To review the physics of denoising PET and MRI-PET images.
2. To explain the state-of-the-art methods for denoising PET, PET-CT, and PET-MRI images.
3. To define the constraints of PET denoising.
4. To propose the future trends of PETand MRI-PET denoising.

CONTENT ORGANIZATION
1. Introduction 2. Physics of PET and MRI-PET denoising 3. State-of-the-Art Denoising Approaches a. Kernel Based Methods i. Gaussian ii. Bilateral iii. Singular Value Soft Thresholding iv. Local Adaptive Diffusion b. Statistics Based Methods c. Multi-resolution Based Methods i. Wavelets ii. Laplacian Filters d. Denoising Methods i. Intensity standardization ii. Inhomogeneity correction iii. MRI denoising 4. Constraints a. Edge Preservation b. Clinical Preservation (SUVmean1, SUVmax,etc.) c. Imaging Marker Preservation for Post Processing d. Common Fallacies 5. Concluding Remarks and Future Trends
SUMMARY

- Reviewed the basic principles behind denoising images.
- Reviewed state-of-the-art denoising methods for PET and MRI-PET images.
- Reviewed denoising constraints.
- Discussed future trends for denoising PETand MRI-PET images.

Challenges, Techniques, and Advancements for State-of-the-Art PET Image Segmentation

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LL-INE4628

Brent Foster
Ulas Bagci , PhD, MSc
Awais Mansoor , PhD
Ziyue Xu , PhD
Daniel J Mollura , MD

PURPOSE/AIM

1. To present current state-of-the-art PET image segmentation techniques
2. To provide an assessment of the current methods and the current challenges of PET image segmentation—challenges, accuracy, and usability
3. To discuss recent developments in PET image segmentation and define which segmentation techniques are most effective

CONTENT ORGANIZATION
1) Introduction
2) Background for PET imaging, from infancy to state-of-the-art technology
3) Challenges of PET image segmentation
a. Resolution related issues
b. Noise
c. High smoothing from attenuation correction
d. Discontinuous boundaries
e. Large variability of pathologies
4) Segmentation Evaluation
a. Surrogate ground truth creation
b. Commonly used quantitative measures
5) Semi-automated Segmentation Methods
a. Region based
b. Intensity based
6) Automated Segmentation Methods
a. Machine learning classification/clustering methods
b. Optimal thresholding value selection
7) Recent Advancements in PET Image Segmentation
SUMMARY

- Review general background and the challenges of PET image segmentation
- Emphasize which state-of-the-art PET image segmentation techniques are most effective
- Define where users can locate PET segmentation methods that will quantify different anatomical regions

The Malpractice Liability of Radiology Reports: What can You Do to Minimize the Risk

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LL-INE4629

Aparna Srinivasa Babu , MD
Michael L Brooks , MD, JD

PURPOSE/AIM
According to a study published in Radiology by Baker and colleagues, the likelihood of a radiologist being the defendant in at least one suit is 50% by age 60. A radiologist's report is the single entity by which he/she is recognized. This exhibit is a comprehensive evaluation of malpractice issues related to radiology reports.
CONTENT ORGANIZATION
SUMMARY
In today's contentious society, there is no escaping the practice of defensive medicine. This exhibit helps readers develop an understanding of the legal implications of radiology reports and may enable radiologists to develop strategies to avoid malpractice lawsuits.

Can We Talk? Enhancing RIS-EMR Integration to Facilitate Clinical Care

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LL-INE4630

Judah Burns , MD
Mary Munnelly
Kathy Dornbush
Amichai J Erdfarb , MD

PURPOSE/AIM
The purpose of this exhibit is to highlight the multiple elements that underly successful integration of radiology order-entry into a larger electronic medical records system (EMR). Successful integration is a tangible goal which requires input from a variety of both physician and non-physician sources.
CONTENT ORGANIZATION
Using an outline format, we will review the various stages of successful RIS-EMR intergration. Tables and flow chartrs will be used to highlight complex orocesses. The various stages of planning include:

- Pre-planning
- Inpatient vs. outpatient electronic order entry
- Physician steering committee
- Content organization vs. disorganization
- Overcoming technological hurdles
- Buy-in
- Follow-up enhancements

SUMMARY
Smooth integration of radiology order-entry into any EMR environment is essential in an increasingly digital medical environment. Successful systems can help reduce medical error, improve quality of care and facilitate medico-legal compliance and coding/billing systems.

Appropriate Statistical Methods for Radiologists: Life beyond 'p' Value and ROC Curve

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LL-INE4631

Vasanthakumar Venugopal , MD
Ashok K Sharma , MD
Santosh K Arjun , MBBS

PURPOSE/AIM
1. Enumerate the appropriate statistical tests for different research designs
2. Describe the commonly encountered stastical errors in research articles
3. Briefly outine some statistical guidelines that can be followed by authors
CONTENT ORGANIZATION
The Exhibit is organised under following headings:
1. Types of data
2. Radiological research designs
- Common types
- Appropriate stastistical models for the research designs
3. Sample Size Estimation
4. Correlations and Regressions
5. Measures of agreements
6. ROC curve - appropriateness and applications
7. Commonly encountered statisitcal errors
8. Some guideliness for authors
SUMMARY
The major teaching points in this exhibit are:
1. Correlations are used to assess the assocation between variables
2. Regression analysis is used to assess the assocation between a characteristic and independent variables
3. Reporting only P values for results is a common statistical error
4. Tables and figures should be used to communicate information, not simply to store data

Navigating Electronic Book Digital Publishing Formats: A Compass for Radiologists and Educators

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LL-INE4632
Joseph J Budovec , MD
Sanjay K Paidisetty , MD
Scott J Erickson , MD

PURPOSE/AIM
Electronic books (e-books) are revolutionizing radiology education. E-books are quickly becoming the preferred reading medium of residents. E-books provide a visually rich layout with color, imagery, multimedia content, and interaction. Digital publishing formats are numerous and varied, with differences between formats and large divergences in purpose, capability, and device support. The purpose of this exhibit is to compare and contrast the advantages and limitations of commonly used digital publication formats with emphasis on radiology education.
CONTENT ORGANIZATION
SUMMARY
E-books are revolutionizing radiology education, permitting an interactive and multimedia rich experience. There are numerous digital publishing formats, each with its advantages and limitations. Choosing the most appropriate format depends upon the desired combination of purpose, capability, and device support.

Interactive Tool to Teach Concepts of Bibliometric Parameters and Analysis

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LL-INE4633
Nickalus R Khan , BSc
Bhumin J Patel
Asim F Choudhri , MD

PURPOSE/AIM
Quantitative bibliometric parameters including impact factor and h-index have become important tools in evaluating academic productivity, however the true meaning of these metrics is often poorly understood. We have created an interactive quiz which teaches the meaning of common and uncommon bibliometric parameters, and gives guidance on how to interpret (and how NOT to interpret) these values.
CONTENT ORGANIZATION
An interactive quiz reviews the nature of journal citation analysis and author-specific bibliometric parameters including h-index, g-index, e-index, m-index, I-10 index, as variants of these including the contemporary h-index. Methods to calculate these values using databases such as Scopus, Web of Science, and Google Scholar will be taught, and the various strengths and limitations of each of these databases will be reviewed. Journal Impact factor will also be discussed, with an emphasis on understanding changes in journal publication patterns such as the trend to not accept case reports.
SUMMARY
Bibliometric parameters have become commonplace in university promotions committee evaluations, and journal impact factors are commonly used to determine where to submit research. A proper understanding of these measures will improve the ability to assess academic productivity.

ISP: Informatics (Education and Research)

Sunday, 10:45 AM - 12:15 PM • S403A

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IN ED

SSA11 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Gary H Danton , MD, PhD
Moderator
Ayis T Pyrros , MD *

SSA11-01 • Informatics Keynote Speaker: Informatics and Education
Gary H Danton MD, PhD (Presenter)

SSA11-02 • An Anonymized Radiological Database with Open-source Search Engine and Image Request System for Biomedical Researchers

Michael D Torno DSc (Presenter) ; **Nicholas P Gruszauskas** PhD ; **Roger Engelmann** MS * ; **Adam Starkey** ; **Paul J Chang** MD * ; **Samuel G Armato** PhD

CONCLUSION
Software which de-identifies and indexes clinical data for a queryable research database was created. Users have the ability to save radiology reports and request de-identified medical images via the system's web interface. Additionally, the opt-out paradigm provided a substantial number of consented patients and maximized the amount of data available to researchers. Autonomous operation of our dedicated research system resulted in minimal PACS performance degradation.

Background
A system to mine, organize, anonymize, and request de-identified images from a radiological database was required to fulfill the needs of biomedical researchers. The system must function autonomously from a clinical PACS to minimize its impact on performance during clinical use. Independent operation allows keyword queries of anonymized radiology reports through a web interface; this interface also functions as a database creation and de-identified image request system. A custom database interface was designed to fill this need.

Evaluation
The software includes (1) Perl and VB apps to extract data from a clinical PACS and anonymize PHI in accordance with IRB and HIPAA standards; (2) an indexing search engine that allows keyword queries via a web browser; (3) PHP-based exporting of queried radiology reports with an option to request associated de-identified images through the Human Imaging Research Office at our institution. An "opt-out" IRB paradigm was created: outpatients in radiology reception areas are presented with an opt-out form to establish consent for use of clinical images and associated data for research.

Discussion
The "opt-out" paradigm began in October 2008; to date 128,000 patients are enrolled and de-identified image data is available for query via our database interface. 1,324 patients have declined the study resulting in a 1% withdrawal rate. Previous "opt-in" paradigms resulted in an enrollment of less than 3,000 patients over a 5 year period. Over 1.2 million radiology reports encompassing over a decade of data were anonymized and indexed from our PACS and are available for use in medical research.

SSA11-03 • Workflow, Standards and Database of Quality Control in Multi-institutional Clinical Trials of Cancer Imaging at the Alliance Imaging Corelab

Jun Zhang PhD (Presenter) ; **David Poon** BS ; **Preethi Subramanian** ; **Richard Jacko** BS ; **Nathan C Hall** MD, PhD * ; **Michael V Knopp** MD, PhD ; **Kristin Sullivant** ; **Ajay Siva** ; **Stephanie Telek** ; **Andrea Markowitz** ; **Talha Saif** ; **Michael Finneran** ; **Katherine Binzel** BS ; **Joe Milacek**

PURPOSE
To introduce and evaluate the workflow, standard and database established at the Alliance Imaging Corelab for cancer imaging quality control in multi-institutional clinical trials

METHOD AND MATERIALS
The imaging Corelab (ICL) established an overall clinical trial implementation pipeline from trial initiative to trial closure. Along the roadmap, workflows of data quality control were defined with more than 15 individual sub-components integrated (site credentialing, virtual site visit, automatic quality check, real-time image remote review and so on). Quality control standard in 15 items under 4-level categories (timing, imaging, data and patient) was established with SOP driven. (Semi)-automatic softwares were developed enabling mega-data processing and database management in 10 important steps and audit process.

RESULTS
A total of 2992 patients with 8246 studies (PET/CT, CT, MR, NM) from 27 clinical cancer trials over 300 participating sites within USA were included in this assessment. The established thin-client real-time image review approach enables off-site reviewers performing remote image review with no data transfer required; a success rate of better than 91% in adaptive trials has been achieved in evaluating over 1500 real-time central reviews of which 75% enabled
CONCLUSION
Quality control is critical component of cancer imaging clinical trials to assure appropriate executions and the success of clinical trial. The study proposed and evaluated our established workflow, standards and database of quality control in 10-yr multi-institutional clinical trials implementations experiences at the imaging corelab with efforts in helping people better understand the components, challenges and strategies of doing quality control for clinical trials.

CLINICAL RELEVANCE/APPLICATION
Conducting multi-institutional clinical trials requires a set of standards and workflows in quality control defined for professional trial implementations making sure trials to be valid and successfu

SSA11-04 ● Implementation and Clinical Evaluation of Content-based Searching Engine in RIS-integrated PACS

Jianguo Zhang PhD (Presenter) ; **Tonghui Ling** MS ; **Jianyong Sun** ; **Suo Li** ; **Yuanyuan Yang** MS ; **Kai Zhang** BS

PURPOSE
We had designed a searching engine combining semantic space searching and CBIR techniques to search lung CT images with solitary pulmonary nodules (SPN) in PACS environment, and presented this prototype system in scientific presentation in 2009 RSNA Conference. In this presentation, we present new approach to extend this searching engine to cover more organs and lesions, gave an implementation of this searching engine in RIS-integrated PACS, and discussed its clinical evaluation.

METHOD AND MATERIALS
The studies of cardiology CT images with coronary heart disease, brain CT and MR images with stroke, and abdomen CT with colorectal cancer as well as lung CT images with SPN, were included in our research. The diagnostic reports of the studies with findings of lesions are first analyzed by a NLP engine and then indexed in an inverted index. The contents of images of related to the reports are identified by their low level features extracted from the ROIs of images containing the lesions and indexed in a specified high-dimensional database. The first step in using this search engine uses the inverted index to search for relevant radiology report matching the symptoms or diagnoses specified by users as query criteria. The second step searches and retrieves the features of images from the high dimensional database associated with each report returned in the first step and computes the feature similarities between user query image and the retrieved images. The final search results are then sorted by similarities computed on the second step.

RESULTS
The developed searching engine was integrated a clinical RIS-integrated PACS, and operated for two years in Huadong hospital in Shanghai. There were about more than 30 cases averagely being searched and retrieved by using this searching engine daily. But the usages of this search engine for the purposes of decision support, research, and education were quite different.

CONCLUSION
The developed content-based searching engine can be easily integrated with a clinical RIS-integrated PACS and has been operating for two years in a hospital. The evaluation results showed that searching engine can be used for the purposes of decision support, research, and education.

CLINICAL RELEVANCE/APPLICATION
The presented search engine is extremely useful to assist radiologists, medical researchers and students to mine meaningful information from PACS and RIS for their decision support, research and case-

SSA11-05 ● Development of a Dedicated Workstation to Facilitate Rapid Performance of Observer Studies in Low-dose CT

David R Holmes PhD (Presenter) ; **Rickey Carter** PhD ; **Kurt E Augustine** MS ; **Yu Liu** MD ; **Maria Shiung** ; **Lifeng Yu** PhD ; **Phillip Edwards** ; **Cynthia H McCollough** PhD * ; **Joel G Fletcher** MD *

PURPOSE
While numerous CT noise reduction methods have been developed, it is difficult to directly measure the clinical impact of each approach. We have developed an open source computer workstation to efficiently conduct observer studies of low dose CT protocols to determine the superiority or non-inferiority of new reconstruction methods.

METHOD AND MATERIALS
The workstation allows a user to conduct lesion detection and characterization, and image quality assessment in a time-efficient manner. The user is required to identify the location and size of all lesions in a dataset by delineating the long axis of the lesion. Both manual and automatic software tools have been developed to match corresponding lesions between an observer and routine dose FBP reference standard. The automatic matching algorithm computes correspondence by determining if the reference ROI overlaps with an observer ROI. Matching rules are employed to insure lesions are appropriately characterized (e.g., benign/malignant) if they are detected. The algorithm reports true positives (TP), false positives (FP), and false negatives (FN) to a back-end database for export and JAFROC analysis.

RESULTS
The automated matching algorithm was validated using ten radiologist observers each reviewing 10 datasets. The study PI created the reference standard based on correlative imaging, follow-up and pathology reports. Observers required an average of 5.6 minutes (range 0.5 25.4) min to review each case. The PI completed semi-automated visual matching of observer and reference marks and diagnoses. The observers delineated a combined 644 lesions (including TP, FP, and FN) across all 10 observers. Automated matching required < 1 second and correctly matched 94.7% of the lesions (compared to the manual matching). Incorrect responses by the algorithm included 11 overmatched (e.g. multiple overlapping ROIs) detections and 23 mis-matches between reference and observer ROIs.

CONCLUSION
A system for interactively evaluating CT denoising methods must minimize radiologist effort, accurately match reference detections and classifications with observer markings using automated and manual visual tools, and create a streamlined workflow and statistical analysis.

CLINICAL RELEVANCE/APPLICATION
Dedicated workstations for observer performance in low dose CT minimize radiologist effort with streamlined workflow and provide automated and visual tools for reference standard matching.

SSA11-06 ● Compression of Radiology Reports Using a Semi-static Dictionary and Directed Pseudoforest

Naveen Garg MD (Presenter) * ; **Peter Kamel** ; **Sarfaraz Sadruddin** MD ; **Jorge Herskovic** MD, PhD ; **David J Vining** MD * ; **Kevin W McEnery** MD *

PURPOSE
A radiologist will generally dictate a normal chest the same way every day, and usually describe the same pathology in a consistent style. Speech recognition systems rely on these recurring patterns of reporting style to develop statistical language models for improving. Because of this, we hypothesized that radiology reports would be highly compressible using static dictionaries. The more commonly used compression algorithms such as gzip obtain approximately 4x compression, but lose random access of the compressed data. In this work, we report on the compression ratios achieved on a large corpus of radiology reports using static dictionaries. We also present a novel method of compressing the static dictionary itself using a directed pseudoforest.

METHOD AND MATERIALS
We constructed dictionaries from a variable number of radiology reports. Dictionaries were constructed using a variation of a generalized suffix tree pruned by a threshold frequency of the suffixes. The dictionary was then itself compressed using a directed pseudoforest, taking advantage of the shared structure between phrases in the dictionary. Source documents were then compressed using the integer indices into the dictionary, coded with a prefix-free entropy code. The algorithm was coded in c++11 with no platform specific dependencies.

RESULTS
Compression ratios improved with increasing number of reports. A million reports compressed to 18.7% of original size including the compressed reports, and dictionary.
These randomly accessible compressed reports were further compressible by gzip, bringing compressed size to 13.7 %. Pruning the dictionary of less frequently used n-grams substantially decreased the size of the dictionary with only a minor increase in the size of the compressed reports. On a million reports, limiting the dictionary to n-grams that occur at least 30 times in the corpus results in overall better compression than allowing n-grams that occur 10 or more times.

CONCLUSION
Static dictionaries with directed pseudoforests can compress radiology reports with a very high efficiency while retaining random access capability.

CLINICAL RELEVANCE/APPLICATION
Better compression of radiology reports and other medical records can be used to enable data mining applications to retain more data in memory allowing faster analytics.

SSA11-07 ● Detailed Comparison of Average Journal Impact Factors of Oral and Poster Abstracts Presented at Scientific Session that Achieved Publication at 2009 Radiological Society of North America Scientific Assembly and Annual Meeting

Hiroyuki Takaoka MD, PhD (Presenter) ; **Nobusada Funabashi** MD, PhD ; **Naoko Mizuno** ; **Koya Ozawa** MD ; **Yoshio Kobayashi**

PURPOSE
To determine the average journal impact factors of oral and poster abstracts presented at the scientific sessions of the 2009 Radiological Society of North America (RSNA) 95th scientific assembly and annual meeting that achieved publication for each category using Pubmed.

METHOD AND MATERIALS
From the 2009 RSNA meeting program (total of 1509 oral abstracts, and 684 poster abstracts), authors names and abstract titles were entered into PubMed.

Publication consistent with abstract content was confirmed by PubMed in March 2013.

RESULTS
Percentages of all oral and poster abstracts in the scientific sessions achieving publication were 18.4 and 11.4% and that of oral abstracts was significantly higher than that of poster abstracts. The percentage of oral abstracts achieving publication was significantly higher than the poster abstracts in Breast (26.3 vs 10.0%, P < 0.05), Nuclear Medicine (20.6 vs 3.2%, P < 0.05), Musculoskeletal (29.0 vs 14.0%, P < 0.05), and Radiation Oncology categories (12.7 vs 0.1%, P < 0.05). Even though impact factors were significantly higher for the oral abstracts that achieved publication (3.3 ± 1.8) than for the poster abstracts that achieved publication (2.6 ± 1.3) in all categories (P < 0.04), but there were no significant differences in average Impact factors achieving publication between oral and poster abstracts in each category.

CONCLUSION
Although the percentages of oral abstracts to achieve publication were significantly higher than poster abstracts in all, Breast, Nuclear Medicine, Musculoskeletal, and Radiation Oncology categories, both oral and poster abstracts at the 2009 RSNA 95th scientific assembly and annual meeting were similar in achieving publication in terms of average journal impact factor in each category.

CLINICAL RELEVANCE/APPLICATION
Both oral and poster abstracts presented at the scientific sessions of the 2009 RSNA annual meeting were similar in achieving publication in terms of average journal impact factor in each category.

SSA11-08 ● Developing a Computer Game for Problem Based-learning (PBL) of Radiology for Undergraduate Medical Education (MEDGAME)

Salvador Pedraza MD, PhD (Presenter) * ; **Joan C. Vilanova** MD, PhD ; **Elda Balliu** MD ; **Carles Munoz** ; **Enric Marti** ; **Jordi Arnal** ; **Pere Nolla** ; **Joan Domenech** ; **Albert Ramon** ; **Luis Branda**

CONCLUSION
In response to the need to improve the learning of radiology in medical schools using PBL, we have created MEDGAME. We discuss the task to build a computer educational game and thorough radiological aspects involved

Background
Problem-based learning (PBL) is a recognized and implemented educational strategy in the learning of radiology. In this project we developed and validated a learning tool radiological computer game (MEDGAME) of image interpretation in order to improve the effectiveness of PBL applied to radiology and its associated disciplines.

Evaluation
The study population was composed of 150 second-year medical students at the Medical School of the University of Girona during the 2012-2013 academic year. MEDGAME has been developed under Mac Platform with the Unity3D Engine which allows deployment for Mac and Windows standalone application. 3D Studio MAX program was used to the create 3D characters and environments models. Images of five scenarios of typical radiology departments were obtained: a reporting room, a plain-film X-ray room, a sonography room, a computed tomography room, and a magnetic resonance imaging room. It was decided to include only three roles: a) The player requests a radiological examination and then must answer the questions asked by the senior radiologist; b) senior radiologist, who asks the player; c) patient, whose avatar is different in each challenge. Summarizing picture is shown in Figure 1. On the other hand, four challenges have been developed into the game: Cervical trauma, appendicitis, pulmonary embolism, and acute stroke. Each challenge contains several questions about the patient&#65533;s radiological diagnoses.

Discussion
This project will make it possible to examine the degree of relevance of a specific computer game dedicated to PBL radiology education. Each student trained with MEDGAME is completing a written surview about the knowledge and skills acquired in the Educational program. Currently, we are analyzing the preliminary results for demonstrating whether this new tool is improving students&#65533; motivation and their learning of radiology.

SSA11-09 ● A Diagnostic Problem? Think www.diagnologic.com!

Raphael E Khayat MD (Presenter)

PURPOSE
Diagnologic.com is a free innovating medical database allowing an unique computer assisted diagnosis in radiology. The website has several goals:
- To provide a quick and reliable computer assisted diagnosis in radiology using more than 500 gamuts.
- To educate radiologists by showing more than 150 000 images, Diagnologic.com publishes cases of radiology everyday on fabecook with the account Diagnologic Radiology

METHOD AND MATERIALS
After 4 years of collaboration between radiologists, and experts in database, a Diagnostic Decision Support System has been developed.
The website has more than
- 100 000 images,
- 2500 diagnostics,
- 200 anatomical locations,
- 500 gamuts

RESULTS
Three search modes are available:
- A search mode by gamuts, which allows the user to make a diagnosis in just a few clicks, through the use of more than 500 gamuts
- A search mode by anatomy, which lists all diagnoses present in database according to a simple but comprehensive anatomic classification
- A keyword search, which works like a conventional search engine, for which the user enters the name of diagnosis, allowing access to many images of the same diagnosis Diagnologic is present on social networks, and presents the 'case of the day' commented by radiologists woldwilde.

CONCLUSION
www.diagnologic.com is a simple, rapid, and complete website, to solve diagnoses problems, even the most complex one

CLINICAL RELEVANCE/APPLICATION
Diagnologic.com is a free radiologic website to help and educate radiologists.

Physics (CAD I)

Sunday, 10:45 AM - 12:15 PM ●S403B

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PH IN CT

SSA19 •*AMA PRA Category 1 Credit* ™:1.5 •ARRT Category A+ Credit:1.5
Moderator
Heang-Ping Chan , PhD
Moderator
Kyongtae T Bae , MD, PhD *

SSA19-01 ● Virtual Colon Tagging Based Dual-energy Electronic Cleansing for Fecal-tagging CT Colonography

Wenli Cai PhD (Presenter) ; **Se Hyung Kim** ; **Da Zhang** PhD ; **June-Goo Lee** PhD ; **Yasuji Ryu** MD ; **Hiroyuki Yoshida** PhD *

PURPOSE
Material decomposition ability in dual-energy CT (DE-CT) provides a promising solution to identify tagged fecal materials in electronic cleansing (EC) for fecal-tagging CT colonography (CTC). The purpose of this study was to develop and evaluate a novel dual-energy electronic cleansing (DE-EC) scheme based on 'virtual colon tagging' (VCT) for minimizing EC artifacts in the cleansed CTC images.

METHOD AND MATERIALS
Based on our localized three-material decomposition model for DE-CT, we developed a DE-EC scheme denoted as VCT-EC, with the following steps: 1) DE-CTC images were decomposed into three material mixture fields of luminal air, soft tissue, and iodine-tagged fecal material; 2) a Poisson-based derivative smoothing algorithm smoothed the gradients and implicitly smoothes each material mixture field; 3) VCT images were calculated by virtually elevating the CT value of luminal air to be as high as that of tagged fecal materials and thus virtually tagging the entire colonic lumen, and 4) the entire colonic lumen was segmented and thus cleansed by its high values in VCT images. Twenty-one patients underwent a bowel preparation with a low-fiber, low-residue diet, and oral administration of iodine contrast agents. Dual-energy CT scanning (SOMATOM Definition Flash) was performed at two photon voltages of 140 kVp and 80 kVp with the automatic dose exposure control module (CARE Dose 4D) in both supine and prone positions. Resulting DE-CTC data were subjected to VCT-EC

scheme. For comparison purpose, we applied a conventional single-energy EC (SA-EC) to the standard fused DE-CTC images.

RESULTS
A visual assessment was performed by two radiologists for evaluating the cleansing quality by counting of the regions with distractive cleansing artifacts observed in the fly-through of the colon. Compared to SA-EC, the total number of EC artifacts in VCT-EC was reduced significantly by 72%. In specific, the numbers of three types of EC artifacts were reduced by 63% (type1 - caused by pseudo-enhancement), 75% (type 2 - caused by partial volume effect), and 70% (type 3 - caused by inhomogeneous tagging), respectively.

CONCLUSION
Our VCT-based DE-EC scheme provides an effective solution for significantly reducing EC artifacts by use of the material decomposition ability in dual-energy CT.

CLINICAL RELEVANCE/APPLICATION
New dual-energy EC method can substantially reduce EC artifacts and it may lead to artifact-free visualization of the colon.

SSA19-02 ● Computer Aided Detection of Ureter Abnormalities on Multi-detector Row CT Urography

Lubomir M Hadjiiski PhD (Presenter) ; **Heang-Ping Chan** PhD ; **Elaine M Caoili** MD, MS ; **Richard H Cohan** MD * ; **Chuan Zhou** PhD

PURPOSE
To develop a CAD system for automated detection of ureter abnormalities in multi-detector row CT urography, which potentially can assist radiologists in detecting ureter cancer.

METHOD AND MATERIALS
Our CAD system consists of two stages. In the first stage, an automatic tracking of the ureter is performed by previously proposed COmbined Model-guided Path-finding Analysis and Segmentation System (COMPASS). Given an initial starting point, the ureter is tracked by COMPASS based on the CT values of the contrast filled lumen. In the second stage, lesion candidates are identified using histogram analysis within the ureter to differentiate the abnormality from the background, which is the ureter filled with contrast material. A uniformity measure is designed to detect non-uniformity of the CT values within the ureter volume. If an abnormality is present in the ureter, the uniformity of the CT values will be distorted and reduce the uniformity measure. The size and shape of the detected region further differentiate lesions from noise. In this pilot study, a limited data set of 15 patients (13 malignant and 2 benign) with biopsy-proven ureter lesions was used. Experienced radiologists identified 30 biopsy-proven ureter lesions (25 cancers and 5 benign) on the multi-detector row CT images. The average lesions size was 3.4 mm (range: 2.1 mm ◆ 7.6 mm). The average conspicuity was 3.5 (range: 2 to 5) on a scale of 1 to 5 (5 very subtle).

RESULTS
The COMPASS successfully tracked the ureters in all patients. 90% (27/30) of the ureter lesions including 88% (22/25) of the ureter cancers were detected with 2.5 (37/15) false positives per patient. The three missed cancers were small lesions with average size of 2.2 mm.

CONCLUSION
The preliminary results show that our COMPASS and CAD system can track the ureter and detect ureter cancer of medium conspicuity and relatively small size. Further study is underway to improve the detection performance with a larger data set. This pilot study is a first step towards the development of a CAD system for detection of ureter cancer in multi-detector row CT urography.

CLINICAL RELEVANCE/APPLICATION
An accurate CAD system has the potential to assist radiologists in detection of ureter cancers at an early stage which usually are small in size with subtle appearance.

SSA19-03 ● Detecting Vertebral Degenerative Disease on 18F-NaF PET/CT Using a Novel Cortical Shell Map

Jianhua Yao PhD * ; **Hector Munoz** ; **Joseph E Burns** MD, PhD ; **Karen A Kurdziel** MD * ; **Peter L Choyke** MD * ; **Le Lu** PhD ; **Ronald M Summers** MD, PhD (Presenter) *

PURPOSE
Vertebral degenerative disease can mimic metastatic disease on 18F-NaF PET/CT. The purpose of this study is to develop a computer system to automatically detect vertebral degenerative disease on 18F-NaF PET/CT.

METHOD AND MATERIALS
The dataset consisted of 46 18F-NaF PET/CT scans (36 men, 10 women, mean age 65±9 yrs). All patients were scanned on a Philips GEMINI TF scanner. The PET resolution was 4*4*4mm. The CT portion of the studies was performed with 5mm slice thickness and without intravenous contrast.
The PET data was first resampled to have the same resolution as the CT data. The spine was segmented on the CT images. The cortical shell of each vertebral body was then extracted and unwrapped to a 2D map using a cylindrical coordinate system. The maps were stacked to form a panoramic map of the spinal column (figure). The novel panoramic cortical shell map converted the complex 3D detection problem to a 2D problem. Morphological and physiological features derived from both CT and PET were projected onto the map. A three-tier classification scheme was then applied to detect spinal degenerative osteophytes. The annotated location markers for the osteophytes were used as the reference standard to train the classifiers at each stage. The system was trained on 20 cases and tested on 26 cases. The performance was evaluated using FROC analysis.

RESULTS
The numbers of osteophytes larger than 5mm were 163 and 179 in the training and testing sets, respectively. The sensitivities and false positives per case were 82.2% and 4.7, and 77.1% and 4.6 for the training and test sets respectively. The performance with CT and PET data alone were 69% (4.7) and 59% (4.4) respectively. Missed osteophytes were most commonly due to image artifact. Common false positives include the costovertebral junction and partial volume averaging.

CONCLUSION
This is the first CAD system to detect spinal osteophytes on 18F-NaF PET/CT. The novel unwrapped cortical shell map facilitates the detection and visualization of degenerative disease. The combination of PET and CT features improved the performance of CAD.

CLINICAL RELEVANCE/APPLICATION
By enabling the detection of degenerative change on PET/CT, it may in future be possible to exclude such areas from the images to improve the ability of physicians to perceive metastatic lesions.

SSA19-04 ● Automated Axial Right Ventricle to Left Ventricle Diameter Ratio Computation in Computed Tomography Pulmonary Angiography (CTPA)

German Gonzalez PhD (Presenter) ; **Kanako K Kumamaru** MD, PhD ; **Daniel Jimenez-Carretero** MSc ; **Elizabeth George** MBBS ; **Maria J. Ledesma-Carbayo** PhD ; **Frank J Rybicki** MD, PhD * ; **Sara Rodriguez-Lopez** ; **Raul San Jose Estepar** PhD ; **Dimitris Mitsouras** PhD ; **Arash Bedayat** MD

PURPOSE
The RV/LV diameter ratio is a proven metric of prognosis in patients with CT pulmonary angiography (CTPA) findings of acute pulmonary embolism (PE). The purpose of this report is to introduce and test, using radiologist and clinical outcomes reference standards, a completely automated algorithm to output the right ventricular to left ventricular (RV/LV) diameter ratio from CTPA images.

METHOD AND MATERIALS
A completely automated algorithm with the following six steps was designed to compute the RV/LV diameter ratio. Step 1: image pre-processing. Step 2: right and left heart detection based on machine-learning techniques. Step 3: detection on clustering and seed positioning. Step 4: septum detection. Step 5: right and left heart segmentation based on level-sets with curvature constraints and edge priors. Step 6: caliper positioning and ratio computation. Implemented in Matlab, the algorithm analyzes 600 CTPA reconstructed slices in 10 minutes (Intel i7 computer). Automated reports with snapshots of the slices where the RV and LV diameters are found are sent to the physician for reporting. The algorithm was tested in 198 consecutive patients with acute PE diagnosed with CTPA using (a) reference standard RV/LV radiologist measurements and (b) 30-day PE-specific mortality plus the need for intensive therapies.

RESULTS
Using radiologist reference standard, the algorithm correctly detected and segmented 96% (190/198) of CTPA studies. Even including failure cases, the correlation between the RV/LV diameter ratio obtained by the algorithm and that obtained by the radiologist was high (r=0.72). Compared to the radiologist, the algorithm equally achieved high accuracy in predicting 30-day PE-specific mortality plus the need for intensive therapies, with area under the curve of 0.74 for the automated method and 0.77 for the radiologist measurements. Failure cases were readily identified by the output snapshots available to the radiologist.

CONCLUSION
An automated algorithm for determining the CT derived RV/LV diameter ratio in patients with acute PE has high accuracy when compared to measurements made by a radiologist and prognostic significance when tested against reference standard outcomes.

CLINICAL RELEVANCE/APPLICATION
An automated RV/LV diameter ratio algorithm has promise to generate data for prognosis in patients with acute PE that can be readily implemented into clinical reporting.

SSA19-05 ● Computer-aided Diagnosis (CADx) as a Surrogate Measure of Image Quality: Dependence of CADx Performance on Reconstruction Parameters in Dedicated Breast CT

Ingrid Reiser PhD (Presenter) ; **Robert M Nishikawa** PhD * ; **John M Boone** PhD * ; **Karen K Lindfors** MD * ; **Kai Yang** PhD

PURPOSE
The purpose of this work was to investigate whether the performance of computer-aided diagnosis (CADx) of breast masses in CT images with different reconstructions parameters can serve as surrogate measure for image quality. The first step towards this goal is an investigation into the relationship between reconstruction parameters and CADx performance, which is presented here.

METHOD AND MATERIALS
The data set consisted of cone-beam breast CT data from 69 patients containing 78 masses (24 benign, 54 malignant). 3cm^3 regions-of-interest centered on each mass were reconstructed with the FDK reconstruction algorithm. Volumes were generated for two apodization filter cut-off values (L=1.0 and L=0.5) and three reconstructed image voxel sizes (150 mum, 300 mum and 450 mum isotropic). All parameters produced images that were visually judged to be of diagnostic quality. From each set of ROIs, lesions were segmented and feature analysis was performed using algorithms that were developed previously. Three features were manually selected to ensure that variation in CADx performance was due to different image parameters rather than different feature sets. ROC analysis was used to estimate CADx performance in the task of distinguishing benign from malignant lesions using a leave-one-out resampling scheme.

RESULTS
Visually, reconstruction parameters affected the sharpness and apparent noise of the images. As expected, L=0.5 produced smoother images than L=1.0, and images with smaller voxel size had a noisier appearance. CADx performance, measured as area under the ROC curve (AUC), ranged between 0.78 and 0.86, with larger reconstructed voxels, and smoother images (L=0.5) producing higher AUC values. This trend was also observed for individual features.

CONCLUSION
Our study indicates that CADx performance depends on reconstruction parameters and therefore it has the potential to measure the quality of the reconstructed images. The next step of this research is to measure the correlation between CADx and radiologists' performance as reconstruction parameters are changed.

CLINICAL RELEVANCE/APPLICATION
This CADx methodology has potential for assessing clinical performance of reconstruction algorithms, and ultimately to improve diagnostic accuracy by optimizing CT reconstruction.

SSA19-06 ● Computerized Risk Assessment Imaging System for Predicting the Likelihood of Breast Cancer

David Izhaky PhD (Presenter) * ; **Tamar Sella** MD ; **Maya Cohen** MD ; **Arnaldo Mayer** PhD * ; **Tanir Allweis** MD ; **Miriam Sklair-Levy** MD *

PURPOSE
Early detection and prevention strategies for breast cancer depend on the ability to accurately identify individuals with significantly increased breast cancer risk. Currently, such risk assessment models are statistical in nature and rely mainly on clinical features such as genetic susceptibility, family history or mammography breast density. The purpose of this study is to develop a computerized imaging system and method for assessing the likelihood of a malignant tumor based on breast vascular maps.

METHOD AND MATERIALS
3D breast vascular maps of 334 women were included in the study. IRB approval was obtained. Vascular maps were acquired using a prototype 3D functional infrared imaging device (Real Imaging). Of these 334 women, 209 were healthy (mammography BIRADS 1), 36 had benign lesions (mammography BIRADS 2) and 94 had biopsy proven breast cancer. A linear discriminant classifier with feature selection which was previously trained to compute the cancer likelihood on image dataset was applied. Analysis was blinded to clinical and pathological diagnosis. The diagnostic accuracy of the breast cancer likelihood was evaluated using receiver-operating characteristic (ROC) analysis and bootstrapping.

RESULTS
An area under the ROC curve of 0.84 (95% CI 0.77-0.89) was obtained for determining the cancer likelihood.

CONCLUSION
A risk assessment model for predicting the likelihood of malignant tumor based on vascular maps was developed. The results warrants further evaluation in a larger population-based clinical trial.

CLINICAL RELEVANCE/APPLICATION
A novel imaging system and method for assessing the likelihood of breast cancer was developed with accurate performance. This technology could be implemented as an adjunct to mammography.

SSA19-07 ● Effect of Adaptive Iterative Dose Reduction (AIDR 3D) on a Computer-aided Detection System for Lung Nodules: Performance Evaluation Using CT Scans in Standard to Ultra-low-Dose Range

Sumiaki Matsumoto MD, PhD (Presenter) * ; **Yoshiharu Ohno** MD, PhD * ; **Takatoshi Aoki** MD, PhD ; **Tae Iwasawa** MD, PhD ; **Fumito Okada** MD ; **Kota Aoyagi** * ; **Hiroyasu Inokawa** * ; **Hitoshi Yamagata** PhD * ; **Kazuro Sugimura** MD, PhD *

PURPOSE
To assess the effect of adaptive iterative dose reduction (AIDR 3D) on the stand-alone performance of a prototype computer-aided detection (CAD) system for lung nodules using CT data acquired at standard-, low-, and ultra-low-dose levels.

METHOD AND MATERIALS
This study used CT data of 60 patients who prospectively underwent a chest CT examination using a multidetector-row scanner with a protocol including standard-dose (125 mAs), low-dose (25 mAs), and ultra-low-dose (5 mAs) unenhanced scans. Each scanned data were reconstructed into 1-mm-thick images without and with AIDR 3D. The following groups of CT images, each consisting of 60 datasets, were thus obtained: (S-wo) at 125 mAs, without AIDR 3D; (S-w) at 125 mAs, with AIDR 3D; (L-wo) at 25 mAs, without AIDR 3D; (L-w) at 25 mAs, with AIDR 3D; (U-wo) at 5 mAs, without AIDR 3D; (U-w) at 5 mAs, with AIDR 3D. Two experienced chest radiologists carefully reviewed the group S-wo and determined a gold standard of nodules ranging 5-30 mm in diameter by consensus. Based on the gold standard, the sensitivity and false positive rate of the CAD system on all groups were determined. Regarding sensitivities, the group S-wo and each of the other groups were compared using McNemar&#65533;s test; similar comparisons regarding false positive rates were made using signed rank test.

RESULTS
The reference standard consisted of 198 (104 solid and 94 subsolid) nodules. The sensitivity and false positive rate (per patient) on the group S-wo were 58.6% and 0.97. The sensitivities (corresponding p values of the comparisons with the group S-wo) on the other groups (S-w, L-wo, L-w, U-wo, and U-w) were 67.7% (
CONCLUSION
Regarding sensitivities, 25-mAs and 5-mAs groups with AIDR 3D were comparable to the 125-mAs group without AIDR, whereas 25-mAs and 5-mAs groups without AIDR 3D were inferior to the latter group; furthermore, the 125-mAs group with AIDR 3D was superior to that without AIDR 3D. Regarding false positive rate, corresponding comparisons showed no highly significant difference.

CLINICAL RELEVANCE/APPLICATION
In terms of the performance of a CAD system for lung nodules, standard-dose CT with AIDR 3D and low- or ultra-low-dose CT with AIDR 3D can respectively surpass and parallel usual standard-dose CT.

SSA19-08 ● Computer-aided Detection of Colitis in Computed Tomography Examinations

Evrim B Turkbey MD (Presenter) ; **Le Lu** PhD ; **Jianhua Yao** PhD * ; **Zhuoshi Wei** PhD ; **Ronald M Summers** MD, PhD *

PURPOSE
To develop a computer aided detection (CAD) tool for automated detection of regions with colitis in CT examinations.

METHOD AND MATERIALS
One representative axial CT image per patient passing through the cecum or ascending colon was selected from 17 colitis patients (mean age= 38±13 yrs, 8 women, 9 men) and 25 healthy subjects (mean age=44±13yrs, 18 women, 7 men). Colitis was defined as presence of colonic wall thickening (>3mm) accompanied by pericolonic fat stranding and was manually segmented by a radiologist. The CAD method is three-tiered. An image intensity and gradient checker, trained from annotated colitis regions, is used to quickly discard non-informative image areas. A discriminative scanning window detector using covariance descriptor, selective data resampling and extended Gaussian kernel support vector machine follows for image patch classification as colitis or not. Finally, the local patch detections with confidences are spatially aggregated to form statistical features per image that label the whole dataset as with or without colitis. A k-nearest neighbor classifier is used. Three-fold cross validation is employed for classification performance assessment.

RESULTS

The mean wall thickness at colitis segments was 9.3 mm (range: 4.2-20.2 mm) whereas it was 2.3 mm (range: 1.2-3.2 mm) at normal colon segments (P=0.0001). The overall per patient classification accuracy is 83.3%. For colitis patients, the sensitivity is 88.2% (15 out of 17). 19 out of 25 healthy subjects are classified correctly with the specificity of 76% .

CONCLUSION
The CAD tool introduced in the current study can detect colitis affecting the cecum/ascending colon region with high sensitivity and good specificity. The challenge of colitis image pattern being visually ambiguous is solved by the high description power of covariance descriptor, hard negative bootstrapping and the tiered classification at local and global image levels.

CLINICAL RELEVANCE/APPLICATION
Early diagnosis of colitis is critical to prevent bowel necrosis and perforation in immunosuppressive patients. A computer-aided detection tool may help to increase detection rates of colitis in CT.

SSA19-09 ● A Computer-aided Diagnosis System for Detecting Renal Extracolonic Findings on CT Colonography

Jian Fei L Liu MD ; **Shijun Wang** ; **Marius G Linguraru** DPhil, MS ; **Ronald M Summers** MD, PhD (Presenter) *

PURPOSE
To accurately detect renal calculi and lesions on CT colonography (CTC) by computer-aided diagnosis.

METHOD AND MATERIALS
We studied 66 patients (age range, 43-72 years; mean 57±7 years) undergoing CT colonography. The slice thickness was 1 mm. There were 52 renal calculi (size range, 1-7mm; mean size, 2±1 mm) and 58 renal lesions (size range, 3-51mm; mean size, 16±10 mm). 36 lesions and 25 calculi were located in the left kidney, and 22 lesions and 27 calculi in the right kidney. We first segmented both kidneys on the supine CTC images. Total variational (TV) flow was used to remove image noise in the kidney regions for a maximally stable extremal region (MSER) detector to extract calculi candidates. We detected lesions by performing manifold diffusion on the kidney surface and searching for points with local maximum diffusion response. Both calculus and lesion candidates were finally classified by a support vector machine to determine the final detected calculi and lesions. There were 30 patients in the training dataset and 36 patients in the test set for renal calculi and lesion detection. The training set contained 20 calculi and 24 lesions, and the test set had 32 calculi and 34 lesions. We performed a free-response receiver operating characteristic analysis on the test set to validate the results.

RESULTS
There were 41 true detections on calculi (from 29 unique calculi) and 417 false positives. The sensitivity of renal calculi detection was 80% at 1 false positive per patient. There were 33 true detections on renal lesions (from 31 unique lesions) and 277 false postives. The sensitivity of lesion detection was 87% at 7 false positives per patient.

CONCLUSION
Detection of renal calculi and lesions is challenging on CTC images because the primary purpose of CTC is to screen for colon cancer and the studies are typically done with lower dose and without intravenous contrast. TV-flow and MSER detector are efficient means to detect renal calculi by reducing image noise and extracting image regions with high intensity values. The manifold diffusion efficiently detects kidney lesions based on their geometric properties. Our method can detect renal calculi larger than 1 mm with few false positives and renal lesions with moderate false positive rates.

CLINICAL RELEVANCE/APPLICATION
Our CAD system accuately detects renal calculi and lesions on CTC images and, with future clinical validation, may lead to improved diagnosis.

Quantitative Medical Imaging for Clinical Research and Practice: Hands-on Workshop

Sunday, 11:00 AM - 12:30 PM ●S401CD

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IN BQ

ICIA11 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Sonia M Pujol , PhD
Katarzyna J Macura , MD, PhD *
Ron Kikinis , MD

LEARNING OBJECTIVES
1) Enhance interpretation of DICOM images through the use of 3D visualization. 2) Gain experience with interactive, quantitative assessment of complex anatomical structures. 3) Present current directions of quantitative imaging as a biomarker in clinical trials.
ABSTRACT
Quantitative imaging has the potential to bring valuable information for the accurate interpretation of clinical data. Technological breakthroughs in medical imaging hardware and the emergence of increasingly sophisticated image processing algorithms permit the display of complex anatomical structures, and the estimation of quantitative functional parameters with increasing sensitivity and specificity. For the past 9 years, the National Alliance for Medical Image Computing (NA-MIC), one of the seven National Centers for Biomedical Computing funded by the National Institutes of Health, has converted some of the major scientific advances made by the biomedical imaging community into open-source software tools. As part of the NA-MIC toolkit, the 3D Slicer open-source software has been developed as a technology delivery platform for clinical researchers. This workshop provides an introduction to quantitative medical imaging data analysis for clinical research and practice. Cases from multiple imaging modalities and from multiple organ systems will be highlighted to illustrate the depth and breath of this field, and series of hands-on sessions using 3D Slicer will provide participants with a practical experience of quantitative image analysis.
Course url: http://www.na-mic.org/Wiki/index.php/RSNA_2013
URL's
http://www.na-mic.org/Wiki/index.php/RSNA_2013

IHE Clinical Solutions for Interoperability - Imaging and Beyond

Sunday, 11:00 AM - 12:30 PM ●S501ABC

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IN

ICII11 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
David S Mendelson , MD *
David S Mendelson , MD *
Richard L Kennedy , MSc
Albert Edwards
Jean Chalaoui , MD

LEARNING OBJECTIVES
1) Understand the organization of IHE and the IHE profiles. 2) Understand the importance of interoperability in healthcare. 3) Learn about the various IHE profiles that address interoperability, including XDS. 4) Learn about how XDS-I and related profiles address interoperability for imaging. 5) Learn about real world implementations regarding interoperability and how IHE profiles have been employed to solve interoperability issues including: a. The RSNA Image Share b. Cleveland Clinic enterprise-wide multi-specialty imaging integration and implementation c. Canada Health Infoway: emphasis on the Province of Quebec Project d. Kaiser Permanente. 6) Understand the challenges in attaining safe, secure and transparent interoperability.
ABSTRACT

National Library of Medicine PubMed: Find Articles You Need: Searching PubMed/MEDLINE Efficiently

Sunday, 11:00 AM - 12:30 PM ●S401AB

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IN

ICIW11 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Holly A Burt
Chezire Aclimandos
Annabelle Nunez , MA
Wendy Wu , MS

LEARNING OBJECTIVES
1) Understand how PubMed constructs a query and how to develop and refine effective search strategies in radiology. 2) Use PubMed tools including Clinical Queries, Related Articles, Single Citation Matcher and Loansome Doc. 3) Build focused searches using the Medical Subject Headings (MeSH) vocabulary for

radiology and limit searches to radiology-oriented journals. 4) Understand how to save and download citations.
ABSTRACT
This hands-on workshop covers key searching techniques, changes to PubMed, and how to develop effective search strategies for PubMed and MEDLINE. Topics covered include: why keywords don't always give the results you expect, how to limit to specific journals, quick searches to find evidence-based citations, how to access full-text articles, and downloading citations to reference manger programs. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov). MEDLINE is a subset of PubMed which includes links to sites providing full text articles and to other related databases and resources.

Informatics - Sunday Posters and Exhibits (12:30PM - 1:00PM)

Sunday, 12:30 PM - 01:00 PM ● Lakeside Learning Center

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IN

LL-INS-SUA • *AMA PRA Category 1 Credit* ™:0.5
Host
Ayis T Pyrros , MD *

LL-INS-SU1A ● DAISY: Open Source Mobile App Helping Patients Prepare for Radiology Exams and Procedures after Order Entry

Qinglin Chen (Presenter) ; **Daisy Q Huang** MD ; **Ramin Zabih** PhD * ; **Deborah Estrin** PhD ; **Keith D Hentel** MD, MS ; **George L Shih** MD, MS *

CONCLUSION
DAISY provides a simple interface to enhance the preparation for imaging exams and procedures, providing both how the exam is performed and also walks the patients through any preparations required, thereby reducing the potential for rescheduling as well as improving patient satisfaction and overall efficiency of healthcare delivery.

Background
Certain imaging exams (eg, CT) or procedures (eg, barium enema) will often have a short list of instructions (eg, NPO after midnight). After ordering an exam, some patients either never get these instructions or forget to follow them, which may result in rescheduling of these exams. Rescheduling of exams may delay patient care and disrupt clinical workflow, as well as having financial implications for unused healthcare resources (physician time, imaging equipment). As more patients rely on smartphones to organize their lives and their health, a mobile app may help address these exam preparation issues, instead of relying on paper instructions.

Evaluation
We created an open source mobile app called DAISY which provides both information about the exam and procedure, and also uses both mobile notifications to remind patients to complete each task and also has mobile calendar integration to add each exam preparation step as events. When a exam get ordered, an email will be sent to patients' email address, and then patients can launch the app via a special URL which can then populate all the relevant exam information, including exam appointment time. Patients can then acknowledge each part of the exam preparation, and can also provide additional information (eg, allergies) and comments (eg, couldn't tolerate bowel prep) to the radiologist. The open source ohmage framework is used in order to keep track of the app usage and obtain feedback for app improvement.

Discussion
DAISY may be used to provide useful information about what to expect for imaging procedures as well as to give them step-by-step tasks for any preparation required, all customized for their particular imaging procedure, which may reduce potential confusion as to when to perform each task, since the reminders via the mobile device are customized for the exact time of appointment.

LL-INS-SU2A ● Under Scrutiny: The Role of Radiology in Imaging Approval

Sarah Russell (Presenter) ; **Alison Wilcox** MD * ; **Cameron Hassani** MD ; **Christopher Lee** MD ; **Ana Maliglig** MD, MPH ; **Suzanne L Palmer** MD *

CONCLUSION
Though a CT request may be initiated by a physician, nurse practitioner, or physician's assistant with a sound knowledge of the question asked, there is variable understanding of the complexities of CT scanning protocols. Institutions may have several protocols for evaluation of the same body part, each answering a different clinical question. These complexities lead to both confusion and inaccurate ordering of CT scans. The review of CT requests is both time consuming and under-appreciated by the requesting physician. However, there is clearly a benefit for both the patient and the institution when this review occurs. If the provided information is sufficient, studies are approved without further review.

Background
CT scans are frequently ordered inaccurately or with inadequate justification. In this era of managed health, limited financial resources, and increasing concerns regarding ionizing radiation exposure, a review process may become a necessity. The purpose of this review was to assess the clinical impact of a radiologist overseen imaging approval process at a large academic medical center.

Evaluation
All CT imaging orders are placed into a radiology information system system by nonradiologists. A radiologist reviews all CT requests (excluding trauma) and either approves without changes, approves with changes, or deems the study inappropriate. Records for all CT studies ordered between March 1, 2012 and September 1, 2012 were collected and analyzed. CT studies that were approved with changes were categorized as a clarification to the order, intravenous (IV) contrast change, or protocol change.

Discussion
During this 6 month period, a total of 23,337 CT studies were ordered. 9049 exams were ordered from the ER. Of the non-ER studies, 2571 (14.2%) were approved with changes by a radiologist. 719 (27.9%)of these studies required a change in the IV contrast protocol, 860 (33.4%) required a clarification of the order, and 436 (16.9%)required a change in the protocol. In the ER, 5073 (56.1%) studies were not reviewed by a radiologist, as they were related to trauma. Additionally, 1795 (9.9%) of all studies and 228 (2.5%) of all ER studies were deemed not appropriate by a radiologist reviewer.

LL-INS-SU3A ● Computer-aided Volumetry of Ground-glass Opacity and Solid Component through the Nodule Segmentation and Vascular Structure Elimination in Chest CT Images

Ju Lip Jung BEng (Presenter) ; **Helen Hong** PhD ; **Jin Mo Goo** MD, PhD * ; **Kyunghee Lee** MD ; **Sang Joon Park** ; **Jae Yeon Wi** MD

CONCLUSION
The proposed method can be used to differentiate malignant and benign nodules by analyzing the volumetry changes of GGO and solid component in follow-up chest CT scans.

Background
To differentiate malignant and benign nodules through computer-aided volumetry of ground-glass opacity (GGO) and solid component, we propose a GGO nodule segmentation method using asymmetric multi-phase deformable model with intensity constraint and vascular structure elimination.

Evaluation
The chest CT images were obtained on the Lightspeed Ultra CT scanner (GE) and the Sensation 16 Scanner (Siemens) with various reconstruction kernels (B30f, B50f and B60f). The dataset is consisted of 10 pure GGO nodules and 24 mixed-GGO nodules (diameter 7.4-25.7mm, mean diameter 17.1±5.1mm). To extract initial GGO and solid component, optimal volume circumscribing a nodule was decided by clicking inside nodule and solid component was extracted by applying thresholding with -200HU. Then GGO was extracted by estimating the adaptive threshold value based on intensity histogram modeling. To segment final GGO and solid component, GGO and solid component were simultaneously separated from lung parenchyma using asymmetric multi-phase deformable model with intensity constraint. To eliminate vessels inside GGO nodule, vessel-like structures are enhanced by Hessian-based vessel enhancement filtering with oval blob-like structures suppression. To evaluate the performance of computer-aided volumetry, solid component proportion difference (SCPD) between computer-aided volumetry and manual volumetry was measured. The solid component proportion was calculated as (solid component volume / GGO nodule volume) and the SCPD was calculated as ((computer-aided volumetry − manual volumetry) / manual volumetry × 100). The average SCPD was 2.7±6.6% and the limits of agreement were 15.7% and -10.4%.

Discussion
Our asymmetric multi-phase deformable model with intensity constraint accurately seperates GGO and solid cpmponent from lung parenchyma. Our vessel enhancement filtering with oval blob-like structures suppression helps to eliminate vessels without the loss of solid component and accurately measure the GGO and solid component volumes.

LL-INS-SU4A ● Visualizing Biomedical Literature: Integration and Application of Clinical, Imaging, and Genomic Evidence Reported in Research Studies

William Hsu PhD (Presenter) ; **Maurine Tong** ; **Rick K Taira** PhD ; **Alex A Bui** MS, PhD

CONCLUSION
We present a framework for structuring, integrating, and visualizing scientific claims and associated context from biomedical papers. We demonstrate the utility of this information in translational research by facilitating hypothesis generation and knowledge discovery.

Background
The rate of scientific discovery is greatly outpacing our ability to comprehend and apply this knowledge. Medline indexed over 2,900 papers about non-small cell lung cancer in 2012 alone. The number of papers reflects the fast pace at which insights are being generated. However, this growing body of literature also exposes our inability to effectively integrate and understand the vast body of evidence. Current literature retrieval tools do not provide functionality to easily identify and summarize studies based on participant demographics, study design, and measured variables. This information is useful in identifying areas of active research, studies reporting conflicting evidence, and gaps in our understanding of a disease. We have created an interactive visualization that permits clinical scientists with exploring information provided by biomedical papers, summarizing scientific claims, and understanding relationships among studies.

Evaluation
The visualization tool is presented in the context of characterizing the role of EGFR expression in treatment response of NSCLC patients through the lens of clinical, imaging, and genomic factors. Scientific claims from a set of 31 full-text papers were extracted, standardized, and mapped to entities and attributes in the standardized data model. Use cases were developed to guide development and usability assessment of the user interface.

Discussion
This work addresses the need for a standardized data model for biomedical literature, text extraction tools to map information from full-text papers to the data model, and a web-based visualization to explore and query a large, multidimensional dataset. Informatics challenges related to the semantic characterization of scientific claims and integration of heterogeneous evidence encompassing multiple biological scales are discussed.

LL-INE-SU5A ● Pathological Lung Segmentation in Computed Tomography (CT) Images: Current Approaches, Challenges, and Future Trends

Awais Mansoor PhD (Presenter) ; **Ulas Bagci** PhD, MSc ; **Brent Foster** ; **Ziyue Xu** PhD ; **Jayaram K Udupa** PhD ; **Daniel J Mollura** MD

PURPOSE/AIM

1. To identify the clinical importance of lung segmentation and explain why CT images are used to quantify lung pathology.
2. To review the current state-of-the-art image segmentation approaches for pathological lungs from CT scans.
3. To identify the challenges in pathological lung segmentation.
4. To discuss the future of lung segmentation methods and explain how engineering advancements in CT plays a valuable role.

CONTENT ORGANIZATION
1. Introduction a. Lung disease b. Clinical importance of segmentation 2. Segmenting Lung Pathology from CT images a. Why use CT images? b. Lung disease or normal lungs—no difference 3. State-of-the-Art Segmentation Methods for CT Images a. CT-based attenuation correction methods b. Registration-assisted methods c. Registration-assisted image smoothing methods d. Graph-based methods e. Model-based methods 4. The Challenges of Segmenting Lung Pathology a. Image quality b. Time needed for analysis 5. Concluding Remarks and future trends in lung segmentation pathology

SUMMARY

- Review the clinical importance of lung segmentation.
- Review state-of-the-art lung segmentation methods for CT images.
- Review the challenges of lung segmentation.
- Review the challenges of lung segmentation.

LL-INE-SU6A ● Structured MRI Report Templates for Initial Staging of Cervical and Endometrial Cancers

Rekha N Mody MD (Presenter) ; **Namita S Gandhi** MD ; **Myra K Feldman** MD ; **Noushin Vahdat** MD ; **Shetal N Shah** MD ; **Dipika Patel** MD

PURPOSE/AIM
• Illustrate a structured reporting template for Cervical and Endometrial Cancer MRI at initial staging.
• Describe the FIGO staging system and the role of MRI in staging cervical and endometrial cancer
• Discuss key interpretive points essential in the pre-operative staging of cervical cancer with respect to TNM classification

CONTENT ORGANIZATION
• Female Pelvis MRI Protocol
• Anatomy of the uterus, cervix and parametrium
• TNM/FIGO staging classification of cervical and endometrial cancers.
• Structured report for cervical cancer MRI with imaging examples to highlight the specific content pertinent to staging of cervical cancer for example parametrial invasion and lymph node status
• Structured report for endometrial cancer with imaging examples to highlight the pertinent staging features like depth of myometrial invasion and nodal status.

SUMMARY
Structured reports for cervical (table 1) and endometrial cancers can provide an accurate, reproducible and concise framework for communication of pertinent positive and negative findings to aide oncologists and surgeons in developing appropriate treatment strategy and can be helpful for clinical outcome measurements.

LL-INE3243-SUA ● Cloud Computation of Anatomical Features from Imaging Studies to Discover Radiation Toxicity Trends Using a DICOM-based Decision Support System

Ruchi Deshpande MS (Presenter) ; **Anh H Le** PhD ; **John J Demarco** PhD ; **Daniel A Low** PhD * ; **Patrick Kupelian** MD * ; **Brent J Liu** PhD

Background
Radiation therapy treatment plans are determined by patient anatomy, which often limits the dose to the tumor and the degree of protection to surrounding organs-at-risk. Targeting the tumor sometimes holds priority over limiting damage to normal tissue, leading to radiation toxicity. Since the dose distribution and treatment plan are determined by the patient's anatomy, it is possible that different patterns and combinations of anatomical features, plan parameters and dose characteristics lead to specific radiation toxicity outcomes. Our decision support module uses cloud computing for discovering and utilizing these patterns, thereby obviating the need to download and install software, by providing Software as a Service (SaaS). This follows current trends in Radiation Oncology departments, which are trying to move away from traditional in-house stand-alone workstations, towards a client-server architecture.

Evaluation
We have collected 80 treatment-planning data sets of patients who have undergone radiation therapy for prostate cancer. This data includes CT slices, DICOM RT Dose, Structure Set, Plan as well as quantified radiation toxicity outcomes. We are using this data to test our algorithms and evaluate the workflow of the system's ability to predict toxicity outcomes in a cloud-computing environment.

Discussion
We have created a knowledge base by quantifying anatomy and radiation toxicity outcomes of retrospective patients. This can be used to predict the radiation toxicity of future patients, or to search for treatment plans of previous patients with similar anatomy in order to optimize treatment for new patients. Our decision support tools are embedded in a cloud-based web application that features several presentation and visualization tools for analyzing treatment data.

CONCLUSION
We have developed a web application that utilizes cloud computing and quantifies patient anatomy using imaging studies, in order to categorize radiation toxicity risks associated with external beam radiation therapy. The methods and results of this work can also be applied to other computationally intensive post processing workflows in radiology.

LL-INE3237-SUA ● Automatic Creation of Structured Cardiothoracic Computed Tomography Reports Using Natural Language Processing

Paras Lakhani MD (Presenter) ; **Christopher G Roth** MD * ; **Richard E Sharpe** MD, MBA ; **Kristen E McClure** MD ; **Paul J Read** MD ; **George P Hobbs** MD ; **Vijay M Rao** MD ; **Adam E Flanders** MD

Background
Structured reporting (SR) is felt to have many advantages over free-text reporting, including that it is preferred by clinicians, facilitates data-mining, business analytics, retrospective research, and quantitative imaging. However, traditional SR reporting applications were found to be time-consuming by some radiologists, resulting in decreased productivity. Thus, the purpose of this study was to determine the feasibility a natural language processing (NLP) solution

to automatically create standardized reports from free-text radiology dictations. Such a solution could provide the benefits of structured reporting with minimal loss in productivity. In this exhibit, we demonstrate the ability of an NLP solution to transform free-text cardiothoracic CT interpretations into structured reports.

Evaluation
A web-based computer programming application using NLP techniques was developed at our institution to transform free-text cardiothoracic CT interpretations into structured reports. Examples of the software in converting free-text to structured reports will be provided. In addition, users will be able to enter in their own free-text cardiothoracic CT dictations, and test the software's ability to structure their reports in real-time.

Discussion
This NLP solution re-organizes the report by placing text into anatomy-driven subheadings. The goal of this is to improve the readability and consistency of the reports. The application can transform reports in real-time during sign-off or retrospectively on a database of reports. The software uses common web-based programming languages (PHP, Javascript, HTML) and can integrate with different reporting and radiology information systems. Future efforts are underway to adapt the lexicon of the free-text report into those supported by RADLEX.

CONCLUSION
Natural language processing can automatically generate structured cardiothoracic CT radiology reports from free-text. The organization and content of such reports can be customized for institutional or individual preferences.

LL-INE3162-SUA ● Improving Persuasiveness of Computer-aided Differential Diagnosis (CADx) System by Disclosing Reasons for Diagnosis

Masahiro Yakami MD, PhD (Presenter) ; **Masami Kawagishi** ; **Gakuto Aoyama** ; **Koji Fujimoto** MD, PhD ; **Takeshi Kubo** MD ; **Kaori Togashi** MD, PhD * ; **Ryo Sakamoto** ; **Koji Sakai** ; **Hiroyuki Sekiguchi** ; **Yutaka Emoto** MD, PhD ; **Yoshio Iizuka** ; **Hiroyuki Yamamoto**

Background
Many CADx systems have been reported to improve differential diagnosis on lung nodules by radiologists. However, radiologists still have reluctance to accept CADx suggestion. To improve diagnostic accuracy with a CADx system, it is also important to improve persuasiveness of CADx suggestion, as well as the diagnostic accuracy. Thus we developed a CADx system which suggests the diagnosis on a specified lesion and reasons for the diagnosis, and evaluated the persuasiveness of the suggestion.

Evaluation
With the approval of the institutional review board, we built a database on 491 lung nodules on which diagnoses were clinically confirmed as primary lung cancer, metastatic nodules or other benign nodules. This database consisted of CT images, image findings on the nodules, the confirmed diagnosis, clinical information such as laboratory data and patient history. The image findings were described by consensus of two board-certified radiologists.
The CADx was trained and evaluated by using 179 and 312 nodules in the database, respectively. The CADx derived and suggested a list of possibilities for differential diagnoses on each nodule using a Bayesian network (ICAD). It also derived image findings and/or clinical information having high influence on the diagnosis with the highest possibility and suggested them as the reasons for the inference in addition to the list (RCAD).
Eleven radiologists, with five years' experience in diagnostic imaging, interpreted the 312 nodules under three different conditions (without CAD, with ICAD, with RCAD) with more than one month intervals.
The numbers of cases on which each radiologist disagreed with the CADx initially, and changed his/her diagnosis to follow the CADx suggestion, were counted as disagreed and 'persuaded' cases for evaluation, respectively.

Discussion
The average number of disagreed cases among the 11 radiologists were 99.5 (SD=13.5).
That of 'persuaded' cases by RCAD among them was 47.5 (SD=15.2), and significantly larger than that by ICAD, 43.9 (SD=13.9) (Wilcoxon signed-rank test, p
CONCLUSION
RCAD was more persuasive for the radiologists than ICAD.

LL-INE3166-SUA ● A Computer Aided Diagnosis (CADx) which Discloses the Reason of Diagnosis May Improve a Low Accuracy Group of Radiologist More than a CADx without Reason Disclosure

Yutaka Emoto MD, PhD (Presenter) ; **Masahiro Yakami** MD, PhD ; **Koji Fujimoto** MD, PhD ; **Takeshi Kubo** MD ; **Ryo Sakamoto** ; **Kaori Togashi** MD, PhD * ; **Gakuto Aoyama** ; **Masami Kawagishi** ; **Koji Sakai** ; **Hiroyuki Sekiguchi** ; **Yoshio Iizuka** ; **Hiroyuki Yamamoto**

Background
Computer Aided Diagnosis (CADx) has been expected to help radiologists. Because a CADx does not always suggest the right diagnosis, a radiologist may not agree the suggestions. If a CADx shows why it suggests the diagnosis, a radiologist can make better decision. We developed a CADx system which discloses the reasons of diagnosis of lung nodules in CT images, and evaluated the accuracy of radiologists influenced by the CADx.

Evaluation
We built a database of 491 lung nodules whose diagnoses were clinically confirmed as primary lung cancer, metastatic nodules or benign nodules. The database consisted of CT images, image findings, clinically confirmed diagnosis, clinical information such as laboratory data and patient history. The image findings were described by consensus of two board-certified radiologists. 179 and 312 nodules in the database were used for training the CADx and for evaluation, respectively. The inference model of the CADx was a Bayesian network, which was constructed using the Markov chain Monte Carlo method with the training data set. The CADx derives a set of inference probabilities of each diagnosis (ICAD). In addition to the result, image findings and/or clinical information are indicated as reason of the inference for each case (RCAD). The reason is derived based on influence degree for the diagnosis with the highest inference probability.
11 radiologists, with 5 years' experience for diagnostic imaging, interpreted the 312 nodules with three different conditions (with no CAD, ICAD, RCAD) with more than 1 month interval.
Mean accuracy rates are 0.714, 0.763, 0.766, 0.74 with no CAD, ICAD, RCAD, CAD alone, respectively.

Discussion
Radiologists are grouped into 2 groups by the average accuracy rate with no CAD. In the high accuracy group, 2 radiologists are better with ICAD than with RCAD, 2 show no change. In the low accuracy group (LA), 2 are better with ICAD than with RCAD, 5 are better with RCAD than with ICAD. RCAD improves LA better than ICAD.

CONCLUSION
A CADx which discloses the reason of diagnosis may be effective for radiologist with low accuracy rate of lung nodule diagnosis.

LL-INE3200-SUA ● Imaging Informatics System Utilizing DICOM Objects for Treating Pain in Spinal Cord Injury Patients Utilizing Proton Beam Radiotherapy

Sneha K Verma MS (Presenter) ; **Brent J Liu** PhD ; **Ruchi Deshpande** MS ; **Sophia Chun** ; **Daila S Gridley** PhD

Background
Many US combat personnel have sustained nervous tissue trauma during service, which causes Neuropathic pain that is difficult to manage. In select patients, synapse lesioning can provide significant pain control. Our goal is to determine the effectiveness of using Proton Beam radiotherapy for treating spinal cord injury (SCI) related neuropathic pain as an alternative to invasive surgical lesioning. The research is a joint collaboration of USC, Spinal Cord Institute VA Healthcare System, Long Beach, and Loma Linda University.

Evaluation
This is the first system of its kind that integrates preclinical data, from animal studies and research related human studies, on one web-based platform with standardized DICOM data objects. It supports integration and standardization of imaging informatics data in DICOM format; clinical evaluation forms outcomes data and treatment planning data from the Treatment planning station (TPS) utilized to administer the radiation dose in DICOM-RT format. In addition, it supports evaluation of SCI subjects for recruitment into the clinical study, which includes the development, and integration of digital forms and tools for automatic subject evaluation and classification of SCI pain as well as a rules-based decision tree. For evaluation and development purposes of the overall system, data sets from 10 human and 5 animal studies will be used and integrated into the system.

Discussion
This imaging informatics system is capable of integrating different datasets like patient recruitment, preclinical studies and patient related studies - all accessible via web-based platform. In this computer exhibit we will show design of DICOM standard database that incorporate preclinical data with patient related studies on a web-based platform and a fully developed graphical interface for a pain classification tool, as well as viewing patient recruitment and preclinical studies.

CONCLUSION
We present a medical informatics system capable of integrating various data objects, such as patient recruitment information; preclinical studies, treatment related information utilizing the DICOM standard and implemented on single web-based platform.

LL-INE3239-SUA ● A Comprehensive Ontology of Radiology Differential Diagnosis

Charles E Kahn MD, MS (Presenter) * ; **Dhiraj Baruah** MD ; **Joseph J Budovec** MD ; **Gerald Cameron** MS ; **Stephen W Goth** BS, MD ; **Cesar A Lam** MD ; **Kaushik S Shahir** MD ; **Matthew W Shore** MD ; **Kenneth C Wang** MD, PhD *

Background
Radiology 'gamuts' -- lists of differential diagnoses of imaging observations -- are an important source of knowledge in diagnostic radiology. Although gamuts appear in radiology textbooks and online information resources, there has been little effort to develop a formal treatment of this form of knowledge. We sought to develop the Radiology Gamuts Ontology (RGO) as a comprehensive knowledge model of radiology differential diagnosis, to provide the ontology's knowledge to radiologists and others through an interactive Web site, and to integrate its knowledge with heterogeneous biomedical knowledge resources for research, education, and clinical decision support.

Evaluation
The RGO contains more than 1,300 differential-diagnosis lists with 20,699 terms for disorders and imaging observations with 1,766 synonyms and abbreviations; it specifies 1,175 subsumption relations and 49,819 causal relations. The RGO spans imaging findings in all organ systems and a variety of imaging modalities. The ontology is made available primarily through an open, interactive web site (www.gamuts.net) where users can browse the terms, view their relationships to other entities, and follow hyperlinks to view the related concepts. The model's knowledge also can be accessed through a RESTful web service and a Web Ontology Language (OWL) document.

Discussion
The Radiology Gamuts Ontology provides a form of ﬠcomputable knowledgeﬠ for differential diagnosis in radiology, and has been applied to create an illustrated gamuts reference and a differential-diagnosis quiz generator. The interactive Web interface allows information to be incorporated from other sources, such as Wikipedia, ARRS GoldMiner, and the biomedical literature.

CONCLUSION
Radiological knowledge, such as the relationships of medical conditions and their imaging manifestations, can be represented and shared through Semantic Web technologies. The Radiology Gamuts Ontology promotes integration of radiology differential diagnoisis with decision support systems, clinical image repositories, and the biomedical literature.

Informatics - Sunday Posters and Exhibits (1:00pm - 1:30pm)

Sunday, 01:00 PM - 01:30 PM ●Lakeside Learning Center

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IN

LL-INS-SUB •*AMA PRA Category 1 Credit* ™:0.5

LL-INS-SU1B ● A Mobile Web Application for Learning and Documenting Competency in Radiology Procedures

Joel M Stein MD, PhD (Presenter) ; **Suyash Mohan** MD

CONCLUSION
A cross-platform application for mobile device can be created to facilitate learning and documenting competency in neuroradiology procedures.

Background
Learning to perform routine procedures is an important component of radiology training at the residency and fellowship levels. Documenting procedural experience can be important for licensing. In addition, with the new ACGME Milestones initiative, attendings will need to verify and evaluate procedures performed by trainees. The smartphones and other mobile devices that many trainees already carry could be used to facilitate learning and rapid documentation of procedural experiences.

Evaluation
We developed a mobile web application that incorporates step-by-step procedure guides, a procedure log, attending assessment and review into a single platform. The application uses the Sencha Touch JavaScript framework to mimic a native application on iPhone, Android and Blackberry smartphones as well as the Apple iPad and other tablets. It also runs on Mac and Windows desktop computers. The procedure log includes fields to enter procedure type, date, accession number, and attending radiologist as well as an evaluation form that can be completed and electronically signed by the attending radiologist. These data may be stored locally or remotely. A summary page presents a graphical representation of procedures performed and trends and averages with respect to fluoroscopy time. Data can be made available to the program director for comparison across trainees.

Discussion
Our application should enable rapid documentation and attending verification of trainee radiology procedural experiences at the time and location they are performed. The cross-platform nature of the application facilitates data entry where the procedure is perfomed. Remote storage of the procedure and evaluation data should prevent data loss. We have initially focused on neuroradiology procedures, lumbar punctures and myelograms, but the application could be easily expanded to include other procedures. In the future, we also intend to allow additional user customization of procedure guides, procedure types and evaluation forms.

LL-INS-SU2B ● Communicating Radiology Results to Patients: Results from Universal Online Release by an Academic Radiology Department

Seetharam C Chadalavada MD (Presenter) ; **Tessa S Cook** MD, PhD ; **Curtis P Langlotz** MD, PhD *

CONCLUSION
Our experience with the online release of radiology reports shows that release of reports is feasible, with no significant adverse effects. As measured by patient viewing rates, patients have a strong interest in their radiology results.

Background
As patients become more involved in their care, organizations are providing access to radiology reports via online patient portals. Portals provide an opportunity for radiologists to engage patients and to meet meaningful use requirements. Since May 2012, we released all radiology reports to patients with activated portal accounts.

Evaluation
We conducted a retrospective review of the utilization of our patient portal (MyChart, Epic Systems, Verona, WI) from May 2012 to March 2013. Patient demographics and online metrics were obtained from audit logs. Our health system is responsible for 2.1 million outpatient visits annually. Since the portalﬠs inception, 315,450 accounts have been issued, and 105,095 (33.3%) have been activated. 63% of accounts were activated for female patients. Women aged 50-59 and men aged 60-69 had the largest number of activated accounts.
Unless embargoed by the referring physician during a 3-day delay, all imaging test results were released to patients with activated accounts. 118,901 imaging test results were released, of which 49.3% (58,580) were viewed--similar to laboratory results released during the same period (51.8%; 588,567/1,134,389). The most frequently viewed imaging results were screening mammograms (50.1% view rate), chest X-rays (52.7%), and dual-energy X-ray absorptiometry (DEXA) scans (55.1%). No adverse events were reported. Patient phone calls to clinics and radiologists were unchanged.

Discussion
Many patients seek direct access to their imaging results, making them a voluntary partner in their care and promoting environmentally friendly communication. The potential savings relative to printing and mailing results to patients may be substantial. The number of calls from patients to clinics seeking radiology results may be reduced.

LL-INS-SU3B ● Automation Process for Pulsed Wave Doppler Measurement Using Bloodstream Information

Yunsub Jung MS (Presenter) ; **Hwan Shim** PhD * ; **Beunggeun Cheon** MS * ; **Hyungjoon Lim** MS * ; **Youngtae Kim** PhD *

PURPOSE
Measuring the blood velocity with Pulsed wave (PW) Doppler is affected by parameters such as Doppler angle, positioning of the sample volume (SV), and Doppler gain and these parameters are generally decided by human. To overcome error by human, operation complexity and time consumption in measurement, we present an automation process for PW Doppler.

METHOD AND MATERIALS
Proposed automation method was designed based on vessel and bloodstream information and include the following steps; 1) vessel detection and aliasing area removal 2) region of interest (ROI) searching and SV positioning 3) B, C-mode image fusion 4) vessel angle estimation using virtual ray 5) computing of Doppler and steering angle 6) measurement of blood velocity. As a result of mentioned process, SV position and vessel angle are automatically computed without user intervention. Then, the vessel angle obtained from automation method were compared with manual results by two experts, also repetition test was performed to evaluate a reproducibility of each way. We collected 300 pair images (B-mode : 300, C-mode : 300) including the carotid artery from three subjects without vascular disease for clinical assessment.

RESULTS
Vessel angle in collected images is distributed approximately from -40 to 40 degree. To evaluate the vessel angle accuracy of automation method, we

calculated the mean absolute difference (*D*) between computed angle and manual measurement angle, at this time, each angle was estimated under same conditions such as ROI and SV position. Automation method compared to manual results by two experts shows *D1* = 1.2 ± 0.7 and *D2* = 1.7 ± 0.9 respectively. In the case of repetition test, automation method always present *D* = 0 ± 0, however, manual measurement (*D1* = 1.7 ± 0.4, *D2* = 2.3 ± 0.7) shows a variation definitely.

CONCLUSION
Automation method for PW Doppler allows the robustness measurement of blood velocity without variance caused by subjective human factors, moreover, enhance the accuracy and reproducibility of the results.

CLINICAL RELEVANCE/APPLICATION
The described technique might be useful for current clinical environment in aspect of time reduction and reproducibility.

LL-INS-SU4B ● A Comprehensive and Innovative Program in Radiology for Medical Students

Andres Vasquez MD (Presenter) ; **Bibiana Pinzon** MD ; **Diego A Aguirre** MD ; **Anibal J Morillo** MD ; **Yenny A Moreno Vanegas** BSc ; **Sergio A Puentes** MS ; **Alfonso Esguerra** MD

CONCLUSION
Combined theoretical/on-site programs combined with the latest WEB 2.0 and 3.0 technologies can be key in the training of medical students in diagnostic imaging.

Background
The use of diagnostic imaging has increased significantly on a global scale in the past two decades.Because of this it is essential that medical students acquire more knowledge related to the adequate use of these diagnostic tools, their indications, interpretation of basic findings and patient safety. In Colombia less than 5% of medical schools have a radiology course or clinical rotation. When they do exist, they often end up becoming a rotation where the students sit behind a radiologist listening to him/her dictate studies.

Evaluation
We created a live and virtual 6 weeklong course last year medical students at Los Andes University in Bogot  Colombia. This program was created based on the aims and competencies described by AMSER. The students would have a Problem Based Learning (PBL) session and would have to revise academic reviews on a daily basis in addition to clinical rotations divided by sections. At the same time, students had access to platforms based on WEB 2.0 and WEB 3.0 where they would have the possibility of reviewing podcasts of the classes and answer questions in forums based on practical cases of basic pathologies, which would place the student in the midst of learning and generate discussion among peers creating the concept of collective learning. There were a total of 90 participating students between the years 2009-2012. We applied exams at the beginning and end of the course. The mean of the pre-course exam was 24/100 compared to 85/100 for the post-program exam. A complete statistical analysis was done.

Discussion
It is necessary to create innovative programs for teaching the basics of Diagnostic Imaging to medical students in order for them to acquire an adequate training in the use and interpretation of these tools due to their ample use in the present world. This is very important in order to ensure the adequate use of medical resources by all practitioners and at the same time will result in benefits and greater safety for patients.

LL-INE-SU5B ● The Liver Imaging Atlas: A Structured Learning Resource of Liver Imaging

Orpheus Kolokythas MD * ; **David L Coy** MD, PhD ; **Puneet Bhargava** MD (Presenter) ; **Sadaf F Zaidi** MD ; **Sherif Osman** MD ; **Neeraj Lalwani** MD ; **Claudia T Sadro** MD ; **Lee M Mitsumori** MD, MS * ; **Grace S Phillips** MD ; **Alex P Tornow** MD ; **Larissa A Alemany** MD ; **Luana Stanescu** MD ; **Adeel R Seyal** MD * ; **Sarah Bastawrous** DO

PURPOSE/AIM
1. To present a structured web-based interactive reference of liver imaging that includes a comprehensive spectrum of liver pathology in CT, MR, and ultrasound imaging. 2. To provide an educational resource for liver imaging targeted to radiologists in training and in practice.

CONTENT ORGANIZATION
The interactive educational website **www.liveratlas.org** has been designed with a detailed tagging system that allows authors to upload, structure, and categorize cases of liver imaging in CT, MR, and ultasound. The tagging system permits users of the atlas to filter, search, and retrieve cases by their general or modality-specific imaging features, disease category, diagnosis, or through a free text search. A quiz mode feature has been designed to allow the Liver Imaging Atlas to be used as a training tool by educators and residents. Cases in the atlas can be shared with colleagues via email and can be also saved for educational presentations and quizzes.

SUMMARY
The website **www.liveratlas.org** is an interactive comprehensive reference tool to rapidly and effectively access imaging examples of liver pathology on CT, MR and ultrasound. It allows radiologists to narrow down their differential diagnoses in specific clinical scenarios, test their diagnostic skills, and compile selections of interesting liver imaging cases to save and share.

LL-INE-SU6B ● Improving Critical Test Result Notifications Performance

Ingy Hanna MD ; **Jacquelyn Copeland** MD (Presenter) ; **Mark A Flyer** MD ; **Brian D Gale** MD *

Background
Failure to communicate is an increasing source of litigation against physicians, and specifically radiologists. From 1991-2009, radiology malpractice awards increased by an average of $4.7 million annually with communication failures accounting for 7-8% of the total cost. Unread test results may also be a source of significant CMS compliance penalties. Consequently, many institutions expedite reportable result notification by using critical test result management (CTRM). These systems enable the radiologist to asynchronously communicate findings to referring clinicians. After the radiologist sends the finding into the CTRM system, the referring physician receives a notification that a critical or significant radiologic finding has been made allowing them to both retrieve the finding and trigger a receipt time stamp. This facilitates and documents communication of significant radiologic findings to the referring physician.

Evaluation
We implemented a performance report that allows us to quickly and effectively analyze the data from the CTRM system over a given period of time. Administrators can determine, amongst other things, the significance of the message sent, the referring physicians and departments with the longest message retrieval intervals, and how referring physicians rank amongst others in compliance with message retrieval times. This information can be used to manage providers' performance and optimize communications of diagnostic test results.

Discussion
Compiling this information into a unified summary would allow institutions to assess the strong and weak points in communication of radiologic information, thereby allowing them to focus corrective efforts on those that are not in compliance. Importantly, it allows departments to track improvement in compliance after corrective efforts are made.

CONCLUSION
Using CTRM performance metrics could enable institutions to target weak points in communication, improving test result communication reliability and accelerating appropriate treatment decisions. This can improve length of stay, reduce the incidence of medical errors and enhance patient safety, subsequently reducing liability from malpractice litigation and compliance penalties.

LL-INE3196-SUB ● Fast and Automated MRA/ MRV Reconstruction Technique to Fly-through the Artery/ Vein

Mallikarjunarao Kasam PhD (Presenter) ; **Yunhong Shu** PhD ; **Kirk M Welker** MD ; **Vaibhav Juneja** PhD, MS

Background
Accurate quantification of artery/vein occlusion in acute ischemic stroke is necessary as this information can aid in reaching precise diagnosis. Recently several angiographic reconstruction methods were used to quantify occlusion in acute stroke. But these methods need long computational time. In the conventional clinical practice, artery/vein occlusion in an ischemic stroke patient is usually detected by MRA/MRV or CTA/CTV followed by Doppler ultrasound to confirm the stenosis profile. But the ultrasound exam is limited by its qualitative nature and high degree of subjectivity. More quantitative methods are needed to visualize the site of occlusion and measure the extent of occlusion.

Evaluation
Patient exams were performed under an IRB-approved protocol. Two 3D SWIRLS single phase contrast-enhanced angiographies with $1mm^3$ spatial resolution were used for this work. Clinical exams were acquired on 3.0T MRI(GE, WI). Data analysis: The raw data was post-processed using tree analysis and virtual endoscopy modules of Analyze 11.0 software (Analyze 11.0; Biomedical Imaging Resource, Mayo Clinic, Rochester, MN) to fly through the vessel. A statistical parameter called Brightness Area Product (BAP) was defined as the sum of the intensities above the sample minimum intensity/threshold set by the user.

Discussion
We proposed a simple and fast automated post-processing method to fly through the artery/vein using Analyze11 software. This technique can be extended to any arteries or veins for neuro, cardiac and body applications to monitor internal vasculature and to estimate the stenosis using the statistical parameter BAP,

which generates a master profile/database of arteries/vein.

CONCLUSION
This isthe first step towards the above problem by establishing a simple, automated post-processing method to fly through the vessels using tree analysis module and visualization of these vessels.This technique provides a simple, fast and automated method to fly through and have virtual endoscopic view of entire artery/vein trees especially at the regions of bifurcations where the occlusion possibility is prominent.The computation time for this method is < 5 min compared to the other reconstruction techniques (>~ 30 min).

LL-INE3199-SUB ● A Stand-alone Decision Support Tool for Managing Liver Lesions on CT and MRI Based on the LI-RADS v2013.1 Criteria

Ramin Javan MD (Presenter) ; **Mustafa R Bashir** MD *

Background
Decision support tools will likely become an integral part of many aspects of radiology in the near future, especially as part of the Imaging 3.0 movement by the ACR. In the field of breast imaging, standardized management and recommendations have been guided by the BI-RADS. Recently, an effort to standardize classification of liver lesions in the setting of cirrhosis has lead to the development of LI-RADS. This method aims to add consistency to radiologists' interpretations and provides a lexicon of terms, decision algorithms, and an atlas of imaging findings.

Evaluation
A decision support tool must be ideally simple, user friendly, intuitive, and preferably work in a step-wise fashion, minimizing the possibility of confusing the user with an excessive number of choices, features, and definitions. Microsoft Visual Basic 2010 was implemented for creating an application that allows the user to arrive at the appropriate LI-RADS category and therefore a standardized recommendation, which can then be copied to the clipboard for insertion into the radiology report. A step-wise algorithm as well as a tabulated algorithm with the exact appearance as the LI-RADS v2013.1 is developed. This user interface functions based on the active/inactive state of each command point and includes features such as 'educational mode', 'image atlas' and allows for 'backtracking' through the algorithm, lending more control to the user, which especially proves useful for training purposes and in practical situations.

Discussion
With the current boom in health IT and government's emphasis on meaningful use, emerging decision support tools can utilize a vast array of patient data to allow for better decision making and enabling evidence-based radiology. The fundamentals behind the design of such tools can also be applied elsewhere, such as a PACS plug-in or a web-based application.

CONCLUSION
A PC-based stand-alone decision support tool was designed and implemented, for simplifying the use of the newest version of LI-RADS. We hope that this tool encourages the widespread use of this recently developed scheme by radiologists and aids in bringing consistency to the recommendations made to clinicians.

LL-INE3238-SUB ● Generating Structured Reports through Calculator Applications

Alex Towbin MD (Presenter) * ; **Jonathan Borders** ; **Jay A Moskovitz** MS ; **Timothy OConnor** MBA ; **Neil D Johnson** MD *

Background
Calculators have been created for multiple medical specialties in an attempt to help physicians perform complex calculations more efficiently and accurately. When typical medical calculators are used, the output is the answer to a specific equation. This is not the output needed for most radiologists—the end product of a radiologist's work is not the answer to a formula but a dictated report. The purpose of this exhibit is to show a series of radiology-based calculators and demonstrate how they can be used to generate structured reports.

Evaluation
A novel, web-based application was created to help radiologists calculate leg length discrepancies, femoral/tibial torsion, and bone age. Each calculator was designed with two components. The graphical user interface (GUI) component directs the user to enter data for specified variables based on the examination being interpreted. Images are presented as part of the GUI to instruct the radiologist how to obtain each data point. After entering data for each variable, the calculator displays the answer to the equation along with a standardized, structured report via the second component—a structured report generator.

Discussion
While computerized, equation-based calculators have been used in medicine for over 15 years, they are infrequently used in radiology. Coupling a calculator with a structured report generator is a novel concept that allows radiologists to work efficiently while at the same time creating accurate, standardized, structured reports. Currently the three calculators in use in our department help radiologists interpret nearly 2,500 examinations each year, accounting for approximately 1% of all studies.

CONCLUSION
Structured reports can be generated through calculator applications. These applications can help to improve radiologist efficiency along with reporting accuracy and standardization.

LL-INE3161-SUB ● Relationship between Characteristics of Pulmonary Nodules and Performance Improvement of Radiologists: Comparison between CADx with and without Reasoning

Takeshi Kubo MD ; **Gakuto Aoyama** (Presenter) ; **Koji Fujimoto** MD, PhD ; **Masahiro Yakami** MD, PhD ; **Masami Kawagishi** ; **Kaori Togashi** MD, PhD * ; **Yutaka Emoto** MD, PhD ; **Ryo Sakamoto** ; **Yoshio Iizuka** ; **Hiroyuki Sekiguchi** ; **Koji Sakai** ; **Hiroyuki Yamamoto**

Background
A number of studies have demonstrated the improved accuracy of nodule diagnosis using CADx systems. The gain in the accuracy, however, may vary with nodule characteristics. Thus, to take full advantage of CADx, we evaluated the relationship between the performance of radiologists with a CADx system and the nodule characteristics.

Evaluation
In accordance with the IRB approval, we built a database of 491 lung nodules with clinical or pathological confirmation as a primary lung cancer, metastasis or benign nodule. The image findings were scored by consensus of two board-certified radiologists.
We developed a CADx system (Bayesian network / Markov chain Monte Carlo method, 179 training data) that can provide the reasoning behind the suggested diagnosis. CADx which indicates the probability of diagnosis (ICAD) and probability of diagnosis with additional reasoning such as image findings and/or clinical information (RCAD) were used for this experiment. The reasoning was determined by the degree of influence on the highest possible diagnosis.
11 diagnostic radiologists with 5 years— experience made the diagnoses for the 312 nodules with three different conditions (without CAD, with ICAD, with RCAD) with a more than 1 month interval.
We focused on 61 clinically relevant nodule characteristics. For each characteristic, a group of nodules was defined so that the nodules in the group share that particular characteristic. With regard to 61 resultant groups, the mean accuracy of 11 radiologists was compared among three conditions (Wilcoxon signed rank test with Bonferroni correction).

Discussion
For all groups, ICAD and RCAD significantly improved the diagnostic accuracy of radiologists (p For groups of nodules with 1) coarse speculation, 2) polygonal shape and 3) satellite nodules, accuracy was significantly better with RCAD than with ICAD (p
CONCLUSION
Effectiveness of CADx depended on nodule characteristics. Recognition of nodule characteristics that benefit from CADx support may lead to optimizing the CAD-assisted diagnostic process by the radiologists.

LL-INE3165-SUB ● Does Computer-aided Diagnosis System which Presents the Reasoning for the Diagnosis Improve Radiologists' Diagnostic Performance for Pulmonary Nodules on CT?

Koji Fujimoto MD, PhD (Presenter) ; **Masahiro Yakami** MD, PhD ; **Takeshi Kubo** MD ; **Ryo Sakamoto** ; **Gakuto Aoyama** ; **Kaori Togashi** MD, PhD * ; **Yoshio Iizuka** ; **Masami Kawagishi** ; **Hiroyuki Sekiguchi** ; **Yutaka Emoto** MD, PhD ; **Koji Sakai** ; **Hiroyuki Yamamoto**

Background
Without reasoning, radiologists might not be able to determine whether the output of computer-aided diagnosis (CADx) is reliable or not. This may lead to difficulty in judgments of the CADx output by radiologists. The purpose of this study was to evaluate the effect of CADx software which presents reasoning for the diagnosis on radiologists— performance.

Evaluation
With the approval of the IRB, we built a database of 491 lung nodules with clinical or pathological confirmation as primary lung cancer, metastatic, or benign. This database included thin-slice CT images, 49 nodule features interpreted by board-certified radiologists, laboratory data and patients— past history. We developed a CADx that provide nodule features as reasoning for the suggesting diagnosis. An inference model with a Bayesian network was constructed using the Markov Chain Monte Carlo method with the 179 training data set. CADx with the inference of the Bayesian network (ICAD), with additional reasoning (RCAD) were evaluated. RCAD presented image findings and/or clinical information as reasoning according to the relevance with the presenting diagnosis. For evaluation, 11 radiologists interpreted 312 nodules under three different conditions; without CAD (NCAD), with ICAD, and with RCAD. Each radiologist inputted likelihoods of diagnosis (primary, metastatic or benign), which in total should be 100% on each nodule. The likelihood agreed with the confirmed diagnosis was regarded as the confidence in each interpretation. For each radiologist—s input, Shannon entropy was calculated using the likelihoods and was regarded as the

uncertainty of the interpretation. Accuracy, AUC for each diagnosis, confidence, and uncertainty for 11 radiologists are compared for each condition (Wilcoxon signed rank test with Bonferroni correction).

Discussion
Accuracy, AUC for primary lung cancer, and confidence were higher, and uncertainty was lower in the order of NCAD(0.71, 0.86, 59.2, 0.92, respectively), ICAD(0.76, 0.90 ,65.1, 0.80) and RCAD(0.77, 0.91, 66.3, 0.74). Significant difference was seen for NCAD vs ICAD, and NCAD vs RCAD.

CONCLUSION
RCAD improved accuracy and reduced uncertainty for their diagnosis, but significance was seen only with NCAD.

LL-INE3163-SUB ● Can Computer-aided Diagnosis (CADx) System that Presents Reasoning Reduce Radiologists' Inter-observer Variability?: Evaluation in Interpreting Lung Nodules on Computed Tomography

Ryo Sakamoto (Presenter) ; **Koji Fujimoto** MD, PhD ; **Masami Kawagishi** ; **Gakuto Aoyama** ; **Takeshi Kubo** MD ; **Kaori Togashi** MD, PhD * ; **Masahiro Yakami** MD, PhD ; **Yoshio Iizuka** ; **Yutaka Emoto** MD, PhD ; **Hiroyuki Sekiguchi** ; **Koji Sakai** ; **Hiroyuki Yamamoto**

Background
Inter-observer variability among radiologists may lead to inappropriate clinical recommendations. With appropriate reasoning, CADx may help reducing variability among radiologists diagnosis. The aim of this study was to compare variability of radiologists interpretations of lung nodules on CT between with and without using a CADx, which is capable of presenting reasoning for the diagnosis.

Evaluation
With the approval of the institutional review board, we built a database of 491 lung nodules consisted of primary lung cancers, metastases and benign nodules. It includes image features scored by two board-certified radiologists and clinical data sets. We employed a Bayesian network for the inference engine of the CADx system and trained it by 179 nodule data sets. Our CADx system infers the diagnosis of nodule with providing the reasoning. Eleven radiologists with 5 years' experience interpreted 312 nodules under three different conditions: without CADx (NCAD); with inference only (ICAD); with presenting reasoning (RCAD). The level of likelihood for each diagnostic category was recorded in percentages up to 100 %. Inter-observer variability was assessed and compared among three different conditions (NCAD, ICAD and RCAD) by using following evaluation criterion: 1) Multi-rater ? (the level of agreement for diagnosis); 2) Standard deviation of AUC for the diagnosis in ROC analyses (variation in diagnostic accuracy); 3) The variance in radiologists output (degree of diagnostic consensus for each nodule).

Discussion
Multi-rater ? was moderate (?=0.561, 95%C.I.; 0.558, 0.564) by NCAD and was improved to good agreement by ICAD (?=0.679, 95%C.I.; 0.676, 0.682) and RCAD (?=0.692, 95%C.I.; 0.689, 0.694). The variation of accuracy was reduced with RCAD compared to ICAD as well as NCAD. The degree of radiologists consensus was also improved significantly by using both ICAD and RCAD, but there was no significant difference between ICAD and RCAD.

CONCLUSION
CADx reduced the radiologists' variability in interpreting lung nodules. With presenting reasoning, CADx was more effective in the aspect of improving the level of agreement for the diagnosis and variation in diagnostic accuracy.

LL-INE3164-SUB ● Computer Simulation of Clinical Conference: Evaluation of the Effect of Increasing Number of Participant and Joining Computer-aided Differential Diagnosis (CADx) as a Participant

Masahiro Yakami MD, PhD (Presenter) ; **Masami Kawagishi** ; **Gakuto Aoyama** ; **Hiroyuki Yamamoto** ; **Takeshi Kubo** MD ; **Kaori Togashi** MD, PhD * ; **Yoshio Iizuka** ; **Ryo Sakamoto** ; **Koji Sakai** ; **Koji Fujimoto** MD, PhD ; **Hiroyuki Sekiguchi** ; **Yutaka Emoto** MD, PhD

Background
In the process of determining diagnosis at a clinical conference, each physician explains one's differential diagnoses including their possibilities. This study proposes a computer simulation of clinical conference to evaluate the effect of increasing the number of the participant and joining a CADx as a participant.

Evaluation
With the approval of the institutional review board, we built a database on 491 lung nodules on which diagnoses were clinically confirmed as primary lung cancer, metastatic nodules or other benign nodules. This database consisted of CT images, image findings on the nodules, the confirmed diagnosis, clinical information such as laboratory data and patient history. The image findings were described by consensus of two board-certified radiologists.
The CADx was trained and evaluated by using 179 and 312 nodules in the database, respectively. The CADx derived a list of possibilities for differential diagnoses on each nodule using a Bayesian network.
Eleven radiologists, with five years experience in diagnostic imaging, interpreted the 312 nodules. Each radiologist inputted the possibilities for differential diagnoses, which in total should be 100%, on each nodule.
Among all possible diagnoses, the one with the highest total possibility in all participants was defined as the diagnosis at a conference. The average accuracy in the simulated conference among each combination of 2 to 11 (N) radiologists (R-Only), and that among all the combinations generated by replacing any radiologist in the combination with the CADx (R+C) were calculated for evaluation.
The radiologists interpreted the same nodules referring CADx later with more than one month interval.

Discussion
The average accuracies by each radiologist without/with CADx were 71.4% and 76.3%, respectively.
Those by RadOnly (N=2 to 11) were 73.5%, 75.6%, 76.4%, 76.9%, 77.2%, 77.4%, 77.5%, 77.5%, 77.8% and 77.9%, respectively.
Those by R+C (N=2 to 11) were 77.2%, 78.3%, 79.1%, 79.3%, 79.4%, 79.4%, 79.4%, 79.4%, 79.3% and 79.3%, respectively.

CONCLUSION
Increasing the number of participant improved the diagnostic accuracy, and joining CADx as a participant showed relatively higher improvement.

LL-INE3242-SUB ● Smarter Communications: Integrating VoIP Solutions for Streamlining Radiology Workflow

Sarfaraz Sadruddin MD (Presenter) ; **Rohit Ramanathan** MD ; **Leonardo I Valentin** MD ; **Sean D Raj** MD ; **Naveen Garg** MD *

Background
Efficient radiology workflow with reduced distractions is essential in practice today to maintain productivity, provide quicker turnaround times to our referring clinicians, and most importantly, to provide better patient care. Current workflow is burdened by high volumes of phone call attendance and communications with the ordering providers and technologists. These interruptions not only decrease efficiency, but the current telephone based system is less accommodating to an ideal workflow where majority of time is spent on PACS and reporting. An integrated Voice Over Internet Protocol (VoIP) within a webapplication provides a great solution and promises to revamp diagnostic radiology workflow in the near future as we demonstrate a working enterprise level solution.

Evaluation
Initial pilot data provided important feedback for evolution of our technology. Currently, we are collecting real-time user metrics while testing the webapplication, in addition to user satisfaction surveys. Future implementations will study head to head evaluation of traditional telephony service vs. VoIP integration with appropriate metrics.

Discussion
Using webtechnologies and server side coding, an IP based VOIP server was utilized and the newest Webrtc techonology was implemented for DTLS-SRTP encryption, which is HIPPA compliant. A webapplication was then developed with departmental phone numbers and all the outpatient phone numbers in an easy to use format with a rapid AJAX based search. A click to call feature was implemented enabling utilization of the Dictaphone directly without disturbing workflow during dictation. Additionally, a first to pick up, first to talk rule allowed for calling multiple phone lines concurrently (for different pods at the outpatient clinic), and further reduced time wasted by the radiologist.

CONCLUSION
An excellent solution to reduce the phone call burden on the radiologist is a direct browser based VoIP implementation that features smart rules for calling and receiving via the Dictaphone to increase workflow efficiency.

LL-INE3197-SUB ● The Use of a Digital Camera to Measure the Luminance of a Medical Monitor

Peter A Hardy PhD (Presenter)

Background
Medical Image monitors used for image interpretation on MR and CT systems applying for ACR accreditation must be assessed for adequate luminance range and uniformity. Typically this is done with a calibrated spot luminance meter. These devices are expensive and are not readily available to most radiology departments. We sought to calibrate a digital camera so it could be used to estimate the luminance of medical displays.

Evaluation
We used three digital cameras (Canon Power Shot SX100, Canon PowerShot SX10 and a Nikon D60) to take photographs of a flat panel LCD monitor displaying a SMPTE pattern. The luminance of the varying contrast squares of the SMPTE pattern were measured using a calibrated photometer. The photographs were exported from the cameras as JPEG files and analyzed in a program developed in IDL to measure the average grey value within ROI

encompassing 75% of the area of each contrast block. We fitted the grey values to a polynomial equation to derive an equation L=f(G) linking the photographic grey values (G) to the monitor luminance (L). We then tested this equation by taking similar photographs of a second monitor and comparing the luminance estimated from the photograph against that measured using the photometer.

Discussion
The relationship between monitor luminance and photographic grey value was best parametrized with a quadratic function where the grey value was transformed to x= log(1-G/Gmax) where Gmax was 255 as the photographs were three byte (RGB) JPEG files. Each camera had a unique, but similar, opto-electronic conversion function (OECF). Using the OECF we confirmed the luminance could be corrected for different exposure settings (EV) on the camera, (ISO, F-stop, shutter speed).This allowed us to estimate luminance even if the EV were different between calibration and use. The ratio of the estimated to the measured luminance was 1 to within a small value (10%, 5%, 3% for the three cameras) over the luminance range 0 - 90 Cd/m ^{2} .

CONCLUSION
With careful calibration a digital camera can measure monitor luminance rapidly and repeatedly. Photographs can be stored for subsequent review. It obviates the need to acquire an expensive and seldome used piece of equipment.

LL-INE3240-SUB • Quantitative Cardiac MR and Thoracic MRA Reporting with National Cancer Informatics Program (NCIP) Annotation and Imaging Markup (AIM) with Integrated Logic Case Report Form

Jeremy D Collins MD (Presenter) * ; **Vladimir Kleper** ; **Skip Talbot** BS ; **Michael Teistler** PhD ; **James C Carr** MD * ; **Pattanasak Mongkolwat** PhD

Background
Cardiac MR (CMR) is the gold standard for assessment of biventricular function and when combined with 3D MR angiography (MRA), enables a comprehensive assessment of the heart and thoracic aorta. Although CMR exams are well suited for structured reporting, standard voice recognition dictation systems are not optimized to efficiently extract and store quantifiable data. There is a need to standardize qualitative descriptions and reporting of quantifiable CMR results. The NCIP AIM 4.0 has been integrated into a ClearCanvas open source imaging workstation, providing a foundation to integrate structured reporting into clinical practice. The case report form created by AIM Template Builder (ATB) 2.0 is capable of branching logic and providing default answer(s). Custom case report forms and the workstation enable a reporting tool for cardiac MR and thoracic MRA evaluation that incorporate logic to generate qualitative descriptions of quantifiable CMR results.

Evaluation
Cardiac MR and Thoracic MRA templates were created using the AIM template builder for myocardial evaluation using the 17-segment AHA model, morphological assessment of the aortic valve, and quantification of thoracic aortic size. Advanced templates incorporate left ventricular T1 and T2* values for tissue characterization and evaluation of the left ventricular extracellular volume fraction.

Discussion
Anonymized CMR and thoracic MRA studies were used to collect data for purposes of trialing the AIM templates. The imaging studies were visualized and analyzed on an NCIP AIM 4.0 enabled ClearCanvas workstation. Users were able to annotate images and store data as XML files. This format enables ready extraction of data for clinical and research purposes.

CONCLUSION
The NCIA AIM 4.0 deployed on a ClearCanvas imaging workstation with the ATB is well suited for clinical reporting. Integrating this system into clinical practice could enable efficient query of clinical data for education and research purposes, while providing efficiencies at structured reporting. Information initially entered and stored in this manner is suitable to establish an imaging registry without dedicated clerical staff.

Health IT Tools to Improve Quality and Safety in Radiology (An Interactive Session)

Sunday, 02:00 PM - 03:30 PM • S103AB

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QA IN

RC126 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Kevin W McEnery , MD *

RC126A • Measuring Quality in Radiology, a Practical Framework

Ramin Khorasani MD (Presenter) *

LEARNING OBJECTIVES
1) Describe some of the reasons and the urgency for measuring quality in radiology. 2) Describe a simple and practical framework for establishing radiology quality metrics in your practice. 3) Use a case example to illustrate how quality metrics can be implemented in your practice.

ABSTRACT
Making continuous improvements is a hallmark of successful organizations. Such improvements can impact every aspect of your radiology practice including quality, safety, efficiency (including financial performance), and quality of work-life. By focusing on few important and relevant metrics to your performance gaps and quality improvement initiatives, one can communicate current state and clearly identify the goals on key improvement initiatives In this session, we will demonstrate how using a practical framework, such as Institute of Medicine's attributes (IOM) for high quality of care or the National Quality Forum (NQF) framework for creating quality metrics, a radiology pracitce can create and adopt quality metrics to help drive performance improvement. We will use case examples to demonstarte how measuring quality can help improve performce within the radiology department and the healthcare enterprise. The panel discussion will focus on how you can take practical steps in measuring quality and how to use quality metrics for performance improvement.

RC126B • Using Quality Metrics to Drive Change and Improve Quality within a Radiology Department

Paul G Nagy PhD (Presenter)

LEARNING OBJECTIVES
1) Discuss the National Quality Forum model for evaluating quality metrics based upon Importance, Repeatability, Feasability, and Usability. 2) Identify informatics mechanisms to assist in the capture, collection, analysis, and communication of quality metrics within Radiology. 3) Talk about actionable information and how to use quality metrics to drive change and enable effective management oversight.

RC126C • Using Quality Metrics to Drive Change and Improve Quality Across the Enterprise

Kevin W McEnery MD (Presenter) *

LEARNING OBJECTIVES
1) Understand potential to leverage the Electronic Medical Record to drive changes within radiology departments. 2) Learn about the benefits of extending radiology workflow into the enterprise to enhance workflow processes within radiology departments. 3) Appreciate capabilities of coordinating patient schedule activities to improve radiology performance and clinical interactions with clinicians in the Emergency Center and In-patient setting.

ABSTRACT

Standardized Terminology in Radiology: Applications and New Developments

Sunday, 02:00 PM - 03:30 PM • S403A

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IN

RC130 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Daniel L Rubin , MD,MS *

LEARNING OBJECTIVES
1) To recognize the need for standardized terminology for radiology imaging examinations. 2) To introduce the RadLex Playbook, which provides standard names for radiology orderables and procedure steps. 3) To demonstrate the value of RadLex Playbook in applications to improve radiology practice and regulatory compliance.
ABSTRACT
Every hospital performs virtually the same types of imaging procedures, but they all name them differently. The lack of a standardized naming scheme for radiology procedures thwarts the ability of radiologists and hospitals to share data or to consistently measure and track imaging procedures in a standard way. The need for standard imaging procedure names recently has been heightened by the emergence of a national dose registry that will establish benchmarks on

dose exposure and by interest by FDA and other organizations to track and improve quality measures related to imaging. Thus, the RSNA RadLex project recently created the Playbook, a system for creating standard names for radiology procedures and procedure steps. The RadLex Playbook provides a comprehensive set of standard names in addition to a grammar that enables institutions to map their existing list of terms to Playbook terms. Existing hospital information technology infrastructure can thus adopt Playbook immediately and begin deriving the benefits from this standard terminology. In this presentation we will introduce the Playbook, describe experience adopting it at several institutions, and present use cases on how it will enable radiologists and hospitals to meet emerging regulatory requirements and participate in national quality initiatives. Hospitals, payers, registries, researchers, radiologists, and even patients will be able to refer to their imaging studies using a common language and communicate radiology information unambiguously.

RC130A • Terminology Standardization in CT: Progress and Challenges

Thalia T Mills PhD (Presenter)

LEARNING OBJECTIVES
1) Identify challenges associated with non-standard CT terminologies. 2) Compare currently available standard CT lexicons. 3) Explain the role of consensus standards in FDA's regulation of radiological devices.

ABSTRACT
The inconsistency in names used for CT acquisition and reconstruction parameters across different scanner models can be confusing to operators, possibly leading to unnecessary radiation exposure or poor image quality. The AAPM Working Group on Standardization of CT Nomenclature and Protocols (WGCTNP) is working toward a set of consensus recommended CT parameter terms and definitions. Ongoing work includes: identifying relevant terms from existing standard lexicons; mapping generic terms to vendor-specific terminology (lexicon published on the AAPM 'CT Scan Protocols' website); and identifying preferred names based on use in the literature and clinical practice.

RC130B • RadLex® Playbook: Standardized Terminology for Naming and Coding Imaging Procedures

Daniel L Rubin MD,MS (Presenter) *

LEARNING OBJECTIVES
1) To recognize the need for standardized terminology for radiology imaging examinations. 2) To introduce the RadLex Playbook, which provides standard names for radiology orderables and procedure steps. 3) To demonstrate the value of RadLex Playbook in applications to improve radiology practice and regulatory compliance.

ABSTRACT
Every hospital performs virtually the same types of imaging procedures, but they all name them differently. The lack of a standardized naming scheme for radiology procedures thwarts the ability of radiologists and hospitals to share data or to consistently measure and track imaging procedures in a standard way. The need for standard imaging procedure names recently has been heightened by the emergence of a national dose registry that will establish benchmarks on dose exposure and by interest by FDA and other organizations to track and improve quality measures related to imaging. Thus, the RSNA RadLex project recently created the Playbook, a system for creating standard names for radiology procedures and procedure steps. The RadLex Playbook provides a comprehensive set of standard names in addition to a grammar that enables institutions to map their existing list of terms to Playbook terms. Existing hospital information technology infrastructure can thus adopt Playbook immediately and begin deriving the benefits from this standard terminology. In this presentation we will introduce the Playbook, describe experience adopting it at several institutions, and present use cases on how it will enable radiologists and hospitals to meet emerging regulatory requirements and participate in national quality initiatives. Hospitals, payers, registries, researchers, radiologists, and even patients will be able to refer to their imaging studies using a common language and communicate radiology information unambiguously.

RC130C • Standard Terminology for Radiology Reporting

Charles E Kahn MD, MS (Presenter) *

LEARNING OBJECTIVES
1) Define the roles of standardized vocabularies in radiology reporting. 2) Describe how terms from standardized vocabularies are being incorporated to RSNA's radiology reporting templates. 3) Understand how standardized vocabularies allow reporting templates and radiology reports to be interoperable across a variety of languages, information systems, and applications.

ABSTRACT
Standardized terminologies can help radiologists communicate the results of imaging procedures more effectively. A well-defined terminology can eliminate ambiguity, and can guide radiologists to use appropriate descriptive terms. Standardized vocabularies can overcome language barriers and the limitations of proprietary systems. This presentation will explore the roles of standardized terminologies in the reporting templates being developed by the RSNA Reporting Initiative. Structured reporting gives radiologists the opportunity to incorporate controlled vocabularies, such as RadLex, into their reports to enhance the reports' clinical usefulness, facilitate data extraction, and improve quality.

Introduction to Social Media (Hands-on Workshop)

Sunday, 02:00 PM - 03:30 PM • S401CD

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IN

RC153 • *AMA PRA Category 1 Credit* ™:1.5
Safwan Halabi , MD
Garry Choy , MD, MS
C. Matthew Hawkins , MD

LEARNING OBJECTIVES
1) Understand the different methods of communication offered by Facebook and Twitter. 2) Be able to establish active accounts/profiles on basic, mainstream social media platforms.
ABSTRACT

Introduction to Workflow Engines, Hands-on with an Open-source Platform

Sunday, 02:00 PM - 03:30 PM • S401AB

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IN

RC154 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Bradley J Erickson , MD, PhD *
Steve G Langer , PhD
Daniel J Blezek , PhD

LEARNING OBJECTIVES
1) Become familiar with workflow engine technology and how it relates to databases and imaging systems. 2) Attempt to build a workflow for an imaging task using a graphical workflow builder and workflow engine.
ABSTRACT
IN this hands-on session, attendees will be given the chance to observe and then operate a workflow engine that has been adapted to medical imaging tasks. THe session will begin with a description of what a workflow engine is, and how it compares with other technologies used in imaging departments. We will then describe adaptations we made to a standard workflow engine, to make it more amenable to medical imaging departments. Finally, we will have each attendee attempt to create a simple workflow, deploy it, and then run it. At the end of the session, attendees should be familiar with the strengths and weaknesses of workflow engines, and how they complement existing systems in an imaging department.

Structured Annotation and Image Markup (AIM) Template and Toolsets: Hands-on Workshop

Sunday, 04:00 PM - 05:30 PM • S401CD

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IN

ICIA12 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Pattanasak Mongkolwat , PhD
Justin Kirby
Vladimir Kleper

LEARNING OBJECTIVES
1) To introduce the participant to collecting image annotations as coded terminologies in a structured manner using NCIP Annotation and Image Markup (AIM) Version 4.0. 2) To provide an overview of and where to obtain the AIM tools used to create image annotations. 3) To provide an end-to-end demonstration on how to use the tools including AIM Template Builder, AIM Template Service, and AIM on Clearcanvas.
ABSTRACT
One of the major challenges associated with &#65533;big data&#65533; as it relates to imaging informatics is the lack of structured metadata for collecting image annotation information. The Annotation and Imaging Markup (AIM) version 4.0 information model captures pixel descriptions of an image interpreted by a human or machine with graphical drawings and related calculation results placed on the image into a single common information source. This course will demonstrate how the AIM project tools generate annotations and markup using coded terminologies in a way that automatically maintains the association to the images. The result is an interconnected suite of tools which allows researchers to easily generate minable structured metadata for research.

In this course, participants will receive an overview on generating image annotations and markup as coded terminologies in a structured manner utilizing freely available open source tools developed through the National Cancer Informatics Program (NCIP). First, we will introduce the AIM Template Builder for creating structured data entry templates. Next, we will discuss the AIM Template Service which allows for centralized storage and sharing of these AIM templates. Finally, we will cover the AIM on Clearcanvas workstation which is used to import and display the AIM templates alongside the image data and allows for structured annotation and markup creation. These tools allow study designers and imaging interpreters to focus on clinical problems and the types of information needed for collection without also comprehensively understanding the AIM model.

Ergonomics

Sunday, 04:00 PM - 05:30 PM • S501ABC

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IN

ICII12 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
William J Weadock , MD *
Eliot L Siegel , MD *

LEARNING OBJECTIVES
1) The attendee will learn how the radiology reading room environment can physcially affect the radiologist. 2) Learn about repetitive stress injuries and how they may affect radiologists and technologists. 3) Learn about how PACS workstations (including mice, keyboards, screens, etc. room lighting, sounds and temperature; and room furniture may be optimzed to help prevent repetitive stress injuries. 4) Learn how radiologic technologists can also be affected by repetitive stress injuries.
ABSTRACT
This presentation will review the features of a reading a study at a PACS, and the interactions of the radiologist with the various devices. This includes desktops/tables height, chairs, keyboard location, monitor position, mouse position (and cleanliness), microphone positioning, room temperature, sound volume, ambient light, and body positioning. Each of these components will be discussed, showing how to prevent future problems with repetitive stress disorders. The goal is to raise awareness of ergonomics for the radiologist.

The RSNA Image Share Network - How It Operates and How to Put It into Your Office

Sunday, 04:00 PM - 05:30 PM • S401AB

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IN

ICIW12 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
David S Mendelson , MD *
Steve G Langer , PhD

LEARNING OBJECTIVES
1) Understand the different means of sharing images and reports. 2) Describe the functional model of the RSNA Image Share system. 3) Identify the elements of the IHE XDS-I employed in the solution. 4) Learn about the technical architecture of the RSNA Image Share and plans for future development. 5) Learn how a site can participate in the RSNA Image Share, obtain an Edge Server and enroll patients.

Controversy Session: Radiology Reporting: Is Structured Reporting the Answer?

Monday, 07:15 AM - 08:15 AM • E350

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IN

SPSC20 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Curtis P Langlotz , MD, PhD *
Richard B Gunderman , MD, PhD

LEARNING OBJECTIVES
1) Understand how structured reporting differs from conventional dictation. 2) Learn the strengths and weaknesses of structured reporting. 3) Evaluate arguments for and against adopting structure reporting. 4) Decide whether adopting structured reporting is right for your practice.
ABSTRACT
The clinical report is an essential part of the service radiologists provide to their patients. The report is a tool that communicates information to referring physicians, serves as the legal record that documents the episode of care and records information for future use. A structured report is uniform, comprehensive, easily managed report that is 'readable' to humans and machines alike. Structured reporting improves radiology reporting practice by creating clear and consistent reports that contain reusable structured data. Structured reports facilitate closed-loop result communication, real-time radiologist decision support, quality improvement processes, and clinical research. This session will develop logical arguments regarding the strengths and weaknesses of structured reporting, thereby enabling the listener to form reasoned opinions about its value.

Technologies for Creating Educational Content and Teaching Files

Monday, 08:30 AM - 10:00 AM • S102D

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IN ED

RC230 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Kitt Shaffer , MD,PhD

LEARNING OBJECTIVES

RC230A • Podcasting and Screencasting for Teaching

Mahesh M Thapa MD (Presenter)

LEARNING OBJECTIVES
1) Identify the utility of podcasts and screencasts. 2) List major software packages available for creating podcasts and screencasts. 3) Understand the steps required to create a podcast or screencast.

RC230B • e-Publishing in Radiology

Michael L Richardson MD (Presenter)

LEARNING OBJECTIVES
1) Know the pros and cons of publishing electronic books. 2) Know the two main formats for publishing electronic books. 3) Be aware of several strategies for converting one's book to electronic form. 4) Know the pros and cons of several software packages used for electronic book conversion.

RC230C • Incorporating the iPad in Resident Education: Using Mobile Technology to Improve the Way We Teach

Harprit S Bedi MD (Presenter)

LEARNING OBJECTIVES
1) Identify techniques to incorporate mobile technology into your teaching program. 2) Appraise your current teaching practices in light of the new pedagogical approaches introduced in the lecture.

Introduction to Social Media (Hands-on Workshop)

Monday, 08:30 AM - 10:00 AM ● S401CD

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IN

RC253 • *AMA PRA Category 1 Credit* ™:1.5
C. Matthew Hawkins , MD
Safwan Halabi , MD
Garry Choy , MD, MS

LEARNING OBJECTIVES
1) Understand the different methods of communication offered by Facebook and Twitter. 2) Be able to establish active accounts/profiles on basic, mainstream social media platforms.

Introduction to Workflow Engines, Hands-on with an Open-source Platform

Monday, 08:30 AM - 10:00 AM ● S401AB

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IN

RC254 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Bradley J Erickson , MD, PhD *
Steve G Langer , PhD
Daniel J Blezek , PhD

LEARNING OBJECTIVES
1) Become familiar with workflow engine technology and how it relates to databases and imaging systems. 2) Attempt to build a workflow for an imaging task using a graphical workflow builder and workflow engine.
ABSTRACT
IN this hands-on session, attendees will be given the chance to observe and then operate a workflow engine that has been adapted to medical imaging tasks. THe session will begin with a description of what a workflow engine is, and how it compares with other technologies used in imaging departments. We will then describe adaptations we made to a standard workflow engine, to make it more amenable to medical imaging departments. Finally, we will have each attendee attempt to create a simple workflow, deploy it, and then run it. At the end of the session, attendees should be familiar with the strengths and weaknesses of workflow engines, and how they complement existing systems in an imaging department.

Radiology Informatics Series: Mobile Computing Devices

Monday, 08:30 AM - 12:00 PM ● S404CD

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IN

VSIN21 • *AMA PRA Category 1 Credit* ™:3.25 • ARRT Category A+ Credit:3.5
Moderator
David S Hirschorn , MD

VSIN21-01 ● Introduction
David S Hirschorn MD (Presenter)

VSIN21-02 ● Platforms and Security

George L Shih MD, MS (Presenter) *

LEARNING OBJECTIVES
1) iOS vs. Android platforms: a. Provide basic understanding of the differences and similarities between the Apple iOS and Google Android operating systems, as it mainly applies to the realm of medical imaging for end-users and developers; b. Introduce other competing platforms. 2) Mobile Security: Provide basic understanding of different security concerns and technologies (VPN, wifi, etc) available on mobile devices.

ABSTRACT
The physician dream of replacing the ubiquitous clipboard is now almost a reality. Radiologists and non-radiology clinicians will benefit from the enlarged screen size of the iPad and other mobile devices. The two main platforms for tablet mobile devices are currently the Apple iOS and the Google Android operating systems. While they share many similarities in terms of user interface functionality, they also have differences in the ways applications are created and used. This session will compare and contrast those differences, and also introduce other competing platforms. These devices will need to have the same or enhanced security compared with traditional computers because of increased portability and potential use of devices off the hospital wifi network (eg, iPad), including the use of VPN and other encryption methods (eg, https). Managing and controlling stored content will remain a major challenge for all portable devices. Other issues such as image capture (from the internal camera) and uploading them to the PACS or EMR will also need to be addressed. The recently introduced ability for locating a lost device and performing a remote wipe will hopefully allow for better adoption in medical settings, by alleviating anxiety for hospital IT departments. These devices clearly constitute a fundamental game change for radiology, both for inpatient and outpatient use cases, once security concerns are properly addressed.

VSIN21-03 ● A Global Market Analysis for Clinical Imaging Mobile Applications

Charles T Lau MD ; **Ahmed El-Sherief** MD (Presenter)

CONCLUSION
A viable market for clinical imaging practice mobile applications exists worldwide, particularly if coupled with formal marketing efforts, augmented user value, and cross-platform development. Although resources for mobile application development can be evenly distributed between smartphone and tablets for mature markets, similar efforts should heavily favor tablet deployment in emerging markets.

Background
Smartphones and tablets represent a powerful platform for deployment of clinical tools that can advance the quality of clinical imaging practice worldwide. Effective efforts to leverage mobile technology in the advancement of medical care require an understanding of the global market for thoracic imaging mobile applications.

Evaluation
Two radiologists at a major academic medical center in North America created and deployed seven clinical imaging practice mobile applications for the iOS platform addressing anatomy, oncology, differential diagnosis generation, and common practice guidelines. One mobile application was specifically deployed with independent versions for tablets and smartphones in order to assess differences between these subsets of the mobile market. All mobile applications were distributed free of charge and without in-app advertising in over 150 nations. Trends in sales volumes and sales by country were observed during a 4-month period following a 3-month rollout window.

Discussion
A total of 6,116 unique sales were observed during a 4-month period. The top 8 national markets for clinical imaging practice mobile applications included the United States, Brazil, Italy, United Kingdom, Spain, Turkey, India, and China. Customers in the U.S. represented the largest national market, accounting for 27% of all sales. Analysis of mobile application sales with independent smartphone and tablet versions revealed that the ratio of tablet versus smartphone uptake among providers is different in emerging markets than markets in North America and Europe. Whereas the tablet version of one application outsold the smartphone version by 22% in the U.S. and 12% in the U.K., tablet versions outsold smartphone versions by 144% in India, 70% in China, and 300% in Russia.

VSIN21-04 ● The Process of Creating and Deploying a Mobile Application for iOS: An Introduction for Radiologists

Charles T Lau MD (Presenter) ; **Ahmed El-Sherief** MD

CONCLUSION

Most radiologists are familiar with the process of publishing in a peer-reviewed journal or speaking at a national conference. Mobile platforms such as iOS will be an important alternative venue of communication, and an understanding of this medium is required for those who hope to take advantage of it.

Background
Mobile applications on platforms such as the iPhone and iPad represent an exciting venue for radiologists seeking to enhance their impact on colleagues' practices. Individuals interested in leveraging the iOS platform can benefit from an understanding of how this process works from beginning to end.

Evaluation
Many smartphone and tablet users are familiar with mobile applications. However, the process that proceeds from the genesis of an idea and results in a mobile app in the iTunes App Store can be complex.

Discussion
Developing a powerful mobile iOS application for health care providers in radiology is a long and multi-step process. The process begins with the identification of a concept or practice guideline that can be enhanced by electronic and mobile media, but underutilized because of the limitations of current media. A convenient user-interface providing a simple and understandable way of supplying user input and displaying answers is designed within Xcode Interface Builder. Software code is written in Objective-C to convert user-supplied input values to appropriate output. The resulting mobile app represents a unification of user interface design and software code tailored for a small screen, an app that must be rigorously tested and subsequently vetted by the App Store. Marketing efforts to communicate user value must be undertaken. User feedback is solicited to guide continued improvement. Many hurdles and pitfalls during these steps may be encountered and are discussed.

VSIN21-05 ● Digital Improvement of Mobile X-ray Machines Based on Wi-Fi Flat Panel System

Jian Guan MD (Presenter) ; **Xiao Mei Cheng** ; **Ling Zhang** MD ; **Shengwen Deng** ; **Shao Chun Lin**

CONCLUSION
Digital improvement of mobile X-ray machines based on Wi-Fi flat panel system is practical and proven to have many advantages by clinical application.

Background
There are 5 mobile X-ray machines distributed in different buildings in our hospital. The aging of equipments obviously influence image quality. Medical technologist (MT) have to take a stack of imaging plates and make many times trips between department of radiology and different wards. The cost for replacement with new mobile DR is great and all old machines will be abandoned. So we need to find a simple and available way to improve them.

VSIN21-06 ● Apps, Bandwidth, and Integration

Asim F Choudhri MD (Presenter)

LEARNING OBJECTIVES
1) To have an understanding of available applications available for mobile medical imaging, including native clients, web clients, and virtual desktop/terminal server approaches. 2) To have an understanding of bandwidth concerns in mobile medical imaging, including device data handling, network speeds, and possible bandwidth cost issues. 3) To have an understanding of possible clinical implementations of mobile medical imaging within radiology departments and in health care networks overall.

ABSTRACT
Applications: There are several vastly different approaches to mobile viewing of medical images. Native clients are programs written using a software development kit for a given platform. These clients can retrieve data from remote servers and view locally stored image data. Web clients are web-based programs which are often (but not always) platform independent. They will typically access remotely stored data which may be stored in a local cache but is usually not permanently stored on the mobile device. Virtual desktop/terminal server software allows a mobile device to access a remote computer or server. The remote server handles all higher level processing and data storage, minimizing the processing requirements of the mobile device but possibly straining bandwidth limitations. Examples of several applications using each of these approaches will be presented, with a discussion of pros and cons for each method as it pertains to an individual user and as it pertains to widespread implementation within a healthcare network. Bandwidth: Viewing medical images may require transfer of datasets that are tens or hundreds of megabytes in size. This provides a special challenge for mobile devices which typically receive data via wireless communication. If using a cellular network, network bandwidth can be a limiting factor (as can data transfer costs). File compression can reduce the size of files, however requires data processing power and may involve compromises in image quality. Once data is on a device, image processing may overwhelm its processing capabilities compared with dedicated PACS workstations. We will discuss both network and device bandwidth concerns as it relates to mobile medical imaging, and possible solutions for overcoming obstacles. Integration into a healthcare system: Mobile review of medical imaging is a tool which has potential to significantly change health care delivery, but the specifics for implementation are unclear. After a device platform has been selected, security protocols established, and bandwidth concerns solved, each institution will need to determine what role this technology will play. Possibilities include radiology residents (or even faculty) consulting with subspecialty faculty, surgeons and interventionalists triaging patients for procedures and for procedure planning, however these approaches are simply extensions of existing practices. New frontiers in consultation will be discussed, including an example involving mobile imaging review in a multidisciplinary stroke team. Guidance will also be provided regarding training and establishing institutional "standard operating procedures" documents. The current state of medical-legal concerns and risk management strategies will also be discussed.

VSIN21-07 ● A Secure, Mobile Device-based System for Rapid Consultation and Sharing of Interesting Cases

Loyrirk Temiyakarn MD (Presenter) ; **Asim F Choudhri** MD

CONCLUSION
Mobile device-based systems show great promise for secure yet rapid consultation and sharing of interesting cases. Such systems have already been deployed on an institutional and cross-institutional basis and have demonstrated great success.

Background
With the wide variety of PACS in use, radiologists in a group covering different hospitals often find communication between different PACS difficult. This is especially cumbersome when quick and informal consultations are desired between colleagues. With the recent improvements in camera optics and sensors in mobile devices, coupled with highly secure text and picture messaging networks, such limitations in communication can be more easily overcome.

Evaluation
Several mobile device-based applications were evaluated for ease of use, fidelity of image capture, security of transmission, and ease of sharing images among a group of colleagues. Applications tested were on different mobile device platforms and deployed across different mobile service providers. One particular commercially available application/device combination was chosen as a proof of concept at our institution. The chosen device demonstrated the ease with which images could be captured, regardless of PACS used. Captured images retained enough quality for viewing and diagnosis on the device, and could be cropped to exclude protected health information (PHI). In addition, the chosen application for image transmission has recently demonstrated encryption security sophisticated enough to limit court-mandated law enforcement efforts at interception and decryption. Finally, the chosen application allowed for easy yet secure dissemination of images to a group of colleagues for rapid consultation or review.

Discussion
As a proof of concept, the chosen device/application combination has proven extremely effective in the dissemination of still images for rapid consultation and sharing. The ubiquity of mobile devices combined with the flexibility in image capture allows for great versatility. However, the ability to share a series of consecutive images (e.g. cine clips) remains somewhat dependent on the user's ability to capture a movie clip of the desired image series.

VSIN21-08 ● Optimization of Patient and Staff Radiation Protection in X-ray Imaging Procedures Using a Mobile Phone Application

Francis R Verdun PhD (Presenter) ; **Nick Ryckx** MSc ; **Jean-Christophe Stauffer** ; **Jean-Jacques Goy** MD ; **Reto A Meuli** MD, PhD ; **Nicolas Goy**

CONCLUSION
The promotion of radiation protection must be done using all available means. The tremendous growth of mobile devices in the recent years called for a gap to be filled. When ready, our mobile application will help the physician to reach the lowest dose possible while still keeping diagnostic accuracy by estimating his/her practice with respect to the local diagnostic reference levels and giving useful working tips.

Background
The number and complexity of interventional radiology and cardiology (IR/IC) procedures has been steadily increasing over the last twenty years. This implies an increased risk of stochastic and even deterministic effects (skin burns) to the patient, as well as an increased exposure of IR/IC staff. Radiation protection must thus become of prime importance and should be promoted by all possible means.

Evaluation
We are developing a mobile application that will help the physician to evaluate his/her current state of practice regarding radiation protection. The key elements to achieve this goal are:
- Comparing his/her patient delivered doses to the local diagnostic reference levels (DRL).
- Estimate the risk and severity of potential radiation-induced skin burns and the necessity of patient follow-up.
- Estimate one's average personal dose.
- Give advice in order to reduce patient and staff exposure.
- Give general information about radiation protection.

Discussion
As radiation-induced erythema occur several days or weeks the X-ray exposure, it can be easily diagnosed as being caused by another factor, such as medication or allergy. Giving the patient more information about his/her personal risk would greatly improve his/her follow-up to minimize negative side effects of a high dose IR/IC procedure. As for the staff, it will help them with their daily practice by giving them useful tips aiming to reduce the dose delivered to the patient and, as a consequence, their own personal dose.

VSIN21-09 ● The Use of Mobile Devices for Specimen Mammography Interpretation: Feasibility Study

Bo La Yun MD (Presenter) ; **Sun Mi Kim** MD, PhD ; **Mijung Jang** ; **Hye Shin Ahn** MD

PURPOSE
To assess feasibility of mobile device in specimen mammography interpretation by using safety margin on pathologic result as reference standard.

METHOD AND MATERIALS
This retrospective study was approved by the institutional review board. Patient informed consent was waived. A total of the 79 consecutive breast specimen mammography (52 invasive cancer, 26 DCIS, and 1 mixed DCIS and LCIS) in 79 women (median age, 49 years; age range, 30-76 years) was included. Three radiologists independently reviewed specimen mammography with three different mobile devices (Nexus10, Google, CA; Galaxy note 10.1, Samsung, Korea; New iPad, Apple, CA;). Other two radiologists independently interpreted the same set of specimen mammography on 5megapixel LCD monitor. Margin evaluation on pathologic report was reviewed as the reference standard. Each reader was asked to measure the shortest distance from the lesion to the margin lesion. The interpretation time was also assessed. Absolute measurement discrepancy defined as the difference between measured shortest distance on specimen mammography and pathological safety margin, and interobserver agreement, sensitivity and specificity were analyzed.

RESULTS
Intraclass correlation coefficients were 0.546 for LCD monitor, 0.459 for Nexus, 0.508 for Galaxy, and 0.392 for iPad. The mean absolute measurement discrepancy were .66 ± .49 for LCD monitor, .61± .47cm for Nexus, .59± .47cm for Galaxy, .60± .48cm for iPad without statistical significant difference among devices (P= .59). The mean sensitivity and specificity were 66.8% and 35.2% for LCD monitor, 73.3% and 24.5% for Nexus, 77.8% and 30.2% for Galaxy and 73.3% and 26.0% for iPad. The mean assessment time were 44 seconds (sec) for LCD monitor, 42 sec for Nexus, 38 sec for Galaxy, 45 sec for iPad. There were no statistical significant between LCD monitor and mobile devices interpretation time (P=.18).

CONCLUSION
The mobile devices and 5-megapixel LCD monitors are comparable in terms of surgical margin evaluation of breast cancer in digital mammograms. The mobile devices could be an option to safety margin evaluation on specimen mammography.

CLINICAL RELEVANCE/APPLICATION
Mobile devices are comparable in 5-megapixel LCD monitor in evaluation of specimen mammography margin and could be used for display tool of immediate assessement when LCD monitor is inavailable.

VSIN21-10 ● Displays and Quality Assurance

David S Hirschorn MD (Presenter)

LEARNING OBJECTIVES
1) Discuss ranges of spatial and contrast resolution for medical imaging. 2) Explore options for calibration and quality assurance. 3) Understand the impact of ambient light and viewing distance and angle on medical image display.

ABSTRACT
Mobile devices have significantly smaller displays than desktop or even laptop computers to make them lighter and more easily transported. They are also designed for shorter viewing distances which require smaller pixels. The smaller total display size tends to reduce the number of pixels, while the smaller pixel size tends to increase the number of pixels. On balance, these displays typically have considerably fewer pixels than their stationary counterparts. Nonetheless, even desktop displays typically have less resolution than the original image size of a radiograph which is typically about 5 megapixel (MP) for a chest radiograph. And both types of displays have more resolution than a single CT image, which is 0.25 MP. Since these devices do allow zooming and panning, they may be suitable for image interpretation under controlled circumstances. The main purpose of the DICOM Part 14 Grayscale Display Function is to ensure that contrast is preserved across the range of shades of gray from black to white, particularly at the edges where uncalibrated displays tend to fall off. With desktop displays this can be measured with a photometer, either external or built-in, and graphics adapter adjustments can be made to make the display conformant. Mobile devices typically do not offer this degree of adjustability. This requires a different approach to DICOM curve conformance, and a reasonable alternative is to present the user with a visual challenge to identify low contrast targets placed randomly on the display. If the user can find them and tap on them, then the display may be considered compliant, and if not, then the display should not be relied upon.

VSIN21-11 ● How Good Is the iPad for Detection of Pneumothorax on Chest X-ray? Diagnostic Performance of Radiologists and Emergency Medicine Physicians

Rameysh D Mahmood MBBCh, FRCR (Presenter) ; **Justin Sim Jw** MBBS ; **Angeline, Choo Choo Poh** MBBS ; **C. C. Tchoyoson Lim** MBBS

PURPOSE
Tablets like the iPad have been successfully used as remote image review devices for emergency teleconsultation of high contrast studies e.g. CT. However, their utility in the interpretation of radiographs which require higher spatial and contrast resolution displays is less certain. This study aims to compare the accuracy of pneumothorax (PTX) detection on chest x-rays (CXRs) between the iPad and the PACS monitor and the diagnostic performance between radiologists and emergency medicine (EM) physicians.

METHOD AND MATERIALS
Annonymized full DICOM images of 140 CXRs [40 normal, 48 small PTX (2cm)] were retrospectively chosen from the PACS database and uploaded to 3 iPads (3rd gen). Three radiologists and 3 EM physicians of equivalent experience (2 residents, 1 attending physician each) independently read the CXRs on the iPad running iRAS viewing application (ASTAR, Singapore) and a 5MP Barco monitor running Amalga PACS (Microsoft, USA). The sets were randomized and the PACS and iPad reading sessions were separated by 1 month to avoid memory bias. Each reviewer had to indicate the absence or presence and location of the PTX. The percentage of correct diagnosis was calculated for each display and reader. The detection accuracy of small and large PTX between both displays was also compared.

RESULTS
The iPad diagnoses of the 140 CXRs were accurate in 97.4% compared to 97.6% for PACS. In the CXRs that had PTX, the accuracy of the iPad was 95.0% compared to 97.4% for the PACS monitor (p=0.03). The diagnostic accuracy of the radiologists with the iPAD was 97.8% compared to 94.5% with the EM physicians (p=0.002). 8.8% of small and 1.6% of large PTX were missed on the iPad, compared to 4.5% and 0.9% on PACS respectively.

CONCLUSION
Although there is overall high accuracy in diagnosis of PTX on CXR with the iPad, there was a statistically significant difference compared to conventional PACS monitors, and between radiologists and EM physicians, possibly due to small PTX.

CLINICAL RELEVANCE/APPLICATION
Potential clinical applications of 3rd generation iPad in the field of remote emergency diagnostic teleconsultation.

VSIN21-12 ● The Diagnostic Performance of a Tablet-PC with a High-resolution Display in Emergency MDCT Interpretation as Compared to a Dedicated 3D PACS Workstation

Susanne Tewes MD ; **Thomas Rodt** MD ; **Steffen Marquardt** ; **Evdokia Evangelidou** ; **Frank K Wacker** MD * ; **Christian Von Falck** MD (Presenter) *

PURPOSE
To evaluate a potential role of tablet PC with a high-resolution display (iPad 3) for the interpretation of emergency CT examinations in comparison to a dedicated 3D PACS workstation.

METHOD AND MATERIALS
Three readers compared the detectability of early signs of cerebral infarction and subtle pulmonary embolism in 40 CCT and 40 CTPA examinations using both, a tablet PC with a high-resolution display (iPad 3, Apple Inc., USA) running a radiology app (Visage Ease, Visage Imaging GmbH, Berlin, Germany) and a 3D PACS workstation (Visage 7.1, Visage Imaging GmbH, Berlin). Diagnostic confidence was evaluated on a 5-point Likert scale. Wilcoxon rangsum test, Spearman's correlation and Cohen's kappa were calculated for statistical evaluation.

RESULTS
For all readers, there was no significant difference in the median score between the iPad 3 and the PACS for the CCT and the CTPA, respectively (p>0.05). The mean Spearman's correlation coefficients were 0.46 (±0.2) / 0.69 (±0.16) for the comparison between the iPad and the PACS, 0.41 (±0.16) / 0.68 (±0.06) for observer agreement using the iPad and 0.35 (±0.05) / 0.68 (±0.10) for observer agreement using the PACS for CCT and CTPA, respectively. Mean kappa values were 0.52 (±0.17) / 0.67 (±0.19) for the comparison between the iPad and the PACS, 0.33 (±0.16) / 0.69 (±0.08) for observer agreement using the

iPad and 0.32 (±0.16) / 0.60 (±0.14) for observer agreement using PACS. The differences were not considered statistically significant (p>0.05)

CONCLUSION
The agreement in the interpretation of typical emergency CT examinations between the iPad 3 and a dedicated 3D PACS workstation does not differ significantly from interobserver agreement.

CLINICAL RELEVANCE/APPLICATION
The image quality of the iPad 3 with a high-resolution display allows for a preliminary interpretation of typical emergency CT datasets.

VSIN21-13 • Can the iPad Be Used in the Diagnosis of Bone Fractures: Preliminary Results

Spyros D Yarmenitis MD ; **Maria T Tzalonikou** MD (Presenter) ; **Socratis Gavriilidis** MD ; **Grigorios Rigas** MD ; **Irene Vraka** MD ; **John Spigos** BS ; **Athanasios D Gouliamos** MD ; **John Andreou** MD ; **Dimitrios G Spigos** MD

PURPOSE
To evaluate the usefulness of tablets in the diagnosis of bone fractures in a general hospital's emergency department.

METHOD AND MATERIALS
Seventy-eight consecutive trauma cases were evaluated retrospectively. Skeletal radiographs and the corresponding diagnostic reports were retrieved from the PACS-RIS database. They included 39 upper extremities, 28 lower extremities, 7 spinal, 3 rib cages and 1 skull x-rays. Of the cases reviewed, 35 had fractures. The images were anonymized and distributed after randomization to two attending radiologists and to two radiology residents. They used diagnostic monitors and a non-retina display iPad2 device. DICOM images were transferred in a compressed 1263x1536 matrix.

RESULTS
On the diagnostic monitors, the attendings made 130 correct and 26 incorrect diagnoses, while the residents made 127 correct and 29 incorrect diagnoses. On the iPad, the attendings made 128 correct and 28 incorrect diagnoses, while the residents made 125 correct and 31 incorrect diagnoses. In the detection of fractures, the iPad had a Sensitivity 70.9%, Specificity 89.4%, Positive Predictive Value 84.7%, and Negative Predictive Value 78.8%. As a group, the attendings and residents made 257 correct and 55 incorrect diagnoses on the monitors and 253 correct and 59 incorrect diagnoses on the iPad. There was no difference in the accuracy of interpretation among attendings and residents and no difference was found in their performance depending on the device used.

CONCLUSION
Based on this study, tablets will play increasingly important role in the radiographic detection of bone fractures. Although the FDA approved monitors will continue as the diagnostic devices in Radiology departments, tablets will play an essential role as they are mobile and can be used in the Emergency department or for teleradiology purposes.

CLINICAL RELEVANCE/APPLICATION
iPads can be used in diagnosis of fractures in the emergency department and for consultation between physicians from afar.

DtiStudio/MriStudio: Integrated Software Resource for White Matter Mapping and Quantitative Image Analysis

Monday, 10:30 AM - 12:00 PM • S401CD

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IN

ICIA21 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Kenichi Oishi , MD, PhD
Andreia V Faria , MD
Johnny T Hsu , MS

LEARNING OBJECTIVES
1) Learn practical aspects of DTI calculation: While the tensor calculation is an established process, there are several potential pitfalls and limitations. We will highlight these issues and discuss how we can resolve them. 2) Learn the concepts of image normalization: Image normalization is one of the crucial steps for quantitative image analysis. While this approach is widely used, the technology is far from complete. The issues specific to white matter anatomy and potential solutions will be discussed. 3) Learn atlas-based image analysis: Once the brain is normalized, there are many options for the final quantification step. Advantages and disadvantages of these options will be discussed.
ABSTRACT
Diffusion tensor imaging (DTI) can provide rich anatomical information of the brain white matter. Various white matter tracts, which are not visible in T1 and T2-weighted anatomical scans, can be clearly delineated in DTI-derived maps. The quantification of the white matter anatomy is, however, not straightforward. MriStudio consists of three programs designed for quantification of white matter anatomy. DtiStudio reads image data (such as DICOM) from multiple platforms and calculates various quantitative maps based on tensor calculation. Special emphasis is placed on image quality control at a various calculation steps. DiffeoMap then transforms the patient image into a common atlas space (or transform the atlas to the patient brain). Finally, RoiEditor provides an interface to perform automated or manual white matter segmentation, followed by reporting of anatomical properties of each segmented area. The quantification of 3D anatomical features poses many challenges and there are also difficulties specific to white matter structures. The purpose of this course is to learn various options to study white matter anatomy, practical issues encountered during the quantification, and their advantages and disadvantages.

Practical Informatics for the Practicing Radiologist: Part One (In conjunction with the Society for Imaging Informatics in Medicine)

Monday, 10:30 AM - 12:00 PM • S501ABC

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IN

ICII21 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
1) Define and describe the fundamental components of imaging informatics in a very practical and easy-to-understand way. 2) Understand methods to minimize distraction and reporting time when using speech recognition and structured reporting. 3) Understand the history and basic principles of business analytics.

ICII21A • The Road Ahead in Radiology Informatics

Paul G Nagy PhD (Presenter)

LEARNING OBJECTIVES
1) Discuss the current state of market penetration of RIS and PACS in the US. 2) Identify several commercial areas of innovation in the RIS. 3) Illustrate a model for a practice to assess how competitively they are leveraging informatics.

ICII21B • Using the RIS to Improve Efficiency in the Radiology Department

Alex Towbin MD (Presenter) *

LEARNING OBJECTIVES
1) Identify inefficiencies in radiology departmental workflow. 2) Provide examples of how the Radiology Information System can be used help to improve efficiency in the Radiology Department.

ABSTRACT
The radiology information system (RIS) is the central information system of many radiology departments. It was initially built as a system to schedule appointments and bill patients; however, it has grown to encompass all aspects of departmental workflow from the time an examination is ordered through the time a bill is sent and beyond. While certain elements of the RIS have been built for efficiency, others have lagged behind. The purpose of this talk is to describe methods by which the RIS can improve departmental efficiency. Case examples will be used to illustrate these methods and will include using the RIS to identify critical examinations at the time they are ordered, using the RIS to decrease incorrect orders, and using the RIS to drive departmental initiaives such as structured reporting.

ICII21C • Making the Case for Business Intelligence in Radiology

Matthew B Morgan MD (Presenter) *

LEARNING OBJECTIVES
You are starting to hear about 'big data' and you wonder how this will play a role in your radiology practice? What is Business Intelligence and Anaylitics? How will it help you, and how do you get started? You will learn the answers to these questions and more when you attend this presentation.

ABSTRACT

Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC®: A Hands On Course

Monday, 10:30 AM - 12:00 PM • S401AB

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IN ED

ICIW21 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Krishna Juluru , MD
Frederick E Weiss , MD
Tessa S Cook , MD, PhD

LEARNING OBJECTIVES
1) Learn how easy it is to install the new and improved RSNA teaching file software with the one-click installer. 2) Learn how to create, organize, and share teaching files, create conference documents and save interesting cases for yourself, your group or your department.

ISP: Informatics (Enterprise Integration)

Monday, 10:30 AM - 12:00 PM • S402AB

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IN

SSC09 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Rasu B Shrestha , MD, MBA *
Moderator
Safwan Halabi , MD

SSC09-01 • Informatics Keynote Speaker: Enterprise Imaging-The U Pittsburgh Experience
Rasu B Shrestha MD, MBA (Presenter) *

SSC09-02 • Effect of Computerized Evidence-based Clinical Decision Support (CDS) on the Use and Yield of Computed Tomography Pulmonary Angiography (CTPA) in the Inpatient Setting

Ruth M Dunne MBBCh (Presenter) ; **Ivan Ip** MD, MPH ; **Sarah K Abbett** MD, MPH ; **Ali Raja** MD, MBA * ; **Andetta R Hunsaker** MD ; **Ramin Khorasani** MD * ; **Esteban Gershanik** MD, MPH *

PURPOSE
To determine the effect of evidence-based CDS on the use and yield of inpatient CTPA for acute pulmonary embolism (PE).

METHOD AND MATERIALS
This HIPAA-compliant study included all adult inpatients at a 793-bed quaternary care hospital between April 1, 2007, and June 30, 2012. The intervention incorporated previously validated decision rules regarding clinical suspicion for PE and D-dimer measurement in low/intermediate risk patients. CTPA utilization was obtained from the institutional radiology information system. Using a validated natural language processing algorithm, each study was classified as positive for acute PE or not based on radiology report analysis. Admission data was gathered from administrative claims database. Clinical data, including use of prophylactic anticoagulation, was obtained from patient's electronic medical record. Primary outcome measure was quarterly utilization intensity of inpatient CTPA, defined as the number of examinations performed per quarter per case-mix-adjusted admissions (CMAAs), a product of gross number of admissions and Centers for Medicare & Medicaid Services' case-mix index of diagnosis-related groups for each quarter. Secondary outcome was the imaging yield, defined as the percentage of examinations positive for diagnosis of acute PE. Outcomes were compared before and after CDS implementation in October 2009. Chi-square was used to assess for differences in CTPA use and yield between the pre- and post-implementation periods. A two-tailed p-value of
RESULTS

CONCLUSION
Use of evidence-based CDS in the in-patient setting was associated with a significant decrease in use of CT pulmonary angiography for the evaluation of acute PE.

CLINICAL RELEVANCE/APPLICATION
Implementation of evidence-based CDS may significantly decrease the use of inpatient CT pulmonary angiography in the evaluation of acute PE without a decrease in study yield.

SSC09-03 • Replacement of a Conventional Alphabetic ORDER (PERFORM) PRIORITY System with a Stratified Numeric System: Implementation and Impact on EXAM PERFORM TIME at a Large Academic Medical Center

Dustin Boatman MD ; **Ryan P McWey** (Presenter) ; **Michael Hanshew** MS ; **Cree M Gaskin** MD *

CONCLUSION
A simple, defined, and hierarchical numeric exam order priority system was associated with desirable impacts upon exam perform time, including appropriate stratification by priority as well as improved uniformity amongst high priority orders, compared to results with a conventional alphabetic order priority system.

Background
Conventional radiology order priority systems often include alphabetic levels of priority, e.g., STAT, routine, and ASAP. Such choices offer potentially competing or ambiguous priorities. Informal polling of MD's and chief techs at our site revealed lack of consensus on prioritization using the alphabetic system. Our institution switched to a strictly numeric system with defined hierarchy to better leverage the ordering provider's level of concern for inpatient and ED exams and convey it more clearly to the technologists.

Evaluation
This QI project was not human subject research. We retrospectively reviewed the order-to-perform time (OTPT) parsed by order priority for all ED and inpatient radiology exams (n=136,652), excluding fluoroscopy, for the same six months (Mar-Aug) one year prior to and immediately after implementation of the numeric system. A hard stop requirement to choose a priority was also added.

Discussion
Prior to implementation of the numeric system, our 9 most commonly used alphabetic order priorities and their average (OTPT) in hours(std dev) for all modalities combined were ASAP 4.4(7.6), PRIOR1 0.9(2.15), PRIOR2 0.5(0.76), PRIOR3 0.9(1.4), PRIOR4 1.9(2.5), PRIORITY 0.4(2.59), ROUTINE 6.7(11.9), STAT 1.1(1.6) and BLANK (i.e, no selection) 6.5(12.3) (Fig.'left side). The hierarchical options of PRIOR1-4 were extra options for radiographs only. After implementation of the numeric order priority system of 1-4 with defined descriptions, OTPTs for all modalities by priority were 1.4(4.1), 1.7(3.4), 5.8(17.1), and 8(33.7) hrs (Fig.'right side). Similar improvements were reflected by each modality. There was desirable stratification of OTPTs after implementation of the numeric system while there was less dependable stratification with the alphabetic system. Smaller STD DEV values for high priority studies indicated greater uniformity in perform times.

SSC09-04 • Implementation of a Numeric READING PRIORITY System as a Distinct Step beyond Conventional Use of ORDER PRIORITY for the Prioritization of Radiology Exam Interpretation: Impact on STRATIFIED REPORT TURNAOUND TIME in a Large Academic Medical Center

Dustin Boatman MD (Presenter) ; **Ryan P McWey** ; **Michael Hanshew** MS ; **Cree M Gaskin** MD *

CONCLUSION
Addition of a numeric reading priority system as a step beyond order priority for prioritizing radiology exam interpretation was associated with more desirable stratification of RTAT, as well as improved (reduced) variability in RTAT for high priority exams.

Background
The prioritization of radiology exam interpretation is conventionally based upon the order priority set by the ordering provider. This may not allow for revision of priority based upon new information (e.g. pending clinic appointment or concerning imaging finding noted by the tech). It also yields competing priorities between inpt, outpt, and ED exams when folded into a common reading work list.

Evaluation
This QI project was not human subject research. Our institution implemented a numeric reading priority (1-9, with defined criteria) set by the tech at end exam in addition to the provider's order priority. We sought to determine the impact of this additional priority score on stratified report turnaround time (RTAT) (i.e. time between end exam and release of first report). We retrospectively reviewed RTAT for all exams, excluding fluoroscopy, (n=309,331) parsed by read priority for the same 6 mos (Mar-Aug) at 2 points: immediately following implementation (when radiologists continued existing patterns of prioritization,

largely ignoring the new data) and 1 yr later (after they had adopted prioritizing interpretations with the new read priority score).

Discussion
With existing patterns of priority for interpretation, RTAT was not well stratified by hierarchical reading priority and demonstrated wider variation. Avg RTATs in hours(STD DEV) for all combined modalities, in order from most urgent (score 1) to least(score 9) were 11.9(6.1),4.7(6.9), 13.6(31.4), 11.8(59.7), 17.4(21.5), 14.9(42.9), 28.8(13.8), 26.2(47.1), and 21.7(27.7). After radiologists adopted use of the read priority score, RTATs for the same priorities were 1.7(4.2), 1.3(2.5), 6.5(15.6), 6.6 (17.1), 13.4(20.6), 10.1(11.9), 18.9(16.2), 18.8(28.9), and 18.2(27.5). The high priority studies had the greatest improvements with reduced and more uniform RTAT. Included FIGURE demonstrates improvement across all priorities but most notably among high priority studies.

SSC09-05 ● Truly Meaningful Use

Kambrie Kato MD (Presenter) ; **Joshua J Reicher** MD * ; **Alberto Kywi** MS ; **Michael A Trambert** MD *

CONCLUSION
11 radiologists qualified attesting to the EHR Incentive Program in 2012, possibly making this group the first community hospital-based outpatient radiology practice in the U.S. to do so. Compliance was achieved using a complete cloud-based EHR. Benefits extend beyond the incentive payment, including real time access to clinical data by the radiologist and increased patient engagement.

Background
The Center for Medicare and Medicaid Services EHR Incentive Program provides financial incentives to providers who "meaningfully use" a certified EHR. Although temporary exemptions to penalties, which begin in 2015 are available, failure to comply threatens to isolate radiologists from physicians, patients, and hospitals that have rapidly adopted the specified technologies. With over 350,000 eligible providers participating as of 12/31/2012, the ability to exchange information according to these standards may soon be a "must have" feature of any successful radiology practice, though a minority of radiologists have attested to date.

Evaluation
Successful implementation of a complete cloud-based certified EHR in a community hospital-based outpatient radiology practice is reported, with shown benefits of greater clinical relevancy and direct patient engagement.

Discussion
The medical group discussed herein uses a cloud-based EHR system (DR Systems, Inc., San Diego, CA) that can be incorporated into any third party RIS or PACS. Cloud-based architecture results in rapid deployment of updates and the ability to communicate with patients via a personal health record (PHR) (Health Companion, Inc., San Diego, CA). As a result, patients can provide required data prior to the appointment and can automatically access required information via the web. An upstream electronic interface enables automated input of some data. Patients can pre-register using the PHR over the web, and data is collected via a single-page paper questionnaire. Relevant EHR data is single-click accessible to the radiologist during the exam interpretation. An unanticipated benefit was leveraging the EHR to satisfy a joint commission request for access to outpatient medication and allergy data.

SSC09-06 ● Patient Access to Radiology Report Via an Internet Portal: Low Rate of Patient Utilization and Concerns about Delayed Care

Nogah Shabshin MD, MBA (Presenter) * ; **Sahar Darawshi** ; **Ifat Abadi-Korek** PhD ; **Martine Szyper-Kravitz** MD ; **Joshua Shemer** MD, MPH

PURPOSE
In recent years communicating radiology reports to patients directly through an internet portal is becoming more popular. Patients log into a portal with a personal password and can view the radiology report. Although online access is the fastest way to get the report, in our institution, after 5 years of using this technology, only 30% of patients log in to the portal. The purpose of this study was to investigate whether patients with abnormal studies who didn't access their reports online received the results, and to examine whether they returned to the referring physicians for further work-up and treatment.

METHOD AND MATERIALS
A telephone survey was conducted with1594 patients who had an abnormal CT or MRI between April and October 2012, and whom received a password for the internet portal but did not log in. Patients were asked the following questions: 'Did you receive the report?' If answered yes: 'did you return to your referring physician after receiving the report'?

RESULTS
Two hundred and twenty of 1594 (14%) patients with abnormal studies that did not log into the portal did not receive the results although these were available to them. Of the 1374 patient that did get the results 190 (14%) patients did not return to their referring physician.

CONCLUSION
Despite the availability of the reports online, and despite studies reporting that patients prefer to receive results fast, preferably online, the utilization of this technology is surprisingly low and most patients receive the results in an alternative way. When patients receive abnormal reports not through their physician, the compliance for further work-up and treatment is concerning and may lead to delay in diagnosis and treatment.

CLINICAL RELEVANCE/APPLICATION
Even when patients receive results directly it is of high importance to deliver the results to the referring physician as well to minimize delayed patient care.

SSC09-07 ● Impact of a Point-of-Care Electronic Clinical Decision Support (CDS) Tool on Adherence to Departmental Guidelines for Follow-up of Incidental Pulmonary Nodules on Abdominal CT

Michael T Lu MD (Presenter) ; **David A Rosman** MD * ; **Carol C Wu** MD * ; **Tarik K Alkasab** MD, PhD ; **Jo-Anne O Shepard** MD * ; **Giles W Boland** MD ; **Matthew D Gilman** MD

PURPOSE
The indeterminate pulmonary nodule is a common incidental finding on abdominal CT. While the abdominal radiologist plays a critical role in recommending appropriate follow-up, we have previously demonstrated that the majority of recommendations deviate from best practice guidelines. We implemented an automated decision support tool to provide evidence- and consensus-based recommendations at the point-of-care for further imaging based upon the Fleischner Society guidelines. The goal of this study was to evaluate the effect of the CDS tool on adherence to guidelines for follow-up of incidental pulmonary nodules.

METHOD AND MATERIALS
The RIS was mined for abdominal CT reports from 10/22/12 – 4/4/13 with a solid, noncalcified, pulmonary nodule that did not have a prior abdominal CT or prior or concurrent chest CT. History of smoking or malignancy, whether follow-up chest CT was recommended, and the time interval for follow-up were recorded. Concordance between the radiologist's recommendation for follow-up and departmental guidelines was compared between three groups: reports where the CDS tool was used, those where it was not used, and 268 historical controls prior to the implementation of the CDS tool.

RESULTS
Out of 7,713 consecutive abdominal CT reports, 243 described a pulmonary nodule. Manual review of these reports yielded 141 consecutive patients who met inclusion criteria. The CDS tool was used in 40% (57/141). When used, 95% (54/57) of the recommendations were concordant with guidelines. In the remaining 5% of cases (3/57), the radiologist overrode the CDS tool and recommended more aggressive follow-up. Concordance with guidelines was significantly greater for the CDS group than the non-CDS group (45%, 38/84, $p < 0.01$) and historical pre-intervention controls (50%, 133/268, $p < 0.01$).

CONCLUSION
A point-of-care CDS tool improved adherence to departmental guidelines for follow-up of incidentally detected pulmonary nodules.

CLINICAL RELEVANCE/APPLICATION
Real time, point-of-care CDS tools can decrease the variability of radiologist recommendations, which may impact patient outcomes and cost.

SSC09-08 ● Impact of a Multi-screen Decision Support Alert on Repeat Use of CT

Stacy D O'Connor MD (Presenter) ; **Aaron D Sodickson** MD, PhD ; **Ivan Ip** MD, MPH ; **Ali Raja** MD, MBA * ; **Luciano M Prevedello** MD,MPH ; **Wendy Mar** ; **Michael J Healey** MD ; **Louise I Schneider** MD ; **Ramin Khorasani** MD *

PURPOSE
Evaluate the impact of a multi-screen decision support alert on repeat use of CT.

METHOD AND MATERIALS

This institutional review board-approved, pre-post study was conducted at a 776-bed academic medical center with computerized physician order entry and decision support systems. Previously, a single-screen alert notified orderers in real-time if the patient's same body part had been imaged with the same modality within 90 days. Providers could ignore the alert and proceed, or drop the order. The intervention was a multi-screen repeat decision support alert. Orderers ignoring the single-screen alert received a second screen requiring selecting a clinical justification from a predetermined menu to complete the order, otherwise it was dropped. All 28,420 CT orders triggering a repeat alert in 2010, excluding those for malignancy restaging (n=11,862), were included. Primary

outcome was proportion of dropped orders, evaluated with the Chi-square statistic. Multiple logistic regression assessed effect of care setting, orderer role, patient age and gender.

RESULTS
682/6,542 (10.4%) of CT orders triggering single-screen alerts were dropped; the multi-screen alert resulted in a 12.9% (1,290/10,016) drop rate (23% relative decrease; p
CONCLUSION
A multi-screen decision support alert requiring clinical justification to proceed with a repeat CT order prevented 1 in 8 CT orders, significantly enhancing the impact of a single-screen alert which prevented 1 in 10 repeat CT orders.

CLINICAL RELEVANCE/APPLICATION
Multi-screen decision support (DS) significantly reduces repeat CT orders; some proportion of dropped orders are likely unnecessary exams. Our study helps inform optimum DS design and implementation.

SSC09-09 ● An Enterprise Class Computer Aided Detection Platform Scalable from Laptop to Cloud

Mark Hinton (Presenter) * ; **Olga A Kubassova** PhD, MSc * ; **Mikael Boesen** MD, PhD *

CONCLUSION
The challenges of handling large image datasets and real-time overlay calculations have been addressed through a novel architecture. Our validation in real clinical practice has shown that our cloud based architecture gives the same or better performance than a workstation. Further it supports multi-center collaboration and seamless data sharing. There are low costs to deploy the software. Development of new functionality is faster and automatically deployed to all users

Background
To achieve efficiency in analysing medical images many radiology units use cloud based computer aided detection (CAD). The problem is to keep calculations and image overlays up to date whilst providing good user experience across bandwidths and latencies that are not controlled. Further, to support new developments, the architecture of the software must support easy integration of algorithms without compromising performance. We present a novel approach to multi-tier architecture, Dynamika, which has successfully addressed the problems and been validated in radiology practices.

Evaluation
The architecture of Dynamika makes use of a classic back end framework of Spring and Hibernate to give robust server side scaling and performance. It uses Spring Webflow to control the path through the application. Webflow has been enhanced to allow for tightly controlled batch processing, which is utilized in clinical trials or routine analysis. The front end is based on Google Web Toolkit to give high performance in the client, desktop like behavior through AJAX and the power of HTML5. 3D visualization and animation is achieved through WebGL.

Discussion
Software using the new architecture has been bench marked against a conventional workstation solution for user experience and development efficiency. The performance of the cloud is comparable or better than the workstation in scrolling images with complex overlays and making calculations such as image registration, saving clinician time. To implement new algorithms, which was measured by recording time of code and test, was up to 10 times less in the cloud architecture. The cloud architecture properly supports collaboration and sharing and supports any device with network access.

Informatics - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM ●Lakeside Learning Center

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IN

LL-INS-MOA •*AMA PRA Category 1 Credit* ™:0.5
Host
George L Shih , MD, MS *

LL-INS-MO1A ● Open Source Automated Web-based System for Tracking and Analyzing CT Radiation Dose Reports

Michael Y Park MD (Presenter) ; **Seung Eun Jung** MD ; **Kwang Pyo Kim** ; **Kyung-Hyun Do** MD ; **Jung Eun Lee** ; **Hyung-Soo Kim**

PURPOSE
To develop an open source web based system for tracking and analyzing CT radiation dose reports with an emphasis on ease of use and increased compatibility in diverse environments without dependencies on external electronical medical records (EMR) or Picture Archival and Communication System (PACS).

METHOD AND MATERIALS
We identified potential problems preventing easy and widespread use of automated methods for analyzing CT radiation dose reports. Based on an open source automated dose extraction project RADIANCE, the Ministry of Food and Drug Safety modified the project and developed KDose to alleviate these problems.

RESULTS
Major obstacles of prior automated methods for dose extraction include dependencies on external electronical medical records (EMR) or picture archiving system (PACS), difficulty in customizing solutions, difficult in automating the whole process, and CT scan protocols which image multiple body parts in a single scan. To overcome these obstacles KDose removed dependencies on external systems by using an easy to use fully customizable web based interface to determine CT exam types depending only on DICOM headers. This was implemented by developing a custom text parsing system fully configurable by a web interface. KDose is also fully installable automatically and does not require special knowledge to install. Guides for automatically sending images to the KDose system was created for major CT vendors. KDose identifies and parses multiple CT body parts created from a single scan. The source code for KDose is open source and may be used or modified freely.

CONCLUSION
KDose introduces new approaches that solve many problems preventing easy and widespread use of automated methods for analyzing CT radiation dose reports.

CLINICAL RELEVANCE/APPLICATION
The development of KDose identifies real world problems in regard to using automated methods for analyzing CT radiation dose reports and offers potential solutions.

LL-INS-MO2A ● Computerized Method for Detection of Swelling Lymph Nodes Adjacent to Colon Cancer on CTC Images: Preliminary Results

Mitsuru Sato (Presenter) ; **Toshihiro Ogura** PhD ; **Norio Hayashi** PhD ; **Yoshiaki Yasumoto** ; **Hyunjong Lim** ; **Kunio Doi**

CONCLUSION
Our computerized method based on a template-matching technique would be useful in assisting radiologist in the detection of lymph nodules adjacent to colon cancer in CTC.

Background
A major challenge in the current computer-aided detection (CAD) in CT colonography (CTC) is to detect polyps at a high sensitivity level. However, there is almost no reports regarding the detection of swelling lymph nodes on CTC images. Our purpose was to develop a novel CAD method for detection of swelling lymph nodes adjacent to tumor using a template-matching technique on CTC images.

Evaluation
For detection of swelling lymph nodes, our method was applied to reconstructed slab maximum-intensity-projection (MIP) images in orthogonal plane of virtual endoscopic images. Since CT artifacts of MIP images can be reduced compared with that of MPR images, CAD system can be developed for detection of round patterns on relatively low noise images. Our approach consisted of the following steps: 1) creation of templates by use of swelling lymph nodes, 2) initial candidate detection using template matching technique and, 3) reduction of false positives using image features. Our scheme was evaluated with use of FROC analysis.

Discussion
Since MIP images provided extra-luminal images by depicting blood vessels as liner patterns, blood vessels were removed easily. Since this method was applied to a large number of MIP images, it is possible to have a very high sensitivity in the detection of swelling lymph nodes. The initial candidate detection before classification achieved a 100% (14/14) sensitivity in the detection of peripheral lymph nodes with 12 FPs per case. The subsequent feature selection removed 66.7% (8/12) of FPs without removal of lymph nodes in a leave-one-lesion-out cross-validation test; thus, a 100% sensitivity with 4 FPs per patient was achieved.

LL-INS-MO3A ● Selection of Reference Images Based on the Similarity Map by a Multidimensional Scaling: Precision for 324 Independent Test Cases

Chisako Muramatsu PhD (Presenter) ; **Tokiko Endo** MD ; **Mikinao Ooiwa** ; **Misaki Shiraiwa** MD ; **Kunio Doi** ; **Hiroshi Fujita** PhD

PURPOSE
Previously diagnosed cases with known pathologies can be used as a reference for diagnosis of a new lesion. In order for reference images to be useful, they must be similar to and belong to the same pathologic group as the unknown lesion. In this study, precision of our new image retrieval method was evaluated.

METHOD AND MATERIALS
In our previous study, a similarity measure for image retrieval was determined using an artificial neural network (ANN) that estimates radiologists' subjective ratings by image features. In this study, a similarity measure was determined on the basis of a multidimensional scaling (MDS) analysis. In both studies, subjective similarity ratings for 351 pairs of masses, all possible pairs for 27 images, by 8 experts were used. In the previous study, the average subjective ratings were used as teacher data for the ANN. In this study, the subjective similarity ratings were linearly converted to dissimilarities and applied to MDS. Each dimension of the 3 dimensional MDS map was modeled by ANN with the image features. Parameters for ANN were determined by a leave-one-out cross validation with the 27 cases. For evaluation, 324 independent test images were employed. Using the similarity measures, one to ten most similar images were retrieved for each test case. Results were compared in terms of an average precision, which is the fraction of the pathology-matched cases in the retrieved cases.

RESULTS
Average precisions for the previous measure and MDS-based measures ranged from 0.70 to 0.69 and from 0.80 to 0.79, respectively, when the number of retrieved images was varied from 1 to 10. The precision for MDS-based method can be considered high despite the small number of training cases. Although the precision varies between cases, on average, 4 out of 5 retrieved cases were retrieved from the same pathologic group as an inquiry case.

CONCLUSION
Although ANN was used in both methods, MDS analysis may be advantageous by breaking down the complicated similarity relationship to several characteristic dimensions. Reference images retrieved by using the proposed similarity measure may be useful in the diagnosis of a new lesion.

CLINICAL RELEVANCE/APPLICATION
Automated image retrieval may be useful for providing reference images in clinical practice and in education.

LL-INS-MO4A ● A Picture Is Worth a Thousand Words: Needs Assessment for Multimedia Radiology Reports in a Large Tertiary Care Medical Center

Lina Nayak MD (Presenter) ; **Christopher F Beaulieu** MD, PhD ; **Daniel L Rubin** MD,MS * ; **Jafi A Lipson** MD

PURPOSE
Radiology reports are the major, and often only, means of communication between radiologists and their referring clinicians. Radiology reports could include embedded images (multimedia reports) though the value to referring physicians has not been studied. The purpose of this study is to identify referring physicians' preferences about radiology reports and quantify their perceived value of multimedia reports compared with narrative text reports.

METHOD AND MATERIALS
1800 attending physicians from a range of specialties at large tertiary care medical center were contacted by email and a hospital newsletter linking to a 25-question web-based electronic survey between July and November 2012. 160 physicians responded, yielding a response rate of 8.9%. Survey results were analyzed using Statistical Analysis Software (SAS Institute Inc, Cary, NC).

RESULTS
142 out of the 160 referring physicians respondents (89%) indicated a general interest in reports with embedded images and completed the remainder of the survey questions. 103 out of 142 respondents (73%) agreed or strongly agreed that reports with embedded images could improve the quality of interactions with radiologists. 97 out of 142 respondents (68%) agreed or strongly agreed that having access to the significant/key images embedded in an electronic version of the text report would significantly reduce the time required to understand/process the information in the report. 129 out of 142 respondents (91%) agreed or strongly agreed that having access to the significant/key images when reviewing a text-based report enhances understanding of the report content. Regarding physician satisfaction, 110 out of 142 respondents (77%) agreed or strongly agreed that multimedia reports would significantly improve referring physician satisfaction, and 85 out of 142 respondents (60%) felt strongly or very strongly that multimedia reports would significantly improve patient care and outcomes.

CONCLUSION
Creating accessible, readable, and automatic multimedia reports should be a high priority to enhance the practice and satisfaction of referring physicians, improve patient care, and enhance the critical role radiology plays in current medical care.

CLINICAL RELEVANCE/APPLICATION
Multimedia radiology reports are regarded as clinically valuable to referring physicians for improving patient outcomes.

LL-INS-MO5A ● Quality Assurance Scoring of Computed Radiography Images: Comparison of Gray Scale and Color Monitors during Image Processing

Regina Shirley RT ; **Eric A Brandser** MD (Presenter) ; **David Agard** PhD ; **Carly Smith** RT ; **Marcia Flaherty** RT

PURPOSE
Techologists usually perform quality assurance (QA) at the acquiring workstation, using lower resolution color monitors compared to gray scale higher resolution monitors found on diagnostic workstations. We noticed that some computed radiographic (CR) images seemed adequate on the technologist workstation (TW) but not on a diagnostic workstation (DW). We wanted to test the effect of monitor type on image QA scoring by techologists.

METHOD AND MATERIALS
100 CR examinations performed at one institution were collected prospectively over a 5 day period. All images were taken on a single sytem by two technologists not included in this study. Each case was reviewed by 3 radiology technologists twice. One viewing was on a gray scale Barco 3220D monitor (1536x2048) and the other on a color HP LA2206x monitor (1920x1080). Both sytems used an HP 6700 tower, Windows XPpro, with McKesson HRS-A version 11.6 software. Order of image viewing was randomized for each reviewer at each sitting with a two week delay between viewings to minimize case recall. The following grading system was used: 1= 'should never pass', 2 = 'passable/acceptable', and 3 = 'no need for improvement/perfect'. Factors reviewed were mottle, motion, density, and contrast. Positioning errors were not considered. 12 cases were then reviewed a second time on each system for intra observer agreement assessment. The scores were analyzed with a multifactor Analysis of Variance (ANOVA) procedure taking into account the effects for Monitor type, Evaluator, and image. The interaction between Monitor and Evaluator was also included in the model. Absolute agreement assessed on test/retest cases.

RESULTS
The average quality score on the TW is significantly higher than for the DW sytem. ($F=74.33$, $p = .012$). There was no significant interaction between Monitor Type and Evaluator ($F = 1.73$, $p = .178$). Monitor effect was constant across the 3 reviewers. There was a significantly higher intraclass agreement with the DW system.

CONCLUSION
There is a statistically significant difference for QA scores given by technologists for quality of CR images when viewed on a color monitor when compared to the gray scale diagnostic monitors. Precision was higher with the gray scale DW system.

CLINICAL RELEVANCE/APPLICATION
The addition of a gray scale monitor may improve the precision and accuracy of technologist assessment on image quality prior to submission for radiologist interpretation.

LL-INS-MO6A ● Protected Health Information on Posted Obstetric Ultrasound Images: An Analysis of Information Security among Patients

Loyrirk Temiyakarn MD (Presenter) ; **Harris L Cohen** MD ; **Asim F Choudhri** MD

CONCLUSION
Obstetric ultrasound images posted on publicly accessible websites often result in inadvertent disclosure of protected health information. Radiologists are well positioned to educate patients on taking charge of their own information security.

Background
With the increasing availability of high quality camera phones and mobile devices, patients now have greater access to their own imaging and ability to capture screenshots at the point of care. A particularly common scenario is the new mother who uses a mobile device to obtain an image of her obstetric (OB) ultrasound and then directly posts the images to a public website or forum. The oft-overlooked concern is the public posting of protected health information, now publicly available for any would-be identity thief to take.

Evaluation
A consecutive series of OB ultrasound images were acquired from a publicly accessible website and analyzed using several criteria, including method of image capture, visibility of patient name, date of birth, imaging institution, date of exam, time of exam, estimated due date, and whether any attempt was made to obscure such data. A large percentage of images sampled were found to include protected health information in some form, such that a savvy individual could

harvest enough personal information to perpetrate identity theft.

Discussion
Many patients may not realize or even care about the implications their simple image post may have. While patients are ultimately responsible for their own information security, we as radiologists are uniquely positioned to educate patients on simple measures they can take to prevent inadvertent posting of protected health information, such as proper framing, cropping, and photo editing.

LL-INE3206-MOA ● Radiology Informatics Service Ticketing System

Seth Hall ; **Jonathan Borders** ; **Jay A Moskovitz** MS ; **Timothy OConnor** MBA (Presenter) ; **Alex Towbin** MD *

Background
As a Radiology Informatics support team at a large tertiary care hospital with multiple outpatient centers, we were faced with the problem of managing simultaneous complex Radiology support issues across the enterprise. To address the service and support workflow, we designed and implemented an easy-to-use, web-based informatics issue tracking application. The system provides for the collection of issue data as the tickets are worked to resolution.

Evaluation
A web-based application was created that allows our staff to easily enter service tickets. The user interface was designed for rapid ticket entry with pre-configured problem categories and severities. Expected response times are displayed in order to communicate service levels at the point of ticket entry. A ticket dashboard was created for service personnel to quickly view and assign tickets. As tickets are worked to resolution, the system captures status and resolution information. Automated notification was incorporated to alert service staff of newly entered tickets. Ticket and resolution data is maintained in an SQL database that provides a knowledge base of problems and resolutions which can be mined for problem trends and adherence to service levels.

Discussion
The radiology informatics service ticketing application has been in regular use for approximately 39 months. During that period, 195 distinct users entered 1480 informatics tickets including 465 classified as &#65533;critical&#65533; in severity. Anecdotal evidence suggests the system allows issues to be better tracked and disbursed among support staff. We have recently begun mining the database in an attempt to identify common issues that may indicate additional user training is needed. Informatics management will be using ticket timestamps to generate metrics related to timely service.

CONCLUSION
The use of an electronic issue tracking system can introduce industry standard best practice to the service and support of information systems in Radiology. The need to provide timely resolution to issues is critical to quality patient care and business continuance. In addition, service ticketing systems provide a better means to track, monitor and collect service quality metrics and aid in management decision making.

LL-INE3208-MOA ● ISO 27001 - Implementing Medical Imaging Archiving Using Big Data Architecture: Open Source Approach

Suranarong Kamtasila MEng (Presenter) ; **Krongrat Kangwanklai** BS, MS

Background
An Image Archiving System can be characterized as a Big Data architecture.It is considered based on the growth of Modality data, various data structure,a need for faster response time, a longer storage duration, and regulatory requirements to maintain personal data for a very long period of time.This research focuses on exploring a suitable data architecture that meets the ISMS ISO 27001 needs and is based on the principles of Big Data architecture and Cloud.

Evaluation
Based on the ISO 27001 requirements, the medical data, its DBMS, and log files are our most important concern.An archiving system must have no limitation on the storage.The data must be encrypted, must not be tampered with and is accessible only through the specified applications.The file system must be fault-tolerance. The backup facilities must be adequate and its copies must be available in both a main site and a remote location. The system must be able to recover from major failures and support a business continuity management. We use Hadoop framework to ensure that the above requirements are met.The main reasons that HDFS is selected are it can support the Big Data architecture, stream data access, large data set, and simple coherency model.

Discussion
There are three Clouds. Two of them are designed for storage and the third one is for applications. These Clouds will be resided in two locations and connected through VPN. At each data center, it is comprised of two Hadoop framework, one cluster of MySQL, one cluster of EJBCA, and one cluster of application. There is DICOMSync at each location which acts as a connecting point. It will compress and send the data from one DICOMSync to another, decompress and forward the data to the storage cluster.

CONCLUSION
For ISO 27001 requirements, it is required that ISMS data are secured.The business continuity management process is implemented. The data is encrypted to maintain the data confidentiality. The log files are kept systematically to enable effective monitoring and traceability. The application interfaces are readily available to support research activities. All these are designed and implemented using the open source software.

LL-INE3204-MOA ● Learning Musculoskeletal Radiology on the Go: PACS-Like Testing of Both Recognition and Interpretive Skills on the iPad

Benjamin L Yam MD (Presenter) ; **Jose Morey** MD ; **Stuart D Kinsella** BA ; **Nora M Haney** BS ; **Tessa S Cook** MD, PhD

Background
Teaching files, formal presentations, and collections of interesting cases are used to teach radiology residents and fellows. However, such materials provide only a small subset of images in order to feature noteworthy findings, whereas to make a diagnosis in regular clinical practice requires reviewing multiple stacks of images. To more effectively test the ability of trainees to recognize abnormalities on musculoskeletal MRI and CT, we developed a mobile application that presents a mixed array of normal and abnormal exams. To replicate the way they would be viewed on a PACS workstation, all cases are presented as scrollable image stacks. Presenting this content on a mobile platform enables radiology trainees to practice outside the reading room while still simulating clinical practice.

Evaluation
Multiplanar image stacks from musculoskeletal MRI and CT scans are randomly presented in a scrollable image viewer. Cases are classified as basic or advanced. For each case, the app allows the user to scroll through the image stack on a mobile device as if reviewing at a workstation. Once the images have been reviewed, the possible diagnoses can be revealed as a multiple-choice quiz, but only after the case images are hidden! This is intended to simulate daily practice, during which each patient's study does not arrive with a multiple-choice list of possible diagnoses, which can sequentially be eliminated. A running score is tallied as the trainee reviews each case. At the end of the quiz, the answers are revealed by way of explanation.

Discussion
We have created a mobile-friendly test of visual perception for musculoskeletal imaging that presents joint, extremity, and spine MRI and CT scans as they would be viewed on a PACS workstation.

CONCLUSION
This mobile application provides an approach to giving radiology trainees additional opportunities to practice their diagnostic skills outside the reading room. The app can potentially be used as a performance tracker during training, as well as be extended to other modalities and subspecialties.

LL-INE3202-MOA ● Comparison-Bot: An Automated Preliminary-Final Report Comparison System

Amit D Kalaria MD (Presenter) ; **Ross W Filice** MD

Background
Regular comparison of preliminary to final reports is a critical part of radiology resident and fellow education as prior manual comparisons have documented substantial preliminary to final discrepancies. Unfortunately, there are many barriers to this comparison: high study volume; overnight rotations without an attending; the ability to finalize reports remotely; the subtle nature of many changes; and the loss of the preliminary report after finalization.

Evaluation
We receive a real-time Health Level 7 (HL7) feed from our Radiology Information System (RIS) (Siemens). Our Mirth Connect HL7 engine (Mirth Corporation) filters radiology report messages and parses report data into a MySQL (Oracle) database separated by preliminary and final status. A Bash (GNU) script queries all preliminary reports over a desired time period, finds the associated final report, evaluates for differences, compiles positive difference reports by radiologist, and emails these reports automatically.

Discussion
Our system automatically compiles and emails a weekly summary of report differences for all residents and fellows. Differences between preliminary and final report are clearly highlighted with links to the associated study in PACS for efficient review and learning. This provides an easy way to review changes to preliminary reports with immediate access to the associated images. We hypothesize that this will improve our education and learning experience and may also decrease discrepancy rates over time. A comparison of discrepancy rates prior to implementation of this system with prospective discrepancy rates will be presented to quantify impact. Subjective resident and fellow survey results regarding opinions of the weekly report and how it affects their education and

learning experience will also be summarized across PGY levels. We will continue to refine our discrepancy algorithm to try and more intelligently distinguish significant differences and prioritize the presentation order in the weekly reports.

CONCLUSION
We believe this system will improve our department education and learning experience and will hopefully reduce future radiology report discrepancy rates.

LL-INE3168-MOA ● m-SARCC (Mobile Stroke Acute Radiology Command Center): Image Review and Neurological Care Team Coordination Linking PACS and Mobile Smart Devices

C. C. Tchoyoson Lim MBBS ; **K. N. Bhanu Prakash** PhD ; **Anand Ananthasubramaniam** MEng ; **Guo Liang Yang** PhD (Presenter) ; **Yanjiang Yang** PhD ; **Wieslaw L Nowinski** PhD ; **Mahendran Nadarajah** ; **Ramarajulu Srinivasan** BS ; **Kok Haur Ong** MSc

Background
Widespread adoption of mobile smart-phones and tablets has potential to facilitate timely clinical care team image review, group communication and decision making, but this is not well supported in hospital PACS. We tested a prototype command center using iStrokeSuite (demonstrated at RSNA 2010) push technologies extending clinical PACS to test acute team coordination and neuro-oncology multidisciplinary team management.

Evaluation
Time-critical acute patients with subarachnoid hemorrhage (SAH) and ischemic stroke had their emergency head CT angiography or MR images (encrypted using HIPPA-compliant symmetric key encryption and fine-grained public key encryption) and sent to a prototype Mobile Stroke Acute Radiology Command Center (m-SARCC). m-SARCC is connected to an SMS/Email/Notification alert system, which alerts defined team members including radiologists, nurses, technologists and clinicians to securely log into the system to review the decrypted images, respond and update all, triggering a "go" procedure (aneurysm coiling or mechanical thrombectomy) or "no-go" conclusion. Non-critical scenarios involved radiologists, medical and radiation oncologists, neurosurgeons and nurses discussing case management options. Multiple input (text, audio, video, and image annotations) and functionalities (multiplanar reformat, volume calculation, anatomical atlas) were assessed by team members in structured and unstructured surveys.

Discussion
The system potentially unifies PACS image review with a communication center linking mobile devices. Rapid review and narrowcast of results and decisions decreased communication time, with text preferred to voice files as a vehicle in time-critical situations. Non-critical scenarios were more ambiguous but video and non-radiological image data were requested by clinicians.

CONCLUSION
A radiology command center linking PACS to mobile smart-phones and tablets can support image review, group communications and decision making especially in patients with SAH and ischemic stroke.

Using myRSNA®: Hands-on Workshop

Monday, 12:30 PM - 02:00 PM ● S401CD

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IN

ICIA22 • *AMA PRA Category 1 Credit* ™:1.5
John W Basco , MS

LEARNING OBJECTIVES
1) Understand the different tools and applications within myRSNA. 2) Log in to myRSNA and set up a personal profile. 3) Using the tools within myRSNA, highlight different use case scenarios.

Practical Informatics for the Practicing Radiologist: Part Two (In conjunction with the Society for Imaging Informatics in Medicine)

Monday, 12:30 PM - 02:00 PM ● S501ABC

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IN

ICII22 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
1) Describe approaches to minimize eye strain, neck pain, and repetitive motion disorders and overall stress without compromising productivity in the radiology reading room. 2) Understand the challenges and unforeseen obstacles encountered when deploying your next PACS system. 3) To understand the utility of volumetric rendering and computer aided detection (CAD) in clinical practice.

ICII22A ● Saving Your Body (and Your Mind): Redesigning the Radiology Reading Environment

Eliot L Siegel MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

ICII22B ● Divorce Counseling: Changing PACS

Steven C Horii MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

ICII22C ● So Many Images, So Little Time: Advanced Imaging Techniques

Adam E Flanders MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

National Library of Medicine PubMed: There's More to PubMed/MEDLINE: The Free My NCBI Tool

Monday, 12:30 PM - 02:00 PM ● S401AB

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IN

ICIW22 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Holly A Burt
Chris Childs , MS
Susan M Anderson , MS

LEARNING OBJECTIVES
1) Use My NCBI to personalize PubMed. 2) Understand how to save search strategies and create email alerts. 3) Use filters to link to library full-text articles and to focus PubMed searches. 4) Understand how to save collections of citations including a personal bibliography.
ABSTRACT
In this hands-on workshop session, explore the free My NCBI tool in PubMed. Discover how to save search strategies, create email alerts to keep up with the latest publications, create instant links to library full-text resources, and build permanent online bibliographies. Topics covered include creating a free My NCBI account, adding search and library filters to PubMed, using My Bibliography to create an online list of personal publications, and the link between the NIH Manuscript Submission System and PubMed. Important highlights on effectively searching PubMed searching will also be included. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov MEDLINE is a subset of PubMed.

Informatics - Monday Posters and Exhibits (12:45pm - 1:15pm)

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IN

LL-INS-MOB • *AMA PRA Category 1 Credit* ™:0.5

LL-INS-MO1B ● Improving the Practical Capability of an Eye-tracking System in Clinical Settings

Hiroyuki Sekiguchi (Presenter) ; **Masahiro Yakami** MD, PhD ; **Koji Fujimoto** MD, PhD ; **Takeshi Kubo** MD ; **Yutaka Emoto** MD, PhD ; **Kaori Togashi** MD, PhD * ; **Koji Sakai** ; **Ryo Sakamoto** ; **Gakuto Aoyama** ; **Masami Kawagishi** ; **Yoshio Iizuka** ; **Hiroyuki Yamamoto**

CONCLUSION
Performance of a current eye-tracking system in clinical settings can be improved with use of our eye-tracing unit.

Background
An eye-tracking system has great potential for innovative diagnostic applications such as an oversight indication system. However, current eye-tracking systems are impractical in clinical settings because they cannot cover the entire diagnostic screen, especially in the height direction. We solved this problem by employing a self-directed eye-tracing unit that automatically tilts the base of the eye-tracking system according to the observer's eye position.

Evaluation
We calibrated the eye-tracking system (X120; Tobii Technology, Stockholm, Sweden) against a diagnostic screen that consisted of two 20-inch lengthwise monitors. Then, eye-tracking data from daily radiograms were interpreted by three radiologists. The recording time for each data set was about 3 hours. During the data acquisition session, our head-tracking unit was switched on and off at 10-minute intervals.
Finally, we compared the number of times the eye-tracking system lost the radiologist's viewpoint both with the support of the eye-tracing unit and without this support. The improved ratios when using the eye-tracing unit were 26%, 17% and 3% for radiologists A, B and C, respectively.

Discussion
This unit had a large effect on the results of radiologists A and B, while it had almost no effect on that of radiologist C. We therefore examined a viewpoint pattern for each radiologist and found that radiologist A divided the screen into three parts in the height direction and looked at them almost evenly. Radiologists B and C divided the screen into two parts in the height direction. We also found that radiologist C looked at images displayed mainly on upper parts of the screen. Therefore, his head was considered to have been almost stable during his diagnosis, and that is the reason why our eye-tracing unit had no effect on the results of radiologist C. For radiologists who use the entire diagnostic screen, this unit is helpful in improving the capacity of the eye-tracking system.

LL-INS-MO2B ● Use of Natural Language Processing to Classify Radiology Reports Containing Description of the Abdominal Aorta

Amilcare Gentili MD (Presenter) ; **Brian E Chapman** PhD

CONCLUSION
Using pyContex is possible to correctly classify reports containing description of AAAs, simplifying the task of finding patients that may need a follow-up.

Background
Current recommendations are for one-time screening for abdominal aortic aneurysm (AAA) by ultrasonography in men aged 65 to 75 who have ever smoked, followed by yearly ultrasonographic screening if aortic diameter is between 3.0 to 4.0 cm; ultrasonography every 6 months if aortic diameter is between 4.0 to 4.5 cm; and referral to a vascular specialist if aortic diameter is greater than 4.5 cm. To separate radiology reports describing AAAs from reports describing normal aortas, we use natural language processing.

Evaluation
For this study, we used pyConText, a Python implementation of the ConText. ConText is a simple text-processing algorithm that uses simple lexical cues to relate modifying phrases, such as expressions of uncertainty, temporality, or negation, to findings described in text. The classification performed by a radiologist reviewing the radiology reports was compared with pyConText classification.

Discussion
Out of 473 reports pyConText classified 82 patients as having an AAA, and 391 as not having an AAA including 4 false negative and 5 false positive for a sensitivity of 95.1% and a specificity of 98.7%.

LL-INS-MO3B ● Image-based Kernel Conversion Technique Normalized the Reconstruction Kernel Effects in the Measurement of Emphysema Index in CT

Hyeongmin Jin (Presenter) ; **Jong H Kim** PhD ; **Chang Yong Heo** BS

PURPOSE
The emphysema index (EI) in CT is known to be strongly affected by reconstruction kernel. This study presents an image-based kernel conversion technique which converts CT image of sharp kernel to that of standard kernel and evaluates its impact on EI normalization for images obtained with different kernels.

METHOD AND MATERIALS
48 sets of CT data taken at 120kVp, 40mAs, 1mm thickness, of 2 reconstruction kernels (B30f, B50f) were selected from low dose lung cancer screening database. An image-based kernel conversion technique, which converts an image to take effect of different kernel by applying the ratio of kernel MTFs to the Fourier transformed spectral components, was performed to the CT data set of B50f kernel to produce a converted B30f data set. The EI (RA950) was measured with a software package (Pulmonalizer, Seoul, South Korea) and compared between two data sets of B30f kernel and those converted B30f kernel. The accuracy of kernel conversion was evaluated with the mean and standard deviation of pair-wise differences in EI.

RESULTS
Population mean of EI was 10.57±5.84% for the B30f data set, 28.76±6.24% for B50f data set, and 10.86±6.37% for the converted B30f data set. The mean and standard deviation of pair-wise differences in EI between B30f and the converted B30f 0.85% and 0.76%, respectively. The correlation between the EI of two data sets was 0.987

CONCLUSION
Our study demonstrates the feasibility of image-based kernel conversion technique for normalization of kernel effect in measurement of EI.

CLINICAL RELEVANCE/APPLICATION
This technique has a potential to be used in evaluating the longitudinal changes of EI even when the CT was reconstructed with different kernel.

LL-INS-MO4B ● Data Analysis of Brain MRI at a Tertiary Hospital in Sudan

Radya G Osman MBBS (Presenter) ; **Abdalla M Gabir** MD, FRCR ; **Mirghany O Babiker** MBBS, FRCR ; **Isam M Izzeldin** MBBS, MRCP

CONCLUSION
16 cases of brain pathology where matched with radiology and histopathology diagnoses .Those 16 cases are presented in this study.

Background
Sudan is a country with a population of 36,787,012 and a size of 718,723 square miles. There are 17 MRI machines present in the entire country. Fifteen of them are located in the capital Khartoum, while 2 machines are left to serve the other 16 states. Out of the 17 MRI units, only 3 diagnostic MRI centers have a data archiving option, leading to the loss of valuable patient data.

Evaluation
For this study, a database of 1,540 MRI brain images, scanned during 2012, was created. The data was used to identify 662 cases with brain pathology.

Discussion
Age and gender distribution of cases was also analyzed. For the purpose of comparison, 87 histopathology reports from the same hospital were obtained in order to confirm the radiologic diagnosis.

LL-INS-MO5B ● Tablet Computer Assisted Target-oriented Forensic Autopsy

Alina Sassenberg MMed (Presenter) ; **David Simons** MD ; **Ignaz Reicht** ; **Heinz-Peter Schlemmer** MD ; **Kathrin Yen** MD

PURPOSE
Radiological data has proven to support forensic autopsy and often is required before or during the procedure. For e.g., detecting gas or foreign bodies, computed tomography (CT) has shown to be superior to the autopsy. Image viewing usually requires a workstation which is rarely located in the autopsy suite. Thus CT images are seldom accessible during autopsy. The aim of this study was to evaluate if the display of radiological data on a tablet computer (PC) could support and guide forensic autopsy.

METHOD AND MATERIALS
We installed software for interpreting radiological data (MITK-pocket, a slighter version of the CE-certified MITK) on a tablet PC (iPad A 1430, Apple Inc.). In 20 randomly selected cases, postmortem CT scans (Somatom AR.SP, Siemens AG) of the head, thorax and abdomen were performed at least 1 hour before autopsy. CT data was uploaded to the tablet PC and analyzed prior to autopsy by a radiologist in consensus with a forensic pathologist. The tablet PC was prepared for observing hygienic standards. For the current study we focused on bone fractures, air, foreign bodies, liquids, the position of organs, and if collapse of the aorta was present in the thorax region. Radiological results were used to guide the autopsy process. A standardized questionnaire about handling and benefit was filled in by both the radiologist and the forensic pathologist.

RESULTS
Radiological data was easily accessible during the whole course of autopsy., Autopsy techniques could be preselected and used target-oriented. The detection and localization of the addressed injuries was clearly supported by the additional imaging data. A fluent workflow was established which directly guides the course of autopsy in the determined cases.

CONCLUSION
The tablet PC provides useful assistance, increased convenience and additional information during forensic autopsy. However, before entering daily practice we recommend to further evaluate the use of tablet PCs at autopsy site in a multiple centre study. Tablet PC assisted forensic autopsy supports forensic case assessment and has a general potential to be broadly used as being cheap and easily available.

CLINICAL RELEVANCE/APPLICATION
The availability of radiological images during autopsy can support target-oriented forensic autopsy and injury assessment. The use of tablet devices for delivering radiological images therefore seems

LL-INS-MO6B ● The Pursuit of Meaningful Use Part 2: When Penalties Don't Matter

Adeel Siddiqui MBBS (Presenter) ; **Mehwish Shayaan** MBBS ; **Keith J Dreyer** DO, PhD *

CONCLUSION

Group structure and timing of the upgrade cycle are key factors in determining whether a radiology group should pursue meaningful use. Many groups may still take advantage of the EHR incentive program not only for the short term financial gain, but also for the increased interoperability it brings with referring physicians.

Background

The purpose of this talk is update the radiology community regarding meaningful use to see if it is right for their practice. This is meant as an update to the 2012 abstract "The Pursuit of Meaningful Use". Meaningful use (MU) is a government run program to accelerate the adoption of electronic health records in the United States. In 2014, Individual radiologists can earn up to $24,000 if they comply with the program. Recent addition of the significant hardship exemption to radiologists gives groups a convenient way to avoid penalties. Lack of specialty specific criteria, and availability of certified products have already made people wary. When should a practice look to upgrade to MU? When should a practice avoid MU?

Evaluation
Radiologists can claim significant hardship exemptions based on the radiology specialty codes to avoid penalties. Radiology must be listed as the primary specialty of the physician in the Provider Enrollment, Chain, and Ownership System (PECOS).

Discussion
Recently published significant hardship exemption rules limit potential penalties by radiologists. On the other hand, Radiology groups affiliated with an institution that already has a certified electronic health record (EHR), or groups that are single site with a single radiology information system (RIS) are in a great position to benefit from MU with little effort or cost. Small groups that have resisted upgrade cycles will never have a better time to upgrade. These types of practices can would also enjoy the benefits of being better integrated with the entire hospital information systems. Groups that have completed upgrades recently or do not have a high Medicare population are the most vulnerable to excessive costs and "upgrade fatigue". These groups might take advantage of the significant hardship exemption.

LL-INE3205-MOB ● Using the Scored Quiz Feature of MIRC TFS to Run a Departmental Case of the Week Contest

Tessa S Cook MD, PhD (Presenter) ; **John Perry**

Background
Case of the day (or week) contests are popular among residency programs and radiology depoartments to foster friendly competition while still promoting individual or collaborative learning. Our case of the week (CoW) implementation has evolved over the past few years to its current implementation using the RSNA MIRC Teaching File System (TFS).

Evaluation
The original CoW consisted of images posted within a Microsoft SharePoint site, with a link to a web form that collected submitted diagnoses and emailed them to the CoW manager. Subsequently, it was revised to be a self-contained, database-driven website into which images and content were loaded and updated on a weekly basis. Using TFS along with the new scored quiz feature, we can send images directly from PACS via the patient-centric workflow to be incorporated into a new case. The scored quiz enables the addition of a text box to a case so that TFS users can log in, view the case and submit their favored diagnosis. The case owner can score the submitted entries and track users' scores during the contest using the administrative features of TFS.

Discussion
By implementing our CoW within TFS, we can preserve the content posted from week to week for users to access for independent learning. In addition, the process of creating a new CoW each week has been streamlined yet again, as all the functionality of the TFS can now be brought to bear on content creation and management. In addition to running case contests, the scored quiz can be used to create assessment modules (such as to track ACGME milestones), interactive conference presentations (to prepare residents for the Exam of the Future) and even to educate medical students and non-radiology residents.

CONCLUSION
MIRC TFS can be used to successfully maintain a case of the week application for a radiology program, without requiring the administrator to be technically savvy or manually program the system. This latest iteration of the CoW-now using the MIRC TFS-is the most robust to date, with the added advantage of persistent case content from week to week. Scored quizzes in MIRC TFS have a number of potential applications which can be used to enhance radiology resident and fellow education.

LL-INE3201-MOB ● An Imaging Informatics-based System with a Novel Intelligent Workflow Engine to Support Rehabilitation Clinical Trial Research

Brent J Liu PhD ; **Ximing Wang** MS (Presenter) ; **Clarisa Martinez** ; **Carolee J Winstein** PhD

Background
Workflow engines have been shown to improve efficiency in business by automating processes. Complex clinical research workflows--such as those of rehabilitation clinical trials--that efficiently collect, analyze, and distribute multimedia data at various stages within the workflow can also benefit from these workflow engines. Currently, the data management needs of clinical trials are typically addressed with custom-built systems. However, the challenge arises when changes to the workflow require additional software development, a step that can be time- and resource-consuming, and can negatively impact data collection. To address this issue, we present an intelligent workflow engine for complex randomized control trials. We will first apply it to the existing system that was developed for a rehabilitation clinical trial designed to understand the optimal dose of a principle-based rehabilitation intervention after stroke (DOSE). The results will yield a new application of workflow engines that can be possibly extended to other clinical trials.

Evaluation
The system enables a project coordinator to build a data collection and management system specifically related to study protocol workflow through a graphical user interface. A library of modules can be chosen and added to each phase of the workflow. Prior to each treatment session, the user can predetermine which evaluation tools will be utilized and in what order they will be performed according to protocol. A web-based DICOM viewer is integrated for visualization of brain images. The usefulness of the system will be evaluated with data from the 12 subjects enrolled in the DOSE trial. The target enrollment is 60 subjects over a 4-year period.

Discussion
Intelligent workflow engine provides flexibility to build and tailor the workflow for different stages within the clinical trial. By providing a solution to tailor and automate the workflow, the system will save time and reduce errors for project coordinators.

CONCLUSION
We developed a new imaging informatics-based system with an intelligent workflow engine. Although our system is designed for a rehabilitation trial, it has the

potential to be extended to other non-rehabilitation clinical trials

LL-INE3203-MOB • Demonstration of a Novel Diagnosis Support System for Lung Lesions: Computed Tomography with an Image-retrieval Technology Based on Radiologists' Knowledge

Toyohiko Sakai MD (Presenter) ; **Kenji Kondo** * ; **Kazutoyo Takata** * ; **Kazuki Kozuka** * ; **Masakai Kiyono** * ; **Hirohiko Kimura** MD, PhD ; **Masato Tanaka** PhD

Background
The use of diagnosis support systems, which show similar cases from medical archives, has been proposed in recent years. However, such systems can mislead radiologists if similar cases are not appropriately selected.
In this presentation, we have proposed a novel image-retrieval system that employs a weighting technique based on radiologists' knowledge to select reference images and demonstrated an actual system that employs this principle.

Evaluation
To compile the data required for weighting, radiologists marked 1026 regions of interest (ROIs) on lung CT images and classified them into 12 imaging patterns, including consolidation and wide-spread ground glass. Image similarity was primarily calculated using 413 types of image features. In the new technique, the calculation was weighted on the basis of the regression coefficients for each lesion pattern classified by radiologists. Similar images were retrieved with or without a weighting technique. Finally, image similarity was graded on a 5-point scale (with a score of 5 indicating 'very similar') by 2 radiologists in a blinded manner.
For each evaluation, 60 ROIs that included the 12 patterns were extracted as a query. The precision (subjective evaluation score = 4) was 78.0% and 75.0% using the proposed method with a weighting technique, and 62.7% and 62.0% without it. The 2 sets of values showed statistically significant differences ($P < 0.01$).

Discussion
Lung disease generally involves diverse lesion patterns, and diverse image features are used in queries. Therefore, a simple combination of all image features results in degradation of search performance. Subjective evaluation clearly showed that the use of a weighting technique can solve this problem.

CONCLUSION
A novel image-retrieval technology is introduced in this study. This diagnosis support system, which uses weighted image retrieval with an archive of images, might help radiologists make rapid and appropriate diagnoses and consequently encourage them to make greater use of these systems.

Mobile Computing for Decision Support and Learning While You Work

Monday, 02:30 PM - 04:00 PM • S401CD

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IN

ICIA23 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Michael P D'Alessandro , MD
Jeffrey R Galvin , MD
James J Choi , MD

LEARNING OBJECTIVES
1) Learn to perform decision support on a mobile device at the point-of-care to answer questions that arise during clinical work and thus tie learning to practice and receive point-of care CME for it. 2) Learn to read Ebooks and educational apps on a mobile device. 3) Learn to stay up-to-date with radiology journals and society news on a mobile device. 4) Learn to manage a library of journal articles on a mobile device. 5) Learn to view podcasts and vodcasts on a mobile device. 6) Learn to maintain a learning portfolio / teaching file on a mobile device.
ABSTRACT
Acquiring and maintaining competency in the practice of radiology requires a program of continuous learning. This continuous learning would be most effectively performed during clinical work, when it has the greatest potential for modifying physicians' knowledge, attitudes, and behaviors as well as positively affecting patients' care, outcomes, and lives. The advent of mobile computing, and the rich assortment of authoritative radiology resources it allows easy access to, now allows this dream to become reality. This course will be a hands-on, state-of-the-art review that will teach the radiologist how to use mobile computing to perform continuous learning while you work. The Apple iOS and Google Android platforms will be covered. Participants will be encouraged to bring their own mobile phone or tablet to the course and will be asked before the course to download into their mobile device several free apps that will be demonstrated, so they can follow along during the session. These free apps are listed on the course handout at http://www.radiologyebooks.com/rsna.html

3-D Printing: Bridging the Gap between Theory and Practice

Monday, 02:30 PM - 04:00 PM • S501ABC

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IN

ICII23 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Frank J Rybicki , MD, PhD *

LEARNING OBJECTIVES
1) To understand the potential role of 3D printing in clinical practice. 2) To learn an algorithm for preparing volumetric CT images for 3D printing applications. 3) To learn the basics of 3D printing, including materials and formats. 4) To show illustrative examples of 3D printing, such as in surgical planning and for cardiac analyses.
ABSTRACT
Printing in three-dimensions (3D) has become a reality for many applications, including some in medicine. However, the printing of volumes in diagnostic radiology has not been extensively studied. There are several applications that have potential use. For example, complex surgical planning to date uses two-dimensional (2D) displays of 3D volumes to communicate findings between radiologists and surgeons. Because of the inherent 3D data sets used for these applications, there are potential uses for 3D printing for planning. We apply these principles to full face transplantation to illustrate the complexity of the analyses and the benefits of 3D computed tomography (CT) models when compared to traditional two-dimensional display formats. We also illustrate how 3D printing can be applied to clinically relevant research questions such as flow derived metrics from CT. These data can then be translated to clinical interpretations, as illustrated with examples currently under investigation.

ICII23A • 3D CT and MR Acquisitions
Karin E Dill MD (Presenter)

ICII23B • 3D Printing Technologies and Applications
Peter C Liacouras PhD (Presenter)

ICII23C • 3D Visualization verus 3D Printing
Michael L Steigner MD (Presenter) *

ICII23D • Current Indications for 3D Printing
Gerald T Grant DMD, MS (Presenter)

ICII23E • Future Indications for 3D Printing
Frank J Rybicki MD, PhD (Presenter) *

ICII23F • Congenital Heart Disease Models 'In Your Hands'
Shi-Joon Yoo MD (Presenter)

ICII23G • Models in Imaging Research: CT Flow
Dimitris Mitsouras PhD (Presenter)

Optimizing PowerPoint Slides

Monday, 02:30 PM - 04:00 PM • S401AB

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IN

ICIW23 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

William J Weadock , MD *

Sarah C Abate , BS

LEARNING OBJECTIVES
1) Review the components of an optimal slide presentation. 2) Learn about common errors made in slide preparation and how they can be avoided. 3) Learn about how to improve the quality of a presentation by using optimal different slide backgrounds, font size and color, and image sizes. 4) Learn tips to ensure a smooth presentation.
ABSTRACT
Electronic presentations are very common in radiology practice. This hands-on demonstration and questions and answer session will show attendees how to optimize their presentations. The focus will be on the use of slide templates, color selection (font and background), font and image size, and animations. Additional review of image and video display and management will be covered. Demonstrations will include tips to decrease time creating and modifying presentations. Bring your questions!

Informatics (Workflow and Displays)

Monday, 03:00 PM - 04:00 PM • S402AB

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IN

SSE13 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
David S Hirschorn , MD
Moderator
Sanjiv Bajaj , MD

SSE13-01 • RadPath: An Electronic Platform to Integrate Radiology and Pathology Consultations for Indeterminate Lesions

Corey W Arnold (Presenter) ; **Dean Wallace** MD ; **Fereidoun G Abtin** MD ; **Benjamin M Ellingson** MS, PhD * ; **Alex A Bui** MS, PhD ; **Scott Binder** ; **Denise R Aberle** MD ; **Dieter R Enzmann** MD

CONCLUSION
The RadPath application allows radiologists and pathologists to efficiently communicate and integrate diagnostic findings, and provides treating clinicians with a succinct summary of results and conclusions.

Background
In general, current workflows for diagnosing indeterminate lesions include a radiologist and pathologist working separately to issue reports on the same patient, without a formal process for correlating findings and resolving possible discordance. Treating clinicians are then required to discover all reports pertaining to a patient and resolve any unclear findings and diagnoses.

Evaluation
We implemented an electronic platform to facilitate communication between radiologists and pathologists during indeterminate lesion diagnosis to enable the creation of a specialized interface for treating clinicians that provides a concise summary of salient diagnostic findings and conclusions. After a biopsy procedure, a RadPath report is typically initiated by the radiologist, who triggers the system to pull and process reports from various clinical databases. Using text processors and structured elements within the record, RadPath automatically presents a radiologist with a distilled view of diagnostic information, including report sections and key image slices. The radiologist confirms this view and then shares it with a pathologist, who triggers the system to retrieve and distill pathology reports and images. If after performing his/her analysis, the pathologist finds any conflicting information with the radiologic exam, the RadPath report may be shared back to the radiologist with attached comments from the pathologist. This asynchronous process provides a formal way to efficiently correlate findings.

Discussion
Preliminary findings indicate that creating a RadPath report requires approximately five minutes from the radiologist and pathologist. A pilot study is underway to determine impacts to the speed and accuracy of diagnoses. Additional software modules are under development that allow treating clinicians (e.g., oncologists and surgeons) to add information to RadPath, enabling a succinct temporal view of a patient's diagnostic, treatment, and outcome information.

SSE13-02 • Just in Time Data: Accessing Relevant Clinical Information during Image Interpretation Using MPage Summaries

Norman B Thomson MD (Presenter) ; **James V Rawson** MD ; **Kristopher N Lewis** MD

CONCLUSION
The Georgia Regents University Medical Center imaging MPages went live April, 2011. The various uses of the MPages, feedback from Mpage users, and lessons learned will be described and discussed.

Background
Imaging providers require up to date clinical patient information to optimally protocol, review and interpret imaging examinations. A clear understanding of clinical context is needed to provide valuable, focused reports and offer effective conclusions and recommendations to improve patient care and outcomes. Paging thru multiple consult and progress notes, procedure descriptions, laboratory and pathology reports, problem lists, vital signs summaries, IandO charts, nursing notes, and other electronic health records to find key contextual information is laborious, inefficient and prone to error. At Georgia Regents University Medical Center, a multidisplinary team designed, created and implemented a set of custom designed Cerner MPages to provide organized contextually focused patient information to a provider in a single display window, which could be incorporated within the Radiology Information System Desktop. The MPages were designed to assist and augment radiology workflow.

Evaluation
The design, build, and implementation of the Georgia Regents University Medical Center MPages will be described and discussed. Design issues included limitations and opportunities related to the structure and organization of the EMR database, quality and accuracy of data in the EMR, the time needed to search the EMR and load the page, and ease of use and interpretation of the MPage output

Discussion
MPages are configurable tabs that can harvest patient information from the Electronic Medical Record via a CCL script and output the collected information to a web page. The team at Georgia Regents University Medical Center designed a series of image provider centric MPages to provide key patient information needed to protocol exams, review and report studies, and provide effective recommendations to referring providers and clinical teams regarding patient follow up and treatment options.

SSE13-03 • Optimized Hospital Radiologist Staffing in a Multisite Radiology Enterprise: A Data Driven Rational Approach to Efficiently Delivering Real Time Subspecialized Radiology

Lily Zou MD (Presenter) ; **Murray D Becker** MD, PhD ; **Alberto F Goldszal** PhD, MBA * ; **Lisa Martinez**

PURPOSE
The current environment requires subspecialization with rapid turnaround times to maximize diagnostic accuracy and time efficiency. These challenges are complicated by the demands of real time reading and the day to day variation in study volumes. Thus, radiologist staffing is a balance of having adequate staff/subspecialization to cope with peak demand, while not incurring waste due to overstaffing. We investigate: 1. study volumes by day/shift; 2. distribution of study types by skillset; 3. variation in volumes by day/shift; 4. impact of aggregation of studies from multiple sites on variations in volume. The results are used to show how to optimize radiologist staffing.

METHOD AND MATERIALS
Data was collected from 5 hospitals (1 academic/4 community) that use a common radiologist staff and unified multisite workstation/worklist. HL7 messages from 285,981 diagnostic radiology studies over 180 consecutive days were analyzed. Studies were sorted by: time (8hr shift: 1st, 2nd, 3rd); day of week; specialty (Neuro, Body, General); Stat flag, and Site. Parameters calculated: avg shift volume (by skillset, day, site, stat flag) and volume variability was characterized by the coefficent of variation.

RESULTS
All sites are similar : ≥50% of all studies and ≥60% stat studies occur between 4pm and 8am (2nd/3rd shifts). By narrow margins, the 1st shift has more total studies than the 2nd shift, but the 2nd shift has more Stat studies. The fraction of Stat studies is higher on weekends than weekdays. Smaller hospital sites tended to have larger variations in per shift volume, but all sites show variablility (coefficient of variation=20-40%). Variation was least for General and higher for Body and Neuro. Variation was greatest on the 3rd shift. No site had adequate volume to have 1 FTE in each of General, Body, and Neuro on all shifts. But by aggregating sites, this goal could be attained, and the overall per shift study variation was significantly reduced.

CONCLUSION
Real time subspecialized reading requires adequate 2nd+3rd shift (4pm-8am) staff. Individual sites do not have adequate volumes to always support subspecialization. By aggregating studies from multiple sites, volumes reach a critical mass that supports subspecialization, with the added benefit of reducing day-to-day volume variations.

CLINICAL RELEVANCE/APPLICATION
The analysis of an enterprises study volumes provides a mechanism to optimize the use of radiologists through rational staffing models.

SSE13-04 ● Angular Dependency of the Spatial Resolution in Handheld Display Devices

Aldo Badano PhD (Presenter) * ; **Asumi Yamazaki** MS

CONCLUSION
We found that handheld display devices have subtle viewing angle dependency corresponding to different display technologies. While the angular dependency is small, further investigations are needed to determine the effect on lesion detectability in radiological images.

Background
The increased use of handheld devices for medical image viewing is due in part to improved display image quality, portability, and internet access. A challenge in handheld display devices is that performance should be consistent under different ambient environments. The angular dependency of display luminance and contrast has been extensively investigated for workstation displays. In this study, we report on the spatial resolution as a function of viewing direction for various handheld display devices.

Evaluation
We characterized a liquid crystal-display (LCD) phone, two LCD tablets, and two light-emitting-diode (OLED) phones using a PenTile sub-pixel arrangement. Each screen displaying one pixel line pattern was captured using an imaging photometer camera directed at the screen center at various orientations with 1-degree steps from -8 to 8 degrees relative to the perpendicular viewing direction. The line luminance profiles were obtained and modulation transfer functions (MTF) were calculated.

Discussion
The resolution properties of LCD handhelds are independent of viewing directions. As expected, the maximum luminance value on the line profile decreases at tilted angles. On the other hand, we observe the maximum luminance of the horizontal line profile in OLEDs at -8 degrees while the maximum luminance gradually decreased for angles up to 8 degrees. The MTF at 8 degrees decreased by a maximum of 3.4% at the Nyquist frequency from the highest MTF measured at 0 degrees. In the vertical direction, while the maximum luminance is almost constant except for the extreme tilt angle cases, the highest MTF at 0 degrees gradually decreased with off-normal angle resulting in the lowest MTF with 5.3% decrease at -8 degrees at the Nyquist frequency. Angle dependency of OLED displays can be attributed to the sub-pixel driving of PenTile designs with horizontally asymmetric sub-pixel layout.

SSE13-05 ● Creation of an Interactive, Real-time Single Screen Depiction of Personal Imaging History in the Electronic Medical Record

H. B Harvey MD, JD (Presenter) ; **Akshay Saini** ; **Pari Pandharipande** MD, MPH ; **Tarik K Alkasab** MD, PhD

CONCLUSION
We have created and deployed an interactive imaging history in the EMR to facilitate utilization of this data by clinical providers and reduce unnecessary exposure to diagnostic radiation.

Background
Patient imaging histories provide treating clinicians and radiologists with valuable information and help to avoid duplicative imaging and unnecessary exposure to diagnostic radiation. However, imaging histories in the electronic medical record (EMR) are often not structured with the needs of these providers in mind. We created and deployed an interactive, real-time, single screen depiction of an individual's imaging history in the EMR aimed at optimizing utility to clinical providers.

Evaluation
The interactive display is driven by a background service that retrieves a record of the imaging history from the enterprise clinical data repository through a medical record aggregation and search tool. This provides records of imaging exams at all sites across the nine component hospitals of the system, including outside exams that have been uploaded to the system. For each retrieved record, the exam date, description, and report impression are extracted. The system uses a lookup table to map each exam description to a body part and modality and attaches this information as well. This processed data set is then passed to the ordering physician or radiologist's web browser, where a JavaScript plugin integrated into an icon in the electronic EMR converts the dataset into an interactive display. For each combination of body part and modality, the tool displays an approximate time when a matching study was last obtained. When the user hovers the cursor over one of these pairs, it shows the sublist of exam dates and descriptions in a popover. When the user hovers over one of the line items in the list popover, a second popover shows the impression of the selected report.

Discussion
The EMR-integrated tool enables clinical providers to more efficiently access and utilize the patient imaging history for clinical decision making. Integration of radiation dose information is a logical next step but should be preceded by educational efforts for clinicians to ensure that radiation dose histories are not misused.

SSE13-06 ● A Web-based Multimodality Mammography Case File for Mobile Devices

Jason D Balkman MD (Presenter) ; **Steven P Poplack** MD *

CONCLUSION
A novel web-based platform and workflow were developed for presenting mammography cases on a mobile device. Large mammogram files were optimized to balance download times and image quality. Scrollable MRI, tomosynthesis, and ultrasound images were also presented with PACS-like navigation using a mobile touchscreen.

Background
There is currently no existing radiology app that offers a web-based multimodality and mobile-friendly mammography case file. This may be in part due to difficulties transferring large file sizes over the Internet and adapting image content to a small touchscreen. A method for optimizing image files for size and quality would lessen these difficulties, and thus enable mobile devices as an accessible teaching tool in breast imaging.

Evaluation
An online database of radiology cases was developed and presented elsewhere. Ten breast cases with mammogram, tomosynthesis, MRI, and ultrasound images were collected, optimized, and uploaded to the database using a web browser. Mammography images obtained using a Hologic Selenia system were cropped and scaled from a maximum dimension of 4096 pixels (70 micron resolution) to 2250 pixels (130 micron resolution) to accommodate mobile screens. File sizes were reduced to 1 MB or less using JPEG compression with a quality factor of 90-100. As a result of these optimizations, download times for compressed digital mammography files were within 2 seconds for a WiFi-connected mobile device with a typical data rate of 4 Megabits per second. Despite JPEG compression, pathology under 1 mm could be adequately resolved for teaching purposes. Scrollable stacks of breast MRI, tomosynthesis, and ultrasound images were also made available, and content could be navigated using a touchscreen.

Discussion
High resolution images and multimodality content make mobile presentation of breast cases challenging. However, when mammograms files were cropped, scaled, and compressed to 1 MB or less, download speeds were reduced to within 2 seconds per image and image quality remained sufficient to represent subtle pathology. The web-based approach to this case file allowed users to upload image stacks of any modality with immediate online availability.

Physics (CAD II)

Monday, 03:00 PM - 04:00 PM ● S403A

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PH IN

SSE22 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
Hiroyuki Yoshida , PhD *
Moderator
Hiroshi Fujita , PhD

SSE22-01 ● Digital Breast Tomosynthesis (DBT): Computerized Detection of Clustered Microcalcifications in Planar Projection from Multiscale Bilateral Regularized Simultaneous Algebraic Reconstruction

Ravi K Samala PhD (Presenter) ; **Heang-Ping Chan** PhD ; **Yao Lu** PhD ; **Lubomir M Hadjiiski** PhD ; **Jun Wei** PhD ; **Mark A Helvie** MD *

PURPOSE
To develop computer-aided detection (CADe) methods for microcalcification clusters (MCs) in DBT.

METHOD AND MATERIALS

With IRB approval and informed consent, DBTs were acquired from human subjects using a GE prototype DBT system. The data set was divided into a training set (127 views from 64 breasts with MCs) and an independent test set (104 views from 52 breasts with MCs and 76 views from 38 breasts without MCs). The biopsy-proven cluster location was marked by an MQSA radiologist. DBT volume is reconstructed using our recently developed simultaneous algebraic reconstruction technique (SART) with multiscale bilateral regularization that reduces noise, enhances MCs, and preserves the sharpness of tissue structures. A planar projection (PPJ) image is generated by selectively extracting the high-frequency information including potential MCs from the 3D volume and projecting it to a plane. Cluster centroid objects and individual seed points are then detected from the PPJ image using iterative adaptive thresholding in combination with segmentation guided by the local contrast-to-noise ratio (CNR). The cluster centroid objects are further screened using a neural network trained for recognizing true signals and false positives (FPs). Dynamic clustering embedded with machine learning rules based on CNR, size and number of signals is used to detect MCs. FP clusters are further reduced using the size, skewness and kurtosis properties of the CNR histogram of the cluster. The detection on PPJ images was compared with that in the 3D volumes using jackknife free-response receiver operating characteristic (JAFROC) analysis.

RESULTS
For the test set, the FP rate decreased by 50% at 85% sensitivity for both the view-based and case-based performance (0.81 and 0.54 FPs/view, respectively) on the PPJ images compared to that in the 3D volumes (1.92 and 1.01 FPs/view). The case-based sensitivity reached 95% at 0.82 FPs/view in the PPJ images. JAFROC analysis showed a significant improvement with a figure-of-merit of 0.65 and 0.58 for PPJ and 3D, respectively (*p*-value=0.006).

CONCLUSION
Computerized MC detection on PPJ images outperforms that in 3D reconstructed volumes. Further study is underway to improve the PPJ method.

CLINICAL RELEVANCE/APPLICATION
CADe can be an adjunct to radiologist reading and has the potential to improve detection of subtle microcalcification clusters and increase the workflow in DBT interpretation.

SSE22-02 • Benchmarking Computer-aided Detection of Pulmonary Nodules on the Recently Completed Publicly Available LIDC/IDRI Database

Colin Jacobs MSc * ; **Bram Van Ginneken** PhD (Presenter) ; **Stephan Fromme** * ; **Mathias Prokop** MD, PhD * ; **Eva M Van Rikxoort** PhD

PURPOSE
The recently completed LIDC/IDRI database provides by far the largest public resource to assess the performance of algorithms for the detection of pulmonary nodules in thoracic CT scans. We report the performance of two detection systems, and address the issue of completeness of the reference standard.

METHOD AND MATERIALS
The LIDC/IDRI database contains 890 thoracic CT scans with section thickness of 2.5mm or lower, one per patient, from 7 centers acquired with 17 different scanner models from 4 manufacturers. Cases have been annotated in an extensive reading process comprising a blinded and an unblinded review by four radiologists who indicated all nodules 3mm effective diameter. We define nodules >3mm indicated by all four observers as positive findings. We applied two pulmonary nodule detection systems: Herakles, an industry research prototype (MeVis Medical Solutions, Bremen, Germany) and ISICAD (Image Sciences Institute, Utrecht, The Netherlands), a system trained with data from the Dutch-Belgian NELSON lung cancer screening trial. We report sensitivity at 1, 2, and 4 false positive (FP) detections per scan and analyze the FPs.

RESULTS
The 890 scans contained 775 positive findings. At 1, 2, and 4 FP/scan, Herakles had a sensitivity of 69%, 75%, and 79%, respectively. For ISICAD this was 51%, 63%, 72%. We analyzed the FPs of Herakles at an operating point of 2 FP/scan. Of these, 31% were annotated by at least one radiologist as a nodule >3mm. An additional 17% were indicated by at least one radiologist as a nodule
CONCLUSION
The LIDC/IDRI data set is an excellent benchmarking tool for nodule detection algorithms. Automated detection can identify pulmonary nodules that have not been annotated in an extensive reading process with blinded and unblinded review by four human observers.

CLINICAL RELEVANCE/APPLICATION
Algorithms for automatic detection of pulmonary nodules can be compared and improved through the availability of a common database for benchmarking.

SSE22-03 • Independent Combination of Multiple Readers for the Detection of Lung Nodules in Chest Radiographs: Setting a Benchmark for Computer-aided Detection

Steven Schalekamp MD (Presenter) * ; **Nico Karssemeijer** PhD * ; **Cornelia M Schaefer-Prokop** MD * ; **Bram Van Ginneken** PhD

PURPOSE
The detection performance for lung nodules in chest radiography shows a large interreader variability. High miss rates of lung cancer have been reported though judged as being visible in retrospect. History has proven that computer intelligence is able to surpass human performance also for complex tasks (e.g., Watson). Purpose of our study was to explore the potential gain in performance by independent combination of multiple observers. That way we aimed to define the upper boundary of visual detectability that ideally should be achieved by a computer aided detection (CAD) system.

METHOD AND MATERIALS
111 digital chest radiographs (CXR) containing a single small nodule (average diameter 16mm.) and 189 normal controls served as study group. Nodules had to be visible on the frontal radiograph with 42% of them judged as being of low and very low conspicuity. Twelve observers were asked to localize the lung nodules in the CXRs with help of bone suppressed images. Location based ROC was used for analysis. Mean sensitivity in a false positive fraction range between 0 and 0.2 was used to measure nodule localization performance. This was done for all observers separately and subsequently for the combination of multiple observers (up to 12). Observer findings were averaged when findings were located within 1.5 cm of each other. When no finding was present at the location of another observers finding a zero-score was assigned in the averaging calculation.

RESULTS
The mean sensitivity at a false positive fraction range between 0 and 0.2 was 64.0% for single reading (range 45.5% 78.2%). Combining the readings of two observers improved lung nodule detection on average to a mean sensitivity of 73.1%. Adding more observers lead to a further performance increase up to a mean sensitivity for 12 observers of 82.3%. On average, 26 nodules were missed by single observers, 15 nodules by a combination of 2 observers, and only 5 nodules were missed when combining 12 observers.

CONCLUSION
The variable and partially low baseline performance underlines the limitation of the single observer. If CAD is able to reach the combined performance of multiple readers, a dramatic increase of nodule localization performance can be expected with drastic reduction of missed rates.

CLINICAL RELEVANCE/APPLICATION
An independent combination of multiple readers for the detection of lung nodules in chest radiographs should be used as measure for achievable CAD performance.

SSE22-04 • Computer-aided Detection of Epidural Masses in Computed Tomography Using a Constrained Gaussian Mixture Model

Sanket Pattanaik BS ; **Jiamin Liu** PhD ; **Jianhua Yao** PhD * ; **Weidong Zhang** PhD ; **Evrim B Turkbey** MD ; **Ronald M Summers** MD, PhD (Presenter) *

PURPOSE
Although epidural masses detection is often accomplished using MRI, the more routine use of CT imaging makes early detection in this modality advantageous. Our preliminary Computer-Aided Detection (CAD) framework addresses the dearth of work focusing explicitly on the detection of epidural masses. We supply a spatially-constrained Gaussian Mixture Model (CGMM), using tissue classes informed by the spinal canal composition, to localize candidate detections and reduce false positives.

METHOD AND MATERIALS
40 patients with chest-abdomen-pelvis CT scans were examined. 23 patients were selected with MRI reports confirming an epidural mass. 17 patients without epidural masses were randomly selected to serve as controls. Two radiologists manually demarcated the centroids of each epidural mass identified in the CT scans to serve as ground truth. The CAD system segments the whole spine using a watershed algorithm and directed graph search. It isolates the spinal canal using a four-part vertebra medial model, boundary dilation, and intensity thresholding. Four tissue classes were generated using K-means clustering to represent normal intradural tissue, fat/vasculature, the epidural mass, and a partial volume region between the bone and soft tissue. CGMM was employed to refine classification, taking advantage of both spatial and intensity parameters. Detections were limited to masses extending from the canal boundary. These detections were then submitted for feature extraction and support vector machine classification (SVM).

RESULTS
Before classification with SVM, our CAD system detected 44 out of 47 detections. Missed detections resulted from undersegmentation of the canal in the L5-S1 regions. A sensitivity of 80% with 7.2 false positives per patient was attained following classification and ten-fold cross-validation, which compared favorably with the sensitivity of 76% with 7.4 false positives per patient attained by restricting CAD to intensity based K-Means clustering.

CONCLUSION
Our CAD system lays the groundwork for detection of epidural masses in CT scans and points to the importance of using a combination of spatial and intensity based parameters to localize masses in the canal.

CLINICAL RELEVANCE/APPLICATION
Epidural masses in the spinal canal can cause pain or paralysis and can indicate metastasis. Alerting radiologists of the presence of these masses in CT can speed response to underlying pathologies.

SSE22-05 ● A Fully Automatic Registration Algorithm for Multiparametric Prostate MRI

Valentina Giannini (Presenter) ; **Anna Vignati** ; **Simone Mazzetti** ; **Filippo Russo** MD ; **Christian Bracco** PhD * ; **Michele Stasi** ; **Daniele Regge** MD

PURPOSE
Multiparametric (mp) MRI has been proposed as a potential alternative screening method for prostate cancer (PCa) diagnosis. One of the most challenging problems is to correctly align different types of images so that features coming from different sequences can be extracted from the same group of pixels. The aim of this study is to present a fully automatic registration system capable of correcting for movements generated during the dynamic acquisition (DCE) and for DW image distortion.

METHOD AND MATERIALS
The dataset includes 21 men with histologically proven PCa (age 65 [7], mean[SD]) that underwent endorectal 1.5T MRI with the following scanning protocol: axial T2-w, DW imaging (b-values 0,600, 1000 and 1400 s/mm^2) and a 13-s time resolution DCE sequence. All patients underwent radical prostatectomy within 3 months from MRI. A radiologist manually outlined regions of interest on the T2-w images in areas corresponding to the tumoral foci at histology and in a non-tumoural region located in the contralateral peripheral zone (PZ).
First a multi-resolution rigid registration algorithm, based on the mutual information similarity measurement, corrected misalignment between T2-w and DCE images. Afterward, a linear deformation field decaying along the vertical axis was applied on the DW images. Pharmacokinetics and ADC parameters coming from registered and non-registered images were fed into a Bayes classifier, and the area under the receiver operating characteristic curve (AUC) was computed before and after registration. The one-tailed paired t-test was used to evaluate differences between AUC, sensitivity e specificity obtained by the classifier before and after registration.

RESULTS
With registration AUC and sensitivity increased from 0.59(0.15) (mean [SD]) to 0.88(0.11) (p

CONCLUSION
This study demonstrated the feasibility of a fully automatic registration framework on a MRI prostate CAD system. The proposed method seeks to have all the MRI dataset registered to the T2-w image, thus allowing a more reliable multiparametric analysis.

CLINICAL RELEVANCE/APPLICATION
An automatic registration algorithm, integrated in a CAD for PCa, can reduce observer variability and reading time, and can be used to guide targeted prostate biopsy directly on the suspected region.

SSE22-06 ● Computer-aided Detection of Prostate Cancer Based on Automatic Multi-parametric Magnetic Resonance Image Analysis

Simone Mazzetti (Presenter) ; **Valentina Giannini** ; **Anna Vignati** ; **Filippo Russo** MD ; **Michele Stasi** ; **Daniele Regge** MD

CONCLUSION
The application of a CAD system based on mp-MRI information that automatically highlight cancer suspicious regions will improve the diagnostic accuracy of the radiologist, reducing reader variability and speeding up the reading time.

Background
Prostate cancer (PCa) is the most common malignancy affecting men in the world and represents the third cause of cancer death in industrialized countries. Diagnosing PCa using multi-parametric (mp) magnetic resonance imaging (MRI) is increasingly being used in the diagnostic pathway, also in combination with computer-aided diagnosis (CAD) systems, in order to automatically detect and localize the disease.
Aim of this study is to present a CAD system based on T2-w imaging, diffusion (DW) and dynamic contrast-enhanced (DCE) acquisitions to produce a pixel-wise malignancy probability map of the prostate gland.

Evaluation
The dataset included 20 men, with PSA > 4 ng/ml and confirmed PCa by transrectal ultrasonography guided biopsy. Patients underwent MRI at 1.5T using an endorectal coil and radical prostatectomy within 3 months of imaging. The pathologist contoured foci of cancer on prostate sections, to create the standard of reference. Then a radiologist compared imaging with histopathology and reported both malignant and benign regions of interest (ROI) on the T2-w images.
The first step for the CAD system was the registration between T2-w, DW and DCE-MRI. Then each pixel belonging a ROI was represented as a vector containing values of T2-w signal intensity, of the apparent diffusion coefficient and of quantitative physiological parameters (e.g. k_{ep}, K^{trans}) from DCE. Selected features were fed into a support vector machine classifier in order to provide a classification that maximized the detection of true positives, minimizing the false positive cases.
The area under the ROC curve for the classifier was equal to 0.93, sensitivity 0.84 and specificity 0.85.

Discussion
The CAD performed automatic mp-MRI analysis, supported by a preliminary registration step between the three MRI datasets. The results are objective and reproducible, providing a unique information for clinicians summarized in a malignancy probability map.

Using IHE Profiles to Plan for Medical Imaging

Monday, 04:30 PM - 06:00 PM ● S401CD

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IN

ICIA24 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Kinson Ho *
David A Clunie , MBBS *
Christopher Lindop *
Kinson Ho *
John T Donnelly , MBA, MS *

LEARNING OBJECTIVES
1) Value of IHE with content and vendor neutral integration. 2) How content neutral clinical information is managed with a Vendor Neutral Archive (VNA). 3) Planning for a Vendor Neutral Archive (VNA) or expand upon an existing VNA system to support both imaging and non-imaging content and systems. 4) The benefit of using IHE Imaging profiles for cross-enterprise and cross-community image sharing.
ABSTRACT
Integrating the Healthcare Enterprise (IHE) is a joint initiative of healthcare professionals and industry vendors to improve the way clinical systems in healthcare share information. IHE promotes the coordinated use of established standards such as webservices, DICOM and HL7 to address specific clinical need in support of optimal patient care. Established in 1997, the IHE Radiology Committee, a development domain of IHE, has profiled the clinical use cases to develop a framework of interoperability, known as the IHE Integration Profiles. Integration Profiles are developed specifically to be 'Vendor Neutral'. The first Integration Profile developed by IHE is known as Scheduled Workflow. It specifies how imaging departmental workflow can operate seamlessly between vendors. The Integration Profiles are maintained and published by IHE in the IHE Technical Framework. With the introduction of Cross-Enterprise Document Sharing (XDS) in 2005, IHE has extended the definition of 'Neutral' to include non-imaging content storage in healthcare. This course will specifically deliver and review the IHE Integration Profiles developed by IHE Radiology and the other IHE domain committees profile which can be used by healthcare professionals and the industry for the interoperability specification, procurement and installation of a 'Content' Vendor Neutral Archive (VNA).

Meaningful Use for Radiology IT Vendors: What Your Customers will Demand, and Your Competition will Provide

Monday, 04:30 PM - 06:00 PM ● S501ABC

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IN

ICII24 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
David E Avrin , MD, PhD *
Keith J Dreyer , DO, PhD *

LEARNING OBJECTIVES
ABSTRACT
Even with Phase II rules of Meaningful Use, the fit with Radiology remains a challenge. The focus of the federal agencies remains on the primary care practices

of internal medicine, family practice, and pediatrics. However, with recent refinement of the US Federal Health IT rulings for Meaningful Use (MU), it is hoped that some US radiologists will be eligible for substantial CMS incentives. Collectively, these incentives could total over $1 billion for radiologists alone. Up to $44,000 is available per qualifying Eligible Provider. As important, incentives may turn to penalties within a few years. MU was initially targeted towards primary care specialties, but under certain circumstances could apply to diagnostic radiology.
Eligibility for MU will depend upon the individual radiologist's practice scenario. Some technology will come from existing infrastructure (including RIS, PACS, Reporting Systems) and others will come from new purchases (including Decision Support, Data Mining, Image Sharing and Patient Portals). In this lecture, the presenters will describe ways to analyze your existing portfolio of products to determine which MU measures they should be eligible for, and to define a pathway toward MU certification of these modules. Further, we will discuss the ability to determine what additional functionality might be added to your existing products to expand your MU certification offerings. Finally, we will explore ways for your company to provide all remaining MU measures, beyond your existing product portfolio, so that your existing and future customers can achieve Meaningful Use. We will also review results of an RSNA sponsored survey to propose a set of criteria that more appropriately define true MU for radiology to affect future federal rule setting when they move beyond primary care specialties.

Using RSNA Clinical Trial Processing (CTP) Software for Clinical Trials and Research Applications

Monday, 04:30 PM - 06:00 PM • S401AB

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RS IN

ICIW24 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
John Perry
Justin Kirby

LEARNING OBJECTIVES
1) Learn how to install, configure, and use the RSNA's CTP software for clinical trials and reseach dataset processing. 2) Learn about the the unique challenges of DICOM image de-identifcation and how to utilize CTP to implement the Attribute Confidentiality Profile (DICOM PS 3.15: Appendix E) to properly de-identify DICOM images. 3) Learn how to customize CTP to process and transfer imaging studies according to the requirements of common research study scenarios.
ABSTRACT
Clincial Trial Processor (CTP) is a highly configurable and extensible stand-alone program that provides many features necessary for managing imaging as part of a clinical trial or research study. In this course participants will be provided with an overview of CTP's functionality, and then perform hands-on image processing of sample data based on common reserach and clinical trial scenarios. Addtionally, participants will receive an overview of the unique challenges associated with de-identifying DICOM images and learn about using CTP to implement the DICOM standard's guidance for how best to ensure removal of PHI without compromising the utility of the data for research.
URL's
http://rsna.org/ctp.aspx
https://wiki.cancerimagingarchive.net/display/Public/De-identification+Knowledge+Base

Quantitative Imaging: A Revolution in Evolution (In Association with the Society for Imaging Informatics in Medicine)

Tuesday, 08:30 AM - 10:00 AM • N229

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IN BQ

RC326 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Co-Moderator
Luciano M Prevedello , MD,MPH
Co-Moderator
Adam E Flanders , MD

LEARNING OBJECTIVES
1) Develop an understanding of what quantitative imaging is and how it may revolutionize the way we practice diagnostic radiology today. 2) Learn the research advances and the current clinical applications of this technology. 3) Appreciate the current challenges involved in using these tools clinically and understand the steps required for a successful clinical implementation.
ABSTRACT
Medicine has undergone a gradual evolution in which diagnostic imaging has become the centerpiece in establishing a clinical diagnosis and in assessing disease response. In recent years, the focus has changed such that for some disease categories (e.g. oncology) we now perceive medical imaging as a phenotypic expression of the genetic makeup of that disease. To that end, imaging now serves as a biomarker of genetic disease subtypes with features that may offer clues to understanding the natural behavior of the disease and specific changes that may occur as part of a therapeutic response. It is now well recognized that there is a substantial amount of objective information contained within diagnostic imaging studies that can be exploited beyond the level of simple measurements. The extraction of quantitative and semi-quantitative information from imaging studies that is both useful and reproducible is the challenge and opportunity for clinical trials research and radiologic reporting today and in the future. This session will explore the revolution and evolution of quantitative imaging; providing attendees with research advances, clinical applications, and the challenges of clinical implementation.

RC326A • What is Quantitative Imaging?

Katherine P Andriole PhD (Presenter)

LEARNING OBJECTIVES
1) Be able to describe what is meant by quantitative imaging. 2) Understand existing issues in iplementing quantitative imaging techniques in the clinical arena as well as in the research realm, and see how informatics tools may help. 3) Be aware of on-going international efforts to address current challenges and to move quantitative imaging forward.

ABSTRACT
Quantitative imaging has rapidly evolved in recent years from a promising research activity to an essential clinical tool. Physicians consider the objective metrics obtained from imaging studies, in making critical patient management decisions. What is meant by quantitative imaging will be described using illustrative real-world use cases. Existing issues including technical as well as workflow challenges will be discussed. An introduction to imaging informatics tools and techniques such as standards, integration, data mining, cloud computing, ontologies, data visualization and navigation tools, and business analytics applications that may assist in filling current gaps in the clinical implementation of quantitative imaging will be given. An overview of activities of the RSNA's Quantitative Imaging Biomarkers Alliance (QIBA), an international initiative whose goal is to optimize the potential of quantitative imaging, including a description of the data warehouse project will be provided.

RC326B • Informatics Approaches to Enable Quantitative Imaging in Real World Radiology Practice

Daniel L Rubin MD,MS (Presenter) *

LEARNING OBJECTIVES
1) To highlight limitations in current radiological quantitative imaging practice and identify opportunities for improvement through informatics. 2) To introduce Annotation and Image Markup (AIM) as a new standard for capturing and sharing quantitative imaging metadata. 3) To demonstrate new AIM-enhanced tools that can streamline and improve quantitative imaging assessment and workflow for the radiologist.

ABSTRACT
Radiology practice is increasingly a quantitative endeavor. Radiologists frequently need to measure the length of lesions to track treatment response or measure the size of structures to for diagnostic assessment. Current practices of quantitation are cumbersome; measurements are recorded as screen captures that cannot be processed by machine, and the numbers must be transcribed into a radiology report. It is currently exceedingly difficult to create structured databases of quantitative image information for discovery about how, say, change in tumor size over time relates to drug treatment. Quantitative imaging is currently at best a labor-intensive process and at worst error-prone. We have been developing informatics methods to streamline the electronic capture of quantitative imaging results as "image metadata" in structured format that can be easily processed by computers. Tools that we are producing will allow the radiologist to perform quantitative imaging assessment in their current routine workflow—measuring lesions on the PACS, while simultaneously their measurements will be captured and transmitted in standardized formats to applications that can automate accurate reporting, analysis, and decision support. In the future such tools will even help researchers to discover new ways that quantitative signals in images can improve assessment of treatment and prediction of disease course.

RC326C • QI Clinical Use Cases Outside of Oncology

Eliot L Siegel MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the use of quantitative imaging outside of oncology. 2) Learn how to apply these QI techniques to current radiology practice.

Hands-on HL7 Data Manipulation (Hands-on Workshop)

Tuesday, 08:30 AM - 10:00 AM • S401CD

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IN

RC353 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Richard J Bruce , MD *
Walter W Peppler , PhD *

LEARNING OBJECTIVES
1) Understand where radiology ordering, scheduling, and reporting workflows utilize HL7. 2) Develop a basic understanding of HL7 messaging principles. 3) Gain introductory hand-on experience with HL7 data manipulation. 4) Understand how HL7 can be used to build functionality in a variety of radiology workflows.
ABSTRACT
HL7 messaging is the foundation upon with many healthcare systems rely for interaction and data exchange.Â Many common radiology functions including order and report transmittal are often dependent on HL7 to function.Â The goal of this hand-on refresher course is to introduce the attendee to HL7 workflows and some of the tools used to build HL7 interfaces and manipulate HL7 data.Â More importantly we hope to show why understanding HL7 can be helpful to radiology practices and show where HL7 can be used to build better radiology workflows.

Next-Generation Educational Content Creation: Screencasting and Video Editing (Hands-On)

Tuesday, 08:30 AM - 10:00 AM • S401AB

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IN

RC354 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
George L Shih , MD, MS *
Richard S Ha , MD
Kurt T Teichman , BSC, MENG
Ian R Drexler , MD,MBA

LEARNING OBJECTIVES
1) Assess the potential of online and mobile e-learning innovations to augment your residents', medical students', and staff's educational curricula. 2) Acquire the domain knowledge to use already available content (eg, PowerPoint presentations) to both create video content and deploy e-learning courses on modern web-based and mobile platforms. 3) Acquire the domain knowledge to use already available content (eg, PowerPoint presentations) to electronic books (e-books), with or without digital rights management (DRM), and obtain an ISBN number for publishing.
ABSTRACT
1. From OpenCourseWare to the Khan Academy, and now to Coursera, e-learning has been dramatically improved over the last decade, changing education from the normal classroom into learning done at convenience, and also allows for more creative and engaging content during the typical lecture. Stanford Med recently published positive initial findings in utilizing video-based lectures in an interactive class setting. Leveraging this new way of learning, requires knowledge about the types of technology and platforms for these courses. 2. The workflow required to host an e-learning course can be summarized in 3 steps: (a) creating the educational content, (b) hosting the materials, and (c) making the materials available to the intended audience. E-content today typically consists of lecture slides along with video recordings captured by technology like TechSmith Camtasia (non-free) and Apple Quicktime (free). Once the materials are created and edited, one must choose a suitable hosting platform realistic to the skills and goals of the instructor with options that include coursesites.com, iTunes U, and YouTube / Google Hangouts. Students can then be invited to view the material or the content can be made available to the public. 3. Creating and publishing e-books is a great way to share your teaching material as an engaging interactive tool. Publishing in e-book format solves many logistical problems of conventional publishing and the e-book format has interactive features that paper books can't match. We will review the process of creating your own e-book from assembling material to layout design to submitting for e-publication. Specifically Apple iBooks Author software will be used to demonstrate converting an existing Powerpoint presentation or journal publication into an e-book. In addition, the course will go over how to publish with or without DRM (copy-protection) and ways to obtain an ISBN for publishing for sale. Online resources will also be reviewed.

Emergency Radiology Series: Leveraging Technology for State-of-the-Art Practice

Tuesday, 08:30 AM - 12:00 PM • E352

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IN ER CT

VSER31 • *AMA PRA Category 1 Credit* ™:3.75 • ARRT Category A+ Credit:4
Moderator
Suzanne T Chong , MD
Moderator
Savvas Nicolaou , MD

VSER31-01 • Information Technology Solutions for Managing Emergency Radiology

Robert A Novelline MD (Presenter)

LEARNING OBJECTIVES
1) Learners will be able to introduce technology solutions for improving the management of Emergency Radiology facilities. 2) Learners will be able to identify techologies for optimizing Emergency Radiology patient scheduling, procedure protocoling, routine reporting, managing important and urgent communications, expediting workflow and satisfying requirements for peer review.

VSER31-02 • Is the Teleradiology Consultation Using a Smartphone with Mobile PACS Helpful When an On-call Radiology Resident Is Not Confident about the Presence of Appendicitis?

Nak Jong Seong MD (Presenter) ; **Bohyoung Kim** PhD ; **Kyoung Ho Lee** MD ; **Seung Chan Lee** MD

PURPOSE
To discover whether the teleradiology consultation using a smartphone with mobile PACS (Picture Archiving and Communication System) can improve diagnostic performance of preoperative CT when an on-call radiology resident cannot make confident CT interpretation in regard to the presence of acute appendicitis

METHOD AND MATERIALS
From a previous randomized controlled trials associating with the acute appendicitis, we collected 68 patients CT scans for which on-call radiologists scored the presence of acute appendicitis as grades 2, 3, and 4 in the 5-grade Likert scale. Two off-site abdominal radiologists retrospectively interpreted CT scans with suspected appendicitis, using iPhone 4 and a commercially available mobile PACS under a wireless network. Inter-observer agreement was measured using kappa statistics for two iPhone readers. Regarding the diagnosis of acute appendicitis as the reference standard, receiver operating characteristic (ROC) analysis was performed to compare the diagnostic performance of four readers: on-call radiologist, in-house attending abdominal radiologist, and two iPhone readers. The confidence grades for the presence of acute appendicitis were compared among four readers by using the Wilcoxon signed rank test for appendicitis and non-appendicitis cases, respectively, along with the heat maps combined with a dendrogram

RESULTS
The kappa statistic for the two iPhone readers was 0.90. The areas under the curve (AUCs) of two iPhone readers (AUC=0.97, 0.91) tended to be higher than that of on-call radiologist (AUC=0.85). For the appendicitis (or non-appendicitis) case, the in-house attending radiologist and two iPhone readers showed significantly higher (or lower) grades for the presence of acute appendicitis than on-call radiologist (P
CONCLUSION
Teleradiology consultation using a smartphone with mobile PACS is acceptable in the diagnosis of inconfidenct acute appendicitis by on-call radiologist.

CLINICAL RELEVANCE/APPLICATION
Smartphone reading using a mobile PACS could be helpful as a teleradiology consultation in the diagnosis of acute appendicitis, especially inconfident CT reading by on-call radiologist.

VSER31-03 • Value of Automated 3D-rendering and Rib Labeling for Evaluation of Rib Fractures in Whole-body CT Data Sets of Polytrauma Patients - Preliminary Results

Stefan Puig MD, MSc (Presenter) ; **Daniel Ott** MD ; **Jennifer L Cullmann** ; **Tomas Dobrocky** MD ; **Johannes T Heverhagen** MD, PhD * ; **Hendrik Von Tengg-Kobligk** MD *

PURPOSE

Aim was to evaluate accuracy and efficiency of a new CT image processing tool, which enables an automated 3D-rendering of whole body CT data sets including an unfolded display of the rib cage and the spine as well as an automated rib and spine labeling.

METHOD AND MATERIALS
Two readers (senior physicians) independently evaluated randomly selected whole-body-CTs of polytrauma patients for rib fractures. All CTs have been performed with a 128-slice-scanner. Axial reconstructions (slice-thickness: 1mm) were used as primary data to be retrospectively analyzed with the "syngo.CT"Bone-Reading" client (syngo.via VA 20; Siemens, Germany). We evaluated numbers and location of fractures and compared the results with previously written reports. A final consensus read served as reference standard for rib fractures. Accuracy of the rib and spine labeling was recorded. In addition, time for reading was measured. Reader satisfaction with the software client was assessed using a 4-point Likert scale (1 = very useful for reporting; 2 = useful; 3 = undetermined; 4 = impedes reporting).

RESULTS
Up to now, 15 whole-body-CT-scans from 15 patients (mean age = 55.3 years; range 21 " 84 years) have been included in the analysis. 6/15 (40.0%) patients had rib fractures, 4/6 (16.67%) showed multiple fractures. Based on patients with rib fractures, sensitivity for reader 1 and reader 2 was 83.3% (5/6) and 100%, respectively. A non-displaced fracture of the first rib was detected by only one reader. According to the prior written reports 4/6 (66.67%) patients were reported as positive for rib fracture based on conventional reading. Time for reading was 2min 38s and 2min 20s, respectively. In 7/15 (46.7%) rib and spine segmentation as well as labeling was correct. Reasons for incorrect segmentation and/or labeling were: congenital anomaly (n=1), severe kyphosis (n=1), no segmentation of first rib (n=5). Both readers rated the software client as useful for reporting (mean rating: 1.8 and 1.6). In no case the software client was rated as to interfere with reporting.

CONCLUSION
Using the "syngo.CT"Bone-Reading" client we could achieve a higher detection rate of rib fractures compared to conventional reading in a relatively short reading time.

CLINICAL RELEVANCE/APPLICATION
Automated 3D-rendering of whole body CTs allows a time-saving evaluation of the ribs and spine and enables a higher detection rate of rib fractures than conventional reading in polytrauma patients.

VSER31-04 • Enhancing Your CT Practice with Dual Energy in the ER

Aaron D Sodickson MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Summarize key concepts of dual energy CT. 2) Describe protocol building, workflow and postprocessing of dual energy scanning. 3) Highlight a variety of game-changing dual energy applications for emergency radiology practice that have the potential to enhance information content, reduce radiation dose, or both.

VSER31-05 • Use of Dual-energy CT and Virtual Non-calcium Techniques to Evaluate the Time to Resolution of MRI-proven Bone Bruises

Song-Tao Ai ; **Mingliang Qu** MD (Presenter) ; **Katrina N Glazebrook** MBChB ; **Peter Rhee** DO ; **Shuai Leng** PhD ; **Maria Shiung** ; **Cynthia H McCollough** PhD *

PURPOSE
The purpose of this study was to investigate the short-term status of post-traumatic bone bruises using dual-energy CT (DECT) and virtual non-calcium (VNCa) techniques in a cohort of patients with MRI-proven bone bruising lesions subsequent to unilateral knee injury.

METHOD AND MATERIALS
Patients with unilateral knee injury occurring between March 2009 and July 2011 resulting in bone bruises confirmed by MRI and who had bilateral DECT scanning of the knee performed within six months of the injury were identified from chart review. DECT examinations were performed using a clinical protocol. Two radiologists evaluated VNCa images without knowledge of MRI results for the presence of increased soft tissue attenuation in four anatomic regions, and DECT findings were compared to the prior MRI and contralateral DECT images.

RESULTS
14 patients with MRI-proven bone bruises were identified by chart review to have undergone DECT subsequent to the MRI exam, with a total of 36 out of 56 (64%) lesion-positive anatomical regions by MRI. DECT detected lesions in 10 out of 14 patients (71%) and identified 22 out of the 36 (61%) lesion-positive regions identified by MRI. The mean CT numbers in VNCa images for positive and negative bone bruising regions were -7.6 ± 24.9 HU (22 regions) and -58.2 ± 19.5 HU (34 regions) (p-value < 0.001), respectively. The number of days between injury and DECT ranged 11 to 99. At 2, 4, 6, and 8 weeks post-injury, 14 (38.9%), 18 (50.0%), 23 (63.9%) and 34 (94.4%) lesion-positive regions by MRI were negative by DECT, respectively.

CONCLUSION
This study confirmed the feasibility of using DECT and a VNCa technique to evaluate the short-term status of post-traumatic bone bruises and found that over 90% of MRI-proven bone bruise regions had resolved by 8 weeks post-injury.

CLINICAL RELEVANCE/APPLICATION
DECT exam provided reliable assessment of the presence or absence of bone bruising and allowed assessment of the time to resolution of bone bruising in this small patient cohort.

VSER31-06 • Lung Perfused Blood Volume (Lung PBV) Imaging on Dual-energy CT: Quantitative Capability for Disease Severity Assessment in Patients with Acute Pulmonary Thromboembolism

Sachiko Miura MD (Presenter) ; **Yoshiharu Ohno** MD, PhD * ; **Yuko Nishimoto** MD ; **Kimihiko Kichikawa** MD

PURPOSE
To determine the capability of lung perfused blood volume (PBV) imaging on dual-energy CT (DECT) for disease severity assessment in acute pulmonary thromboembolism (APTE) patients.

METHOD AND MATERIALS
Twenty-one consecutive APTE patients underwent contrast-enhanced DECT and echocardiography at the onset. A normalized lung PBV (nLung PBV) image was generated by pixel analysis in each patient. In each patient, the overall perfusion (OP) and heterogeneity (H) indexes were assessed as averages of mean and standard deviation of the nLung PBV value within ROIs placed over each lung field in both lungs. In this study, the disease severity of APTE was determined as CT angiographic clot burden score (CBS) according to past literatures and tricuspid regurgitation pressure gradient (?P). Then, all patients were divided into right heart (n=13) and non-right heart (n=8) dysfunction groups. To determine the capability of DECT indexes for disease severity assessment, CBS and ?P were statistically correlated with both DECT indexes. To assess difference of each index between the two groups, all indexes were compared by Student"s t-test. To determine the capability for differentiating the two groups, feasible threshold values of CBS and the DECT indexes as having significant differences between the two groups were determined using ROC-based positive test. Finally, sensitivity, specificity and accuracy were compared to each other by using McNemar"s test.

RESULTS
CBS had significant correlation with OP index (r=-0.82, p
CONCLUSION
The Lung PBV imaging on DECT has a potential for disease severity assessment in APTE patients, and it is considered at least as valuable as clot burden score in routine clinical practice.

CLINICAL RELEVANCE/APPLICATION
The Lung PBV imaging on DECT has a potential for disease severity assessment in APTE patients, and it is considered at least as valuable as clot burden score in routine clinical practice.

VSER31-07 • Comparison of the Image Quality between Virtual Non Contrast Scans Obtained on Solid State Detectors and on the New Fully Integrated Digital Chip Detector that were Generated from Abdominal Dual Energy CT Exams in the Emergency Department

Adrian Reagan MD (Presenter) ; **Patrick McLaughlin** FFRRCSI ; **Savvas Nicolaou** MD ; **Luck J Louis** MD ; **Ana-Maria Bilawich** MD ; **Sharon Gershony** MD

PURPOSE
To determine the effect on noise reduction in VNC studies generated on solid state detector (SSD) and on the new fully integrated digital chip detector (FICD) and to determine whether virtual non contrast images provide similar quality to standard NC studies with the aim of eliminating the need for NC scans effectively reducing radiation dose in the acute setting.

METHOD AND MATERIALS
10 DECT studies were imaged on the SSDs and 10 on the new FICD using the 128 slice DS Definition scanner. Protocol parameters included: 64 by 0.6 mm col. reconstructed to 1.5mm axial DE 100 and 140 kv tin filter data sets. D30 1.5 mm axial DECT images were loaded into the multimodality station within the

liver VNC DE application class. 3mm axial VNC images were exported to pacs for analysis. Routine NCIs were obtained using 64 by 0.6 mm col., reconstructed to a thickness of 3mm axial slices using B30 kernel keeping CTDI vol the same as the DECT protocol. Noise was calculated via SD of ROIs in 5 tissues. Two Radiologists graded the quality of the NC and VNC image sets using a 5-point Likert scale. SNR was then averaged and the means were compared between the VNC data set imaged on the SSD and the VNC data set imaged on the new FICD. Analysis between VNC images and standard NC studies obtained on the FICD was also performed. A Mann-Whitney U test was used to compare the level of noise between VNC images done on SSD and VNC images done on the FICD. VNC images obtained on the FICDs were also compared with regular NCIs from the same detector. VNCIs performed on the FICD revealed a U value of 25 (p 0.05). The new VNC data when compared to the regular NC data obtained on the FICD revealed a U-value of 40 ($p > 0.05$).

RESULTS
VNC images obtained on the FICD demonstrated lower noise values compared to VNC data sets obtained on the SSD. No difference in noise values was found between the standard NC studies and the new VNC images. Subjectively VNC abdomen sets provided equal diagnostic quality compared to standard NC studies.

CONCLUSION
Findings suggest VNC image noise levels are reduced on the new FICDs. New VNC studies provide diagnostic images comparable to standard NC protocols.

CLINICAL RELEVANCE/APPLICATION
The new FICDs resulted in diagnostic VNC studies and thus represent a future dose reduction strategy in the elimination of non contrast studies in abdominal ED protocols.

VSER31-08 ● QandA/Break

VSER31-09 ● Multi-detector CT: One Stop Shop for the Assessment of Acute Chest Pain

Savvas Nicolaou MD (Presenter)

LEARNING OBJECTIVES
1) Discuss diagnostic imaging algorithm for the assessment of acute chest pain. 2) Discuss the benefits and Limitations of cardiac CT in the acute setting. 3) Review the optimization of the Cardiac CT in the emergency department. 4) Assess literature evidence of MDCT in diagnosis of acute coronary syndrome (ACS) with regards to cost, time to diagnosis and outcomes. 5) Discuss the role of a Triple-Rule-Out Protocol in evaluation of acute chest pain. 6) Discuss the characteristics of coronary lesions on MDCT that are associated with ACS. 7) Review new dose reduction techniques which maintain diagnostic quality available including prospective ECG gating, BMI-based tube voltage reduction and iterative reconstruction.

ABSTRACT
Chest pain is a very common presentation in the emergency department (ED), accounting up to 5.8 million visits a year and as the second leading complain in the ED. It is important to properly diagnose acute coronary syndrome (ACS) in these patients; 2-8% of patients with ACS are misdiagnosed and inappropriately discharged home which has been demonstrated to be associated with a doubling of mortality rate. It is vital to differentiate ACS from other serious causes of chest pain including pulmonary embolism and aortic dissection. Multidetector CT (MDCT) has been proposed to be an one-stop shop as it allows quicker time, low costs, and easy access, the ability to rule out ACS confidently using non-invasive visualization, and visualization of extracardiac findings.

VSER31-10 ● Are Cardiac Risk Factors and Risk Scores Useful to Triage Patients Presenting to the Emergency Department with Chest Pain among Those Judged to Be at Low to Intermediate Risk of Acute Coronary Syndrome?

Jacob P Deutsch ; **Maria M Hannaway** ; **Adrian T Estepa** ; **Anand I Kenia** ; **David C Levin** MD * ; **Ethan J Halpern** MD (Presenter)

PURPOSE
To evaluate the predictive value of cardiac risk factors and risk scores for coronary artery disease (CAD) and adverse outcomes in an emergency department (ED) population judged to be at low to intermediate risk for acute coronary syndrome (ACS).

METHOD AND MATERIALS
IRB approval was obtained for this HIPPA compliant, prospective cohort study. The study cohort included consecutive patients who presented to the ED with chest pain over a 36 month period, were admitted to the observation unit, evaluated with coronary CTA (cCTA) and agreed to provide written informed consent. Cardiac risk factors, clinical presentation, ECG and laboratory studies were recorded with a standard template; TIMI and GRACE scores were tabulated. cCTA findings were reviewed by two experienced cardiac radiologists, rated on a 6 level plaque burden scale, and classified for presence/absence of significant CAD (stenosis = 50%). Adverse cardiovascular outcomes were recorded after 30 days.

RESULTS
Among 250 patients evaluated by cCTA, 143 (57%) had no CAD, 64 (26%) demonstrated minimal plaque (70% stenosis). Six patients developed adverse cardiovascular outcomes. Among traditional cardiac risk factors, only age (older) and sex (male) were significant independent predictors of CAD. Correlation with CAD was poor for TIMI ($r=0.12$) and GRACE ($r=0.09$-0.23) risk scores. Although risk factors, patient presentation, and risk scores were poor predictors of CAD and adverse outcomes, cCTA identified severe CAD in all subjects with adverse outcomes.

CONCLUSION
Among patients who present to the ED with chest pain and are judged to be at low to intermediate risk of ACS, traditional risk factors, TIMI and GRACE scores are not useful to stratify patient risk for CAD and adverse outcomes. cCTA is an excellent predictor of outcome.

CLINICAL RELEVANCE/APPLICATION
Coronary CTA is superior to traditional risk factors for triage of patients presenting to the ED with chest pain and who are judged to be at low to intermediate risk of acute coronary syndrome.

VSER31-11 ● MRI in Abdominal Emergencies

Stephan W Anderson MD (Presenter)

LEARNING OBJECTIVES
1) To understand the appropriate use of MRI in the abdominal emergency setting. 2) To discuss the protocol considerations for maximizing the diagnostic yield of MRI in imaging abdominal emergencies. 3) To illustrate relevant imaging findings for a range of abdominal emergencies to which MRI may be appropriately applied.

VSER31-12 ● Efficacy of MR Sequences in the Optimal Visualization of the Appendix

Ajay K Singh MD (Presenter) ; **Garry Choy** MD, MS ; **Mukesh G Harisinghani** MD

PURPOSE
The aim of this study was to determine the frequency of visualization of appendix on different MR sequences.

METHOD AND MATERIALS
The MR sequences obtained in 61 patients for the evaluation of pelvis and right lower quadrant were included in this study. Two board certified radiologists independently evaluated the different MR sequences for the visualization of the appendix. The frequency of visualization of the normal or abnormal appendix was documented for single shot fast spin-echo (SSFSE), T2 fast spin echo (FSE), T1 weighted gradient-echo (GRE) and inversion recovery sequences (STIR).

RESULTS
SSFSE without fat saturation in 3 planes was able to visualize the appendix in 90.9% of the cases (50/55). Amongst the 3 planes (axial, coronal and sagittal) of image acquisition with SSFSE, the coronal image acquisition was considered to be the best in the visualization of the appendix, followed by acquisition in axial plane. The frequency of visualization of appendix on T2 FSE sequences was 62.5% (10/16) without fat saturation and 26.6% (4/15) with fat saturation. In phase T1-weighted GRE (39.2%) sequence was found to be more likely to visualize the normal appendix, compared to out of phase T1-weighted GRE sequence (12.5%). Of the MR sequences evaluated in this study short tau inversion recovery (8.3%) and fat saturated SSFSE (4.7%) sequences were least likely to visualize the appendix.

CONCLUSION
All imaging protocols in patient with suspected appendicitis should include 3 planes SSFSE without fat saturation, T2 FSE sequence without fat saturation and T1 in-phase sequence. Fat saturated SSFSE, STIR and T2 FSE sequences are least effective in visualization of the normal appendix.

CLINICAL RELEVANCE/APPLICATION
This study allows a radiologist to choose the most optimal sequences in the visualization of the appendix in patients with suspected acute appendicitis.

VSER31-13 ● Diagnostic Performance of Noncontrast Abdominopelvic MRI for the Evaluation of Suspected Acute Appendicitis in Patients < 40 Years Old

Matthew Covington MD (Presenter) ; **Shannon Urbina** ; **Lori Stolz** MD ; **Diego R Martin** MD, PhD ; **Dorothy L Gilbertson-Dahdal** MD ; **Sarah M**

Desoky MD ; **Hina Arif** ; **Bobby T Kalb** MD

PURPOSE
Evaluate the sensitivity and specificity of MRI for the detection of acute appendicitis in patients = 40 years old presenting to the ED with right lower quadrant pain

METHOD AND MATERIALS
Study was IRB-approved, HIPPA compliant. Inclusion criteria selected total of 59 patients = 40 years old presenting to emergency room with possible acute appendicitis and evaluated with MRI as the primary imaging test between 8-2012 and 3-2013. Exclusion criteria excluded patients > 40 years old and patients without symptoms of acute appendicitis. All MR exams were performed with a fast, no oral/no intravenous contrast protocol, utilizing a combination of multiplanar, non-breath-hold, T2-weighted HASTE sequences without and with spectral adiabatic inversion recovery (SPAIR) fat suppression. The acquisition time for each exam was recorded. The MRI was interpreted the same day in a prospective fashion by the radiologist assigned to the clinical service that day. Tthe results were classified as a) positive, b) negative or c) indeterminate for acute appendicitis. MRI results were also categorized for additional pathology or sources of pain. Each patient was followed up by either a) surgical findings or b) phone call follow-up at 1 week and 6 months after the ED visit and interrogation of medical records for subsequent clinical work-up. Statistical analysis included calculation of sensitivity, specificity, positive and negative predictive values.

RESULTS
59 patients received MRI for evaluation of right lower quadrant pain and 5 exams were positive for acute appendicitis (8.5%). When compared with gold standards of surgery (5/59) and phone call follow-up with medical records review (54/59), MRI demonstrated a sensitivity of 100%, specificity of 100%, negative predictive value of 100% and positive predictive value of 100%. Out of the 54 patients with negative MRI for acute appendicitis, an alternate diagnosis was offered in 22/54 (40.7%). The average exam time for each MRI was 15 minutes (range 12-22 minutes).

CONCLUSION
MRI is a highly accurate test for the diagnosis of acute appendicitis in patients = 40 years old, with sensitivity and specificity of 100% in our study, utilizing a rapid imaging protocol without oral or IV contrast.

CLINICAL RELEVANCE/APPLICATION

MRI is highly accurate for diagnosing acute appendicitis in patients = 40 years old, providing a rapid, non-radiation based exam for evaluation of right lower quadrant pain in the emergency setting.

VSER31-14 ● Panel/QandA

Radiology Informatics Series: Natural Language Processing: Extracting Information from Text Radiology Reports to Improve Quality

Tuesday, 08:30 AM - 12:00 PM ●S502AB

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IN

VSIN31 •*AMA PRA Category 1 Credit* ™:3.25 •ARRT Category A+ Credit:3.5
Moderator
Curtis P Langlotz , MD, PhD *

LEARNING OBJECTIVES
1) Learn how natural language processing (NLP) can be used to extract information from radiology reports. 2) Understand the basic NLP methods and their strengths and weaknesses. 3) Examine examples of how NLP can be used to automate quality improvement processes in radiology practices. 4) Assess the synergy between NLP and standardized reporting practices.
ABSTRACT
Natural Language Processing (NLP) refers to the automated extraction of meaningful information from narrative text. Some NLP systems use simple rules to categorize text according to whether a particular concept may be present. More sophisticated systems use part-of-speech tagging and grammatical parsing to extract concepts and relationships from text. Some NLP systems use statistical approaches that can learn to categorize text automatically based on a test set of positive and negative examples. When applied to radiology reports, NLP systems are most frequently used to identify and retrieve reports of interest, such as reports containing a critical result, an incidental finding, or a recommendation for follow up. NLP systems are simpler to construct and more accurate when the structure of the analyzed text is constrained in some manner. Several real-world examples of both simple and sophisticated NLP systems in radiology will illustrate the spectrum of applicable techniques and the potential benefit to radiology practice.

VSIN31-01 ● Natural Language Processing: Motivations and Overview

Curtis P Langlotz MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Learn how natural language processing (NLP) can be used to extract information from radiology reports. 2) Understand the basic NLP methods and their strengths and weaknesses. 3) Examine examples of how NLP can be used to automate quality improvement processes in radiology practices. 4) Assess the synergy between NLP and standardized reporting practices.

ABSTRACT
Natural Language Processing (NLP) refers to the automated extraction of meaningful information from narrative text. Some NLP systems use simple rules to categorize text according to whether a particular concept may be present. More sophisticated systems use part-of-speech tagging and grammatical parsing to extract concepts and relationships from text. Some NLP systems use statistical approaches that can learn to categorize text automatically based on a test set of positive and negative examples. When applied to radiology reports, NLP systems are most frequently used to identify and retrieve reports of interest, such as reports containing a critical result, an incidental finding, or a recommendation for follow up. NLP systems are simpler to construct and more accurate when the structure of the analyzed text is constrained in some manner. Several real-world examples of both simple and sophisticated NLP systems in radiology will illustrate the spectrum of applicable techniques and the potential benefit to radiology practice.

VSIN31-02 ● Enhancing Provided Patient Clinical Information by Automated Review of Prior Radiology Reports Using the Clinical Context Indicator (CCI): A NLP Based Data Extraction and Presentation PACS-integrated Tool

Adam R Travis MD (Presenter) ; **Paul J Chang** MD * ; **Yuechen Qian** ; **Merlijn Sevenster** PhD * ; **Gabriel Mankovich** BSC ; **Johannes Buurman** PhD *

PURPOSE
Physicians do not always provide adequate histories when ordering imaging studies; this may be due to Computerized Physician Order Entry (CPOE) systems that allow limited codified indications (drop down menus) as input parameters. Lack of history may result in suboptimal or even incorrect interpretation by radiologists. We test the hypothesis that a PACS-integrated view of patient history automatically synthesized from prior radiology reports improves the quality of clinical history sections in radiology reports.

METHOD AND MATERIALS
CCI functions as a PACS plugin that extracts pertinent information from prior radiology reports and displays it along three axes for each exam: history, acute indication, and follow-up recommendations. CCI uses natural language processing (NLP) to populate the history and follow-up axes by extracting and filtering unique sentences from relevant sections in prior reports. The acute indication axis is populated with the Reason For Exam (RFE) from the CPOE system. Prospective evaluation was conducted by a team of senior residents in normal workflow. First, the reader viewed the CCI summary and dictated the history based only on this information. Then, the reader reviewed all pertinent patient data (e.g., pathology, labs) from the EHR and modified the dictated history, if necessary. Later, for each dictated study an attending radiologist compared the quality of the initial CCI-only history to the final dictated history and to the RFE, which were each used as baselines.

RESULTS
Preliminary data on 32 neuro CT cases shows that 34.4% of CCI-only histories were rated significantly more complete than RFE histories. However, CCI-only histories were significantly augmented with pathology (18.8%) and/or other data (9.4%) derived from the EHR.

CONCLUSION
Patient clinical context derived from CPOE exam indications alone were enhanced by the automated extraction and PACS-integrated presentation of information derived from prior radiology reports. However, additional important patient information was derived from the EHR. Therefore, automated PACS-integrated tools designed to present patient context should extract data from both prior radiology reports and the EHR.

CLINICAL RELEVANCE/APPLICATION
Automated PACS-integrated tools designed to present patient context should extract data from both prior radiology reports and the EHR. These tools can enhance information provided by CPOE alone.

VSIN31-03 ● Facilitate Mammography Quality Standards Act (MQSA) with Automatically Correlating Radiology Reports of Breast Cancer Patients

Containing Biopsy Recommendations with Subsequent Pathology Reports

Ye Xu PhD (Presenter) ; **Thusitha Mabotuwana** ; **Yuechen Qian** ; **Merlijn Sevenster** PhD *

PURPOSE
MQSA mandates for quality control of breast radiology reports suggesting a biopsy follow-up (BIRADS scores 3, 4 and 5) are correlated with pathology outcome. This is typically done manually, which is time consuming and error prone. Our purpose is to develop and evaluate a natural language processing system (NLP) that 1) automatically recognizes if a breast radiology report contains a biopsy recommendations and, if so, 2) finds the pathology reports that discusses biopsy outcome from a stack of pathology reports.

METHOD AND MATERIALS
Our NLP system includes two components: 1) recommendation detector; 2) pathology report finder.
Annotation guidelines were created in an iterative fashion for creating recommendation detection ground truth by four researchers, including one radiologist. Ground truth was created based on 5,200 radiology reports, from a deidentified corpus of breast radiology report obtained from a hospital in the Midwest. From a test set of 300 reports, we selected all reports that contain a recommendation of any type (not necessarily biopsy recommendations), yielding a final test set of 110 reports.
The pathology report finder utilizes laterality, interval and reason for exam information to determine if a pathology report is the follow-up of a give radiology report. We conducted a preliminary evaluation on the full radiology-pathology histories of 21 breast cancer patients with at least one radiology report with a biopsy recommendation.

RESULTS
Evaluated on the 110 reports, the recommendation detector achieves precision, recall and F-measure scores of 0.97, 0.99, and 0.98 respectively. Among 18 of 21 patients (86%), the pathology report finder successfully finds matches between pathology reports and radiology reports containing biopsy recommendation. Among those 18 patients (20 reports), there are 4 breast image studies with BIRADS 4, but their pathology diagnosis identified as benign.

CONCLUSION
This study demonstrates the potential of using NLP technologies to facilitate the quality assurance of MQSA. Our algorithms reliably identify studies that contain biopsy recommendation and can support automatic correlation with biopsy reports. Adequately integrated in a workflow support tool, healthcare providers can use it to get instant feedback on false positive rates of imaging diagnosis based on biopsies.

CLINICAL RELEVANCE/APPLICATION
Facilitate the quality assurance of MQSA

VSIN31-04 ● Using an Enterprise Cloud-based NLP Platform to Convert Unstructured Reports into Structured Clinical Data for Analytics

James Maisel (Presenter) *

CONCLUSION
Natural language processing was demonstrated to extract structured codes from unstructured data sources such as transcription. The structured codes could be queried with a basic analytic tool to provide subsets of patients based upon structured data with typical stratifications required for clinical studies and practice management issues.

Background
Analytics is a tool to extract and use meaning from data and facilitates screening, outcomes analysis, evidence-based decision support, audit protection, research, cross-system communication, and reporting. In our study, an enterprise cloud-based platform was designed to accept unstructured clinical documentation from diverse sources. With Natural Language Processing (NLP), data can be structured and coded for analytics. The study evaluated the potential of the platform to structure data and make it available for secondary use with analytic reporting . Study results and implications will be discussed.

Evaluation
Assorted types of data including over 500,000 records from dictation, scanned records and semi-structured EHR text were evaluated as potential sources for analytics. Dictation was converted to text with backend speech recognition and edited. Transcribed, scanned OCR documents and semi-structured EHR messages were preprocessed and passed through natural language processing (NLP). The output was post-processed and coded into standardized terminologies including SNOMED CT, ICD-9, ICD-10, RxNorm, LOINC and CPT-4 codes derived from postprocessing and stored within a MS SQL database to serve as a clinical data repository. A front end application was designed to allow physicians to query the database for analytic output based on these codes and terms.

Discussion
The NLP platform successfully processed all forms of unstructured text and semi-structured data and output structured codes. The analytic form worked well at extracting subsets of records based on their codes. The analytics reporting application successfully extracted records that contained one or more structured terminologies or exact text searches. Combinations of terms and exclusions and nested searches could be performed in live-time. Record names could be de-identified.

VSIN31-05 ● An NLP-based, Data-driven Paradigm for Clinical Documentation Improvement and Analytics

James Maisel (Presenter) *

CONCLUSION
Not only does natural language processing increase the effectiveness and efficiency of clinical documentation (by reducing physician time required and increasing documentation quality), but it makes possible a variety of secondary data uses.

Background
A clinical documentation workflow utilizing dictation and natural language processing can make the documentation process faster and produce structured data required for software-based clinical documentation improvement, analytics, and reporting. The workflow involves a physician dictating a note, the dictation's conversion to text by speech recognition, natural language processing generating structured data from the text, entry of the structured data and text into the EHR, processing of the structured data by clinical documentation improvement application, manual documentation improvement using the documentation improvement application's output, and making available the note's structured data in a data repository for analytics and reporting.

Evaluation
Integrating Natural Language Processing ('NLP') into the clinical workflow can enable increased documentation efficiency, clinical documentation improvement, and various analytics that take advantage of the structured data generated by NLP.

Discussion
Because free (unstructured) dictation is a faster method of documentation than standard EHR data entry, free text will continue to be an important part of electronic health records. Natural Language Processing (NLP) can be used to structure free text contained in the physician's documentation. The following is an example of a clinical documentation improvement analytics application that would use structured, codes generated by NLP. An 'ICD-10 specificity' application could prompt the physician to enter more details about a medical problem in order to generate a more specific ICD-10 code, which might be beneficial for billing. The structured data stored in the data repository can be used for a variety of analytical and reporting purposes, including for outcomes analysis, value-based medicine, surveillance of high-risk populations, PQRS measure reporting, research, case management, quality informatics, and public health analytics.

VSIN31-06 ● Natural Language Processing to Solve Problems in Clinical Practice

Michael E Zalis MD (Presenter) *

LEARNING OBJECTIVES
1) Describe salient features of electronic health record data and Radiology workflow that create obstacles for efficient, high quality care delivery. 2) Describe and demonstrate essential aspects of natural language processing and related aspects of computer science and show how these tools can begin to improve Radiology work-flow and care delivery. 3) Describe future directions for natural language processing tools in Imaging.

ABSTRACT
Electronic health record data, whether in discretized (structured field) or unstructured forms presents a potentially overwhelming amount of information for a Radiologist to consume at the time of clinical encounter. This applies for both in- and out-patient settings, and spans a broad range of sub-speciality and acuity scenarios. Consuming and understanding this data in an efficient way is essential for efficient, high quality care delivery, especially since most Radiologists have little prior familiarity with their patients. Several natural language processing techniques are available to filter the EHR data to permit a Radiologist or affiliated support staff the ability to ascertain essential information for their care. In addition, related techniques of knowledge management and machine learning can combine to form powerful tools that can assist the Radiologist in rapidly gleaning essential contextual and safety information contained in the EHR. We will show several examples of these techniques at work in clinical settings. Coupled to industry market trends as well as mandates related to Meaningful Use 2, these tools are becoming increasingly powerful and pervasive. Improved automation and accuracy of filtration will make these tools all the more useful, widespread and value-adding to the practice of Radiology.

VSIN31-07 ● Follow-up Imaging of Pulmonary Nodules

Cara L Morin MD (Presenter) ; **Scott Shimp** BS ; **William W Olmsted** MD ; **Amy Kunce** ARRT ; **Eliot L Siegel** MD *

PURPOSE
Initial imaging studies often include findings that cannot be completely evaluated, and radiologists often make recommendations for additional imaging. For pulmonary nodules, well-known guidelines address such recommendations. In routine practice, however, the rates of radiologists recommendations for follow-up and of referring physicians compliance are not well documented. Data are limited on whether clinicians follow the advice of radiologists.

METHOD AND MATERIALS
A retrospective analysis on a sample of 10,000 radiology records from 2006 to 2010 from our institution that included pulmonary nodule findings was performed using statistical and pattern matching methods. Analysis was performed for follow-up recommendations and adherence. If the term 'follow up' was detected in a record, all records were analyzed to determine if there was a subsequent record with a later date and the same patient ID. If such a record was found, it was assumed that a follow up did occur. Analysis was also performed on a subsample of patients with at least 2 reports (5,954 records). Results for the full sample and subsample provided a range of values to be refined in subsequent analysis.

RESULTS
Within the sample of patients obtaining an initial XR (radiograph), CT, or PET study (9,863), ~48% of reports contained a recommendation for follow-up. The recommendation rate varied between 41% and 57% across all sample years. Of reports recommending follow-up, 53%71% resulted in a subsequent study within 2 yr. CT and XR accounted for ~73% and ~23% of all studies, respectively, whereas CT and XR accounted for 83% and 13%, respectively, of follow-up studies. CT and PT studies resulted in follow-up recommendations in ~55% of cases, whereas only ~28% of XR studies resulted in follow-up recommendations. With respect to timing, 38% of follow-up reports occurred within 3 mo, 22% within 36 mo, and 22% within 612 mo.

CONCLUSION
Our data on a large sample set of imaging records indicate that follow-up imaging for pulmonary nodule is recommended for ~48% of XR, CT, or PET studies. In those cases where follow-up imaging is recommended, approximately 53%71% are actually obtained.

CLINICAL RELEVANCE/APPLICATION
Recommendations for additional imaging are common in radiology reports. Our initial analysis demonstrates suboptimal adherence and these cases should be tracked.

VSIN31-08 ● Measuring Expressions of Uncertainty in Radiology Texts for Natural Language Processing Applications

Brian E Chapman PhD (Presenter) ; **Amilcare Gentili** MD ; **James Y Chen** MD * ; **Asako Miyakoshi** MD ; **Wendy Chapman** PhD

CONCLUSION
Our results showed that radiologist had high overall consistency in where they centered probabilities but that their probability mappings had high variability. We observed inconsistency in our NLP cue categorization, particularly the overlap between the definitely and probably negated categories. Further, the results indicate our model of uncertainty could be improved by adding a fifth category of ambivalent to capture the highly uncertain existence cues with probabilities near 0.5.

Background
Natural language processing (NLP) is an important tool for extracting structured information from radiology texts. pyConTextNLP uses linguistic cues to determine whether a finding is negated, asserted, or uncertain. We compared probabilities assigned by radiologists against categories defined in pyConTextNLP.

Evaluation
A set of linguistic cues describing negated and asserted existence with and without uncertainty was created by combining (a) 133 pyConTextNLP cues categorized as definitely negated, probably negated, probably existent, and definitely existent and (b) 108 cues translated from Swedish clinical texts. Three radiologists separately reviewed the cues in random order and assigned single-point probabilities to each cue followed by probability ranges (blinded to single-point responses).

Discussion
Pairwise comparisons of single-point probabilities showed very small differences in the mean values (mean difference of 0.012) but large variability (mean standard deviations of 0.21). Similarly range mappings showed small but somewhat differences in the mean location (-0.0035) and widths (0.0008) of the assigned probability ranges but large variability in these measures (mean standard deviation of 0.21 and 0.30). Examining mean range width versus the mean point mapping showed that cues with point mappings near the extremes (0. and 1.0) had much smaller range widths than cues with point mappings near 0.5. Radiologist discordance showed a similar pattern. For the categorized cues, the mean (standard deviation) of the assigned point probabilities were as follows: definitely negated 0.078 (0.11), probably negated 0.17 (0.16), probably existent 0.71 (0.11), definitely existent 0.91 (0.083).

VSIN31-09 ● Unlocking Information from Text: Pulmonary Embolism, Pneumonia, and Report Clarity

Wendy Chapman PhD (Presenter)

LEARNING OBJECTIVES
1) Be able to define natural language processing (NLP) and describe some of the tasks accomplished through this technique. 2) Understand how NLP could be used to help identify patient cohorts for imaging/radiology studies. 3) Know how well NLP performs at extracting and reasoning with findings described in radiology reports. 4) Be able to describe some of the challenges in developing and applying NLP to radiology reports.

VSIN31-10 ● Natural Language Processing of CT Pulmonary Angiography Reports for the Detection of Pulmonary Embolism Chronicity and Location of Filling Defects

Sheng Yu ; **Ruth M Dunne** MBBCh (Presenter) ; **Andetta R Hunsaker** MD ; **Elizabeth George** MBBS ; **Frank J Rybicki** MD, PhD * ; **Kanako K Kumamaru** MD, PhD ; **Cai Tianxi** ; **Matey Neykov** ; **Arash Bedayat** MD ; **Karin E Dill** MD

PURPOSE
To develop and test a Natural Language Processing (NLP) algorithm that analyzes clinical reports of CT Pulmonary Angiography (CTPA) for the diagnoses of pulmonary embolism (PE), the chronicity of PE when present, and the location of the most proximal filling defect considered positive for PE.

METHOD AND MATERIALS
The final CTPA reports for 10,330 CTPA examinations performed at our academic institution from 8/1/03 and 3/31/10 were manually, independently reviewed by at least two physicians for the diagnosis of PE. For patients with PE, chronicity subtype information (acute, subacute, chronic, acute on chronic, and other) and the most proximal embolus location (central, lobar, segmental, or subsegmental pulmonary artery) were also recorded. A NLP program was developed to analyze the content of the reports and to convert the semantics to numeric features as the counts on the occurrences of relevant concepts related to PE status and subtypes. Statistical models were built to classify the diagnoses of PE, the chronicity, and the most proximal locations by aggregating information from all informative features.

RESULTS
The prevalence of PE was 19.3% (1996/10330), determined from manual review of the reports and considered truth. The classification algorithm based on the NLP extracted features was highly accurate in the detection of PE with a cross-validated AUC of 0.995. Among patients with PE, the true fraction of acute, subacute, chronic, acute on chronic, and other PE were 82.7%, 2.1%, 8.3%, 3.9%, and 3.0%, respectively. Proximal extension of the embolus was classified as central in 24.3%, lobar in 23.2%, segmental in 39.4%, and subsegmental in 13.1% of patients. The current classification models for acute versus non-acute and central versus non-central PE based on the NLP extraction achieved an AUC of 0.897 and 0.936 respectively.

CONCLUSION
Natural language processing is a promising automated tool to identify patients with a positive CTPA report, and provides data regarding chronicity and the proximal embolus location.

CLINICAL RELEVANCE/APPLICATION
Given the relatively standard terminology, range of findings, and low positivity rate, NLP for automated extraction of PE-related information has the potential to creation of large research cohorts.

VSIN31-11 ● Natural Language Processing Enabled Capturing of BI-RADS Data from Unstructured Radiology Reports

V J Jagannathan PhD ; **Claudine Martin** BS ; **Juergen Fritsch** PhD (Presenter) *

CONCLUSION
The proposed BI-RADS information identification approach allows for more efficient mammography reporting workflows (see diagram). Furthermore, it can be used to notify the radiologist in real-time about any missing, relevant information needed for reporting purposes. The recommendation captured in structured form can drive reminders and follow- ups and the assessment captured can be used for patient communication.

Background

Breast Imaging Reporting and Database System (BI-RADS®) is a quality assurance guide developed by the American College of Radiology (ACR) to standardize breast imaging reporting [1]. In this work, we review an approach to capture the standard BI-RADS data elements directly from narrative mammography reports. The data elements include:
1) Breast Density
2) BI-RADS Assessment
3) Recommendation for Follow-Up
4) Laterality The proposed workflow supports processing of unstructured (typed or dictated) Radiology reports via a Natural Language Understanding (NLU) engine to automatically identify and then validate the correctness of the above data elements. Radiology reports are converted into standard HL7 Clinical Document Architecture (CDA) format, which also allows for encoding the discovered BI-RADS data elements in structured form. [1]
http://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Resources/BIRADS/BIRADSFAQs.pdf

Evaluation
Users review and validate the correctness and completeness of the data and thereby provide implicit feedback that is being used to continuously improve system performance, which is being measured via precision and recall on a manually annotated gold standard data set.

Discussion
We present an approach that allows identifying and validating structured BI-RADS data from unstructured, narrative reports. Diagnostic mammograms, MRIs and Ultrasound reports will contain explicit BI-RADS assessments but not typically explicit breast density values as found in screening mammograms. Also, laterality identification in the presence of multiple tumors is non-trivial. Yet, Radiologists prefer narrative reporting systems over structured reporting tools for efficiency and expressivity reasons.

VSIN31-12 ● Error Bot: Improving Radiology Report Quality by Notifying Radiologists of Report Errors in Real-time

Matthew J Minn MD (Presenter) ; **Arash R Zandieh** MD ; **Ross W Filice** MD

CONCLUSION
Radiology report errors inevitably occur and may impact patient management. Our project not only documents error rates, but shows that automated intervention can positively impact patient management by both prospectively decreasing error rates and correcting substantial numbers of errors that do occur.

Background
Radiology report errors occur due to inaccurate speech recognition, report macros, and other human error. We created a system that detects report errors in real-time and sends immediate notifications to the reporting radiologists by page and email. Our goal is to improve report quality by two main mechanisms: correct errors that do occur quickly and provide continuous feedback in hopes of decreasing future error rates.

Evaluation
We receive a real-time Health Level 7 (HL7) feed from our Radiology Information System (RIS) (Siemens). Our Mirth Connect HL7 engine (Mirth Corporation) filters report messages and checks for errors using custom JavaScript algorithms. If a potential error is detected, a call is made to custom Bash (GNU) scripts that page and email the associated radiologists. All related information is tracked in a MySQL (Oracle) database.
We focused on two error types. Laterality errors were flagged on discrepancy between laterality in the procedure name and the report conclusion. Gender errors were flagged on discrepancy between patient sex and descriptors in the report. Error rates were determined for 4 months before (Pre) and 7 months after (Post) the notification system was implemented. Flagged reports were curated to determine true positive detections. These were then followed to see if they were ultimately corrected.

Discussion
We found significant improvement in potential errors detected (Pre: 198/149,537; 0.13%, Post: 290/277,531; 0.10%, p-value 0.01) and true positive rates (Pre: 116/149,537; 0.08%, Post: 147/277,531; 0.05%, p-value 0.002) after the detection and notification system was implemented. Most importantly, the number of true positive reports ultimately corrected improved dramatically after our notification system started (Pre: 17/116; 15%, Post: 133/147; 90%, p-value

VSIN31-13 ● Automated Structuring of Radiology Reports using Natural Language Processing

Paras Lakhani MD (Presenter)

LEARNING OBJECTIVES
1) Learn about the differences between and structured, standardized, and free-text reporting. 2) Learn about basic natural language processing (NLP) techniques, and how they can be applied to transform free-text narrative radiology reports into standardized reports. 3) Learn about the pros and cons of such automated systems. 4) Provide real-life examples of the natural language processing system with various reporting styles. 5) Discuss future directions of NLP and its applicability to structured reporting.

Using myRSNA®: Hands-on Workshop

Tuesday, 10:30 AM - 12:00 PM ● S401CD

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IN

ICIA31 • *AMA PRA Category 1 Credit* ™:1.5
John W Basco , MS

LEARNING OBJECTIVES
1) Understand the different tools and applications within myRSNA. 2) Log in to myRSNA and set up a personal profile. 3) Using the tools within myRSNA, highlight different use case scenarios.

The RSNA Reporting Initiative: Developing a Library of Best-Practices Radiology Report Templates

Tuesday, 10:30 AM - 12:00 PM ● S501ABC

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IN

ICII31 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Curtis P Langlotz , MD, PhD *
Charles E Kahn , MD, MS *
Marta E Heilbrun , MD

LEARNING OBJECTIVES
1) Understand the meaning and purpose of structured reporting and standard terminology. 2) Review the progress on RSNA's library of best-practices radiology report templates. 3) Discuss directions for further development of the report template library. 4) Learn how radiologists can use these reporting templates to improve their practice.
ABSTRACT
This session will review the RSNA-sponsored initiative to improve radiology reporting practices. The RSNA has created a library of over 200 exemplary report templates that contain reusable structured data based on RadLex® and other standard terminologies. These report templates represent best-practices that can be adopted by radiologists and adapted based on local practice patterns. The template library, available on the RSNA web site, serves as a resource for radiologists who wish to improve their practice by standardizing the format, content, and structure of their reports. Over the last 2 years, the RSNA has collaborated with IHE and DICOM to develop standards for radiology report templates that will provide new reporting capabilities. This session will provide an overview of structured reporting, review the progress of the RSNA-sponsored initiative, and describe how radiologists can take advantage of this effort to improve their clinical practice.
URL's
http://www.rsna.org/Reporting_Initiative.aspx

Overview of RSNA's Teaching File Software (MIRC®)

Tuesday, 10:30 AM - 12:00 PM ● S401AB

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RS IN

ICIW31 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Krishna Juluru , MD
William J Weadock , MD *

LEARNING OBJECTIVES
1) Learn the features of the RSNA's MIRC software for teaching files. 2) Learn how to download and install the software. 3) Learn to use the RSNA MIRC Wiki to obtain documentation on the software.

Informatics (3D, Quantitative and Advanced Visualization)

Tuesday, 10:30 AM - 12:00 PM • S402AB

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IN CT BQ

SSG08 • *AMA PRA Category 1 Credit* ™:1.5
Moderator
Asim F Choudhri , MD
Moderator
Safwan Halabi , MD

SSG08-01 • Gray-matter Volumetry Predicts Decline of Intelligence Quotient in Children with Sickle Cell Disease

Rong Chen PhD (Presenter) ; **Michal Arkuszewski** ; **Jaroslaw Krejza** MD ; **Edward H Herskovits** MD, PhD ; **Elias R Melhem** MD, PhD

PURPOSE
For children with sickle cell disease (SCD), we aim to differentiate those with decline of intelligence-quotient (IQ) from counterparts without decline, based on structural magnetic-resonance (MR) imaging volumetry

METHOD AND MATERIALS
This prospective cohort study included 25 children with SCD, homozygous for hemoglobin S, with no history of stroke. We administered the Kaufman Brief Intelligence Test (K-BIT) to each child at yearly intervals for 2-4 years. Each child underwent MR examination within 30 days of the baseline K-BIT evaluation date. We calculated K-BIT change rates, and used rate of change in K-BIT to classify children into two groups: a decline group and a non-decline group. We then generated predictive models to predict the group-membership variable (K-BIT decline / non-decline) based on regional gray-matter volumes computed from structural MR images.

RESULTS
We identified six gray-matter structures (the left median cingulate gyrus, the right middle occipital gyrus, the left inferior occipital gyrus, the right fusiform gyrus, the right middle temporal gyrus, the right inferior temporal gyrus) that, when assessed for volume at baseline, are jointly predictive of whether or not a child would suffer subsequent K-BIT decline. Based on these six regional GM volumes, maternal education, and the baseline K-BIT, we built a prognostic model using the K* algorithm. The accuracy, sensitivity and specificity were 0.84, 0.75 and 1.0, respectively.

CONCLUSION
Structural MR imaging predicts subsequent IQ decline for children with SCD.

CLINICAL RELEVANCE/APPLICATION
Structural MR derived features can be used as a biomarker to predict subsequent IQ decline for children with SCD.

SSG08-02 • Heterogeneity as Biomarker in Tumour Imaging

Lejla Alic ; **Jifke F Veenland** PhD (Presenter)

PURPOSE
Tumour heterogeneity could be a valuable biomarker for differentiation, grading, response monitoring and outcome prediction. Many quantification techniques have been described, however in clinical practice these methods are scarcely used. The aim of this study is to evaluate the performance of the described methods and to identify the bottlenecks for the implementation in clinical practice.

METHOD AND MATERIALS
We searched OVID, EMBASE, and Cochrane CENTRAL up to 24 March 2013. Heterogeneity analysis methods were classified into four categories, i.e., non-spatial methods (NSM), spatial grey level methods (SGLM), fractal analysis (FA) methods, and filters and transforms (FandT).

RESULTS
From 6908 potentially relevant publications, 183 studies were included. The number of studies has been increasing steadily since 2009. Generally, 60 % studies use NSM,49% use SGLM, 11 % use FA, and 28% use FandT. Differential diagnosis, grading or outcome prediction was the goal in 86% studies, 36% studies were based on MRI, and 88% studies were conducted retrospectively. Tumours in the breast and brain together cover 49% of the studies.
No relation was found between the discriminative power and the quantification methods used, or between the discriminative power and the imaging modality. The reported AUC ranged from 0.5 to 1 with a median of 0.89. A negative correlation was found between the AUC and the number of features estimated per tumour, which is presumably caused by overfitting in small datasets. In only 53.4% of the classification studies, the use of cross-validation was reported. None of the publications report the use of an external validation set to test their findings. Retrospective analyses were conducted in 60% of the studies without a clear description of the inclusion criteria. Only 12% of the studies had a prospective study design. Almost none of the papers evaluated the incremental value of the heterogeneity biomarker on top of clinical established markers.

CONCLUSION
To enable the translation of imaging biomarkers from the research stage to clinical practice, research should focus more on prospective studies, use external datasets for validation, and focus on the added value of the proposed heterogeneity biomarker on top of the clinical established markers.

CLINICAL RELEVANCE/APPLICATION
Heterogeneity has the potential of a valuable biomarker.

SSG08-03 • Effective Staging of Fibrosis by the Selected Texture Features of Liver: Which One Is Better, CT or MR Imaging?

Xuejun Zhang PhD (Presenter) ; **Yufan Zeng** ; **Hiroshi Fujita** PhD ; **Yan Wen** ; **Liling Long** MD ; **Yu Huang** MMed

PURPOSE
Different types of datasets acquired from CT and MR images are investigated to select the optimal parameters for the classification of texture patterns of hepatic fibrosis using in Computer-aided Diagnosis.

METHOD AND MATERIALS
149 patients were scanned by MDCT and 218 patients were performed abdominal examination using 1.5T and 3T superconducting MR scanners. All the cases are verified by needle biopsies as the gold standard of our experiment, ranging from 0(no fibrosis) to 5(cirrhosis). For each case, at least four sequenced phase images are acquired: pre-contrast, arterial, portal venous and delayed phase.
15 texture features calculated from gray level co-occurrence matrix (GLCM) are extracted within an ROI in liver as one set of input vectors. Each combination of these input subsets is checked by using support vector machine (SVM) with leave-one-case-out method to differentiate fibrosis into two groups: normal or abnormal.10 ROIs in liver are manually picked up dispersedly by experienced radiologist from each sequenced image and each item in 15 features is averaged by 10 ROIs in each case to reduce the validation time. The number of input items n is selected from the combinations of 15 features exhaustively. (2^{15}-1 different combinations obtained, where n?[1,15])

RESULTS
According to the accuracy rate (AR) calculated from each combination, the optimal number of texture features to classify liver fibrosis degree is from 4 to 7, no matter what modalities are used. The overall performance calculated by the average sum of maximum AR value of all 15 types number of features is 66.83% in CT images, while 68.14%, and 71.98% in MR images (Fig.1a), respectively; among 15 texture features, mean gray value and entropy are in most common used in 3 datasets. Correlation has the lowest AR value and is abandoned to be used in all datasets. AR value tends to increase with the injection of contrast agency, and both CT and MR images reach highest performance in equilibrium phase as shown in Fig.1b.

CONCLUSION
Comparing the accuracy of classification on two modalities, we should reveal that MR images have an advantage over CT images, while 3T MRI is better than 1.5T MRI to detect liver fibrosis. The texture analysis is effective in equilibrium phase than in other phased images.

CLINICAL RELEVANCE/APPLICATION
MR can demonstrate fibrotic texture efficiently and equilibrium phase image is recommended as a main tool for interpretation of cirrhosis.

SSG08-04 • The Development of a Methodology to Simulate 3D Models of Benign and Malignant Breast Masses

Eman Shaheen (Presenter) ; **Chantal Van Ongeval** MD ; **Frederik De Keyzer** ; **Kenneth C Young** PhD ; **David Dance** PhD ; **Hilde Bosmans** PhD *

PURPOSE
Breast cancer remains a major health concern and a leading cause of cancer mortality among women. The commonly used screening mammography has limited sensitivity for small lesions detection due to anatomical noise. Therefore, new breast imaging modalities with proven superiority for lesion detection may remedy this shortcoming in breast cancer screening and diagnosis. Clinical trials are very expensive, giving rise to alternative dedicated simulation studies for the investigation of new modalities in terms of lesion detectability. Here, we present a new method to create more clinically-relevant 3D models of benign and malignant breast masses for use in simulation studies.

METHOD AND MATERIALS
Breast MRI cases with histologically-proven malignant masses, imaged with a 3D contrast enhanced acquisition, were collected. Each mass was manually segmented in three reconstructed orthogonal planes (sagittal, transversal, coronal), and then combined with logical OR, resampled to have isotropic voxel sizes in 3D space, then meshed. Due to the low resolution of MRI images, most of these masses had well defined borders. In order to create spiculated masses, suspicious for malignancy, the segmented model was used as nucleus with branches grown on the surface. The branches had different lengths, bifurcations, orientations and thicknesses. The clinical appearance of these models was assessed by inserting each mass model into 2D digital mammography and breast tomosynthesis (BT) images using a previously-validated simulation framework. Each 2D and BT was shown to an expert radiologist who scored the BIRADS (scale 1-5) and the realism of the simulated mass (scale 1-10, 10=definitely real).

RESULTS
Preliminary results for the benign category (well defined borders) with 7 simulated masses showed a BIRADS score between 2 and 3, and an average realism score of 8.1 (range 8-9) for 2D and 7.9 (7-9) for BT. For the malignant category with 8 spiculated masses, the BIRADS score was between 4 and 5, and the average realism score was 8.3 (8-9) in 2D and 7.6 (7-9) in BT.

CONCLUSION
A new method to simulate 3D models, based on an atlas of real lesions, with variety of shapes and degree of malignancies was presented with promising results.

CLINICAL RELEVANCE/APPLICATION
The proposed 3D mass models are promising candidates to create enriched databases for virtual clinical trials and observer detectability studies to optimize the performance of mammographic systems.

SSG08-05 ● Tumor Heterogeneity Assessed with First Order Histogram Features in Dependence from Image Resolution: A Point to Be Considered in Clinical Routine?

Matthias Benndorf MD (Presenter) ; **Martin Soschynski** ; **Sabine Bucher** ; **Marisa Windfuhr-Blum** PhD ; **Mathias F Langer** MD, PhD ; **Elmar C Kotter** MD, MSc *

PURPOSE
Measurement of tumor heterogeneity in contrast enhanced MRI is a promising method to obtain additional information about prognosis, tumor type and therapy response. One way to describe heterogeneity is by histogram analysis of the tumor signal intensities. Our aim was to analyze to what extent image resolution affects first order histogram features, using breast MRI examinations.

METHOD AND MATERIALS
32 consecutively histopathologically (n=25) or by means of follow up (n=7, one year imaging follow up was considered sufficient) verified breast MRI lesions >9mm were retrospectively analyzed. Parameters of our scanner protocol were: 1.5T, TE: 4.76ms, TR: 11ms, matrix: 480×512. Analysis was performed in early enhancement phase subtraction images. The cross sectional image showing the largest axial tumor diameter was rescaled with a bicubic interpolation function 10 times in decreasing 5% steps. This resulted in a dataset of 352 images. Within each of these images the tumor was manually delineated and the raw signal intensity matrix obtained. Mean, standard deviation, skewness, kurtosis, empirical Shannon entropy [-1×Sp(a)×log(p(a))] and uniformity [Sp(a)^2] then were analyzed in dependence from image resolution.

RESULTS
We demonstrate that histogram features mean, standard deviation, skewness and kurtosis are robust to changes in resolution, with P>0.4 for analysis of variance (anova) comparisons between resolutions for the single feature. Entropy however decreases with decreasing resolution (P
CONCLUSION
The Shannon entropy within tumors decreases with decreasing image resolution, whereas basic distribution information like mean and standard deviation remain relatively stable. Uniformity behaves inversely to entropy.

CLINICAL RELEVANCE/APPLICATION
When interpreting studies about diagnostic performance of histogram analysis, one should consider the imaging protocol used in the respective study. Image resolution affects entropy estimates.

SSG08-06 ● Differential Diagnosis of Benign and Malignant Brain Tumors by Use of Texture Analysis on FDG-PET Images

Shoji Kido MD, PhD (Presenter) ; **Akiko Katamoto** BS ; **Rui Xu** ; **Yasushi Hirano**

PURPOSE
To develop the computer-aided diagnosis (CAD) method by use of texture analysis and pattern classification technique to analyze F-18-fluorodeoxy-glucose (FDG) uptake distribution of brain tumors for differential diagnosis of malignancy and benignancy on FDG-PET images.

METHOD AND MATERIALS
We used consecutive 24 patients with brain tumors (10 benign and 14 malignant cases). Each patient underwent MRI and PET scans continuously. In the PET images, it is difficult to determine the contours of tumors in many cases. So, MR images were used for determination for tumor regions on PET images. In the first step, each patient of MR image data was superimposed to PET image data by use of a three-dimensional registration algorithm. After manual segmentation of tumor regions on MR images, tumor regions on PET images were segmented based on those on MR images. Texture features representing FDG uptake distributions were obtained from these tumor regions on PET images. From these texture features, four optimal parameters to distinguish malignancy from benignancy were selected. For pattern classification technique, we used a support vector machine (SVM) as a classifier. We classified 24 tumors into benign and malignant cases with the SVM by a leave-one-out method. The performance of our CAD method was compared with a maximum standard uptake value (SUV_{max}) based method that was generally used in clinical diagnosis.

RESULTS
The accuracy rate of our CAD method for all cases was 91.7% (22/24 cases). The accuracy rate for benign cases was 80.0% (8/10 cases), and that for malignant cases was 100.0% (14/14 cases). On the other hand, the accuracy rate of SUV_{max} based method for all cases was 62.5% (15/24 cases). The accuracy rate for benign cases was 20.0% (2/10 cases), and that for malignant cases was 92.9 % (13/14 cases). The performance of our CAD method was superior to that of the SUV_{max} based method ($P < 0.05$).

CONCLUSION
The CAD method for differential diagnosis of brain tumors on FDG-PET images by use of texture analysis and the SVM classifier indicated high performance compared with the SUV_{max} based method. This method is feasible for assisting radiologists in the differential diagnosis of brain tumors on FDG-PET images.

CLINICAL RELEVANCE/APPLICATION
The CAD method by use of texture analysis and the SVM classifier on FDG-PET images improves the abilities of radiologists for differential diagnosis of malignant and benign tumors on FDG-PET images.

SSG08-07 ● Quantification of the Distribution and Extent of Automatically Classified Small Pulmonary Arteries and Veins on Volumetric Chest CT

Seyoun Park ; **Sang Min Lee** MD ; **Namkug Kim** PhD (Presenter) ; **Joon Beom Seo** MD, PhD ; **Joon Ho Choi** MD

CONCLUSION
Our automatic vessel classification-based quantification approach may be useful for assessing the status of many pulmonary disease, considering the spatial distribution and extents of automatically classified, small pulmonary arteries and veins.

Background
As one of meaningful indicators for assessing the status of pulmonary circulation in various pulmonary diseases, analysis of the distribution and extent of small pulmonary vessels is necessary. We developed a quantitative analysis method for determining the total vascular structure in 3D from volumetric chest CT.

Evaluation
Non-contrast volumetric chest CT scans with sub-milimeter thickness of 29 patients with chronic obstructive pulmonary disease (COPD) were used for this study. We extracted vessels as 3D points from volumetric CT images. A minimum spanning tree of pulmonary arteries and veins were then generated by construction energy minimization from extracted points. This tree was divided into smaller branches by cutting the mediastinal region. The arteries and veins were then separately collected to observe distributions. From the distal to proximal surfaces, we extracted 6 offset surfaces at 5mm intervals and detected intersecting points with vascular trees. At each point, vascular direction was estimated using neighbor vessel points. Finally, vascular radii were computed by fitting cylinders at each center. Quantitative measures were computed such as the number of vessels and the mean diameters. We collected several

quantitative measures such as the mean diameter, cross-sectional area with the inner pulmonary surface. The diameters of vessels are 1.544±0.158, 1.823±0.093, 1.934±0.079, 1.968±0.073, 1.977±0.082, and 1.994±0.092mm (mean±SD) from distal to proximal surfaces with 5 mm intervals, respectively. Among those, the diameters of only arteries of 29 patients lungs are 1.513±0.159, 1.840±0.105, 1.929±0.076, 1.960±0.073, 1.958±0.085 and 1.960±0.093mm at the surfaces, respectively.

Discussion
This method is especially useful in artery and vein classification and could be possible to evaluate etiology and progress of many pulmonary diseases such as pulmonary hypertension, interstitial lung disease and COPD using volumetric chest CT.

SSG08-08 • Quantitative Analysis of Infectious Lung Disease from Serial PET-CT Scans in Small Animal Models

Brent Foster (Presenter) ; **Ulas Bagci** PhD, MSc ; **Ziyue Xu** PhD ; **Awais Mansoor** PhD ; **Brian Luna** ; **Bappaditya Dey** ; **Colleen Jonsson** ; **William Bishai** ; **Sanjay K Jain** MD ; **Daniel J Mollura** MD

PURPOSE
To develop a complete image analysis and quantification framework that accurately determines disease severity and its progression in pulmonary infections using three small animal models rabbit, ferret, and mouse.

METHOD AND MATERIALS
We designed a fast and robust automated image analysis platform with a quantification tool that facilitates accurate quantification of pulmonary lesions, and an image registration pipeline that supports a volumetric comparison of all serial scans using PET and CT images. The proposed method for analysis contained three steps: (i) the lung was segmented via an interactive region growing method (ii) mathematical morphology was then applied to this binary mask to remove all non-lung regions from the images; and (iii) then the affinity propagation based clustering algorithm was used on all PET images to precisely segment the high uptake regions. The proposed framework was tested using sequentially acquired CT and PET images. The rabbits were infected with Mycobacterium tuberculosis (TB) (92 PET-CT scans). The ferrets were injected with the H1N1 influenza virus (44 PET-CT scans), and the mice were infected with an aerosolized respiratory pathogen (24 PET-CT scans). Segmentations were evaluated by expert radiologists and compared with ground truth segmentations.

RESULTS
Each small animal model was evaluated within the same animal type and the Dice Similarity Coefficient (DSC), and the Haussdorf distance (HD) were used for evaluation of the proposed method. The estimated lesion volume sizes from CT and PET images, estimated from the proposed method and the ground truth (R2=0.8922, p
CONCLUSION
The proposed computational framework can increase the efficiency and quality of pre-clinical findings relative to clinical standards and decrease the inter-observer variation from manual quantification methods that can obscure findings.

CLINICAL RELEVANCE/APPLICATION
This framework can be applied clinically for accurate, efficicent, and robust quantification of infectious diseases using longitudinal PET-CT images.

SSG08-09 • Computerized Differentiation of Regional Patterns of Diffuse Infiltrative Lung Disease for Iodine Quantification in Dual-energy CT Using SVM Classifier and a Hybrid Segmentation Method

Jangpyo Bae MS (Presenter) ; **Yongjun Chang** ; **Jung Won Moon** ; **Ho Yun Lee** MD ; **Namkug Kim** PhD

PURPOSE
To construct the computerized differentiation framework to quantify the iodine concentration according to the regional patterns of diffuse infiltrative lung disease (DILD) in dual-energy CT.

METHOD AND MATERIALS
Volumetric CT scans of thirty patients with diffuse interstitial lung disease (DILD) were performed by a 64-multi detector row dual energy CT scanner (Siemens Definition Flash) with in 0.75mm collimation at dept. of radiology, Samsung Medical Center. Two hundred seventy one rectangular regions of interest (ROIs) with 20x20 pixels, consisting of each 57 ROIs representing three regional disease patterns (ground-glass opacity; GGO; reticular opacity; RO; and consolidation; CONS) and 100 ROIs for normal region were marked at dual-energy CT images of various DILD by two experienced radiologists with consensus. Twenty eight density, textural and shape features (histogram, gradient, run-length, co-occurrence matrix, cluster, and top-hat) were calculated and employed to characterize the ROIs by a SVM classifier with sequential forward selection method which differentiate the ROI into each class. The lung segmentation was performed with a hybrid method using rib information and an inverse level set of which parameters were adjusted with the density histogram of lung region. In addition, five folding cross validation with twenty repetitions were performed for average ROI based accuracy. To validate the region based accuracy, 40 slices were randomly selected from 20 patients and drawn by two radiologists with consensus, which was compared with the computerized method.

RESULTS
The accuracies of the classification of ROIs and whole lung region were 87.61±0.76 and 74.20±4.62, respectively. The region based accuracies of normal, RO, GGO and CONS were 77.04±4.50, 37.69±12.20, 62.38±9.53 and 45.03±13.18.

CONCLUSION
The proposed classification methods showed clinically applicable accuracy. In addition, the proposed segmentation method was effective in the lung with DILD in dual energy CT.

CLINICAL RELEVANCE/APPLICATION
This method is useful in computer aided differentiation and quantification of regional disease patterns of diffuse infiltrative lung disease in dual energy CT images.

Informatics - Tuesday Posters and Exhibits (12:15pm - 12:45pm)

Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

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IN

LL-INS-TUA • *AMA PRA Category 1 Credit* ™:0.5
Host
George L Shih , MD, MS *

Security Model for Medical Image Data Hidden Using a New Digital Watermark and Steganography Technique" class="eventlink" id="13044064">
LL-INS-TU1A • Security Model for Medical Image Data Hidden Using a New Digital Watermark and Steganography Technique

Tokuo Umeda PhD (Presenter) ; **Akiko Okawa** MD, RN ; **Tsutomu Gomi** PhD ; **Kenta Miwa** RT ; **Shuji Yamamoto** PhD ; **Taku Yashima** RT

PURPOSE
The number of images included in a single image series is increasing with the development of multi-detector computed tomography (MDCT). In addition, the application of information and communication technology (ICT) techniques, such as tele-image-reading and external archiving, has been introduced in the medical field. Therefore, there is increasing risk at the time of archiving images and transmission of electronic patient records (EPR). We present information hiding system developed using digital watermarking and steganography technologies.

METHOD AND MATERIALS
1. Digital watermarking technology
Chest CT images of 512×512×16 bits (67 slices) were used. The EPR data, the hash value of the regions of interest (ROI), name of the institute, and the data of the patient support system were hidden in the regions of non-interest (RONIs) in a chest CT image series in the Digital and Communication in Medicine (DICOM) format.
2. Steganography technology
A body CT image series of 512×512×16 bits (100 slices) was used for steganography. These CT images were stored in a subfolder after 7-Zip compression. This folder was then embedded in the cover image of a scene photograph. The cover image with the embedded images was then transmitted to other medical institutions.

RESULTS
When part of the ROIs was altered during transmission, the hash value decoded from the received cover image had a different value from that before cover image transmission. The structural similarity (SSIM) and the peak signal to noise ratio (PSNR) of the watermarked image with 4000 words embedded were 0.99 and 65.3 dB, respectively. In addition, when the medical information was embedded in the low-bit plane, such as the first- and second-bit plane, the radiologist was unable to identify the embedded information. In our technology, there was no change in the image capacity of CT images or cover image before and after embedding.

CONCLUSION
Using digital watermarking and steganography technologies, we developed a medical information hiding system that ensures the copyright of the images, and protects privacy and safety of the EPR. Both technologies are applicable not only to CT images but to all digital images.

CLINICAL RELEVANCE/APPLICATION
The proposed scheme would allow central management of medical images and EPR values, and thus facilitate efficient handling of medical information.

LL-INS-TU2A ● Radiology Reports: What YOU Think You're Saying and What THEY Think You're Saying

Matt Whitehead MD (Presenter) ; **Ryan Forbess** MD ; **Bonmyong Lee** MD

CONCLUSION
Sound physician communication is a critical component of quality healthcare delivery. Certain words and phrases carry different meanings for radiologists and clinicians. With structured reporting becoming more prevalent, the radiology lexicon should be defined in a more concrete manner. Ambiguous terms should be eliminated all together.

Background
Image interpretation and translation into written language is an imperfect process. Yet, the radiology report represents the link between radiologist's opinion and patient's images. Increased access to images through remote viewing stations has made direct communication between radiologists and clinicians less commonplace. We are interested in how accurately the descriptive contents within radiology reports convey the feelings of the radiologist to the referring clinician. We hypothesize that certain words and phrases hold different connotations for radiologists and clinicians.

Evaluation
A two part survey was designed. Medical specialty, level of training, and number of radiology reports read/week was contained in part I. Part II concerned the quantification of radiologists' diagnostic confidence in range percentages based on specific words and phrases. These voluntary surveys were emailed to all faculty at a single university medical center. Additional paper surveys were randomly distributed to medical students, residents, and physicians. A total of 100 completed surveys were collected (33 radiologists and 67 non-radiologists). Data was exported to EXCEL for statistical analysis. Direct comparisons were made between the survey answers from radiologists and non-radiolgists.

Discussion
Percentile ranges for most radiologists and non-radiologists were in agreement in 26/36 questions. However, the absolute percentage value was somewhat variable. 10/36 questions generated discrepancy between radiologists and non-radiologists. The following words and phrases were in disagreement: "suggestive of", "evidence of", "probable", "no apparent", "none detected", "normal", "consider", "recommend", "suboptimal evaluation", and "mildly limited".

LL-INS-TU3A ● An All-encompassing Multi-specialty Incidentaloma Decision Support Tool for the Daily Practice of Radiology

Ramin Javan MD ; **Bryan S Jeun** MD (Presenter) ; **Christopher J Roth** MD

CONCLUSION
A compilation of tables and algorithms regarding incidental imaging findings was created in hopes of assisting radiologists in making more up-to-date and uniform recommendations for further management.

Background
Incidental imaging findings are encountered daily and their management can be challenging and at times controversial. Use of decision support tools appears on the horizon in all aspects of radiology, especially as part of the Imaging 3.0 movement by the American College of Radiology (ACR). With the current focus on cost reduction in health care as well as attempts to improve quality of patient care, a unified and systematic multi-specialty approach to incidental findings seems inevitable.

Evaluation
An array of tables, algorithms, recommendations and figures were collected from the most recent peer-reviewed literature as well as guidelines from various societies, such as the ACR and SRU, regarding incidental imaging findings. These were categorized by body part and are listed as follows. Abdomen and pelvis: Incidentalomas in liver, pancreas, adrenal glands, and kidneys on CT, ovarian cyst on CT, ovarian and paraovarian cyst on US, gallbladder polyp on US, focal gallbladder wall calcification, renal cyst on lumbar MRI, short segment bowel intussusception, mesenteric lymph nodes and misty mesentery, T2 hypointense adnexal lesions on MRI. Thorax: Fleischner pulmonary nodule follow-up, subsolid pulmonary nodules, enlarged mediastinal lymph nodes on CT, coronary artery calcification on CT, breast nodule on CT, pulmonary nodule in abdominal CT, pulmonary nodule on cardiac CTA including small field-of-view, extracardiac incidental findings on cardiac MRI, pleural effusion on screening breast MRI. Brain and Head/Neck: Thyroid nodule on PET and on CT, carotid disease in soft tissue neck CT, parathyroid incidentaloma on thyroid ultrasound, brain fMRI incidentalomas, pituitary incidentalomas.

Discussion
The ultimate goal is to use this collection as the backbone for a stand-alone or web-based all-encompassing incidentaloma decision support tool. Ideally, this tool can manually or semi-automatically be updated by creating alerts when relevant publications or guidelines become available.

LL-INS-TU4A ● Is It Possible to Track Radiologists' Gaze When They Scroll Through Stacked CT Images? Eye Tracking Analysis of Radiologists' Reading Computed Tomography for Metastases Detection

Thomas Sanzalone (Presenter) ; **Olivier Rouviere** MD ; **Caroline Tilikete** ; **Yves Berthezene** MD, PhD

PURPOSE
To assess an eye-tracking device recording eye movements during interactive scrolling of stacked CT images.

METHOD AND MATERIALS
The study used 10 CT examinations of chest, abdomen and pelvis acquired with a similar protocol in patients with melanoma. Seven CTs were abnormal, one with more than 20 obvious metastases and six with 1 to 3 metastases considered difficult to detect by experts. Nine metastases (target lesions) were prospectively selected from these 6 CTs.
74 radiologists interpreted 1 to 3 examinations randomly chosen from the 10 CTs, using a dedicated DICOM-viewer. They were free to scroll up and down through the images. Eye movements were recorded using a remote eye-tracker and synchronized with the image scrolling. 190 interpretations were registered. Regions of interest (ROIs) were then placed on the 9 target lesions and on 9 equivalent areas on the 3 normal CTs. Dedicated software calculated the percentage of radiologists whose gaze was recorded into the ROIs and the dwell time in them.

RESULTS
The average time for each interpretation was 6 minutes and 48 seconds [2 min 19 sec – 16 min 31 sec]. 45 interpretations with radiologist s gaze properly recorded during less than 75% of the interpretation length were excluded, leaving 145 valid interpretations with an average percentage of properly recorded data of 90.16%.
On average, 66.2% [13.3% - 100%] of target lesions were detected, with an average dwell time of 3.84sec [0.14sec – 7.89sec]. The average percentage of visualization of equivalent ROIs on normal CTs was 40.3% [2% - 90.2%], with an average dwell time of 0.33sec [0.02sec – 0.85sec].
Two metastases were detected by 80% and 100% of radiologists when equivalent normal areas were visualized by only 9.8% and 3% of readers suggesting a role of the peripheral vision in their detection. On the other hand, one poorly-contrasted metastasis, detected by only 50% of radiologists, was located in an area visualized by 90.2% of radiologists on normal CTs.

CONCLUSION
Eye-tracking during interactive scrolling of stacked images is feasible and compatible with routine CT interpretation. Peripheral vision may play a role in metastases detection, as well as the contrast and location of the metastases themselves.

CLINICAL RELEVANCE/APPLICATION
Eye-tracking studies during CT interpretation could become a useful tool for analyzing factors influencing metastases detection and thereby improving routine practice.

LL-INS-TU5A ● Using SQL to Create a Searchable Database of Radiology Reports for Research

Adeel Siddiqui MBBS (Presenter) ; **Ari M Blitz** MD *

CONCLUSION
In our study, we were able to create an SQL database of radiology reports after a one time data transfer. This created a research tool that could be used for multiple research projects. Investigators had a tailor made search engine that was suited for research purposes and more robust than traditional RIS/PACS search engines. Combing this approach with pathology and electronic health record information can lead to the formation of even better tools to identify patient cohorts and potential research targets.

Background

Research work can be greatly increased if there are robust tools to search the radiology report database. This need is even more imperative if there is only a unique subset of patients or studies that research is being done for, and querying the entire PACS can become cumbersome. However, searching for specific

reports within a RIS system is often met with limitations. These include but are not limited to lack of direct physician access to search reports, robustness of the RIS in handling system queries, and limitations in ways the information can be extracted from the RIS.

The focus of this abstract was to see whether extraction of the radiology reports onto a separate SQL database would be an attractive alternative to query the pacs repeatedly for each research project.

Evaluation
327 patients underwent a novel skull base MRI protocol between 2010 and 2012 at Johns Hopkins Hospital. The exact MRI protocol used are beyond the scope of this abstract. 515 MRI exams of 327 patients were successfully transferred from the RIS query to an SQL server running Microsoft SQL express. Two SQL tables were created. One table containing patient name, medical record number, etc and the second table containing the entire radiology report text linked to the Accession number. Using a dot-net and visual basic framework, a front end for entering patient data was created (fig 1).

Discussion
All the report text was easily searchable through the front end software. We were able to instantly identify separate cohorts such as patients with specific tumor types and also able to distinguish patients based on demographic factors such age, sex, and race.

LL-INE-TU6A ● Design and Validation of Automated, Customized Clinical History Searches for Imaging Interpretation

Shaan-Chirag Gandhi DPhil (Presenter) ; **Roy G Bryan** MD, MBA ; **Sarita Nair** MS ; **Abraham Lin** BS ; **Arun Krishnaraj** MD, MPH

Background
Clinical practice increasingly relies upon imaging to provide rapid complementary data in the care of patients. While a brief clinical history often accompanies an imaging request, detailed knowledge of a patient's past medical history and presenting symptoms often enhances study interpretation. Searching the electronic medical record (EMR) manually is time-consuming and may lead to lower-quality, less-efficient interpretations due to overlooking relevant history. To address this difficulty, we describe a process for developing customized search queries of the EMR built upon the Queriable Patient Inference Dossier (QPID) health record intelligence platform at the Massachusetts General Hospital.

Evaluation
Through literature reviews and interviews with referring providers, a list of relevant past medical history search parameters specific to three MRI exams (liver, prostate and rectal) was developed. Sixty-two patient records selected at random were searched across nine liver, prostate and rectal MRI search algorithms covering relevant past imaging, laboratory values, medications, and notes (see figure). Two independent reviewers compared the QPID-driven search results to their manual EMR review to assess positive and negative predictive values. In addition, a graphical user interface (GUI) incorporating interpretation guidelines was developed and presented to the end user to assist in image interpretation.

Discussion
The average search time per query was 3.4 ± 1.1 seconds and the inter-observer agreement between reviewers (Cohen's ?) was 0.90. The pooled average positive predictive value (PPV) was 0.86 and negative predictive value (NPV) was 0.91 across all three exam types. For critical searches, such as medication lists or pathologic diagnoses, the PPVs and NPVs for individual exams approached unity.

CONCLUSION
This study demonstrates and validates the utility of constructing automated search queries of a patient EMR and displaying results within a GUI to optimize clinical data gathering for use in enhancing speed and quality of image interpretation. Future directions include a prospective demonstration of the impact of QPID-based searches on the efficiency and quality of imaging interpretation.

LL-INE3215-TUA ● QR Code Management System for Radiologists: Unique and Useful Tool for Communication between Online Smart Devices and Intranet HIS/RIS Terminals

Norio Nakata MD (Presenter) ; **Tomoyuki Ohta** ; **Yukio Miyamoto** MD ; **Kunihiko Fukuda** MD

Background
Because of security reasons, a hospital network is usually isolated from global internet. During routine works of reading, radiologists sometimes want to attach the referential information such as useful case reports or clinical papers with their own diagnostic reports. It is easy for radiologists to search such information using their own smart devices. However, radiologists hardly attach searching results to their reports rapidly. A QR code is a type of barcode that can hold more information than the familiar kind scanned at checkouts around the world. The "QR" stands for "quick response," a reference to the speed at which the large amounts of information they contain can be decoded by scanners.

Evaluation
We have developed a unique management system using the QR code to bridge smart devices and intranet HIS/RIS terminals with secure network. When radiologists want to attach the URL for online special case reports or clinical papers during making diagnostic reports using reading their workstations, they can generate the original QR codes including URL information using our original apps installed their own smart devices. Then reading workstations with web-cam copy the QR codes. It is easy to attach the QR codes to the diagnostic reports. The maximum storage capacity for QR codes is alphanumeric 4,296 characters. Radiologists can create QR codes for: website URL, plain text, email address, email message, Wi-Fi login, twitter and facebook. Recipient physicians can access those useful internet links or other information through QR codes of the reports using their smart devices.

Discussion
Recently, there have been documented cases of QR code misuse and abuse around the globe. advantage and disadvantage of the QR code including security risks of the QR code area discussed in this exhibit. In the near future, smartphone will change to the advanced form such as glasses smartphone. The future of the QR code is also discussed compared with next generation technologies such as mobile visual search (MVS) and augmented reality (AR).

CONCLUSION
QR code management system for radiologists is feasible approach to bridge between online smart devices and intranet HIR/RIS terminals with secure network environment.

LL-INE3211-TUA ● When Is Your CTDIvol Too High? Teaching Recognition and Interpretation of CT Scan Parameters Using Web-based Quiz Modules

Mindy Licurse MD (Presenter) ; **Susan Hilton** MD ; **Tessa S Cook** MD, PhD

PURPOSE/AIM
The purpose of this exhibit is to educate radiologists and technologists to properly identify and understand CT radiation dose parameters, and how to modify such parameters to optimize radiation dose during the performance of a diagnostic CT exam.

CONTENT ORGANIZATION
Dose sheets and CT images will be presented in quiz format. The scenarios will include:

- Inappropriate kVp or quality reference mA parameter settings
- Situations in which parameters should have been modified for patient considerations such as size
- Longer than necessary scan length resulting in increased patient radiation exposure
- Suboptimal patient positioning leading to increased radiation exposure
- CT scanner parameters that exceed conventional thresholds
- Suboptimal parameter adjustment resulting in improper ECG triggering or contrast bolus triggering

SUMMARY
Optimizing CT protocols is an important responsibility for radiologists and technologists. An online quiz module can be an effective educational tool to simulate daily scenarios in which the radiologist and technologist must understand and modify scan parameters in order to decrease the amount of radiation necessary to produce diagnostic-quality CT exams.

LL-INE3174-TUA ● Automatic Extraction of Patient Characteristics from Clinical Reports

Jean Garcia-Gathright (Presenter) ; **Corey W Arnold** ; **Alex A Bui** MS, PhD

Background
The extraction of specific data elements from unstructured free-text documents is a critical task for a range of clinical and research activities, including data mining and disease registry construction. To enable such applications for imaging-based application domains, we have developed a set of natural language processing (NLP) annotators for the automatic extraction of patient characteristics and the subsequent population of a database. The use of this framework is demonstrated for lung cancer screening.

Evaluation
Our input corpus comprises the entire set of medical reports for patients who have undergone a biopsy of an indeterminate lung nodule. We targeted several data elements, including location of tumor, biopsy results, family history of cancer, and smoking history. Extraction performance was evaluated against a manually-annotated gold standard of 112 cases. Precision and recall were as high as 95% for certain data elements, such as location of tumor.

Discussion
An investigation of the input corpus revealed that most of the data elements of interest were found in radiology reports, pathology reports, and oncology consultations. We found that rule-based logic was sufficient for very good annotation performance. Our framework was implemented in Apacha UIMA (Unstructured Information Management Architecture) and includes mechanisms for database querying, section detection, and information extraction based on regular expressions.

CONCLUSION
The successful implementation of these annotators represents an important step in the analysis of unstructured clinical documents. The rules and regular expressions we have developed can be used to further structured reporting templates and other free-text based analyses. Future work also includes the implementation of interactive web-based visualizations of the extracted data to support integrated radiology/pathology reporting and tumor board meetings.

LL-INE3176-TUA ● A Semi-automated System for Communicating Subcritical Results: Follow Up

Melinda J Yeh MD (Presenter) ; **Stephanie W Hou** MD ; **David E Avrin** MD, PhD * ; **Thomas H Urbania** MD

Background
Subcritical imaging findings—those which require follow up but don't pose an immediate threat—create a challenge in the radiologist workflow. In 2011, a semi-automated system for communicating subcritical results was implemented. Subcritical reports are flagged using an XML keyword, and dedicated support staff communicate subcritical findings to the responsible clinician. Our purpose is to assess the performance of this system by analyzing the follow up and significance of flagged radiological findings.

Evaluation
IRB approval was obtained. Retrospective review of consecutive subcritical alerts from 3/21/11 through 2/19/12 was performed (n=2805). The most common study types were CT abdomen/pelvis (17.3%, n=484), PET/CT (8.6%, n=242), CT chest (7.9%, n=222), and US pelvis (7.9%, n=221). In all cases, the responsible physician was contacted, most often on the next business day. The first 253 consecutive subcritical results were analyzed to assess follow up rates and significance of the result (defined as resulting in a change in patient management or outcome). Overall, 62% of findings were followed up (n=156), and 33% of those findings were significant (n=52). When specific follow up recommendations were made (n=119), adherence was 81% (n=96). Additionally, 63% of findings were incidental (n=159) (defined as being unrelated to the study indication). Incidental findings had a lower rate of follow up (48%) compared to non-incidental findings (84%), as well as a lower rate of significance (20% versus 45%).

Discussion
A substantial proportion of patients being imaged at our facilities did not receive all their medical care within our network, so the percentages above likely underestimate the true rates of follow up and significance. The lower rate of follow up for incidental findings (48%) is of concern given that 20% of these findings were clinically significant in our sample.

CONCLUSION
A semi-automated system for communicating subcritical findings allows for prompt notification of referring clinicians, a relatively high rate of follow up, and frequently identifies issues that affect patient care. Further refinements should focus on increasing the rate of follow up for incidental findings.

LL-INE3213-TUA ● Mobile Apps in Radiology - A Structured Online Repository of Mobile Applications in Radiology

Roland S Talanow MD,PhD (Presenter) ; **Andras Szekely** MD

Background
Smartphones and tablets offer new opportunities for diagnostic imaging practitioners; these easy-to-use devices equipped with excellent display may be used for diagnostic reading, reference, learning, consultation, and for communication with patients. However, the mobile market is growing exponentially and for the mobile 'inexperienced' professional it becomes overwhelming to find the right application for the right purpose in its daily work.

Evaluation
A search was performed on iTunes, Android Market, Blackberry App World, and Windows Phone Marketplace for mobile applications pertinent to the field of diagnostic imaging. Over 100 applications were found. Based on the results we created a web-accessible database of available mobile applications that are useful in the field of Radiology. We structured the data based on categories such as Medical books, Journal access, Interactive encyclopedias, News and Magazines, Diagnostic reading, Decision support. For each application, specific information was entered such as platform, title, company, description, publication year, price (if not for free), website for more details, screenshots and others. We also implemented a rating system based on the following criteria: Ease of use, Quality and Price/value ratio. An editorial review has been also provided.

Discussion
This web-accessible database allows the user to search for Radiology relevant mobile applications for different mobile platforms (iOS, Android, Blackberry etc.). In addition it provides a comprehensive description and evaluation of each of these applications. The database can be either browsed by categories or other criteria or the user can actively search for keywords. Users can also share their opinions and rate the applications based on the aforementioned criteria, so that other users can make their own informed decision which application is most suited for their needs.

CONCLUSION
We provide a web-based repository of available mobile applications that are useful in different areas of the daily Radiology work. Comprehensive information, relevant ratings and reviews help users finding the application that suits most their individual needs.

3D Interactive Visualization of DICOM Images for Radiology Applications: Hands-on Workshop

Tuesday, 12:30 PM - 02:00 PM ●S401CD

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IN

ICIA32 •*AMA PRA Category 1 Credit* ™:1.5 •ARRT Category A+ Credit:1.5
Sonia M Pujol , PhD
Ron Kikinis , MD
Kitt Shaffer , MD,PhD

LEARNING OBJECTIVES
1) Facilitate interpretation of DICOM images through the use of computer-assisted 3D visualization. 2) Increase the understanding of the correlation of the three dimensional relationships of the segments of the liver and lung with the surrounding vascular anatomy. 3) Introduce cutting-edge open-source computer graphics applications for Radiology.
ABSTRACT
Three-dimensional visualization of anatomy is emerging as a vital component of clinical imaging through the combined development of technological breakthroughs in Radiology hardware and increasingly sophisticated software tools for medical image analysis. For the past eight years, the National Alliance for Medical Image Computing (NA-MIC), one of the seven National Centers for Biomedical Computing, and part of the NIH Roadmap for medical research, has converted some of the major scientific advances made by the biomedical imaging community into open-source software tools, contributing to increase the deployment of cutting-edge visualization techniques on a national and international scale. As part of the NA-MIC toolkit, the 3DSlicer open-source software has been developed as a technology delivery platform for clinical researchers. 3DSlicer has evolved into a multi-institution effort to share the latest advances in image analysis with the scientific and clinical community. This workshop is an introduction to the basics of viewing and interacting in 3D with DICOM volumes and anatomical models using the 3DSlicer software. The 90 minute course is divided into three sections: the first part introduces the concepts of 3D visualization through an hands-on training session using an MR DICOM dataset of the brain and 3D reconstructed models of cerebral structures; the second section presents 3D models of the segments of the liver reconstructed from three clinical cases; and the third section guides the user through the exploration of the bronchopulmonary segments of the lung reconstructed from DICOM images. Interactions with 3D anatomical models are fostered by a series of five radiological tasks for participants to complete for each clinical case. Detailed answers to the tasks are provided during the workshop as the instructors guide the audience through the 3D visualization settings to enhance the understanding of the complexity of the anatomical structures involved.
URL's
http://www.na-mic.org/Wiki/index.php/RSNA_2012

Meaningful Use: Experience from Private Radiology Practices

Tuesday, 12:30 PM - 02:00 PM ●S501ABC

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IN

ICII32 •*AMA PRA Category 1 Credit* ™:1.5 •ARRT Category A+ Credit:1.5
Moderator
J. Raymond Geis , MD *
James Whitfill , MD *

Alberto F Goldszal , PhD, MBA *
Alan D Kaye , MD

LEARNING OBJECTIVES
1) Learn how various radiology practices have approached Meaningful Use to date. 2) Understand the challenges of achieving Meaningful Use compliance with existing vendor products available today. 3) Explore ways to participate with either your hospital or multi-specialty practice to achieve Meaningful Use.
ABSTRACT

Display Technology

Tuesday, 12:30 PM - 02:00 PM • S401AB

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IN

ICIW32 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
David S Hirschorn , MD
Michael J Flynn , PhD
Elizabeth A Krupinski , PhD

LEARNING OBJECTIVES
1) Appreciate that displays have undergone significant changes in recent years - primarily a shift towards incorporating color displays into primary interpretation environments, using pairs of displays (2MP or 3MP) vs double wide displays (4MP or 6MP), and total number of pixels to pixel pitch and the impact that has of which display you need to buy. 2) Understand the importance of assessing and balancing the key physical properties of displays when engaged in the purchasing process.
ABSTRACT
Displays have undergone significant change over the past 3-4. Specifically, the changeover to mostly color displays, including why some are resistant to the change, using pairs of displays (2MP or 3MP) vs double wide displays (4MP or 6MP), the shift of focus from total number of pixels to pixel pitch and the impact that has of which display you need to buy (e.g., 2 MP vs 3MP, which is almost double the price), the FDA's relaxation of requiring 5 MP for mammography, special needs for tomosynthesis (need short response time for high frame rate, i.e., video sequence) which is relatively new, benefits of centralized monitoring of a fleet of displays (conformance, especially in light of new state laws requiring such records, and even things like properly budgeting for end of life equipment). What is in the future for displays – touch screens, organic LEDs which have astounding contrast ratios because the blacks are so black (which is not always a good thing). Displays are the only special hardware of PACS that radiologists look at all day long and it is important to understand their features in order to optimize them and make the best purchasing decision.

Informatics - Tuesday Posters and Exhibits (12:45pm - 1:15pm)

Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

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IN

LL-INS-TUB • *AMA PRA Category 1 Credit* ™:0.5

LL-INS-TU1B • Development of a Database to Track Resident Dictation Volume and Automatically Tabulate ACGME Case and Procedure Logs across Multiple Hospitals at a Large Academic Program

Thomas W Loehfelm MD, PhD (Presenter) ; **Jesse Knighton** ; **Brent Little** MD

CONCLUSION
Raw data covering resident dictations can be used to automatically generate data for ACGME reporting requirements with minimum administrative staff and resident burden, and allows for advanced analyses to better understand and optimize the resident experience.

Background
We developed a database to track resident dictations across multiple hospitals at a large academic institution in order to satisfy ACGME requirements that Diagnostic Radiology program directors participate in the ACGME Case Log System, and that residents meet minimum numbers of specific case types. With access to raw data, we can generate advanced reports to quantitatively analyze the resident experience in a way that facilitates program improvements and optimizes resident education.

Evaluation
We identified data fields required to meet ACGME requirements and worked with RIS contacts at multiple hospitals to design queries. At a minimum, we required: 1) a unique identifier for each study, such as the accession number; 2) resident identifier; 3) plain-text study description (e.g. "CT Head w/o"); and 4) dictation timestamp. We also obtained a hospital identifier, since our residents cover at least 6 different hospitals, and the verifying attending radiologist, for use in advanced analyses. We retrieved data from the past 5+ years and thus built a comprehensive dataset covering all current residents and fellows trained in-house.

Discussion
We can now produce accurate Case and Procedure Logs for any current or former resident at the push of a button, no longer relying on 60+ residents to each manually track such information, or administrative staff to decipher and transcribe those logs. We have designed advanced reports to quantitatively analyze the resident experience to assess the variable experience of residents within and across training years. We believe that these and similar analyses facilitated by this database will enable data-driven program improvements to optimize resident education.

LL-INS-TU2B • Development of a Novel a Partial Volume Brain Tissue Segmentation Method Based on Diffusion Tensor MR Imaging Data Using Multi-tensor Model

Seiji Kumazawa PhD (Presenter) ; **Takashi Yoshiura** MD, PhD ; **Hiroshi Honda** MD ; **Fukai Toyofuku** PhD

CONCLUSION
Our proposed PV brain tissue segmentation method improved accuracy in estimating tissue types and segmentation of brain tissue on DT-MRI data over the conventional method.

Background
To study the diffusion properties of cerebral gray matter (GM) and white matter (WM) separately in neurological diseases, brain tissue segmentation methods based on diffusion tensor MRI (DT-MRI) data have been proposed. However, in these methods, WM voxels in fiber crossing regions might be misclassified as GM region because of low fractional anisotropy (FA) values due to the partial volume (PV) effect of the DT. Our purpose was to develop a new brain tissue segmentation method for DT-MRI data in which effect of the PV averaging is taken into account by using a multi-tensor model in WM crossing regions.

Evaluation
Our method consisted of 3 steps. First, initial segmentation was performed using a fuzzy c-means clustering. Second, for the GM voxels adjacent to WM region, we estimated the DTs based on the multi-tensor model. Finally, based on the 5 DT parameters (3 eigenvalues, apparent diffusion coefficient and FA), the PV fractions of WM, GM, and cerebrospinal fluid (CSF) were estimated in each voxel using a maximum a posteriori probability principle. We conducted a digital phantom experiment, in which the performance of our method was compared with that of a conventional method by means of the root mean square error (RMSE) and the volume overlap measure with the ground truth for each of 3 tissue types. In addition, the performance of the two methods was compared by visual evaluation of human DT-MRI data obtained from 5 healthy subjects.

Discussion
In the digital phantom experiment, the conventional method and our method yielded similar RMSE for GM and CSF, while RMSE for WM in our method was smaller than that in the conventional method. The volume overlap measures in our method were more than 0.8 in all three tissue types, and were greater than those in the conventional method. In visual evaluation of human data, the WM/GM/CSF regions obtained by our method better agreed with those depicted in the structural image than those obtained by the conventional method.

LL-INS-TU3B • 3D Visualization of Laparoscopic Images by Automatic Registration of 3D CT/MRI Model

Kai-Che Liu (Presenter) ; **Atul Kumar** ; **Lihsun Chen** ; **Yen-Yu Wang** ; **Hurng-Sheng Wu** ; **Min Ho Huang** ; **Soler Luc**

PURPOSE
Current work presents a method to create a stereo image of the monocular laparoscope video image by
incorporating into them the depth information from 3D CT model. A pre-operative CT scan of the abdomen is indicated in many conditions, therefore, the presented method would be very useful in such cases where surgeons would be helped by the stereoscopic view of the organs during laparoscopic surgery.

METHOD AND MATERIALS

A 3D shape from the laparoscope image, using shape from shading algorithm, is generated and registered to the 3D CT model of the patient to identify correspondence between the image pixels and the 3D points of the CT model. Thereafter, the camera position is tracked in the 'real' world (reference frame of the laparoscope) and the 'virtual' world (reference frame of the 3D CT model). The depth information of the scene, in the 2D laparoscope image, with respect to the camera location in the 'virtual' world is combined to the 2D image to synthesize the left and the right images of stereo image.

RESULTS
Data Collection: Four patients participated in the study where abdominal CT scan images were acquired. For the same patients the laparoscopy surgery videos were recorded. The CT images were segmented semi-automatically for the abdominal organs, by a trained resident. A customized software with a combination of VTK and OpenCV, in C++, was made for the visualization of the segmented images 3D virtual model, the calculation of the depth map and display of the stereo image on the 3D monitor. The result of the depth map was investigated for the correlation with the depth obtained from the latest shape from shading algorithm. The correlation coefficient between the depth maps (for selected regions) were found to be within the range of 0.70 to 0.95 ($P < 0.05$).

CONCLUSION
A method for stereo image synthesis from the conventional laparoscope image is presented. The major advantage of using our method is that it can use any volume image data such as CT or MRI and such images are commonly acquired for many pre-operative planning of abdominal surgery.

CLINICAL RELEVANCE/APPLICATION
An improved version of the current method will be easily applicable and useful for most of the conventional laparoscope systems for minimally invasive surgery based on CT or MRI data.

LL-INS-TU4B ● Automatic Respiratory Gating for the Quantification of Perfusion of Liver Metastasis with DCEUS

Damianos Christofides MSc ; **Edward Leen** MD, FRCR * ; **Michalakis A Averkiou** PhD (Presenter) *

CONCLUSION
ARG significantly improves the quantification of perfusion with DCEUS; this improvement has a large impact on the quantification parameters. The impact is especially large in the case of amplitude dependent parameters (PI, AUC) compared to time parameters (RT, MTT), in agreement with other published results.

Background
One of the major challenges in quantitative analysis of the perfusion of liver metastasis with dynamic contrast enhanced ultrasound (DCEUS) is motion due to respiration. Respiratory motion introduces errors in quantitative DCEUS perfusion analysis due to the movement of the lesion within and outside the region-of-interest. A novel automated respiratory gating (ARG) technique has been developed and clinically validated. The impact of ARG on DCEUS quantification parameters is investigated and presented.

Evaluation
Time intensity curves (TIC) from liver metastasis were extracted from 25 patients and were fitted on a lognormal indicator dilution model. The coefficient of determination (R^2) value of the fit of the model to the TIC data was calculated with and without the use of ARG, in order to evaluate whether ARG improves quantification. Also the respiratory amplitude (RA), for each non-ARG-processed TIC, was calculated using a frequency domain analysis that takes into account the fact that the range of respiration frequencies is between 0.1 and 0.5Hz.
The impact of ARG on DCEUS quantification parameters was also evaluated. More specifically rise time (RT), mean transit time (MTT), area under the curve (AUC) and peak intensity (PI) of the model were calculated for each case with and without ARG.

Discussion
A one tailed paired t-test with unequal variances at a significance level of 0.01 was conducted between ARG-processed and non-ARG-processed R^2 values from the fit of the model to the data. T-test p-values indicated that the R^2 increased significantly ($p<R2$ increased across the range of RA, in contrast with the R^2 without using ARG that had a strong linear dependency on RA.
Large differences were found between the quantification parameters for RT (34±32%, mean± standard deviation), MTT (39±75%), AUC (78±72%) and PI (55±56%).

LL-INE-TU5B ● Automatic Detection and Correction the Errors of Laterality in the Radiologic Reports: A Way to Minimize Errors of Laterality

Young Han Lee MD (Presenter) ; **Eun Hae Park** ; **Sungjun Kim** MD ; **Ho-Taek Song** MD ; **Jin-Suck Suh** MD

PURPOSE
The computer has transformed the radiologic reading workflow. The radiologic reading workflow has come to a new era of computer-based radiology. Along with the expectations for improvement of accuracy of interpretation, radiologists should be aware of the typographical errors in radiologic reports as the number of radiologic examinations increase.
Typographical errors of the right and left sides of the extremities are not infrequent during the interpretation of radiographs. With the introduction of PACS, more radiologists have started to typewrite their radiologic interpretations. Among a list of right/left or both sides of studies, radiologists should select the correct exam and typewrite. However, a radiologist could make errors in the laterality of right and left sides in the radiologic report. This tends to occur more frequently in busy radiology departments, especially with a huge amount of radiologic burden.
We think this possible error could be minimized with additional software for Picture Archiving and Communicating System (PACS) and Electronic Medical Record (EMR). With dedicated software, the discrepancy of the examination name and error could be detected, and this additional software would be useful for the next generation PACS.
In this article, we introduce the development of an automated detection and correction software algorithm by using Macro program, and illustrate its practical usages in the radiology reading work flow. From a viewpoint of long term investment, the next generation of PACS or EMR might be expected to include this additional or further advanced function for a better radiologic reading environment.

METHODS
1. Hardware and software
The PACS software was Centricity® Radiology RA1000 (GE Healthcare, Barrington, IL). The EMR software was designed in authors® institution. Macro program AutoHotkey was used to design error detection and correction. This development tool is downloadable from the official webpage (http://www.autohotkey.com).
2. Flowchart
The software was performed according to the flowchart illustrated in Fig. 1. The first step is real-time automatic discrepancy detection of the laterality between radiologic examination name and radiologic report. In our software, one cycle per 0.5 second was used, and this time can be reduced or increased by the PACS workstation performance. The second step is conditioned discrepancy correction. This second conditioned step is done if Yes button is pressed. If there is no laterality or discrepancy, nothing is done, and the radiologic reading workflow is based on the conventional flow. For studies of both laterality (e.g. Knee AP Lt/Rt), we added an additional code for bypass.
3. Accuracy evaluation
The accuracy of detection was evaluated from 300 consequently listed radiologic examinations on one day. Randomly sorted intended discrepancies and concordance of lateralities were input in the radiologic reporting system, and the detection and correction were counted in the radiologic reporting system. The confidence intervals of accuracies were calculated.

CONCLUSION
Automated detection and correction software was designed and ran well by using open-source Macro software. This method can be easily adapted for any PACS and EMR, and is expected to be included in the next generation PACS or EMR for a better radiologic reading environment.

LL-INE3175-TUB ● A Radiology Patient Portal with Personalized Guidelines for Non-small Cell Lung Cancer

Mary McNamara (Presenter) ; **Corey W Arnold** ; **Denise R Aberle** MD ; **Alex A Bui** MS, PhD

Background
An ongoing issue has been how best to provide patients with an understanding of their imaging. One solution has been the implementation of patient portals, which provide access to medical record information alongside extra supporting and explanative content. However, term definitions and supporting information may be patient-specific. In this imaging informatics project, we examine the provision of supporting consumer content for non-small cell lung cancer (NSCLC) and surrounding radiologic studies.

Evaluation
We conducted a survey of preferences for patient portals with 50 lung cancer patients. Guided by these responses, we developed a framework that links concepts from a patient's personalized problem list to medical guideline content available via MedlinePlus' website. The interface consists of a problem list, radiology images, medical record data, and supporting content organized in several information orientations. A natural language processing module drives interface instantiation by identifying concepts in pathology, oncology, radiology, and laboratory documents. These concepts are then linked to MedlinePlus consumer content via their concept unique identifiers (CUIs). This content is made available to the patient within the portal via hypertext links. Concepts in the problem list are also linked to key slice radiological images that feature the region of interest (ROI).

Discussion
Patients in our survey responded positively to the idea of accessing radiology content; and rated diagnosis problem lists, radiology report content and imaging as important in helping them to understand their medical record. In response to these results, our visualization pairs relevant guidelines to medical record content and images to explain patient-specific disease presentations. This eliminates the need for patients to search consumer health websites to determine what content is applicable to their personal health situation.

CONCLUSION
Our framework utilizes patient preferences to design an interface that links NSCLC patients' imaging and reports to supporting MedlinePlus information. This linkage allows patients to focus on consumer health content relevant to their personal health.

LL-INE3214-TUB ● Interactive Gesture Control of Radiologic Imaging Studies at Multiple Institutions Using the Leap Motion Controller

Thomas J O'Neill MD (Presenter) ; **Ryan Moffitt** * ; **Rebecca Wright** MD ; **Bryan J Foley** MD ; **Eliot L Siegel** MD *

Background
The Leap Motion Controller is a novel motion control human interface device which operates in intimate proximity with high precision and high tracking frame rate allowing for fine, touchless three-dimensional motion cotrolled computer interaction. Radiologists and other people who regularly interact with medical imaging studies may benefit from using this device for image manipulation by improving their efficiency and interacting in a more natural way, thereby reducing physical strain and fatigue from repetitive use. Gesture control and natural human-computer interaction is becoming more prevalent and often the expected means of computer control and naturally should follow in radiology/medical imaging.

Evaluation
We will demonstrate our experiences implementing the Leap motion controller for manipulation of three-dimensional and cross-sectional imaging at multiple institutions.

Discussion
As human-computer interactions become more diverse and more advanced, radiologists stand to benefit from more natural image manipulation and computer control. Change from the canonical keyboard-mouse model is imminent and may allow for a more efficient workflow and more ergonomic working environment. We will demonstrate the Leap motion control on various systems including Sectra PACS and TeraRecon.

CONCLUSION
We will demonstrate the use of the Leap motion control device in a real-world radiology environment for interacitve manipulation of three-dimensional and cross-sectional medical imaging.

LL-INE3216-TUB ● A Customizable Cloud-based Integrated Dictaphone and Mouse Device for iOS

Brian C Goss MD (Presenter) ; **Brian J Bartholmai** MD ; **Patricio C Fajnwaks** MD

Background
Newer radiology dictaphones incorporate computer mouse functions. However, combining a simple and reliable device (the mouse) with a complex, less reliable, high maintenance device (the dictaphone) raises important downtime and upgrade issues for the PACS administrator. We present a driverless, iOS-based dictation/mouse device with a USB interface that can be upgraded remotely and store user preferences in the cloud. This device requires no more maintenance on the PACS workstation than a standard keyboard or computer mouse. Furthermore, the device supports dynamic report creation software that can be customized for each dictating radiologist and/or each exam type.

Evaluation
The device consists of 4 components:

- an open source iOS transcription and report creation app
- a serial cable (Redpark C2-DB9)
- an Arduino based USB mouse and keyboard emulator (Teensy 2.0)
- an Arduino program that converts iOS app input into emulated keyboard and mouse events (Teensyduino 1.13)

The device requires a PACS workstation with a USB port and a dictation enabled iOS device with a 30 pin dock connector. No driver installation required.

Discussion
Dictation enabled iOS devices coupled with a USB mouse/keyboard emulator allows dictation to occur independently of the PACS workstation. This reduces PACS maintenance and allows for context-aware report-creation apps that can be customized to the radiologist and/or exam. Touch pad gestures such as pinch-to-zoom or tilt-to-scroll can be adapted to any PACS and can be similarly customized. Dictaphone upgrades and user preference can be controlled remotely from the cloud without affecting the workstation. Many other features are possible, including two-factor authentication.

CONCLUSION
Open source hardware and software combined with widely available iOS devices offers a unique opportunity for improving radiologist efficiency. We present a new paradigm for radiology dictaphones and input devices that removes PACS workstation from the maintenance loop, compartmentalizes software functions, and allows new types of report-creation software with increased customization, context-awareness, and security.

LL-INE3173-TUB ● Variability of Yield for Ordering Imaging Studies between Physicians

Tashfeen Ekram MD (Presenter) ; **Rajan Jain** MD * ; **Daniel L Rubin** MD,MS *

Background
Clinical guidelines such as the ACR Appropriateness Criteria can aid clinicians in ordering the most appropriate radiologic studies. However, it has been shown that such clinical guidelines may not be followed up to 24% of the time. The effect of not consistently following such guidelines on the yield of imaging has not been reported. Our goal was to establish the degree of variation in the yield of imaging among different referring clinicians.

Evaluation
We obtained the last 100 head CT reports ordered by each of six different referring physicians (total of 600 radiology reports) from the emergency department of a single institution. A report was identified as "negative" if the impression contained or expressed the equivalent of "No acute intracranial abnormality." Reports were classified as "positive" if the impression indicated acute intracranial hemorrhage, acute ischemia, or new mass, mass effect, fracture, or hydrocephalus. Reports that were not clearly positive or negative were classified as "indeterminate."

Discussion
We found the rate of positive imaging exams varied among the referring physicians from between 2% and 8%, suggesting there is a difference in ordering habits among these physicians. Indeterminate reports ranged from 1% to 5% while negative reports ranged from 90% to 96%.

CONCLUSION
We have found that the rate of positive imaging studies among referring physicians varies between 4%-7% while the negative rate ranges from 90% to 96% This result may be helpful as a benchmark of baseline performance to be improved through quality improvement tools and education initiatives. We also present our vision of how this information can be presented back to clinicians as a quality assessment tool to improve compliance with appropriateness guidelines.

Process Engineering to Optimize Work Flow Processes in Radiology: A Case Study Approach (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, 01:30 PM - 03:00 PM ● S105AB

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IN GN

MSAS33 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
William A Undie , PhD, RT

MSAS33A ● Improving Patient Experience Through Technology

Carolyn C Meltzer MD (Presenter) * ; **Habib Tannir** MS (Presenter)

LEARNING OBJECTIVES
1) How to produce patient education videos. 2) How to deploy them in a patient care setting. 3) How to measure the impact on patient satisfaction.

MSAS33B ● Designing a New Imaging Center: The Production Preparation Process (3P) - An Innovative Lean Approach

Kristina R Givens BS (Presenter)

LEARNING OBJECTIVES
1) Gain an understanding of the Production Preparation Process, its basic elements and tools. 2) Explore a successful Imaging Center Case Study. 3) Review the benefits, challenges and lessons learned by LandM.

ABSTRACT
The focus of this session will be on the successful design of Lawrence and Memorial Hospital's new Imaging Center. Given the massive capital investment required in healthcare facility construction, hospitals must develop innovative approaches to contain costs while also maintaining organizational and project goals. Over the next 5 years LandM Hospital is embarking on a number of strategic initiatives that are geared toward growth, updating the physical plant, improving our inpatient/outpatient care models, implementing electronic health records, and preserving the overall financial health of the organization. Many of these initiatives require the re-design of existing facilities or the building of new facilities. While the need for capital increases, access to capital continues to become more of a challenge. In order for LandM to achieve its strategic goals within planned timelines and budgets, the hospital has integrated the Production Preparation Process (3P) into the design phase of new and renovation facility projects. The 3P methodology incorporates Lean principles and demands interdepartmental collaboration and transparency at the earliest stages of the design phase. The focus is on rapidly designing or retrofitting facilities, services, and care models that support, and are not in contradiction with, Lean concepts of efficiency, optimal flow, and waste reduction. The overall goal is to implement a high-quality design process that is scalable in size and scope, while ensuring project managers meet timeline requirements at the lowest possible cost. Our key objectives are to create an ideal patient experience, integrate best-practice standards in process and clinical care, maximize space utilization to accommodate current and future volumes, and gain efficiencies in the 7 flows of medicine.

Monitoring Radiation Exposure: Standards, Tools and IHE REM

Tuesday, 02:30 PM - 04:00 PM • S401CD

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IN

ICIA33 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Kevin O'Donnell *
Kevin O'Donnell *
Michael F McNitt-Gray , PhD *
Tessa S Cook , MD, PhD

LEARNING OBJECTIVES
1) Learn about key radiation exposure metrics, such as CTDI, and how to interpret them. 2) Learn about radiation exposure monitoring methods and tools. 3) Capturing dose information with the DICOM Radiation Dose SR (RDSR) standard. 4) Managing RDSR objects with the IHE Radiation Exposure Monitoring (REM) Profile. 5) Integrating 'CT dose screens' from legacy systems into RDSR. 6) Pre-scan dose pop-ups on the CT console defined by the MITA Dose Check standard. 7) Recent AAPM guidance on their use. 8) Learn how to specify the above features when purchasing and integrating Radiology Systems. 9) Learn about components of a dose management program such as protocol optimization. 10) Participation in the ACR Dose Registry, and reporting requirements such as California SB-1237.

Decoding the Alphabet Soup (IHE®, MIRC®, RadLex®, Reporting): Whirlwind Tour of RSNA Informatics Projects

Tuesday, 02:30 PM - 04:00 PM • S501ABC

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IN

ICII33 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
John Eng , MD
David S Mendelson , MD *
Krishna Juluru , MD
Daniel L Rubin , MD,MS *
Charles E Kahn , MD, MS *

LEARNING OBJECTIVES
1) Articulate the main objectives of each of the RSNA-sponsored informatics projects. 2) Identify the practical problems being addressed by each project. 3) Understand the relationships between these informatics projects.
ABSTRACT
The RSNA is a longstanding leader in developing and promoting informatics tools and technologies for the practicing radiologist. In this refresher course, leaders of four of RSNA's most important informatics projects will introduce their respective projects, discuss the latest work, and describe what these projects mean to the practicing radiologist. MIRC is a set of free software tools for managing radiology teaching files and clinical imaging trials. RadLex is a unified system of radiology terminology that allows standardized description and indexing of many kinds of radiology information for diverse applications. The Reporting project creates and maintains a collection of best-practice radiology report templates. IHE is an organization that promotes standardized communication between all types of health information systems such as PACS.
URL's
http://www.rsna.org/Reporting_Initiative.aspx

Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC®: A Hands On Course

Tuesday, 02:30 PM - 04:00 PM • S401AB

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IN ED

ICIW33 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Mary R Wyers , MD
Frederick E Weiss , MD

LEARNING OBJECTIVES
1) Learn how easy it is to install the new and improved RSNA teaching file software with the one-click installer. 2) Learn how to create, organize, and share teaching files, create conference documents and save interesting cases for yourself, your group or your department.
ABSTRACT

Informatics (Business Analytics)

Tuesday, 03:00 PM - 04:00 PM • S402AB

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IN

SSJ14 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
Woojin Kim , MD *
Moderator
Rasu B Shrestha , MD, MBA *

SSJ14-01 • Clinical Temporal Structured Query Language (ctSQL): A General Purpose Clinical Timeline Report Query System

Jaron Chong MD (Presenter)

CONCLUSION
We believe ctSQL extensions will offer a more expressive, accessible, and automated method for users to query for clinically significant events across a patient's entire timeline.

Background
Traditional search applications utilize keyword and exact phrase matching to derive relevant search results. While very flexible in basic searches, clinical applications often require the consideration of not just the presence of concepts within a single document, but a series of events. This project describes the theoretical and practical implementation of syntax extensions to traditional boolean query operators to allow a search engine to implement clinical timeline searches.

Evaluation
Clinical Temporal Structured Query Language (ctSQL) is a syntax translation layer built upon existing PHP/SPHINX API's that converts a ctSQL query into a series of nested queries in SPHINX EXTENDED2 query format. Core concepts include (1) concept lists, (2) temporal operators, and (3) result chains. Concept lists are equivalent to traditional search queries and represent a series of keywords and boolean operators that can be matched to single full-text documents.

Temporal queries represent chains of concept lists that have a particular event sequence specified using custom operator symbols that traverse multiple reports under a single patient identifier. Result chains are the natural consequence of ctSQL's emphasis on clinical timelines, with results returned as report chains instead of individual documents.

Discussion
Using this framework, more complex clinical queries can be resolved in an automated fashion delivering search results that can address more advanced clinical scenarios. We describe application examples involving (1) critical findings of pneumothorax and automated documentation of treatment [Closed Loop Pattern], (2) IVC filter insertion and retrieval [Closed Loop Pattern], and (3) lung nodule growth versus stability [Long-Term Timeline]. Additionally, meta-information present within result chains allows for the straightforward calculation of quality-control metrics such as delays in management, follow-up, or disease progression.

SSJ14-02 ● Taking the Hunting and Gathering Out of Radiology with Intelligent Personal Assistants

Mark A Flyer MD (Presenter) ; **Jonathon Dreyer** BS *

CONCLUSION
Virtual assistants will provide an intelligent layer between radiologists and their RIS or PACS. This will enable them to improve the quality of their reports while reducing the time it takes to create and deliver actionable information to the referring physician and, in turn, the patient.

Background
As the industry transitions from a traditional fee-for-service payment to value-based reimbursement, there is a risk that radiology will become marginalized. One emerging solution that aims to address this issue is an intelligent virtual assistant that can streamline the "hunting and gathering" of information for radiologists.

Evaluation
How can radiologists raise their visibility in the face of the integrated patient care cycle, underlining their importance and contribution to the goals of healthcare today? By leveraging virtual assistants to streamline tasks that involve time-intensive "hunting and gathering" of information. A virtual assistant is an embeddable piece of technology that actively listens and takes directives from a user"a radiologist or other clinical professional"and engages in conversational, human-like dialogs to fulfill specific requests. For example, virtual assistants can provide radiologists with more accurate, timely access to clinical guidelines and alert them to missing information in records. This presentation will discuss the wide ranging use cases and benefits associated with the integration of virtual assistants as part of the radiologists" workflow.

Discussion
As we"ve grown accustomed to the benefits and ease of use of voice-enabled personal assistants like Siri in our everyday lives ("Send text to my wife and let her know I"ll be late for dinner"), we"ve also come to expect this same type of experience in our work lives. Nowhere is this type of virtual assistant technology " a solution that can streamline administrative tasks and aid in information retrieval " more critical than in the healthcare realm. Moreover, the ability to leverage a conversational user interface to make these interactions natural and human-like is critical as radiologists and clinicians alike face more complexity and increasing workloads as a result of ever-evolving state of healthcare.

SSJ14-03 ● Implementation of a Pseudonymized Feedback System to Improve Individual Turnaround-times for Radiology Reports

Achim Escher (Presenter) ; **Tobias Heye** MD ; **Elmar M Merkle** MD *

PURPOSE
To analyze turnaround-times for radiology reports as a key performance indicator (KPI) for referring physician"s satisfaction and to implement a pseudonymized feedback system.

METHOD AND MATERIALS
The time period until a preliminary report was available for clinicians in the hospital information system and the time interval between preliminary to final reports were defined as report turn-around times. Calculation was based on data retrieved from the radiology information system (RIS) and a pseudonymized feedback system was developed and implemented. Hereby, an algorithm respecting complex schedules, including on-/off service times on nights and weekends providing a balanced assessment of turnaround times was used. The feedback system gives an overview of the average turnaround-times of the entire department, all sections (n =6) and each department member (n = 45) in a pseudonymized fashion. Each department member can locate himself/herself on pseudonymized graphs illustrating average turnaround-time of all department members by the identification code only provided to him/her.
The feedback system is composed of three different elements:
a) Monthly target-reporting stratified by sections presented in the department board-meeting to review the achievement of objectives.
b) Monthly benchmarking reports on the average turnaround-times stratified by the individual radiologist in a pseudonymized fashion.
c) The daily current workload for each section within the department was displayed as screen saver on all PACS workstations updated every ten minutes.

RESULTS
Initial results comparing data from introduction of the feedback system in March 2013 with February 2013 showed an improvement in average turnaround-time by11.4% for preliminary reports and by 8.5% for final reports. 70% of department members improved in their individual turnaround-times.

CONCLUSION
Initial results demonstrate that transparency, feedback and comparison of individual performances in relation to the pseudonymized peer group improve turnaround-times of radiology reports as an important KPI.

CLINICAL RELEVANCE/APPLICATION
Timely availability of radiology reports by improved turnaround-times expedites communication of relevant information to clinicians thus optimizing patient care.

SSJ14-04 ● Trends in Inpatient Imaging Utilization Over the Last Decade

Atul B Shinagare MD (Presenter) ; **Ivan Ip** MD, MPH ; **Sarah K Abbett** MD, MPH ; **Richard Hanson** * ; **Steven E Seltzer** MD * ; **Ramin Khorasani** MD *

PURPOSE
We have previously reported inpatient imaging utilization trends at our institution from fiscal years (FY) 1984 through 2002. In this study, we assessed the trends in imaging utilization for inpatients from FY 2003 through 2012.

METHOD AND MATERIALS
In this institutional review board-approved, retrospective study performed at a 793-bed tertiary care academic institution, we reviewed imaging utilization in adult inpatients from October 1, 2002 through September 30, 2012 (FY 2003 through 2012) and recorded the gross number of imaging studies coded by modality (conventional [plain films and fluoroscopy], sonography, nuclear medicine [NM], CT, and MRI) and associated relative value units (RVUs). We used linear regression to assess trends in number of imaging studies and RVUs per case-mix-adjusted admissions (CMAA).

RESULTS
The total number of imaging studies as well as CT, NM and conventional studies adjusted for CMAA decreased (p=0.02, p=0.0006, p=0.0008 and p=0.001 respectively; Fig. 1); CT per CMAA increased until 2009 and then decreased through 2012. Utilization of ultrasound and MRI did not change significantly (p=0.15 and p=0.22, respectively). Unadjusted global RVUs increased until 2009 and then showed a slight decrease through 2012 (p=0.04), while RVUs per CMAA did not change significantly (p=0.18).

CONCLUSION
After decades of continued rise, imaging utilization for inpatients significantly decreased by most measures between 2009 and 2012. Future studies to evaluate the contribution of various factors to this decline, including efforts to reduce inappropriate use of imaging and concerns about potential harms of radiation exposure, may be helpful in optimizing imaging utilization and resource planning.

CLINICAL RELEVANCE/APPLICATION
Understanding the trends in imaging utilization is important to help optimize rational use of imaging as well as informed resource planning for healthcare institutions.

SSJ14-05 ● The Commoditization of Healthcare Information Systems: Is the Time Now?

Nogah Haramati MD * ; **Anne C Krok** (Presenter) ; **Mony Weschler** MSC, BSC ; **Gad Levy** MD ; **Roni Zaharia** *

PURPOSE
We assessed the advantages and disadvantages of at least partially commoditizing radiology healthcare information systems.

METHOD AND MATERIALS
Components included in the study: viewer, archive, worklist or workflow manager, 3D/volume rendering, CAD, decision support tools, integration/interoperability/data exchange engines or tools. Offerings of tools, as well as system components were analyzed from available products.

Incorporation of additional functionalities deemed useful in practice but not available as part of an existing commercial ﬠturn-keyﬠ PACS was included in this study.

RESULTS
Viewer: Majority of commercial systems have viewers that lack essential tools. Open market viewers exist that offer DICOM connectivity to existing archives. **Archive:** Vendor neutral DICOM archive (VNA) is the component that is most aggressively being marketed today. Many options exist in this space. Worklist or workflow manager: Rudimentary but not robust tools needed to create worklists exist as a commodity product. **SEE Note A 3D/volume rendering:** Advanced tools exist. Desktop integration into a viewer is variable. **CAD:** No consensus achieved within radiology regarding effectiveness and necessity of CAD tools. Availability and ease of incorporation of tools into an viewer is variable. **Decision support tools:** This area is one in which many of the needed tools are likely still lacking. **SEE Note A. Integration/interoperability/data exchange engines or tools:** Many vendors are demonstrating IHE XDS/XDSi capabilities at IHE connectathons. Ability to pull data in real-time from other clinical systems within an enterprise, even from the same vendor still lacking. **NOTE A:** Incorporating such tools into a commoditized system, rather than waiting for a vendor to incorporate these tools would likely result in a shorter time cycle from the research bench to the clinical workplace.

CONCLUSION
Viewer and archive commoditized products exist and rival those of commercial turnkey systems. Areas exist in which commoditized systems may be suitable to bring these functionalities to the desktop in a shorter time as compared to commercial vendor turnkey systems.

CLINICAL RELEVANCE/APPLICATION
Commoditized products are generally less expensive than complete systems. As healthcare organizations reach PACS end of life and look for a replacement, a commoditized alternative may offer higher funct

SSJ14-06 • The Evaluation of Academic Productivity Using Bibliometric Profiling

Nickalus R Khan BSc (Presenter) ; **Asim F Choudhri** MD

CONCLUSION
The analysis of academic productivity using bibliometric profiling is a robust way to delineate an individuals productivity. These indexes have use in academic medicine and may precede changes in academic rank or departmental rank. Understanding the calculation and use of these indices is paramount in the future of academic productivity evaluations.

Background
Bibliometrics is defined as the study of statistical and mathematical methods used to quantitatively analyze scientific literature. The application of bibliometrics in academic medicine is in its infancy. Recently there have been many new metrics introduced to evaluate academic productivity such as the h-index, contemporary h-index, m-quotient, g-index, e-index, Google's i10, and more. Of these the h-index has gained the most attention. The authors describe the calculation, interpretation, and comparison of these bibliometric measures in academic medicine.

Evaluation
The h-index, g-index, m-quotient, and contemporary h-index are compared using Scopus, Web of Science, and Google Scholar. The differences between these databases are evaluated. The authors discuss the description of how to calculate these indexes and how to apply the indexes in the evaluation of academic productivity.

Discussion
There are important differences among individuals when using the three different currently available bibliometric databases. The interpretation of the h-index, g-index, m-quotient, and contemporary h-index can provide different perspectives into an individuals academic profile. There are large variations depending on which database is used and caution is advised when searching for individuals using Google Scholar or Web of Science.

Social Media and Medical Imaging Management: What You Do Not Know Can Destroy Your Practice (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, 03:30 PM - 05:00 PM • S105AB

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IN GN

MSAS34 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Cindy R Comeau , BS, RT
Abraham Seidmann , PhD

LEARNING OBJECTIVES
Participants at this session will learn several cutting-edge analytical techniques for leveraging Social Media as an effective tool for monitoring the performance of their medical imaging facility. We are going to discuss the best use of ﬠsocial networksﬠ, ﬠprofessional networks,ﬠ and mobile applications in that context. The session will also teach several effective strategies for promoting the medical imaging services in an increasingly competitive market place.
ABSTRACT
ﬠ Today, a single customer complaint from someone with highly connected social influence, can have more impact on your practice reputation than your best marketing efforts all combined. ﬠ Given the rapid rise in the business impact of Social Media, we are going to discuss how effective social strategies improve off-line social failures for individuals and how in return ask these individuals to perform tasks that are beneficial to the service company. To understand what makes for an effective social strategy, we are going to examine a number of unsuccessful and successful ways of engaging users in medically related applications. Special attention will be given to the emerging role of social media in the medical imaging market place.

Next Generation Infrastructure for Medical Imaging (In Association with the Society for Imaging Informatics in Medicine)

Tuesday, 04:30 PM - 06:00 PM • S404CD

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IN

RC426 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Paul J Chang , MD *

RC426A • Interoperability and Integration-from HL7, DICOM, IHE, to SOA

Paul J Chang MD (Presenter) *

LEARNING OBJECTIVES
1) The participant will be introduced to the importance of information system integration and interoperability to support modern radiology workflow. 2) Examples of practical integration strategies that have been used successfully (e.g. web viewer EHR integration, single sign-on, RIS vs PACS driven workflow) will be discussed. 3) Advanced integration strategies, including using vendor APIs, state aggregation, SOA, and IHE, will be presented.

ABSTRACT
Modern radiology workflow requires consumption, choreography, and orchestration of content from multiple disparate information systems that do not natively ﬠtalk to each other.ﬠ Without optimal integration and interoperability amongst these systems, humans are required to serve as ﬠintegrating agents:ﬠ this frequently results in inefficiency and error. This session will provide an introduction to the importance of system integration and will provide a practical introduction to commonly used integration strategies. In addition, more advanced integration approaches, including leveraging vendor APIs (application programming interfaces), IHE, and SOA (service oriented architecture) will be discussed.

RC426B • Image Sharing-A Fond Farewell to CDs

David S Mendelson MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the importance of Image Sharing / Exchange with regard to the quality of care a radiologist delivers as well as to efforts to control costs. 2) Understand the benefits and pitfalls of CDs and the transition to internet based sharing. 3) Understand the different internet (Cloud) based solutions that are available and what distinguishes them. 4) Learn that the cloud can be employed not only for archival but for a variety of radiology services. 5) Learn about the IHE XDS-I and related profiles and their role in internet based image exchange. 6) Understand what solutions a radiologist might implement at this time. 7) Understand how image exchange fits into the broader efforts directed at healthcare information exchange and interoperability through EHRs.

ABSTRACT

RC426C • Vendor Neutral Archives vs Archive Neutral Vendors: Towards the Next Generation Archive

Richard L Kennedy MSc (Presenter)

LEARNING OBJECTIVES
1) Understand the differences between vendor neutral archives, archive neutral vendors, and and cloud archives. 2) Identify key strategic advantages and disadvantages of these three respective models of archival. 3) Observe some potential obstacles to implementation of these three respective models of archival.

Impact of Legislative Policy and Regulations on Imaging Informatics

Tuesday, 04:30 PM - 06:00 PM • S403A

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IN HP

RC430 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1
Co-Moderator
Arun Krishnaraj , MD, MPH
Co-Moderator
Safwan Halabi , MD

RC430A • Clinical Decision Support and CMS

Safwan Halabi MD (Presenter)

LEARNING OBJECTIVES
1) Identify the primary drivers of imaging utilization. 2) Understand the impact of legislative policy aimed at curbing imaging utilization growth rates. 3) Demonstrate the utility of clinical decision support tools in reducing inappropriate medical imaging. 4) Compare and contrast the impact of radiology benefits managers vis a vis clinical decision support tools built upon the ACR appropriateness criteria in reducing imaging growth rates. 5) Review the purpose of the Medicare Imaging Demonstration project.

ABSTRACT
Increased imaging utilization rates have contributed significantly to the growth of health care expenditures in the United States, particularly over the last decade. In response, a series of legislative policies have been enacted to curb the growth of imaging but thus far none have focused specifically on reducing the inappropriate use of advanced imaging modalities, a major contributor to rising imaging costs. To date two major approaches have been employed to reduce inappropriate imaging utilization rates: 1) Incorporation of clinical decision support (CDS) tools into computerized physician order entry systems and 2) Use of external authorization bodies such as radiology benefit managers (RBMs). While both approaches have been shown to reduce imaging utilization rates, clinical decision support tools are more transparent in their approach and have been shown to specifically address inappropriate use of advanced imaging modalities. Due to the lobbying efforts of the American College of Radiology and the growing body of literature demonstrating the effectiveness of CDS tools in reducing inappropriate imaging, language was included in the Medicare Improvements for Patient and Providers Act of 2008 (MIPPA) which mandated an appropriate use of imaging services demonstration project. The Medicare Imaging Demonstration project (MID) has been deployed at 5 institutions across the US to assess the impact that decision support systems have on the appropriateness and utilization of advanced imaging services ordered for the Medicare fee-for-service population. It is incumbent upon radiologists to be aware of current efforts at decreasing inappropriate imaging utilization so as to drive this progress moving forward.

RC430B • Legislative Impact of CT Radiation Dose Reporting Requirements

Jonathan Breslau MD (Presenter)

LEARNING OBJECTIVES
1) Understand the motivation for dose reduction legislation in California. 2) Understand the structure, benefits and limitations of required metrics. 3) Understand the processes for complying with new regulations in California.

ABSTRACT

RC430C • Informatics Solutions for Meaningful Use

Alberto F Goldszal PhD, MBA (Presenter) *

LEARNING OBJECTIVES
1) Learn what informatics and IT solutions can be used to help practices achieve meaningful use. 2) Understand real-world challenges and solutions faced by existing practices in deploying MU.

RC430D • Mobile Computing, Radiology, and the FDA

David S Hirschorn MD (Presenter)

LEARNING OBJECTIVES
1) Understand the FDA approval process for mobile computing applications in radiology. 2) Learn about new application available for mobile devices in radiology.

Hands-on DICOM Metadata Manipulation (Hands-on Workshop)

Tuesday, 04:30 PM - 06:00 PM • S401CD

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RC453 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Richard J Bruce , MD *
Walter W Peppler , PhD *

LEARNING OBJECTIVES
1) Get introduced to a variety of the available open source tools and have a chance to experiment and familiarize yourself with the software hand-on. 2) Understand how open source DICOM software can help solve common workflow issues. 3) Understand how open source DICOM software can be used in research and education. 4) Learn to use open source tools to address DICOM data management challenges.

Next-Generation Educational Content Creation: Screencasting and Video Editing (Hands-On)

Tuesday, 04:30 PM - 06:00 PM • S401AB

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IN

RC454 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
George L Shih , MD, MS *
Richard S Ha , MD
Kurt T Teichman , BSC, MENG
Ian R Drexler , MD,MBA

LEARNING OBJECTIVES
1) Assess the potential of online and mobile e-learning innovations to augment your residents', medical students', and staff's educational curricula. 2) Acquire the domain knowledge to use already available content (eg, PowerPoint presentations) to both create video content and deploy e-learning courses on modern web-based and mobile platforms. 3) Acquire the domain knowledge to use already available content (eg, PowerPoint presentations) to electronic books (e-books), with or without digital rights management (DRM), and obtain an ISBN number for publishing.
ABSTRACT
1. From OpenCourseWare to the Khan Academy, and now to Coursera, e-learning has been dramatically improved over the last decade, changing education from the normal classroom into learning done at convenience, and also allows for more creative and engaging content during the typical lecture. Stanford Med recently published positive initial findings in utilizing video-based lectures in an interactive class setting. Leveraging this new way of learning, requires knowledge about the types of technology and platforms for these courses. 2. The workflow required to host an e-learning course can be summarized in 3 steps: (a) creating the

educational content, (b) hosting the materials, and (c) making the materials available to the intended audience. E-content today typically consists of lecture slides along with video recordings captured by technology like TechSmith Camtasia (non-free) and Apple Quicktime (free). Once the materials are created and edited, one must choose a suitable hosting platform realistic to the skills and goals of the instructor with options that include coursesites.com, iTunes U, and YouTube / Google Hangouts. Students can then be invited to view the material or the content can be made available to the public. 3. Creating and publishing e-books is a great way to share your teaching material as an engaging interactive tool. Publishing in e-book format solves many logistical problems of conventional publishing and the e-book format has interactive features that paper books can't match. We will review the process of creating your own e-book from assembling material to layout design to submitting for e-publication. Specifically Apple iBooks Author software will be used to demonstrate converting an existing Powerpoint presentation or journal publication into an e-book. In addition, the course will go over how to publish with or without DRM (copy-protection) and ways to obtain an ISBN for publishing for sale. Online resources will also be reviewed.

Cool Technologies for Radiologists

Wednesday, 08:30 AM - 10:00 AM • E351

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IN

RC526 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Mahesh M Thapa , MD

RC526A • Photoshop Ninja Techniques

Mahesh M Thapa MD (Presenter)

LEARNING OBJECTIVES
1) Use Adobe PhotoShop to create and enhance images for publication. 2) Create podcasts and screencasts.

RC526B • OsiriX and File-sharing Technologies

Jonelle M Petscavage-Thomas MD, MPH (Presenter) *

LEARNING OBJECTIVES
1) Identify the applications of Osirix for image processing and formatting in publications, clinical consults, resident instruction, and scientific and educational exhibits. 2) Identify the educational applications of 3D Slicer as interactive visualization of images, triangulation of 3D surface models, and fusion and co-registering of data using rigid and non-rigid algorithms. 3) Recognize the current transition from print textbook to electronic publication. 4) Demonstrate understanding of the basics of ePub for creation of online radiology textbooks. 5) Perform basic functions of the technology for use in one's own practice.

RC526C • Cool Research and Education Tools

Michael L Richardson MD (Presenter)

LEARNING OBJECTIVES
1) Tools for work (e.g. real-time consultations, note-taking technology). 2) Tools for teaching (e-publication and audience response technology). 3) Tools for health (exercise tracking and workplace exercise technology). 4) Tools for surviving RSNA (transportation, communication, weather and decision-making technology).

Managing Radiology IT in the EHR World

Wednesday, 08:30 AM - 10:00 AM • S404AB

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RC530 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
J. Raymond Geis , MD *

LEARNING OBJECTIVES
1) Identify EHR components relevant to radiology. 2) Understand how to assess and use those components to your advantage. 3) Discover potential and pitfalls of EHRs.
ABSTRACT

RC530A • Radiology in the EHR World: What You'll Need to Know

Keith J Dreyer DO, PhD (Presenter) *

LEARNING OBJECTIVES
1) Learn what challenges are faced by radiology departments and practices as hospital systems continue to make the move towards enterprise EHR deployment. 2) Understand how radiology IT and informatics solutions can interface with EHR solutions and manage the gaps and overlaps in EHR deployment.

RC530B • EHR/RIS Optimization of Imaging Workflow for the Enterprise

Peter B Sachs MD (Presenter)

LEARNING OBJECTIVES
1) Review the typical radiology department work flow in an EMR environment. 2) Identify the key work flow items that may require optimzation. 3) Identify the key components necessary to carry out optimaztion. 4) Review examples of optimaztions carried out at the author's institution. 5) Discuss the impact these optimifzations have had on radiology workflow/efficiency and patient care.

ABSTRACT
The development and usage of electronic medical records has resulted had significant impact on radiology work flow both postive and negaitve. Moving from a paper driven to an electronic process allows for creative design and implementation of a variety of methods to improve radiologist efficiency and quality of patient care. The initial impact at our institution was felt most intensely in the areas of physician order entry of imaging studies and imaging study protocol selection. Although there are a number of off-the-shelf products available to support these functions, we chose to build our own systems within our RIS/EMR. The project required that we thoroughly understand the multiple components of our work flow in the EMR environment, something we had not paid sufficient attention to previously. The first step was to put together of a team with expertise in all aspects of this work flow. Utilizing the specific skills of team members, we were able to develop a template for improved data acqusition at the time of physician order entry and study protocol selection. A number of other quality and workflow enhancements spun out of these efforts. This presentation will review this process in order to provide current/future RIS/EMR users with guidance on optimizing their workflow and improving the quality of patient care.

RC530C • EHR Driven Workflow for Diagnostic Radiologists - You Might Actually Want This

Cree M Gaskin MD (Presenter) *

LEARNING OBJECTIVES
1) Review differences between RIS driven, PACS driven, and EHR (RIS-EMR) driven workflow for diagnostic radiologists. 2) Discuss radiologist engagement in EHR implementation for radiology-centric optimization. 3) Present EHR driven workflow for the diagnostic radiologist at the speaker's institution. 4) Discuss impacts of EHR driven workflow on diagnostic radiologists' efficiency and quality of care delivery as well as user satisfaction.

ABSTRACT
Electronic Health Records (EHRs) are touted to improve the quality and efficiency of clinical care. As a result, EHR-meaningful use legislation has been passed in the U.S. to financially incentivize adoption of this technology. Still, some radiologists remain skeptical that the benefits of EHRs are applicable to their practice and some fear that the technology could even unnecessarily complicate their workflow. One newer model for integrating EHRs into radiologists' practice is to use an EHR to drive diagnostic radiologist workflow, rather than the more traditional or widespread models of PACS driven or third-party RIS driven workflow. This newer model provides opportunity to leverage EHR technology and data for the benefit of radiology-related care delivery. This presentation shares a radiologist-centric viewpoint from one institution which has successfully adopted EHR-driven workflow for diagnostic radiologists. Though the process of implementation is touched upon, the presentation focuses on the resultant clinical workflow and the impacts on quality, efficiency, and radiologist satisfaction.

RC530D • PACS and Radiologist Workflow in a Multi-Enterprise Environment

Gary J Wendt MD,MBA (Presenter) *

LEARNING OBJECTIVES
1) Understand workflow challenges for a radiologist operating a multi-enterprise environment. 2) Understanding requirements for environments with a single versus multiple medical record numbers a. PACS b. Dictation systems c. EHR. 3) Using a master patient index to link patient's across sites.

ABSTRACT

As a radiology department expands across multiple organizations there are several challenges that are created. Among these is the capability of the PACS, dictation systems and electronic medical record to operate in a single versus a multiple medical record number environment. These challenges are complicated further if there is no master patient index to link patient's across the multiple sites. All of these need to be taken into consideration prior to attempting to deploy a single workflow solution in multiple environments. Some possibilities that are discussed include using systems that function in a multiple medical record number environment, making changes to the demographic information in an interface engine or simply guaranteeing that each site uses unique identifiers. The benefits of having a single workflow solution across multiple environments is significant and helps to justify the cost of implementing in maintaining this type of environment.

Hands-on DICOM Metadata Manipulation (Hands-on Workshop)

Wednesday, 08:30 AM - 10:00 AM • S401CD

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IN

RC553 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Richard J Bruce , MD *
Walter W Peppler , PhD *

LEARNING OBJECTIVES
1) Get introduced to a variety of the available open source tools and have a chance to experiment and familiarize yourself with the software hand-on. 2) Understand how open source DICOM software can help solve common workflow issues. 3) Understand how open source DICOM software can be used in research and education. 4) Learn to use open source tools to address DICOM data management challenges.

Using RADIANCE for Dose Monitoring and Quality Assurance: A Hands-on Course

Wednesday, 08:30 AM - 10:00 AM • S401AB

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QA IN

RC554 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Tessa S Cook , MD, PhD
Adam H Kaye , MD
William W Boonn , MD *

LEARNING OBJECTIVES
1) Download and install RADIANCE. 2) Configure RADIANCE for their facility. 3) Set up RADIANCE to query and retrieve dose sheets automatically from PACS or another archive. 4) Use the RADIANCE reporting tools to review their institutional dose data. 5) Export dose data from RADIANCE for custom analysis using a spreadsheet or database.
ABSTRACT
RADIANCE is a freely-available, open source software packaged designed to facilitate dose monitoring, dose reporting and quality assurance for computed tomography (CT) examinations. It uses optical character recognition (OCR) to extract structured data from the image-based dose sheets that have been and continue to be produced by CT scanners worldwide. The structured data is parsed and useful dose-related parameters are extracted, including the x-ray tube voltage (kV), x-ray tube current (mA), volumetric CT dose index (CTDIvol) and dose-length product (DLP). In addition, information about the patient, type of study, scanner and performing institution are obtained from the DICOM study header. This aggregate of dose and exam data is stored in a relational database which can be used to perform quality assurance measures. Using the RADIANCE dashboard and scorecards, facilities can closely monitor their dose data, generate monthly reports for individuals and administrators, identify and investigate outliers and evaluate dose reduction and protocol optimization measures. With the development of radiation dose structured reports (RDSRs or Dose SRs), which are generated by newer scanners, facilities can participate in the American College of Radiology's Dose Index Registry (DIR). However, sites without the newest scanners or latest firmware, or those whose scanners will not be updated, can use RADIANCE to generate an RDSR from legacy (i.e., image-based) dose sheets and automatically send it to the DIR. Participants in this hands-on course will learn how to install and configure RADIANCE for optimal use at their facilities.
URL's
http://www.radiancedose.com

Open Access Imaging Data Resources: NIH Cancer Imaging Archive: Hands-on Workshop

Wednesday, 10:30 AM - 12:00 PM • S401CD

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IN

ICIA41 • *AMA PRA Category 1 Credit* ™:1.5
C. Carl Jaffe , MD
John B Freymann , BS
Justin Kirby
Fred W Prior , PhD *
Lawrence R Tarbox , PhD *

LEARNING OBJECTIVES
1) Learn how to find and download collections of clinical images from the multi-terabyte NIH/NCI Cancer Image Archive (TCIA). 2) Understand the index structure of the TCIA DICOM database. 3) Comprehend how the image archive is linked to the open access genomic data portal (The Cancer Genome Atlas - TCGA). 4) Use this tutored hands-on session to initiate institutionally independent leading edge bioinformatics research.
ABSTRACT
To accelerate clinical imaging research consistent with the principle of open-access "big data," the NIH/NCI provides an Web-downloadable massive DICOM clinical image archive entitled The Cancer Imaging Archive (TCIA). It contains a rich breadth of easily retrievable pre-indexed, but privacy compliant, cancer image collections from an intuitive interface. Of special significance, the TCIA archive acts as a repository of case collections that serve the increasingly important research frontier of "radiogenomics." Collections in TCIA designated "TCGA-xxxx" are diagnostic images obtained from individuals whose tissues were genetically profiled in the NHGRI/NCI cancer genome atlas project, TCGA. This tutored hands-on session will teach the basic skills needed to navigate the massive "Big Data" open-access downloadable image archive provided by the NCI Cancer Imaging Program. With this knowledge, interested cross-disciplinary researchers and radiologists can conduct their own leading-edge research to link clinical imaging to the genomics of various cancer tissue types.
URL's
http://cancergenome.nih.gov http://www.cancerimagingarchive.net

Next Generation IT Requirements for Improving Quality and Safety for Radiology

Wednesday, 10:30 AM - 12:00 PM • S501ABC

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QA IN

ICII41 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
1) Broadly describe the role of IT in helping improve quality and safety for radiology. 2) Describe some of the next generation IT requirements for quality and safety improvement. 3) Use case examples to demonstrate the use of IT to improve access, appropriateness, report quality and results communication. Demonstrate how IT tools can help quantify measurable improvements in each function/process. 4) Use case examples to describe system integration requirements and strategies to enable quality and safety improvement.
ABSTRACT
Improving quality and safety in healthcare and reducing medical errors has become an important element of the national dialogue. A series of ground breaking reports from the Institute of Medicine, including Crossing the quality
chasm published in 2001 have helped frame the national debate. It has become apparent that working harder or smarter is not the answer. Broad system

changes are sorely needed to enable the transformation of our healthcare system and creating a patient-centered, evidence-based care model. Information technology (IT) solutions are a critical element for this transformation.

In this session we will present some of the next generation IT requirements for improving quality and safety in radiology. Our speakers will use case examples to demonstrate how information technology tools can be used to improve appropriateness, access, 'value' of the radiology report, and results communication. Where relevant, our speakers will describe how metrics (e.g. with the use of dashboards, scorecards, or analytics tools) can be used to measure the improvements enabled with IT described in each presentation. Speakers will address the importance of system integration and suggest strategies to use existing IT standards to enable quality and safety improvements in our practices.

ICII41A • Using IT to Improve Appropriateness and Access

Keith D Hentel MD, MS (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT

ICII41B • Using IT to Improve the 'Value' of Radiology Reports

Ramin Khorasani MD (Presenter) *

LEARNING OBJECTIVES
1) Describe some of the key attributes of a 'high value' radiology report. 2) Describe some of the existing performance gaps for creation of an optimal radiology report. 3) Using case examples, illustrate how health IT tools could improve the 'value' of radiology reports.

ICII41C • Using IT to Improve Results Communication, Including Critical Results

Luciano M Prevedello MD,MPH (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

Creating Radiology eBooks for the iPad: A Hands-on Introduction to iBooks Author

Wednesday, 10:30 AM - 12:00 PM • S401AB

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IN ED

ICIW41 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Henry J Baskin , MD
Justin LaPlante , MD
Justin Cramer , MD

LEARNING OBJECTIVES
1) Become familiar with Apple's free ebook authoring tool, iBooks Author. 2) Create a sample radiology ebook during the course. 3) Learn how to freely share your ebook with others.
ABSTRACT
The iPad is rapidly becoming the de facto learning tool used by radiology residents and fellows. iBooks Author, a free authoring tool from Apple, enables the creation of ebooks with a near-limitless number of high-resolution images, movies, and other interactive elements. Unfortunately, most radiologists lack the expertise to leverage the advantages of this application. This hands-on workshop will cover the basics of iBooks Author. During the course, attendees will create their own interactive radiology ebook and learn how to freely share it with anyone who has an iPad. iBooks author is only available for Mac OS and bringing your own Mac is required for the hands-on portion of the course. Attendees are encouraged to download iBooks Author prior to attending; the link is provided below. Attendees are also encouraged to come with an idea for their own iBook, ideally with a text file and folder of images they would like to turn into an ebook during the course. Sample text and images will be provided for those who do not bring their own material.
URL's
https://itunes.apple.com/us/app/ibooks-author/id490152466?mt=12

ISP: Informatics (Quality and Safety)

Wednesday, 10:30 AM - 12:00 PM • S405AB

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QA IN CT

SSK11 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1
Moderator
Woojin Kim , MD *
Moderator
David S Hirschorn , MD

SSK11-01 • Informatics Keynote Speaker: Informatics and Quality
Woojin Kim MD (Presenter) *

SSK11-02 • Crying 'Wolf' about Unsatisfactory Study Quality: A Potential Rift in Communication between Radiologists and Referring Clinicians

Shahine Baghai MD (Presenter) ; **Amy Kunce** ARRT ; **William W Olmsted** MD ; **Eliot L Siegel** MD *

PURPOSE
Technically unsatisfactory imaging quality (TUIQ) impacts patient care, but there is wide variability in whether and how TUIQ is identified in radiology reports. The purpose of this study was to determine the relative frequency in which TUIQ is explicitly identified in reports of various modalities, how often recommendations for follow up are made, and whether these recommendations are heeded by clinicians.

METHOD AND MATERIALS
Using software to search 130,733 radiology reports (Montage, Philadelphia, PA), we retrospectively identified studies (CR, US, and CT) describing TUIQ. Search terms included: limited, suboptimal, sub-optimal, and poor. Study date, modality, radiologist, indication, limitation(s), and retake recommendations were recorded. "Retakes" were defined as follow-up exams obtained based on negative remarks about a study's quality, whether or not the radiologist recommended a repeat study. An additional 954 consecutive CR, CT, and US studies were manually reviewed to determine the rate of TUIQ studies and to serve as a control group.

RESULTS
7% of diagnostic imaging reports included at least one comment implying TUIQ. CR had the lowest percentage of TUIQ. Relative to these, the rate of TUIQ was 1.7 times higher for CT and 3.7 times higher for US. 52% of all TUIQ cases underwent no follow up imaging; 29% had a follow up study for clinical reasons other than technical quality and only 19% of cases had follow up imaging performed because of TUIQ (i.e., retake cases). Of these 19%, 52% had a radiologist's recommendation for retake. Conversely, retake occurred in only 36% of total cases where the radiologist recommended one be performed.

CONCLUSION
One in 14 radiology reports contain comments or disclaimers related to TUIQ with US and CT having relatively higher rates than CR. Descriptions of technical issues are often vague and difficult to discern such as poor, limited, and suboptimal and should be avoided when possible. When these descriptions result in retakes, they are usually performed without an explicit recommendation by the radiologist. In instances when the radiologist recommends a retake, it is performed only about a third of the time.

CLINICAL RELEVANCE/APPLICATION
This study is of interest to all radiologists seeking to improve communication with referring clinicians regarding the diagnostic quality of imaging studies and need for repeat imaging.

SSK11-03 • Updating Radiation Dose Rate in Fukushima Two Years after Severe Accident of Fukushima Nuclear Power Plant

Shoichi D Takekawa MD (Presenter) ; **Takahiro Kato** PhD

CONCLUSION
The RDR in Fukushima residence area is decreasing by the effort of eradication by removing the surface soil and leaves of trees contaminated by fallout. However, some radiation is still remaining and further observation and effort to remove contaminated materials in the residence areas are necessary.

Background
It is important to assess the effect of radiation from fallout after accident of Nuclear Powe Plant to keep our health. This is to report the current radiation dose rate(RDR) in various sites in Fukushima Prefecture after severe accident(Level 7) of Fukushima Nuclear Power Plant(FNPP), and also to report the effort to eradicate radiation in soil and trees contaminated by fallout.

Evaluation
Data of radiation were collected from the public announcements of Japanese Government of Education and Science and Fukushima City. The dose rate at 1 meter above the ground was measured also by Airplane on June 28 and November 16, 2012. The results of RDR before and after removal of soil and leaves of trees contaminated by radiation were announced by Fukushima City. The RDR measured 4 to 30.5 ?Sv/hr in the northwet areas within 20km from FNPP even in March, 2013. It measured 0.24 to 1.11?Sv/hr in Fukushima City(ca,70km from FNPP) on 3-8-13, whereas it measured 11 to 15.0 ?Sv/hr on 5-25-11. The RDR at measuring posts on the ground of FNPP measured 3.1 to 6.7?Sv/hr on 3-3-13. The RDR at the chimney for ventilation of capsule measured over 200 Sv/hr.

Discussion
It was estimated that early decrease of Radiation dose rate in the residence areas was due to the decay of ^{131}I and some influence was due to ^{134}Cs (HL: 2.06 years) and washing effect of rains. The rate of decrease of RDR was exceeding the half life of ^{137}Cs(HL: 30.1 years).The effort to eradicate excess radiation in the residence areas is being made, and it was accomplished in 0 to 100% in Fukushima City by August 2012. The procedure to remove some of contaminated soil and plants is going to be started from April, 2013 in Koriyama City, which is the second largest city in Fukushima Prefecture and about 60 km from FNPP. It was estimated that RDR in the soil seems to have been reduced by 20 to 40 %, when compared with that of RDR in May, 2011.

SSK11-04 ● Evaluation of Non Commercial DICOM De-identification Tools Freeware

K. Y. E. Aryanto ; **Matthys Oudkerk** MD, PhD ; **Peter M Van Ooijen** (Presenter)

PURPOSE
To compare freeware DICOM toolkits for their ability to de-identify sensitive elements in the DICOM header that may contain patient's personal health information (PHI).

METHOD AND MATERIALS
Ten non commercial DICOM toolkits were selected and tested to be compared for their de-identification utility. The selection was made through an internet search to get as many tools as possible. The tests were performed in two scenarios. First, de-identification was performed using tools' default setting and then by using the best possible customized settings. The toolkits were also examined for their de-identification profiles and how the configuration could be customized.

RESULTS
The DICOM toolkits were tested to eliminate fifty elements in the DICOM header which are considered to contain private information that may be used to reveal the identity of a patient. Not all of the toolkits provide a full customizable de-identification profile. Two tools use a fixed configuration. In the other eight tools, changes can be made by giving input through user interface, manually into a configuration text file, or providing the appropriate command arguments or options. Using the first scenario, there was only one tool which, by default, was configured to de-identify all selected elements. In the second scenario, three other DICOM toolkits could perform the task after manual adjustment.

CONCLUSION
Only four out of ten selected free DICOM toolkits could de-identify the defined DICOM elements properly. Free DICOM toolkits should therefore be used with extreme care when de-identifying sensitive data since they can have a high risk of disclosing PHI, especially when using the default configuration. In case optimal security is required, one of the four toolkits is proposed.

CLINICAL RELEVANCE/APPLICATION
Guidance to select the proper tool to de-identify DICOM data is important to ensure the security and confidentiality of patient's personal health information in order to prevent patient data breach

SSK11-05 ● CT Dose Variability for Patients Undergoing Repeat Identical CT Scans: A Retrospective Analysis of 2606 Patients Undergoing 12,632 CT Scans

Douglas G Larson MD (Presenter) ; **Daniel T Boll** MD * ; **Olav Christianson** ; **Rendon C Nelson** MD *

PURPOSE
To evaluate the intrinsic variability in radiation dose delivery of CT scanners in clinical use, independent of patient-specific factors.

METHOD AND MATERIALS
We identified colon cancer, lung cancer, and renal stone patients who underwent the same CT protocol at least twice between 1/2007 and 2/2013. Evaluating patients undergoing multiple scans with identical protocols allowed us to control for any patient- and protocol-specific factors which could affect CT dose. Patient and dose data was taken from DICOM headers and dose sheets in PACS. We performed multivariate analysis to characterize the dose variation for each patient, and to identify any significant cofactors in this variability. We used the 'total exam Dose Length Product' (DLP) in our analyses. CT protocols were: (a) Abdomen/Pelvis with IV contrast (A/P), (b) Chest/Abdomen/Pelvis with IV contrast (C/A/P), (c) Renal Stone, and (d) Chest without IV contrast.

RESULTS
2606 patients underwent 12,632 repeat CT scans (mean 4.8, range 2-33 repeat scans/patient). There were 875 A/P, 4620 C/A/P, 1053 Renal Stone, and 6084 Chest CT scans. The per-patient dose variation was identified, then normalized using coefficients of variation, and ratios of maximum dose to minimum dose. In both cases, a higher value indicates higher dose variability. There was statistically significant variation across all patients and protocols (p
CONCLUSION
There is a statistically significant variation in the radiation dose delivered to a single patient undergoing repeat identical CT scans which varies by scanner and is higher in large patients. The data suggests that there are opportunities to reduce this variability by careful monitoring of key factors, CT table height being one example.

CLINICAL RELEVANCE/APPLICATION
Evaluation and scrutiny of CT dose delivery in clinical practice allows for determination of the intrinsic and controllable variability in an attempt to achieve more consistent patient care.

SSK11-06 ● Simulation of Adverse Contrast Reactions - An Educational Tool for Team Training

Taj Kattapuram MD (Presenter) ; **Gloria M Salazar** MD ; **Elkan F Halpern** PhD * ; **Preston D Stingley** MA, MBA ; **Shawn Bonk** ; **Emily Hayden** ; **Margaret Sande** ; **James Gordon** MD ; **Bethany L Niell** MD

PURPOSE
Successful management of a serious adverse reaction to contrast media requires prompt recognition and treatment, as well as effective team dynamics among radiologists, technologists, and nurses. Our radiology department implemented an educational simulation program in which teams of nurses, technologists, and physicians are required to manage simulated adverse contrast reactions. This study evaluates whether simulation training emphasizing team dynamics improved an individual's self-actualization of the management of an adverse contrast reaction.

METHOD AND MATERIALS
Following IRB approval, 56 physicians, 7 nurses, and 56 technologists worked in interprofessional teams of four to manage two cases of simulated adverse contrast reactions. A standardized debriefing occurred immediately following each simulated case, focusing on medical management of adverse contrast reactions, an institutional adverse contrast reaction kit, and team dynamics including role clarity, closed-loop communication, event managers, etc. Participants individually completed pre- and post-simulation questionnaires which included knowledge-based questions regarding the appropriate management of contrast reactions, as well as questions about participants' perception of their ability to manage adverse contrast reactions. Self-actualization was measured with a 6-point Likert scale. Statistical significance was calculated using McNemar's test with a p value
RESULTS
Following completion of simulation training, radiologists, technologists, and nurses reported a statistically significant improvement in their ability to function as a team during a medical emergency, including an adverse contrast reaction (p-value
CONCLUSION
This simulation training program with its emphasis on team training and adverse contrast reaction management was perceived by the participants as an effective tool to improve the self-actualization of radiology personnel managing adverse contrast reactions.

CLINICAL RELEVANCE/APPLICATION
Simulation training is recommended to educate radiology personnel on effective team dynamics in the management of adverse contrast reactions.

SSK11-07 ● Comparison of Image Quality and Lesion Detectability between Knowledge Based Iterative Reconstruction (IMR-L1) and iDose4 with

50% and 70% Reduced-dose CT Scan in Evaluation of Small Abdominal (≤3cm) Lesions

Yuying Gao (Presenter)

PURPOSE
To compare the image quality and lesion detectability of a new reconstruction algorithm IMR-L1 and iDose4 iterative reconstruction technique on a256-slice CT in low-dose abdomen scans, with focus on small (=3cm) lesions detection and evaluation.

METHOD AND MATERIALS
Two sets of images were obtained during arterial phase scanning: standard-dose filtered back projection (FBP) for each, and low-dose scans were performed randomly on 24 patients (10 male and 14 female; mean age 51.3 years) with acknowledged small lesions. (Group 1, 50% dose reduction for 11 patients), (Group 2, 70% dose reduction for 13 patients). Image quality of the iDose and IMR Level 1 (L1) images was evaluated according to these features: lesion sharpness, low contrast detectability, overall diagnostic confidence (1 [poor] to 5 [excellent]). The CNRs for lesions were measured in CT images reconstructed by iDose4and IMR, and compared using the paired-t test.

RESULTS
Group 1 (50% reduction), IMR L1 was better than iDose4in lesion sharpness and low contrast detectability (P0.05; 3.04±0.59,2.98±0.65, P>0.05). In group 2 (70% reduction), IMR L1 was better than iDose4 in lesion sharpness and low contrast detectability (P0.05

CONCLUSION
IMR-L1 enhances lesion's sharpness, and thus improves small lesion's detectability both in 50% and 70% dose-reduced group.

CLINICAL RELEVANCE/APPLICATION
IMR does enhance the interface contrast between different tissues and Sharpen the edges of Small lesions, thus improved the low contrast lesions' detectability.

SSK11-08 • CT Protocol Optimization Using an Automated IT Solution Provided Size Specific Patient Doses, Automatic Tube Current Modulation Information, and Radiologist Feedback

Timothy P Szczykutowicz PhD (Presenter) * ; **Frank N Ranallo** PhD ; **Walter W Peppler** PhD * ; **Richard J Bruce** MD * ; **Myron A Pozniak** MD *

CONCLUSION
Monitoring the radiation dose and image quality of CT examinations is essential to ethical patient care. This work represents a large stride in giving an institution's CT protocol optimization team the tools it needs to carry out that task.

Background
CT protocol optimization for a large multi center institution is complex due to: variations in CT architecture; the wide array of clinical sections using CT; the large number of required protocols to service each clinical section; and highly varied patient populations (i.e. size and age). To aide in this process, our institution has developed an automated system that collects information about patients, the scanner output and configuration for each patient, and a radiologist quality assessment report. All of this information is gathered digitally, and is fully automated. Patient information is taken from DICOM headers. Scanner output information is extracted from structured dose reports and the configuration of the scanner is taken from the DICOM images from individual image series. Patient sizes are measured using the scout images and every axial image slice. All of this information is used to guide protocol development, monitor the function of the automatic mA control, and identify outliers in terms of low or high dose, which may help identify reoccurring errors in patient scanning.

Evaluation
Prior to using the automated system, small subsets of patients were examined individually by medical physicists. This was a laborious task in which patient sizes, DICOM data, the maximum and minimum mA values, and dose information were manually recorded. Compared to this older method, the new automated method provides more information and requires little to no user input. The automated patient sizing information was found to agree to the manual method within the uncertainty of the manual method.

Discussion
The creation of this system at our institution required IT staff, medical physicists, CT technologists, and radiologist support. The implementation of such a system at a center without a CT protocol optimization team would likely be limited.

SSK11-09 • ACR Dose Index Registry Pilot Project: Comparing Digital Radiography Exposure Indices across Facilities

Steven Don MD (Presenter) * ; **Mythreyi Bhargavan** PhD ; **J. Anthony Seibert** PhD ; **Stephen M Moore** MS ; **Scott R Steingall** ARRT ; **Richard L Morin** PhD

PURPOSE
To describe a new digital radiography (DR) national database registry using standardized, automated data collection methods.

METHOD AND MATERIALS
The Dose Index Registry (DIR) DR pilot project collects and compares exposure indices across both adult and children's facilities nationwide. The new International Electrotechnical Commission exposure index standard for digital x-ray systems (IEC 62494-1) is used, eliminating proprietary indices. Elements from DICOM Structured Reporting (SR) are extracted by the American College of Radiology (ACR) Triad software. Captured elements include age, gender, body part, technique factors (kVp, tube current), Exposure Index, Target Exposure Index, and Deviation Index. The information is de-identified and automatically transmitted to the ACR.

RESULTS
Three vendors (Agfa, Fujifilm, and Siemens) currently have equipment that uses the IEC terminology and the DICOM SR with more vendors adding equipment in the near future. Six adult and three children's facilities are participating in the pilot project. To avoid the problems associated with individual institutional examination naming convention, each study is mapped to the new RadLex Digital Radiography Lexicon Playbook. Experiences learned from the DIR CT are used to overcome problems associated with the new DIR DR.

CONCLUSION
A DIR DR national database using standard methods of data collection to monitor changes in exposure indices over time is urgently needed. The ability to track trends in exposure indices is useful to individual practices wishing to compare their own exposure indices against established benchmarks or national practice patterns. This data is useful to advisory radiation safety bodies. The data can be used to document exposure and variability for common examinations nationally and to create diagnostic reference levels for DR.

CLINICAL RELEVANCE/APPLICATION
Exposure creep is common with DR. By participating in national registries, a practice can monitor their DR exposures, monitor trends, and compare their exposures with other centers.

Informatics -Wednesday Posters and Exhibits (12:15pm - 12:45pm)

Wednesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

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IN

LL-INS-WEA • *AMA PRA Category 1 Credit* ™:0.5
Host
William W Boonn , MD *

LL-INS-WE1A • Preparing for PACS Transition with a DICOM Test Migration-Setup and Results

Peter M Van Ooijen (Presenter) ; **Piet J Ten Bhomer**

PURPOSE
The transition from one PACS vendor to the other is a challenging undertaking and one of the most challenging part of this transition is the migration of the DICOM imaging data to the new environment. The purpose of this presentation is to show the relevance and importance of performing a test migration, how we setup the test migration and what resulted from this test migration.

METHOD AND MATERIALS
A standard take-over tool from our new PACS vendor was used to perform a test-migration of selected dates from the history of the legacy PACS (holding 12 years of image data). The test-migration was checked technically and visual inspection of the actual image data was performed comparing the image presentation on viewing workstations of both PACSs.

RESULTS
A total of 90,027 studies were transferred for 67 historical production days. For 91% of these the migration technically succeeded. Of the studies transferred, 2190 were visually inspected during a three week period resulting in 73 issues that need to be solved. Most issues could be solved before starting the actual migration or tackled during or after the migration. One issue remained to be solved related to the presentation of measurements which was not a show stopper for the PACS transition, but needs special attention to be solved eventually.

CONCLUSION
Performing a well-planned test-migration identifies the most critical problems of the data migration and allows early solutions of these problems before starting the actual migration process. This will both ensure a higher rate of successful migration and less problems during the actual migration process.

CLINICAL RELEVANCE/APPLICATION
PACS transition and especially image data migration is challenging. This research shows that a test-migration can effectively identify problems which will allow a more smooth actual migration process.

LL-INS-WE2A ● Medimaging Case Application (MCA): Tweet and Share Your Medical Imaging Case or get Instantly Some Diagnostic Suggestions from Radiologists Worldwide with Your Apple or Android Mobile Device

Otakar Bittmann MD (Presenter)

CONCLUSION

LL-INS-WE3A ● Use of a Mandatory Complication Entry System Integrated into the Radiology Dictation System for Monitoring Effects of Quality Improvement Initiatives

Sharjeel Sabir MD (Presenter) ; **Jay Patel** ; **Thai T Nguyen** ; **Michael J Wallace** MD * ; **Charles T Suitor** MS ; **Kevin W McEnery** MD * ; **Marshall E Hicks** MD * ; **Sanjay Gupta** MD

CONCLUSION
The described mandatory complication entry system and the QA database allow collection of overall and procedure-specific complication data. The system also provides an easy way of monitoring the effect of specific quality improvement projects.

Background
A major barrier to quality assurance (QA) activities in interventional radiology (IR) is the lack of a user-friendly method of data entry and collection. We present our experience with the use of a mandatory program for entry of interventional radiology (IR) procedure-related complications that is completely integrated with the radiology dictation system. We also evaluated its usefulness in monitoring a quality improvement project aimed at reducing lung biopsy related complications.

Evaluation
During the study period, 63,871 IR procedures were entered in the database, 3,273 complications were reported, 318 (0.5%) of which were classified as major. Common major complications included vascular (n=89; 28%), infection (n=70; 22%), and lung biopsy related air-leak events (N=70; 22%). We used the database to evaluate the effect of a quality improvement project, initiated in 2007, aimed at reducing the lung biopsy related pneumothorax and chest tube rates. Based on the entries made in the database, the lung biopsy related pneumothorax rates decreased from 38.3% in 2006 to 24.9% in 2008, and the chest tube insertion rates decreased from 17.8% in 2006 to 11.4% in 2008. Collection of chest tube rates from the Radiology Information System using the CPT codes during this same time period revealed similar data (16.8% in 2006 and 10.7% in 2008).

Discussion
The mandatory IR complication entry process is integrated with the Radiologist Dictation system application and prevents the radiologists to finish the dictation without performing the data entry step. The system also forces the radiologist to enter appropriate complication data to previous IR dictations. All entries are sent to IR database, which can be queried to run reports and to identify trends. All major complications are peer-reviewed and subsequently discussed in the IR peer review committee meetings.

LL-INS-WE4A ● A Growing Need for an Official Introduction to Cloud Computing in the Radiology Residency Curriculum

Chika I Logie MD (Presenter) ; **G. R Haines** ; **Donald E Hatley** ; **Matt Jordan** ; **Mark D Murphey** MD

CONCLUSION
Rapid evolutionary changes in technology, specifically cloud technology cast a new set of challenges to present-day radiologists. A result of these new challenges is a growing and definite need to formally introduce cloud technology to the Radiology education curriculum, with 90% of survey respondents in favor of adding cloud technology lectures to the curriculum. We believe that educating radiologists about cloud technology will ultimately enhance the ability of radiologists to meet new, complex demands that are attributable to rapidly evolving technology and advanced applications.

Background
Present-day radiologists face a novel set of challenges that accompany rapidly advancing technology. Given the absence of cloud technology as a core portion of the Radiology education curriculum, we believe that signs of lack of this specific education are already evident. In acknowledgement of the increased exposure of residents to social applications compared to practicing radiologists (based on lifestyle and age differences), we hypothesized that residents would be more familiar with cloud computing terminology, would use a greater number of relevant applications and devices, and would demonstrate measurably greater knowledge base on the subject of cloud computing.

Evaluation
A 10-question electronic survey was created using Adobe Acrobat FormsCentral. The content and manner of data collection was ascertained to comply with institutional regulations, which categorizes this activity as meeting criteria for exempt status. The survey was emailed to 3000 radiology residents and practicing radiologists. Four independent sample t-tests were used to determine familiarity, cloud use, knowledge base and computing hardware preferences. A Bonferoni corrected alpha level of .013 was used.

Discussion
There were 210 respondents with distribution as follows: Radiology Residents (44%), Radiology Fellows (11%), Academic Radiologists (24%), Community Radiologists (15%), and other (6%). Overall, 63% reported they neither understood the concept of cloud computing nor knew how it applies to radiology. 90% agreed that the Radiology Residency Curriculum would benefit from the incorporation of lectures on cloud technology.

LL-INS-WE5A ● Errors in Interpretation: Lessons Learned from Abdominal Quality Assurance

Aaron W Maxwell BS (Presenter) ; **Jonathan B Kruskal** MD, PhD * ; **Ronald L Eisenberg** MD, JD ; **Vassilios D Raptopoulos** MD ; **Bettina Siewert** MD

PURPOSE
Radiologic errors are common and primarily represent missed findings. Errors in interpretation occur with less frequency, but are potentially more straightforward to remediate because they result from the faulty analysis of appropriately identified findings. The purpose of this study was to analyze such errors and characterize potentially contributing factors, with an emphasis on subsequent opportunities for remediation.

METHOD AND MATERIALS
All submissions to the online quality assurance database at our institution between October, 2004 and April, 2013 were retrospectively reviewed. Only interpretive errors made during CT evaluation of the abdomen and pelvis were included for analysis. Errors were organized by organ system and categorized as undercalls or overcalls. The following contributing factors were analyzed: historical bias, anatomic misconception, technical factors, lack of Hounsfield unit (HU) measurement, inappropriate pattern recognition, and lack of comparison with prior studies. In each case, note was made of the examination setting and the associated report's author (attending if error in full report, resident if error in preliminary report).

RESULTS
2845 cases were identified in our initial search, of which 111 (3.9%) met full inclusion criteria. The majority of errors represented undercalls (59 cases, 53.2%). Contributing factors were identified in all 111 (100.0%) cases, with more than one factor identified in 52 (46.8%) cases. Anatomic misconceptions were noted in 47 (42.3%) cases, historical bias in 43 (38.7%) cases, technical factors in 30 (37.0%) cases, lack of HU measurement in 25 (22.5%) cases, inappropriate pattern recognition in 19 (17.1%), and lack of comparison with prior studies in 16 (14.4%) cases. Errors were most frequent in the outpatient setting (57.7% vs. 27.9% emergency vs. 14.4% inpatient). Errors involved attendings in 104 (93.7%) cases and residents in 7 (6.3%).

CONCLUSION
The factors that most frequently contribute to errors in interpretation are anatomic misconceptions, historical biases, and technical limitations of the study. Undercalls are somewhat more common than overcalls. Frequently, more than one contributing factor is present.

CLINICAL RELEVANCE/APPLICATION
Efforts at remediation of interpretive errors should focus on common potential contributing factors, such as anatomic misconceptions, historical bias and technical limitations of the study.

LL-INE-WE6A ● Load Balancing Breast Imaging Screens In Oceanetta: A Large Scale Radiology Scheduling Application

Shafiqul Abedin (Presenter) ; **Margarita L Zuley** MD

Background
Prospectively planning how many physicians are needed to cover patient demand and also balancing work load at each location in complex medical systems is challenging. UPMC offers breast imaging at 9 locations throughout the region and a large number of these screening exams have been assigned to one physician daily due to the inability to easily manage screening mammography resulting in issues with interpretation quality for those with very low and very high volume as well as requiring one FTE per annum to cover the patient demand. As part of both a quality initiative in breast imaging and staffing management plan, a novel software application, Oceanetta, has allowed prospective planning of how many studies will be read by every physician each day at each location and is based on the number of studies generated through use of technologists' schedules.

Evaluation
We integrating load balancing and technologist schedule into our existing physician scheduling application. This enabled us to project the number of studies generated against numbers interpreted by physicians on a given day, thus allowing prospective analysis of load balancing and overflow. By implementing the process of withholding fixed number of exams and sending the rest to our central location to be read by a physician assigned only to screening, we predicted a reduction in days requiring a dedicated screening reader and reduction in variance of number of cases read across physicians. The model included 9 remote locations generating 240 (avg) exams daily. Results are based on real screen distribution from December, 2012 to February, 2013.

CONCLUSION
With our experimental model applied to real data we decreased needed staffing by .78 FTE and reduced variance in number interpreted to improve quality.

LL-INE3226-WEA ● Development of a Dose Index Registry in Japan (J-DIR) - Dedicated for Low-dose Lung Cancer CT Screening

Yoshihisa Muramatsu PhD (Presenter) ; **Rikuta Ishigaki** ; **Kouzou Hanai** PhD ; **Masafumi Shinozaki** RT ; **Michael F McNitt-Gray** PhD * ; **Akihiro Machitori** ; **Yoshito Tabata** ; **Masato Mori** ; **Tomohiro Arai** RT

Background
A Dose Index Registry for Japan (J-DIR) has been developed for Japan. An extension of the J-DIR is to adapt this specifically for Low-dose lung cancer CT screening. The purpose of this study is to describe the developments in the database software (Combined Application Dose Index: ﷺCADIﷺ) required for this new application.

Discussion
Because a lung cancer screening program involves healthy subjects, strict adherence to a low dose CT protocol is required. In this demonstration phase, a chest phantom was scanned and CADI was used to record and analyze dose information from routine chest examinations. By maintenance of nationwide infrastructure, central collective management is realized.

CONCLUSION
We developed database software (CADI) for Low-Dose lung cancer CT screening with the function of DIR. A pilot study for low dose lung cancer screening will be started in June, 2013 among 10 institutions.

LL-INE3222-WEA ● Abdominal Lymph Node Diagnosis Assistance Based on Automated Lymph Node Detection and Quantification

Kensaku Mori PhD (Presenter) ; **Yoshihiko Nakamura** MEng ; **Kazuhiro Furukawa** ; **Kazunari Misawa** MD, PhD ; **Masahiro Oda** PhD ; **Shigeru Nawano** MD ; **Yukitaka Nimura**

PURPOSE/AIM
The aim of this exhibit:

1. To understand how the system detects abdominal lymph nodes from CT volumes
2. To understand how the system detects candidate regions form CT volumes
3. To understand how the system eliminates false positives from candidate regions by support vector machine
4. To understand how the system quantifies detected lymph nodes
5. To understand how the system visualize detection and quantification results

CONTENT ORGANIZATION
This exhibit consists of two parts:

1. Demonstration of the assistance system for abdominal lymph node assistance

- Automated detection and quantification of lymph node
- CT volume reading with highlighting detected lymph nodes

2. Explanation of lymph node detection and quantification

- How the system initially detects lymph nodes
- How the system eliminates false positive regions by support vector machine
- How the system quantify features of detected lymph nodes
- How the system visualizes detection and quantification results

SUMMARY
The major teaching points of this exhibit are:

- How the radiologist diagnoses lymph nodes with automated detection and quantification functions
- How the system can detect lymph nodes that can be often overlooked by radiologistx
- How the assistance system can be integrated into the workflow of a radiologist

LL-INE3179-WEA ● One Size in No Way Fits All - Quantifying Hip Variations by Automatic Morphometric Measurements from CT

Ju Zhang (Presenter) ; **Jacqui Hislop-Jambrich** PhD * ; **Duane Malcolm** ; **C David L Thomas** ; **Poul Nielsen**

Background
The femur and hip joint in particular are complicated structures that have both clinical and anthropological significance. The variability of surface structures among individuals especially in terms of gender makes the extraction of consistently reproducible measurements non-trivial and time consuming. Automatic image segmentation and meshing methods allow precisely-defined measurements to be taken from CT-volumes as part of an automated pipeline. We present initial findings from such a pipeline for obtaining morphometric measurements of the hip. We believe that the importance of this work lies in the eventual creation of a comprehensive databank that will be of use in the development of prosthetic devices and the tracking of disease and evolutionary morphometry.

Evaluation
A 16-row MDCT was used to acquire images on 55 human cadavers (24 male, 31 female). The outer femoral surface was automatically segmented and meshed with sub-voxel accuracy. Femoral head area, femoral axis length, neck angle, neck width, and subtrochanteric width were automatically measured on the mesh according to mathematical definitions based on mesh geometry. Errors with respect to manual measurements were between 2.4% and 7.6% on average. All automatic measurements except for neck angle showed significant differences between genders (p-value
Discussion
We present this initial evaluation of five measurements with a view toward the creation of a macro-structural atlas of bones in the hip. The automated system shows good promise in terms of accuracy and sensitivity compared to manual measurements. We describe the variability of these measurements in our homogenous population with specific reference to gender to provide an overview of what is possible using current technology.

CONCLUSION
Automatic assessment of proximal femur morphometry has shown that variations are sufficient to warrant the creation of a bank of detailed morphometric assessments of the hip. We believe that detailed knowledge of this complicated structure may be used to support the development of prosthetic devices and assist in diagnosing complex hip-based disorders.

LL-INE3181-WEA ● Organ Segmentation of Fetal MR Images Using Active Contours and Morphology

Shivaprasad A Chikop (Presenter) ; **Sneha Shiradon** ; **Pavan Poojar** BEng ; **Arush Honnedevasthana Arun** ; **Smitha Saraswathi** ; **Sona A Pungavkar** MD ; **Barjor Gimi** PhD ; **Ramesh Babu** ; **Sairam Geethanath**

Background
Previous work performed on fetal MRI use apriori information that is typically dependent on contrast [1]. An algorithm, which is not restricted by such dependence would enable seamless application of segmentation approaches for different MR contrast types.

Evaluation
A database containing 6 MRI volumes of fetuses was used for this study. All images were acquired with the single shot Fast Spin Echo sequence on a 1.5T GE MR scanner. Acquisition parameters were: TR/TE=1750/91.616 ms, flip angle = 90, slice thickness/gap = 4/5 mm. Region of interest (ROI)was selected for the input image and segmentation was performed using active contour method. The number of iterations and smoothing parameter for the active contour were optimized for our algorithm based on 1 volume.Post-processing was performed using morphological operations of opening and closing. Manual and semi-automatic segmentation of the brain and the lungs were performed on the 6 datasets and were compared.The mean and standard deviation for the brain are calculated for each slice from 6 different datasets. On the other hand, lungs can be segmented out clearly only in case of sagittal view with respect to fetus. Lungs were clearly visible in 2 datasets out of 6. Three different slices were selected from each of these datasets, which had sagittal view for quantification.

Discussion
The implemented algorithm resulted in segmentation of the brain(2630±364.08) and lung(558.36±231) that is similar to area of segmentation as obtained manually (2819±274.71), (513.15±243.59) respectively for both cases.The output of our algorithm can also be seen in the figure attached 1(d). The figure also contains the results of segmentation for a representative data set showing the fetus (a), segmented brain (b) and segmented lungs (c).

CONCLUSION
We have proposed asupervised method for the contrast independent segmentation of fetal brain and lungs. The proposed method does not depend on prior information such as eye-localization, which is highly contrast dependent. The results of comparison of the manual and semi-automated segmentation show the utility of the approach. Current and future work involves automation of ROI, 3D reconstruction and volumetric analysis.

LL-INE3185-WEA • Towards Quantitative Stereo Mammography-A Disparity Estimation Algorithm for Stereo Mammograms

Gautam S Muralidhar PhD (Presenter) * ; **Alan C Bovik** ; **Mia K Markey** PhD

Background
Estimating depth reliably from a pair of stereo mammogram images is the first step towards developing quantitative tools for interpreting stereo mammography data. An important problem that needs to be solved in order to elucidate depth is the stereo disparity estimation problem. However, the disparity estimation problem on stereo mammograms is challenging, since nearly all of the 3-D structural information of interest exists as a complex network of multi-layered, heavily occluded curvilinear structures. Towards addressing this difficult problem, we formulate a new stereo model that employs a new singularity index as a constraint to obtain better estimates of disparity along critical curvilinear structures such as blood vessels and spicules.

Evaluation
Twenty synthetic stereo images were generated with ground truth disparity data. The synthetic stereo images are comprised of an inverse power law background, with curvilinear structures superimposed to provide a gross resemblance to real mammograms. We compared our algorithm to a conventional visible light stereo disparity estimation algorithm. The percentage of pixels with an erroneous disparity estimate greater than 1 pixel was used as the performance measure. The singularity index driven stereo algorithm performed significantly better than the conventional algorithm on the synthetic images (Wilcoxon signed rank p-value < 0.0001). The new stereo algorithm was also found to operate favorably when evaluated qualitatively on real stereo mammogram pairs provided by Emory University.

Discussion
Stereo mammography has shown promise in improving upon the sensitivity of breast cancer detection and reducing the number of unnecessary patient recalls. The advent of stereo mammographic imaging, while still nascent, has opened the door for the development of quantitative tools for visualizing and interpreting stereo mammograms. We have taken the first step towards quantitative stereo mammography by developing a new disparity estimation algorithm.

CONCLUSION
The singularity driven stereo disparity estimation algorithm is promising for estimating disparity on stereo mammogram images.

LL-INE3183-WEA • A New Distortion Correction Technique for Computed Diffusion Weighted Imaging (cDWI)

Toru Higaki PhD (Presenter) ; **Yuko Nakamura** MD ; **Yuji Akiyama** ; **Wataru Fukumoto** ; **Mitsukazu Kamata** * ; **Kazuo Awai** MD *

Background
Computed diffusion-weighted images (cDWIs) are virtual DWIs calculated from arbitrary low b-value DWIs. cDWI is advantageous in that images can be generated on MR scanners that do not allow the acquisition of high b-value DWIs. As cDWI is calculated from both b=0 and low b-value (e.g. b=600 sec/mm2) DWI, misregistration between b=0 and b=600 DWIs must be corrected. In an earlier method, the registration technique is applied to b=0 and b=600 DWIs: DWI scans with b=600 are deformed to align with b=0 DWI scans . However, this method entails distortion of the generated cDWIs because both b=0 and b=600 images manifest different degrees of distortion attributable to their acquistion with an echo planar imaging (EPI) sequence. We propose a new distortion correction method for cDWIs that is based on T2 weighted images (T2WI) acquired with a spin echo (SE) sequence and that involves few distortions.

Evaluation
After both b=0 and b=600 DWIs were registered to T2WI for distortion correction with the Insight segmentation and registration toolkit (ITK: www.itk.org) we compared the image quality of the proposed cDWI, conventional cDWI, and actual DWI. Using a 3T MRI scanner (Titan 3T, Toshiba Medical Systems) we scanned a phantom that includes 5 cylinders filled with carrageenan solution (2.0%, 1.0%, or 0.5%), polyvinyl alcohol, or water. For cDWI we acquired DWIs at b=0 and b=600. cDWIs at b=1000 were generated using the proposed- and the conventional method. For comparisons, DWIs with b=1000 were acquired.

Discussion
While the image contrast did not differ between the proposed- and conventional cDWIs, shapes on the proposed cDWIs were closer to T2WI scans and there were fewer distortions than on conventional cDWIs. Also, the proposed cDWI method involves fewer distortions than real DWI. The proposed cDWI method yielded comparable image contrast and exhibited morphologic properties that were better than on conventional cDWI scans.

CONCLUSION
Our new cDWI technique yielded image contrast comparable to conventional cDWI and exhibited better morphologic properties.

Correlating Imaging with Human Genomics

Wednesday, 12:30 PM - 02:00 PM • S401CD

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IN

ICIA42 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Sandy Napel , PhD *
Daniel L Rubin , MD,MS *
Olivier Gevaert , PhD

LEARNING OBJECTIVES
1) Understand the methods for and the potential value of correlating radiological images with genomic data for research and clinical care. 2) Learn how to access genomic and imaging data from The Cancer Genome Atlas (TCGA) and The Cancer Imaging Archive (TCIA) databases, respectively. 3) Learn about methods and tools for annotating regions within images with semantic and computational features. 4) Learn about methods and tools for analyzing molecular data, generating molecular features and associating them with imaging features.
ABSTRACT
Radiogenomics is an emerging field that integrates medical images and genomic data for the purposes of improved clinical decision making and advancing discovery of critical disease processes. In cancer, both imaging and genomic data are becoming publicly available through The Cancer Imaging Archive (TCIA) and The Cancer Genome Atlas (TCGA) databases, respectively. The TCIA/TCGA provide examples of matched molecular and image data for five cancer types, namely breast, lung, brain, prostate and kidney. The data in TCGA includes various omics data such as gene expression, microRNA expression, DNA methylation and mutation data. The community is beginning to extract image features from the MRI, CT and/or PET images in TCIA, including tumor volume, shape, margin sharpness, voxel-value histogram statistics, image textures, and specialized features developed for particular acquisition modes. They are also annotating the images with semantic descriptors using controlled terminologies to record the visual characteristics of the diseases. The availability of these linked imaging-genomic data provides exciting new opportunities to recognize imaging phenotypes that emerge from molecular characteristics of disease and that can potentially serve as biomarkers of disease and its response to treatment. They also provide an opportunity to discover key molecular processes associated with distinct image features, within one cancer type and across different cancer types. This workshop will describe datasets and tools that enable research at the intersection of imaging and genomics, and that point to opportunities to develop future applications that leverage this knowledge for diagnostic decision support and treatment planning.

Meaningful Use: Experience from Radiology Practices in Hospitals and Health Systems

Wednesday, 12:30 PM - 02:00 PM • S501ABC

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QA IN

ICII42 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Ramin Khorasani , MD *
Curtis P Langlotz , MD, PhD *

LEARNING OBJECTIVES
1) Understand the meaningful use program. 2) Learn how hospitals and health systems have achieved meaningful use for their radiologists. 3) Decide how your practice should respond to the program.

Optimizing PowerPoint Slides

Wednesday, 12:30 PM - 02:00 PM • S401AB

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IN

ICIW42 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
William J Weadock , MD *
Sarah C Abate , BS

LEARNING OBJECTIVES
1) Review the components of an optimal slide presentation. 2) Learn about common errors made in slide preparation and how they can be avoided. 3) Learn about how to improve the quality of a presentation by using optimal different slide backgrounds, font size and color, and image sizes. 4) Learn tips to ensure a smooth presentation.
ABSTRACT
Electronic presentations are very common in radiology practice. This hands-on demonstration and questions and answer session will show attendees how to optimize their presentations. The focus will be on the use of slide templates, color selection (font and background), font and image size, and animations. Additional review of image and video display and management will be covered. Demonstrations will include tips to decrease time creating and modifying presentations. Bring your questions!

Informatics - Wednesday Posters and Exhibits (12:45pm - 1:15pm)

Wednesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

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IN

LL-INS-WEB • *AMA PRA Category 1 Credit* ™:0.5

LL-INS-WE1B • Why Isn't There More High-Fidelity Simulation Training in Diagnostic Radiology? Results of a Survey of Academic Radiologists

Chun-Der L Li MD (Presenter) ; **Jessica Hernandez** MD ; **Benjamin L Yam** MD ; **Mary H Scanlon** MD, FACR ; **Curtis P Langlotz** MD, PhD * ; **Tessa S Cook** MD, PhD

PURPOSE
High-fidelity simulation training is performed in other medical specialties, as well as in interventional radiology. We sought to gather attitudes toward simulation training in radiology and identify perceived barriers or challenges.

METHOD AND MATERIALS
An IRB-approved survey was distributed to radiology residency programs within the United States. Program directors, faculty and trainees were invited to respond. The survey asked how programs currently train residents for independent call, whether they receive specific training on communication and professionalism, how on-call performance is assessed (both now and within the framework of the new ACGME milestones) and what barriers to a simulated call environment existed.

RESULTS
More than half of the 63 repondents are program directors or other faculty. Call preparation most commonly involves lectures, shadowing senior residents and baby call. Most programs also prepare residents to protocol studies and communicate with technologists and referring physicians. About half specifically train residents to triage phone calls and multi-task while on call. Very few programs report formal training on professionalism, citing daily practice and observation of senior residents and faculty as sufficient. Evaluation of resident call performance commonly falls to the faculty who review call cases. A few programs can track report changes and notify residents, but this is not widespread. Most programs consider baby call to represent a mimic of the call environment, however, a few report having simulators that provide on-call cases to first-year residents without adding common on-call distractors. The main perceived barriers to a simulated call environment are lack of time and expertise in simulation training within the department. Some feel that this type of training is not necessary as it is supplanted by the first year of residency.

CONCLUSION
The main barriers to high-fidelity diagnostic radiology simulation training include lack of faculty time/expertise in simulation design and a lack of perceived need. Most programs focus call preparation on learning content rather than dealing with the added challenges of time pressure, distractions and communication encountered on call.

CLINICAL RELEVANCE/APPLICATION
High-fidelity simulation training is not heavily used for call preparation in diagnostic radiology; the barriers to its use are primarily lack of time, simulation expertise and perceived need.

LL-INS-WE2B • Quality Assurance in Pipeline Processing of Clinical Brain MRI for Research Applications

Mikhail V Milchenko PhD (Presenter) ; **Pamela Lamontagne** PhD ; **Abraham Z Snyder** PhD ; **Joshua S Shimony** MD, PhD ; **Tammie S Benzinger** MD, PhD * ; **Sarah C Jost** MD ; **Daniel S Marcus** PhD *

CONCLUSION
Our findings indicate that the reliability of automated processing of multi-center clinical imaging studies would be improved by secure image-based methods for determining head orientation and tight control over clinical study acquisition protocols, including file naming conventions. These measures offer the potential to significantly improve large scale, clinical imaging research studies.

Background
Processing pipelines for large neuroimaging clinical research projects must be reliable. This is challenging in multi-site studies because inconsistent acquisition protocols cannot be entirely avoided. We report our experience with the pipeline developed to automatically preprocess and co-register multispectral MRI data acquired by the Comprehensive Neuro-oncology Data Repository (CONDR) project, and analyze the most common reasons of automatic processing failures.

Evaluation
A typical CONDR MR study contains several T1-, T2- and susceptibility-weighted images plus dynamic susceptibility contrast (DSC) perfusion and diffusion sensitized sequences. Our CONDR processing pipeline includes detection of available DICOM scans, identification of known scan types, generation of perfusion and diffusion maps and spatial co-registration of all image data to a pre-selected atlas. Although this preprocessing is intended to be fully automatic, variable patient anatomy (brain distortion consequent to mass lesions) and inconsistent sequence settings may result in a processing failure. We evaluated the most common reasons for pre-processing failure in over 60 tumor studies acquired in two different institutions.

Discussion
Diffusion processing failures were most often attributable to incorrectly detected scan orientation because of missing DICOM metadata. Image registration failures were most commonly attributable to pathologic anatomical distortions and highly anisotropic voxels (i.e., thick slices with high in-plane resolution). A minority of studies failed processing because the required scans were either absent or not detected because of naming inconsistencies.

LL-INS-WE3B • The Translational Imaging Platform (TIP)

Daniel S Marcus PhD (Presenter) * ; **Mikhail V Milchenko** PhD ; **Rick Herrick** * ; **Abraham Z Snyder** PhD ; **Joshua S Shimony** MD, PhD ; **Eric Leuthardt** ; **Carl Hacker** ; **Tammie S Benzinger** MD, PhD *

CONCLUSION
The TIP has enabled streamlined integration of research-based image processing tools into clinical workflows, allowing both clinical use and bidirectional feedback between clinicians and research scientists. The TIP is open source and can be downloaded from the XNAT Marketplace website.

Background
Quantitative imaging processing tools developed in research settings have the potential to enhance clinical diagnostic practice. Conversely, feedback from clinical use could be used to researchers to continue to improve algorithms and functionality. However, integrating these tools into clinical workflows is often a difficult and time consuming process. We have developed a customized version of the XNAT imaging informatics platform to overcome these obstacles. This system is referred to as the Translational Imaging Platform (TIP).

Evaluation
The TIP includes a user interface to retrieve specific patient imaging studies from a selected PACS system using standard DICOM query/retrieve services. :Selected patients can be selected and automatically imported to the TIP repository. :Once in TIP, the study can be processed with automated image processing pipelines. : The TIP uses XNAT's pipeline engine service to configure and exeucte these pipelines. The pipelines are designed to produce addtional DICOM series that may include derived images and/or structured reports. :This generated content can be reviewed by qualified personnel and then sent to the PACS for clinical use.

Discussion
The TIP has been deployed at the Washington University School of Medicine and is jointly managed by BJC Hospital inforamtion technology department and the Mallinckrodt Institute of Radiology Division of Radiological Sciences. The initial pipeline within the TIP generates a series of brain network maps from resting state functional MRI data (rfMRI). These maps are used by neuroradiology and neurosurgery teams to develop surgical navigation plans. An additional pipeline is in development to generate quantitative brain region volumetry reports for use in Alzheimer's Disease diagnosis.

LL-INS-WE4B ● Simulation of Adverse Contrast Reactions-An Educational Tool for Team Training

Taj Kattapuram MD (Presenter) ; **Gloria M Salazar** MD ; **Elkan F Halpern** PhD * ; **Preston D Stingley** MA, MBA ; **Shawn Bonk** ; **Emily Hayden** ; **Margaret Sande** ; **James Gordon** MD ; **Bethany L Niell** MD

PURPOSE
Successful management of a serious adverse reaction to contrast media requires prompt recognition and treatment, as well as effective team dynamics among radiologists, technologists, and nurses. Our radiology department implemented an educational simulation program in which teams of nurses, technologists, and physicians are required to manage simulated adverse contrast reactions. This study evaluates whether simulation training emphasizing team dynamics improved an individual's self-actualization of the management of an adverse contrast reaction.

METHOD AND MATERIALS
Following IRB approval, 56 physicians, 7 nurses, and 56 technologists worked in interprofessional teams of four to manage two cases of simulated adverse contrast reactions. A standardized debriefing occurred immediately following each simulated case, focusing on medical management of adverse contrast reactions, an institutional adverse contrast reaction kit, and team dynamics including role clarity, closed-loop communication, event managers, etc. Participants individually completed pre- and post-simulation questionnaires which included knowledge-based questions regarding the appropriate management of contrast reactions, as well as questions about participants' perception of their ability to manage adverse contrast reactions. Self-actualization was measured with a 6-point Likert scale. Statistical significance was calculated using McNemar's test with a p value
RESULTS
Following completion of simulation training, radiologists, technologists, and nurses reported a statistically significant improvement in their ability to function as a team during a medical emergency, including an adverse contrast reaction (p-value
CONCLUSION
This simulation training program with its emphasis on team training and adverse contrast reaction management was perceived by the participants as an effective tool to improve the self-actualization of radiology personnel managing adverse contrast reactions.

CLINICAL RELEVANCE/APPLICATION
Simulation training is recommended to educate radiology personnel on effective team dynamics in the management of adverse contrast reactions.

LL-INE-WE5B ● The Evolving Role of the Radiologist: Communicator, Educator and Mediator

Ingy Hanna MD ; **Mark A Flyer** MD ; **Jacquelyn Copeland** MD (Presenter)

Background
The growing dependence of medical diagnosis on imaging has made the radiologist a central player on the medical team. Beyond the correct diagnosis there is much that the radiologist is responsible for and can contribute to optimizing patient care. The timely communication of radiologic findings, educating referring physicians and patients about appropriate evidence based imaging options and protection of patient and staff against unnecessary radiation exposure are all responsibilities that fall squarely on the radiologist.

Evaluation
Failure to communicate significant findings is increasingly the cause for radiologist liability. Every institution should have methods for the timely communication of information and a list of which findings require prompt correspondence. Growing media attention to medical radiation is a major factor in the increased conscientiousness of physicians and patients when obtaining imaging, causing many patients to question the safety of imaging. It is the radiologists' duty to minimize unnecessary radiation exposure while optimizing image quality as well as play an active role in educating physicians and patients. Imaging of the pediatric and pregnant patient has markedly increased, making the creation of safety measures for this group of patients imperative.

Discussion
We discuss our institutional protocol to ensure prompt communication of significant findings and the standardization of "critical" and "significant unexpected" findings. Also presented are informative resources the radiologist can use when discussing appropriate imaging with the referring physician or the risks/benefits of imaging with the patient. Safety measures for limiting radiation exposure while optimizing image quality are presented, with special attention to the pediatric and pregnant patient, as well as methodology for monitoring individual patient radiation exposure.

CONCLUSION
Prompt communication of significant findings, referring physician and patient education, and mediation of radiation exposure composes the foundation for safe and effective patient care when providing imaging.

LL-INE-WE6B ● Medical School Graduate Interest in Radiology Residency Programs as Depicted by Online Search Tools

Nora M Haney BS ; **Stuart D Kinsella** BA ; **Jose Morey** MD (Presenter)

Background
Recent media publications have indicated a marked decrease in specialty positions available to medical school graduates, specifically in the field of radiology. Internet search tools have proven useful in the prediction of certain diseases based on the search volume index (SVI) for a specific term. We hypothesize online search data may be useful in the prediction of unfilled residency positions in radiology. The purpose of this study was to gauge medical school graduate interest in the field of radiology by comparing data from Google Trends and the National Residency Match Program (NRMP).

CONCLUSION
In summary, online search data may be a useful insight into medical school graduate interest in residency specialties and may be predictive of unfilled radiology residency positions and eventual increased shortages of community radiologists.

LL-INE3219-WEB ● Access Path Optimization for Software-assisted Radiofrequency Ablation Planning

Christian Rieder ; **Sabrina Haase** (Presenter) ; **Christian Schumann** ; **Philipp Suess** ; **Katrin Teichert** ; **Karl-Heinz Kuefer** ; **Tobias Preusser**

PURPOSE/AIM
For planning of needle-based ablation therapies, the consideration of multiple criteria is a challenging task. To support the radiologist, a novel software tool to interactively plan the access path of the needle is proposed.

CONTENT ORGANIZATION
The presentation is intended to evaluate the feasibility of novel interaction methods for patient-specific access path planning. This is exemplified on planning of radiofrequency ablation, where criteria such as expected thermal necrosis, distance of possible paths to the extracted risk structures as well as the path length are evaluated based on image processing. The system allows for rapid evaluation of possible trajectories, which fulfill the specified criteria. It determines a set of optimal paths such that an interpolation between these paths yields valid paths too. All valid paths can be interactively explored by selecting target values for the criteria and by interpolating the current path from the pre-computed set of valid paths.

SUMMARY
The proposed methods are integrated into a clinical software assistant. The radiologist may interact with the system by iteratively adapting the target values. A combined visualization of the patient anatomy, the currently selected access path and the expected coagulation necrosis incorporating the heat-sink effects of the surrounding blood vessels is updated in real-time.

LL-INE3223-WEB ● A Vendor and Location Independent Workstation Tool for Case Consultation in Private or in a Cloud Based Environment

Roland S Talanow MD,PhD (Presenter)

Background
Especially general and solo radiologists face often situations in which they are in need for a peer consultation for a difficult case. This becomes not only a workflow issue since time consuming literature research might delay the routine work but also a medical-legal issue if providing potentially an inaccurate report. A solution is desired where radiologists who are in need for a case consultation receive such in a timely and convenient manner.

Evaluation
This tool allows radiologists taking images from the current case study and sending it to a dedicated section in a protected community of over 10.000 Radiology professionals or directly to a specialist's workstation. This community has been used for several years for case consultation and opinions about cases are usually provided within minutes to hours. No installation is needed and thus can be used in an environment with limited user rights. The program design is intuitive and provides options for taking the image from the workstation, a title, short description where a question can be placed and optional case relevant parameters. With one mouse click the case is sent to the community of professionals or directly to a person. Cases can be discussed amongst a group of peers/specialists or in a private consultation - also as realtime chat. This tool provides additional useful features like an integrated Radiology specific search engine, image editing, export options and more.

Discussion
This vendor-independent solution allows exporting cases and taking images directly from the screen and sending them through an intuitive interface to a protected community of Radiology professionals or directly to a specialist's workstation for immediate consultation. This tool can be integrated in other communities, practices or hospitals to provide a quick case consult without the need to purchase expensive software.

CONCLUSION
This free clinical tool for radiologists allows receiving quickly and easily consultations from peers / specialists for their difficult cases. This tool helps especially solo radiologists or radiologists in remote locations improving their workflow and decreasing medical-legal liablilty by increasing the accuracy of the reports.

LL-INE3180-WEB • Cardiac Computational Anatomy Works (CAWorks): An Integrated Software Tool to Perform Cardiac Shape Analysis

Siamak Ardekani MD, PhD ; **Michael Bowers** ; **Joseph G Hennessey** ; **Saurabh Jain** PhD (Presenter) ; **Geoffrey Gunter** ; **Anthony Kolasny** PhD ; **Tilak Ratnanather** ; **Rai Winslow** PhD ; **Michael J Miller** RT * ; **Laurent Younes**

Background
Global metrics such as left ventricular (LV) mass, volume, or ejection fraction are not sufficient to address the complex nature of cardiac remodeling. Here we present a software framework (Computational Anatomy Works) for studying local LV shape features. CAWorks can be used to construct an LV atlas. Local shape features can then be studied by mapping this atlas onto individual cardiac images. By studying the atlas_to_subject mapping, one can identify quantitative shape differences between diseased and normal hearts, or between two disease states. This software is available via the CardioVascular Research Grid portal (https://portal.cvrgrid.org/).

Evaluation
CAWorks, an extension to the open source visualization tool: ParaView, is a multiplatform software with the following capabilities: 1) Interactive landmark placement to create segmentation (masks) of desired regions of interest; 2) Support for multiple Medical Imaging data formats, such as Nifti and Analyze; 3) Tri or Quadra Planar view depending on the version;4) Shape Analysis plugin modules, such as the Large Deformation Diffeomorphic Metric Mapping (LDDMM) algorithm. CAWorks has a client-server architecture to facilitate remote visualization and processing and currently evaluated using computed tomography data.

Discussion
Figure 1illustrates the CAWorks cardiac landmarking panel. The user uploads images into the CAWorks client and identifies landmarks in the atlas and subject's images. These landmarks will be used to perform an initial rigid mapping followed by an intensity based non-rigid mapping using the LDDMM algorithm. The mapping describes how much regional displacement is required to deform the reference LV geometry to the shape of individual subject's LV geometry. Large displacement indicates large deviation of the subject's LV geometry from the atlas, and can potentially indicate abnormal structure.

CONCLUSION
We presented a software tool that performs quantitative shape analysis of cardiac images. This process is computationally expensive however the software design allows that the mapping process to be conducted remotely therefore eliminating the high cost associated with acquiring and maintaining computer hardware.

Using myRSNA®: Hands-on Workshop

Wednesday, 02:30 PM - 04:00 PM • S401CD

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IN

ICIA43 • *AMA PRA Category 1 Credit* ™:1.5
John W Basco , MS

LEARNING OBJECTIVES
1) Understand the different tools and applications within myRSNA. 2) Log in to myRSNA and set up a personal profile. 3) Using the tools within myRSNA, highlight different use case scenarios.

RadLex®: Overview of a New Lexicon for Radiology

Wednesday, 02:30 PM - 04:00 PM • S501ABC

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IN

ICII43 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
1) Review the rationale for developing a new lexicon for medical imaging. 2) See how an imaging lexicon can be used for education, research, and clinical reporting. 3) Understand the key technical decision that were necessary to create a complete and organized vocabulary for medical imaging. 4) Learn about the formats in which RadLex is distributed and the tools that are available for maintaining and using terminology systems. 5) Discover how you can take advantage of RadLex in the development of radiology applications.
ABSTRACT
The purpose of the RadLex lexicon is to provide a uniform framework for indexing and retrieval of a variety of radiology information sources, including teaching files, research data, and radiology reports. The RadLex lexicon is unifying and supplementing radiology terms from other medical lexicons, such as the ACR Index from the American College of Radiology, the Unified Medical Language System (UMLS) from the National Library of Medicine, SNOMED-CT from the College of American Pathology, and the DICOM Content Mapping Resource. This session will explain the motivations for the creation of the RadLex imaging lexicon and describe new applications being created that leverage its rich knowledge resources, such as structured reporting, radiology information retrieval, image annotation, decision support, and computerized order entry. RadLex technical experts will describe the formats in which RadLex is distributed, and will demonstrate some of the tools available to incorporate RadLex into the development of useful software applications. An update on the recently developed RadLex ﷺplaybookﷺ will be provided, with an overview of RadLex methods to describe radiology orderables and procedure steps.

ICII43A • Background, Motivations, and Overview of Applications

Daniel L Rubin MD,MS (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

ICII43B • 'RadLex Inside': Information Retrieval, Radiology Reporting, and Beyond

Charles E Kahn MD, MS (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

ICII43C • Practical Use of the RadLex® Playbook: Beyond Chargemasters

David S Channin MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

National Library of Medicine PubMed: Find Articles You Need: Searching PubMed/MEDLINE Efficiently

Wednesday, 02:30 PM - 04:00 PM • S401AB

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ICIW43 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Holly A Burt
Chezire Aclimandos
Annabelle Nunez , MA
Wendy Wu , MS

LEARNING OBJECTIVES
1) Understand how PubMed constructs a query and how to develop and refine effective search strategies in radiology. 2) Use PubMed tools including Clinical Queries, Related Articles, Single Citation Matcher and Loansome Doc. 3) Build focused searches using the Medical Subject Headings (MeSH) vocabulary for radiology and limit searches to radiology-oriented journals. 4) Understand how to save and download citations.

ABSTRACT
This hands-on workshop covers key searching techniques, changes to PubMed, and how to develop effective search strategies for PubMed and MEDLINE. Topics covered include: why keywords don't always give the results you expect, how to limit to specific journals, quick searches to find evidence-based citations, how to access full-text articles, and downloading citations to reference manger programs. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov). MEDLINE is a subset of PubMed which includes links to sites providing full text articles and to other related databases and resources.

Informatics (Image Sharing)

Wednesday, 03:00 PM - 04:00 PM • S403A

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SSM11 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1

Moderator
Rasu B Shrestha , MD, MBA *
Moderator
Sanjiv Bajaj , MD

SSM11-01 • The RSNA Image Share Network: 20 Month Follow-up Results from a Pilot Site

Anand S Patel MD (Presenter) ; **Wyatt M Tellis** PhD * ; **Mary Torosyan** ; **David E Avrin** MD, PhD * ; **Ronald L Arenson** MD

CONCLUSION
A patient controlled image-based ePHR, such as ISN, is feasible and valuable in modern patient centered healthcare, with patients and physicians reporting high satisfaction.

Background
Medicare expenditure on imaging has nearly doubled from $6.5B in the year 2000 to $11.7B in 2009. At least 10-20% of these costs are due to duplicate exams, often from inaccessibility of prior studies during the transfer of care between institutions. In response, the RSNA and NIBIB launched the Image Share Network (ISN). ISN aims to improve efficiency, safety, and empower patients with direct control of their exams via a cloud based electronic personal health record (ePHR). As 1 of 5 pilot sites, we present our experience with enrollment and patient/physician survey results.

Evaluation
Enrollment began in August 2011 while patients were obtaining a study CD, or waiting to undergo their exam. A survey was provided to patients (as well as one to give their referring physicians) to gauge their ISN experience. As of March 2013, 892 patients were enrolled (557 were provided surveys). 154 patients and 81 physicians returned surveys. 93% of patients reported using a computer or the internet for social media/purchases at least weekly. 95% of patients and physicians expressed the need for a patient controlled ePHR, and the ability to view images in a short period of time. 82% of patients and 89% of physicians were either satisfied or very satisfied with ISN in terms of its ease of use and privacy. 33% of patients disagree, strongly disagree, or were neutral that health record privacy is important.

Discussion
Patients and physicians report high satisfaction, although some stated that the online registration process and web interface could be improved. Physician use is difficult to gauge since most patients have a referring physician from the same institution already using the medical center's own online image viewer. A significant number of patients, perhaps more than expected, did not express importance in maintaining privacy of their health records. Underlying selection bias is considered given a relative homogenous computer literate cohort who already believed in the utility of patient controlled ePHRs.

SSM11-02 • DICOM Image Lifecycle Management - Reducing Cost by Applying Rules Based Deletion

Carol L Joseph RN (Presenter)

CONCLUSION
The use of rules based deletion can effectively facilitate the removal of aged images from a DICOM archive. Running rules based deletion enables an archive to be maintained at nearly zero growth. These two actions will significantly reduce the cost of future storage expansion. Sites located in States with complex rules may not be able to enable deletion until vendor solutions mature and a way found to use data not typically in a PACS archive.

Background
Dramatically reducing cost of DICOM image storage is music to an Administrators ears. New imaging studies that are added to a DICOM archive create a cumulative expansion of the server storage size. This produces a continued need to purchase more storage to accommodate the increasing file size. Historically administrators had the ability to delete individual DICOM studies on a single study basis, but the option to delete multiple studies based on rules was not readily available. Managing PACS storage growth, and the associated cost, can be achieved by utilizing rules based deletion. Today there are tools are available to perform rules based deletion but there is little published information on process, outcomes and limitations. The discussion focus will be on the successful outcome and limitations identified when implementing rules based deletion.

Evaluation
Our Health System, located in 23 States and the District of Columbia, has a petabyte of DICOM images stored enterprise wide and an annual growth rate of 230 TB. We identified the vendors that had rules based deletion and selected to work with one that covered the largest amount of images stored. After testing was completed, rules based deletion was used to remove images. The deletion was 100% accurate and opened storage space. Testing also demonstrated the newly opened space can be reused.

Discussion
Performing deletions is dependent the age of studies on the archive and on local regulatory requirements. Many State image retention rules are basic, but others have complex rules that require retention based upon time elapse since the last visit. Such information is not contained in a PACS study, thus a rule cannot be built without adding custom data to the image archive

SSM11-03 • Integration of Globus Online with RSNA Clinical Trial Processor (CTP) for High-throughput Image Data Transfer

Stephen J Granite MS, MBA ; **Dinanath Sulakhe** MS (Presenter) ; **Ravi Madduri** ; **Ian T Foster** PhD ; **Rai Winslow** PhD

CONCLUSION
RSNA's CTP suite already improves data transfer rates for imaging data. Adding Globus to CTP improves the transfer rate even more, allowing more time for physicians to analyze data and improve patient care.

Background
The clinical imaging trials involving images coded according to Digital Imaging and Communications in Medicine (DICOM) standard produce large volumes of data and require sophisticated tools to ensure de-identification, transfer, management and distribution. While RSNA's Clinical Trial Processor (CTP) software suite addresses many of the challenges in handling the imaging data, we present here the development and integration of Globus Online (Globus)-based ExportService within CTP, for a secure, high-throughput data transfer between CTP nodes.

Evaluation
CTP is a tool developed by RSNA that processes and handles data objects in clinical trials in the form of pipelines. The imaging data goes through various

stages (i.e., Import Service, Processors, Storage Services and Export Services). In multi-center clinical image collection projects, CTP's Export Services transfers the DICOM images from the facility producing the images, and CTP's Import Services receives the data at another center. Currently, CTP supports various export services, implemented using HTTP, DICOM-SCP and FTP protocols. We implemented a GlobusExportService (Fig. 1) within CTP that initiates data transfers of DICOM images between two globus online endpoints. Globus leverages GridFTP for high performance transfer of single files and directories. It can manage security credentials; select transfer protocol parameters for high performance; monitor and retry transfers when there are faults, and allow users to monitor status.

Discussion
CTP's HTTP based export service only allows one file transfer at a time (e.g., 500 MB MRI transfer takes 3 hours). The GlobusExportService extends the existing CTP functionalities, collecting all the files from CTP and initiating a bulk transfer using Globus REST API (e.g., same 500 MB transfer takes 2 hours). Thus we preliminarily estimate that the GlobusExportService provides a 33% performance improvement over the existing transfer capabilities of CTP. More tuning may increase performance.

SSM11-04 ● Leveraging 3D Immersive and Collaborative Environments (3D-ICE) to Enhance Interactive Collaboration in the Radiology Workflow

Rohini Pangrikar BEng, MS (Presenter) ; **Sarita S Akolkar**

CONCLUSION
3D-ICE facilitates interactive collaboration in Radiology workflow. It can seamlessly integrate at hospital sites while ensuring secure access and confidentiality of data.

Background
In the Radiology workflow, referring physicians need to interact directly with radiologists to review medical images or critical results. PACS systems facilitate sharing of patient data but do not support interactive collaboration. When interacting remotely, collaborators juggle with image viewing applications, communication equipment and patient reports. This collaboration is error prone and affects quality of patient care. Productive collaboration entails a single environment enabling real-time interactions and easy access to patient data while adhering to healthcare standards.

Evaluation
3D-ICE is increasingly used as a virtual, one stop, cost-effective remote collaboration solution. In 3D-ICE users are represented as human-like 3D *Avatars* capable of interpersonal interactions inside customizable Virtual Workspace (VW). VWs simulate real workspaces aiding interactions with minimal training.
3D-ICE:
•Enables real-time, one-stop collaboration using integrated tools
•Ensures secure access to patient data
•Restricts access to VW preserving data confidentiality
•Supports viewing of 3D-reconstructions
•Is also supported on mobile devices
These features can enhance physicians and radiologists' collaboration while retaining integrity of patient data.

Discussion
3D-ICE can utilize existing infrastructure and integrate into radiology workflow while adhering to healthcare standards:
•Users login to 3D-ICE clients over secure connections(to a secure 3D-ICE server) to enter VW
•Connect to an IHE compliant facility via shared web-browser in VW ensuring access to patient data across enterprises (XDS-I.b) and auditing (ATNA)
•Integrate file sharing systems with VW or drag-drop files in VW for consolidated view of patient data
•Co-view images, reports or share monitor screen using integrated shared applications
•Use 3D cues to point ROI in images for precise reference
•Restrict access to VW or export of data outside VW in compliance with local policies
•Auto-delete VW contents after predefined time ensuring data safety

SSM11-05 ● Always on Virtualization: A Dramatic Improvement for PACS/RIS Applications and Desktops

Craig Dunwoody (Presenter) *

CONCLUSION
Virtual desktop infrastructure (VDI) solutions have been available for many years, but recent technological improvements have now made VDI truly compelling to radiology organizations.

Background
Radiology professionals are facing significant challenges integrating an increasingly complex environment of different devices, operating systems, and applications. Radiology professionals use multiple devices throught their day, resulting in an inconsistent desktop experience. Users must contend with multiple logins, varying hardware configurations, and limited tablet access options. The cost of managing and securing the desktop environment is soaring. Maintaining uptime is critical, but is difficult to achieve, especially in large organizations, when hardware or software refreshes are taking place.

Evaluation
In this paper, I will evaluate these challenges and present a strategy that addresses them. A number of virtualization strategies can support the needs of end users, while making it easier for IT staff to manage and secure appliications and desktop environments. I will evaluate some of the most prominent PACS and RIS applications and the workflows associated with using these tools in the radiology environment. I will then describe use cases for deploying these strategies to workstations and discuss the benefits that are provided to different target users.

Discussion
Managing and securing the high-end workstations with Graphics Processing Units (GPUs) that support diagnostic medical imaging is becoming increasingly challenging, as application and operating system changes are increasingly difficult to implement for IT staff and end-users. The rise of Bring-Your-Own-Device (BYOD) means that multiples devices with different operating systems must be integrated, and the growth of healthcare organizations means that institutions often must share information and images across multiple sites. There are a number of virtualization strategies that can facilitate diagnostic processing time and quality, by helping radiologists reduce downtimes for their workstations, improving the consistency of the user experience, improving remote access, and empowering the use of multiple devices including tablets.

SSM11-06 ● Strategies for Foreign Study Ingestion by a PACS Interfaced to a XDS Affinity Domain

Alain Gauvin MSc (Presenter) * ; **Suzanne Laframboise** RT ; **Greg Ruthman** BSC *

PURPOSE
Ingestion by a local PACS of foreign images is a challenge when importing studies. This work is based on the implantation of a XDS-I.b proxy to allow a PACS to receive pre-fetch priors from other hospitals in a same XDS affinity domain. The coercion of DICOM tags of foreign studies in the context of their ingestion by the PACS needed to be carefully defined. Given that the model was to be used for 6 different PACS technologies, a single automatic ingestion methodology was devised to satisfy all PACS requirements.

METHOD AND MATERIALS
The implementation of the XDS-I.b proxy took place in a center producing about 250 000 studies/year. The XDS registry used in the affinity domain initially allowed the proxy to access studies from 3 different sites. The proxy was able to determine the required pre-fetch set from the HL7 activity of the RIS. Given the modality type and body part of the upcoming study, the required priors were determined by the proxy from a set of pre-defined rules, pulled from their locations, and sent to PACS after the coercion of multiple DICOM tags. The list of coerced tags includes MRN, accession number, institution name, study description and the alphanumerical code of the study. The coercion of the 2 last values of that list was more complex, and was accomplished using logic based on the modality, anatomical code, and keyword detection in the study description of the ingested study. These combined criteria allowed to achieve a granular normalized exam table, comprising more than 170 codes. A simulation tool was set up to allow refining the choice of keyword rules. The normalized codes were configured in the ingesting PACS alongside with the local procedure codes.

RESULTS
The initial daily rate of study intake was on average between 7 and 8, which was expected given that the content of only 3 sites were initially looked up in the XDS registry. That figure was expected to rise to 18 within the following few weeks, and further again over the course of a few months.

CONCLUSION
The implementation of XDS-I in an affinity domain supporting various PACS technologies for the purpose of automatic pre-fetching of prior exams requires careful management of issues related to foreign study ingestion.

CLINICAL RELEVANCE/APPLICATION
It is possible to use the XDS-I.b IHE profile to enhance medical imaging interpretation by increasing the number of priors accessed during reading, as long foreign studies are properly coerced.

Rapid Application Development with XIP™ - the eXtensible Imaging Platform

Wednesday, 04:30 PM - 06:00 PM • S401CD

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ICIA44 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Lawrence R Tarbox , PhD *
Patric Ljung , PhD *
Gianluca Paladini , BEng *

LEARNING OBJECTIVES
1) Learn the basic architecture of an XIP® Application and how it interacts with the XIP Host® and with the GUI system. 2) Become familiar with the capabilities available in the XIP Libraries®. 3) Describe how to use the XIP Builder® and GUI engine to create XIP Applications from modules in the XIP Libraries. 4) Understand the concepts of DICOM Application Hosting and its impact.
ABSTRACT
The eXtensible Imaging Platform (XIP®) is an open source framework supporting rapid development of imaging and visualization applications. In this ®hands on® tutorial participants will dissect a fully functional XIP® application to see firsthand how developers utilize XIP's visual ®drag-and-drop® programming tool (the XIP Builder®) and associated libraries (the XIP Libraries®) in creating applications. In addition to functions from the popular ITK and VTK libraries, the XIP Libraries include modules tailored for medical imaging, many of which are hardware accelerated via GPU programming (e.g., OpenGL® GLSL or OpenCL or CUDA C). Applications created with XIP can either run standalone, or as DICOM Hosted Applications. Through the DICOM Application Hosting interfaces (DICOM WG-23), a Hosting System, such as the XIP Host®, relieves the application developer from the need to re-implement infrastructure common to all applications (e.g. DICOM network connectivity, database, etc.). We will demonstrate how users execute Hosted Applications, such as those created with the XIP Libraries, via the XIP Host.
URL's
http://www.OpenXIP.org

IHE Workflow Efficiency from Acquisition to the Report Attendees

Wednesday, 04:30 PM - 06:00 PM • S501ABC

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ICII44 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Bradley J Erickson , MD, PhD *
Lawrence R Tarbox , PhD *
Bradley J Erickson , MD, PhD *
Curtis P Langlotz , MD, PhD *
Harry Solomon *

LEARNING OBJECTIVES
1) Understand how report templates can improve productivity. 2) Examine how IHE profiles facilitate system interoperability. 3) Learn about the features of the new IHE profile for management of radiology report templates. 4) Review proposed new features for radiology reporting systems.
ABSTRACT
The purpose of this session is to demonstrate how existing and planned IHE profiles can help improve the workflow in a medical imaging department, and help those responsible for its operation, monitor what is happening. Prior IHE profiles focused heavily on traditional RIS and PACS. Newer projects are focused on exchange of images and reports between medical facilities. We will also describe future possible profiles for utilizing RadLex to improve radiologist efficiency. We will also describe workflow terminology in RadLex and describe how that can help manage and improve departmental workflow.

National Library of Medicine PubMed: Free Online Databases: Images and More

Wednesday, 04:30 PM - 06:00 PM • S401AB

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ICIW44 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Holly A Burt

LEARNING OBJECTIVES
1) Identify freely available online image databases and data archives and know their contents and value. 2) Identify freely available online case studies and educational materials. 3) Become familiar with online drug, contrast agents, and other substance databases. 4) Understand basic searching skills across a variety of databases.
ABSTRACT
The National Library of Medicine (NLM) is only one of many agencies which support freely available online databases and data archives. In this hands-on workshop, explore the richness of the online resources for radiographic images and data, imaging tools, drugs and contrast agents, and education (e.g. case studies). Databases covered include PubMed/MEDLINE, the National Cancer Institute®s Cancer Imaging Archive, MedlinePlus.gov and RadiologyInfo for patients and families, plus search engines and portals offering a radiology option. Learn which databases may be the best starting point for your research.

Latest Developments in Meaningful Use: Ask the Experts

Thursday, 08:30 AM - 10:00 AM • E451A

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RC626 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Curtis P Langlotz , MD, PhD *
Keith J Dreyer , DO, PhD *
Michael Peters

LEARNING OBJECTIVES
1) Understand the meaningful use program. 2) Learn how hospitals and health systems have achieved meaningful use for their radiologists. 3) Gain insight into recent and upcoming regulatory changes, and 4) Decide how your practice should respond to the program.

Cloud Computing for Radiologists: A Primer

Thursday, 08:30 AM - 10:00 AM • S403B

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RC630 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Gary J Wendt , MD,MBA *

LEARNING OBJECTIVES
1) Using virtualized systems to improve access to advanced image processing tools. 2) Using cloud based systems to provide access to advanced imaging tools. 3) Getting hands on experience using 2D / 3D / 4D tools to process data in near realtime in a virtual environment. 4) Introduce the basic virtual systems and cloud based systems that are available and how they can be used both within radiology as well as how they apply to referring clinicians from both a image interpretation standpoint as well as their use for teaching.

ABSTRACT
This course will focus on using virtualized systems and cloud based systems to improve access to advanced image processing tools. In addition a focus will be on getting hands on experience using 2D / 3D / 4D tools to process data in near realtime in a virtual environment. It will also introduce the basic virtual systems and cloud based systems that are available and how they can be used both within radiology as well as how they apply to referring clinicians from both a image interpretation standpoint as well as their use for teaching.

RC630A • What is Cloud Computing and What Can It Do For Me?

Fred W Prior PhD (Presenter) *

LEARNING OBJECTIVES
1) Comprehend the basic principles of cloud computing and how this technology might apply to Radiology Information Management. 2) Assess the potential advantages of cloud computing for clinical radiology. 3) Compare the advantages and disadvantages of public, private and hybrid cloud computing environments. 4) Assess the costs, challenges, regulatory issues and security concerns that must be dealt with before this technology can be effectively applied. 5) Be prepared to critically assess the potential applications of cloud computing in your institution.

ABSTRACT
Cloud computing refers to a technology suite that features virtualized processing and storage capacity and a business model where computing resources and software applications are centrally managed and scheduled with the end user renting capacity on demand. Under this model, virtual machines are outfit with requested software packages that are accessed via the Internet. Cloud computing may also be described in terms of privacy and exclusivity along a continuum from widely shared Public Clouds to restricted access Private Clouds. Several critical challenges must be overcome for Public Clouds to be used to support radiology imaging, essentially in place of on-site PACS. Performance, particularly for image visualization and analysis by a radiologist, is a critical requirement. While the data centers that support Cloud computing services have high bandwidth networks internally, the network bandwidth between a radiologist and that data center will not normally be sufficient to support required visualization performance. Simply put, most hospitals focus on internal network performance not connectivity to the Internet. Each covered entity is responsible for ensuring patient privacy and information security. This responsibility would be shared with the Cloud service provider. A Cloud service provider that supports multiple covered entities would be faced, therefore, with a substantial financial risk. Network bandwidth issues would be exacerbated by the additional complexity of ensuring secure data communication with the Cloud provider. These technical challenges essentially disappear if one considers a Private Cloud managed by the hospital system itself. However, Private Clouds also do away with the advantages of outsourcing computing infrastructure and letting a vendor worry about hardware obsolescence and system maintenance. Thus there are trade-offs that must be weighed in a careful cost-benefit analysis of Cloud computing for radiology.

RC630B • Virtualization and Remote Rendering: Enterprise Imaging in the Cloud

Gary J Wendt MD,MBA (Presenter) *

LEARNING OBJECTIVES
1) Using virtualized systems to improve access to advanced image processing tools. 2) Provide an overview of the benefits of using 3D / 4D tools to process data in near realtime in a virtual environment.

ABSTRACT
Introduce the basic virtual systems that are available and how they can be used both within radiology as well as how they apply to referring clinicians from both a image interpretation standpoint as well as their use for teaching

RC630C • Cloud-based Archiving: Opportunities and Challenges

James F Philbin PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the various definitions in play for the term 'cloud' including its compute and storage aspects. 2) Understand the pricing model of at least one cloud storage vendor. 3) Consider the trade-offs of local storage versus cloud storage in terms of: reliability, latency, costs, and scalability.

ABSTRACT
'Cloud Computing' is a highly overloaded and nebulous term in the sense that different people have very different ideas of what it means. To some, it means running applications in someone elses data center, either across town or across the country. To others it means -storing- data in someone else's data center. And in both of the preceding examples, the turnaround time for an expansion of services can be measured in days or minutes, depending upon the underlying technology suite used by that 'cloud' vendor. A conventional storage vendor may require days to honor a request for more storage, whereas vendors relying on logical volume management and virtualization could honor the request in minutes. A well established model of the latter is the approach used by Amazon in its Simple Storage Service (SSS) offering. Amazon was an early adopter of virtualization in cloud methodologies and offers two main lines of products. The Elastic Compute Cloud (EC2) relies on creating made to order virtual machines loaded with the applications the customer requires, and this concept was discussed by an earlier presenter. SSS on the other hand, relies on both virtual storage and logical volume management to grow and shrink storage as a customer requires. This presentation will go into some detail on the pricing model used by Amazon, and describe some metrics to look out for beyond mere cost, including: uptime, latency, security, turn-around-time and hidden costs. The analysis will draw on an earlier work (Langer SG. 'Challenges for Data Storage in Medical Imaging Research', JDI 2011;24(2):203-7. DOI:10.1007/s10278-010-9311-8) to create an evaluation grid useful for comparing across cloud storage vendors - including one's own data center.

Hands-on HL7 Data Manipulation (Hands-on Workshop)

Thursday, 08:30 AM - 10:00 AM • S401CD

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IN

RC653 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Richard J Bruce , MD *
Walter W Peppler , PhD *

LEARNING OBJECTIVES
1) Understand where radiology ordering, scheduling, and reporting workflows utilize HL7. 2) Develop a basic understanding of HL7 messaging principles. 3) Gain introductory hand-on experience with HL7 data manipulation. 4) Understand how HL7 can be used to build functionality in a variety of radiology workflows.
ABSTRACT
HL7 messaging is the foundation upon with many healthcare systems rely for interaction and data exchange.Â Many common radiology functions including order and report transmittal are often dependent on HL7 to function.Â The goal of this hand-on refresher course is to introduce the attendee to HL7 workflows and some of the tools used to build HL7 interfaces and manipulate HL7 data.Â More importantly we hope to show why understanding HL7 can be helpful to radiology practices and show where HL7 can be used to build better radiology workflows.

Advanced Data Analysis with Excel for Research and for Practicing Quality Improvement (Hands-on Workshop)

Thursday, 08:30 AM - 10:00 AM • S401AB

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RS IN

RC654 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Andrea J Frangos , MPH
Jaydev K Dave , PhD, MS

LEARNING OBJECTIVES
1) Describe techniques for creating a spreadsheet to allow trouble-free data analysis. 2) Describe tools for performing basic descriptive statistics. 3) Identify how to perform simple statistical tests. 4) Identify statistical tasks that require more sophisticated software.
ABSTRACT
A spreadsheet program is commonly employed to collect and organize data for practicing quality improvement, for research, and for other purposes. In this refresher course, we will demonstrate
how to create a spreadsheet to allow trouble-free data analysis. We will then review an efficient approach for data collection. With a sample dataset, we will demonstrate how basic descriptive statistics and statistical tests can be performed e.g., t-test, chi-square test, correlation analysis, etc. We will also provide information on other sophisticated software best suited to perform advanced statistical tests and analysis.
This course will accomplish its learning objective through hands-on tutorial demonstrations with Microsoft Excel ® a spreadsheet program. Familiarity with Microsoft Windows and Microsoft Excel environment will be assumed.

Breast Imaging: Interoperability Challenges and Solutions

Thursday, 10:30 AM - 12:00 PM • S501ABC

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IN DM BR

ICII51 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Judith A Wolfman , MD *
Julian Marshall *

Paul Morgan *

LEARNING OBJECTIVES
1) Review the clinical problems once common in the interpretation of digital screening and diagnostic mammograms on vendor-independent and general purpose PACS workstations. 2) Understand the technical solutions provided in the IHE Mammography Image integration profile to those problems. 3) Explore the similar challenges now being faced in the secondary review of Stereotactic Mammography images sets acquired during breast biopsy, while clearly understanding the differences in interpretation requirements. 4) Learn how the new IHE Stereotactic Mammography Image integration profile provides a complete set of solutions to address those challenges. 5) Explore new interoperability challenges presented as Breast Tomosynthesis is adopted. 6) Understand the technical solutions currently available within the DICOM standard that address those challenges, if properly implemented in commercial equipment.
ABSTRACT
The purpose of this session is to review the once prevalent interoperability challenges in Full-Field Digital Mammography acquisition and display that were successfully addressed using the IHE Mammography Image integration profile, and to explore new challenges and solutions in the areas of Digital Stereotactic Mammography (used in breast biopsy) and Breast Tomosynthesis.

Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC®: A Hands On Course

Thursday, 10:30 AM - 12:00 PM • S401AB

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IN ED

ICIW51 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Frederick E Weiss , MD
Krishna Juluru , MD
Mary R Wyers , MD

LEARNING OBJECTIVES
1) Learn how easy it is to install the new and improved RSNA teaching file software with the one-click installer. 2) Learn how to create, organize, and share teaching files, create conference documents and save interesting cases for yourself, your group or your department.

Breast Imaging (CAD/Quantitative Imaging)

Thursday, 10:30 AM - 12:00 PM • E450A

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IN MR DM BQ BR

SSQ02 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Despina Kontos , PhD
Moderator
Jennifer A Harvey , MD *
Moderator
Christopher E Comstock , MD

SSQ02-01 • Computer Derived Texture Features on DCE-MRI Can Separate ER+ Breast Cancers with Low and High Oncotype DX Scores

Tao Wan PhD (Presenter) ; **Boris N Bloch** MD ; **Donna M Plecha** MD * ; **Cheryl Thompson** BS ; **Hannah Gilmore** ; **Norbert Avril** MD ; **C. Carl Jaffe** MD ; **Lyndsay Harris** MD ; **Anant Madabhushi** MS *

PURPOSE
Oncotype DX (ODX) is a gene-expression based assay for predicting response to hormonal therapy in estrogen receptor positive (ER+) breast cancers (BCa) patients. The goal of this study was to identify whether computer derived texture features on DCE-MRI can distinguish low and high ODX scores (i.e. ER+ BCa patients who would and would not benefit from adjuvant chemotherapy), thereby providing a non-invasive pertherapeutic gene-expression assessment tool predicting tumor treatment response.

METHOD AND MATERIALS
A total of 57 ER+ BCa patient studies were collected, in which 21 breast MRIs were acquired from a Phillips 1.5T magnet with a 7-channel breast coil, and 36 MRIs were acquired using a Siemens 1.5T magnet with a 8-channel breast coil, including DCE images obtained prior to, during, and after administration of 0.1 mmol/kg of Gd-DTPA. Each study was accompanied by: i) lesion annotations from an expert radiologist; and ii) ODX scores. A set of 6 morphological features, 3 pharmacokinetic features, 12 enhancement kinetic features (EKF), 12 intensity kinetic features, 312 textural kinetic features, 6 dynamic local binary patterns (DLBP), and 5 dynamic histogram of oriented gradients (DHoG) features were extracted and used to characterize the appearance of the breast lesions. The computed features were evaluated by a linear discriminate analysis (LDA) classifier in terms of their ability to distinguish ER+ BCa with low or high ODX scores via a 2-fold randomized cross validation scheme.

RESULTS
The DHoG, DLBP, and EKF texture features yielded AUC values of 0.85, 0.82, and 0.80 in conjunction with the 2-class LDA classifier for separating low and high ODX ER+ breast lesions.

CONCLUSION
This work to our best knowledge, the first attempt to quantitatively correlate texture measurements on DCE-MRI to patient outcome prediction via the ODX assay. Our results suggested that the DHoG, DLBP, and EKF were robust and stable DCE-MRI markers in distinguishing between low and high ODX scores.

CLINICAL RELEVANCE/APPLICATION
An MRI-based assay to identify ER+ BCa patients that could non-invasively predict which patients would benefit from adjuvant chemotherapy, and could serve as a complement to Oncotype DX assay.

SSQ02-02 • Computerized Characterization of Mass and Non-mass-Like Lesions on Breast MRI

Hui Li PhD (Presenter) ; **Maryellen L Giger** PhD * ; **Li Lan** ; **Sunny Y Duan** ; **Stephan Hu** ; **Gillian M Newstead** MD * ; **Hiroyuki Abe** MD ; **Michelle Lindgren** MD

PURPOSE
To investigate the potential usefulness of quantitative imaging analysis on characterizing both mass and non-mass-like enhancement breast lesions in the task of distinguishing between malignant and benign lesions

METHOD AND MATERIALS
Study was performed on 123 biopsy-proven lesions from 103 MRI studies acquired between January 2009 and April 2010, including 35 benign mass, 50 malignant mass, 11 benign non-mass-like and 27 malignant non-mass-like lesions. Our quantitative imaging analysis method incorporated computerized 3D lesion segmentation and feature extraction, including kinetic, enhancement-variance kinetic, morphological, size, and texture features. Output from the system yielded the probability of malignancy from a Bayesian artificial neural network (BANN). Classification performance was evaluated with a leave-one-case-out method using ROC analysis with area under the ROC curve as the figure of merit.

RESULTS
For mass lesions, the kinetic features of time to peak and curve shape index statistically differed between malignant and benign lesions. However, kinetic features did not contribute significantly in the diagnostic task with non-mass-like breast lesions. By merging computer-selected features with BANN classifiers, AUC values of 0.88 (SE=0.03), 0.95 (SE=0.02), and 0.82 (SE=0.08) were obtained in the task of distinguishing between malignant and benign lesions on the entire dataset, between malignant and benign mass lesions, and between malignant and benign non-mass-like lesions, respectively.

CONCLUSION
Kinetic characteristics are useful in differentiating malignant from benign mass lesions; however, their performance is reduced when the lesions are non-mass-like. Thus, quantitative analysis for diagnostic decision-making should be performed separately on mass and non-mass-like lesions.

CLINICAL RELEVANCE/APPLICATION
In order to improve clinical diagnostic accuracy, quantitative analysis for diagnostic decision-making should be performed separately on mass and non-mass-like lesions in the classification task.

SSQ02-03 • Use of Quantitative 3D Breast Image Analysis to Inform DCIS Staging

Stephanie M Burda (Presenter) ; **Maryellen L Giger** PhD * ; **Li Lan** ; **Kathy Rodogiannis** ; **Hui Li** PhD ; **Gillian M Newstead** MD * ; **Ken**

Yamaguichi ; **Koichi Ishiyama** MD ; **Hiroyuki Abe** MD ; **Michelle Lindgren** MD ; **Adam Starkey**

PURPOSE

Uncertainty on which ductal carcinoma in situ (DCIS) cases will progress to invasive breast cancer currently results in overtreatment. Our purpose was to discern quantitative characteristics of pure DCIS, DCIS with an invasive component, and invasive cancers without DCIS to inform prognosis of patients with lesions presenting initially as DCIS.

METHOD AND MATERIALS

Retrospective, IRB-approved review of our radiology database 2005-2012 identified 303 pathology-proven cancers with correlative MR imaging. Histology yielded 54 pure DCIS lesions, 56 with both DCIS and invasive pathology, and 193 invasive cancers without DCIS. Quantitative 3D image analysis yielded morphological, kinetic, and texture lesion descriptors following semi-automated lesion segmentation. ROC analysis was performed on these image-based phenotypes comparing pure DCIS lesions, DCIS lesions with an invasive component and invasive cancers without an in situ component.

RESULTS

The combination of features that best distinguished pure DCIS from invasive cancer included kinetic feature time to peak, texture features of contrast and correlation, and morphological features of circularity, margin, and surface area. The combination of features that was best able to distinguish pure DCIS from invasive cancers with a DCIS component included contrast, margin, and ratio of surface area to volume. The margin characteristics (determined by spiculation and sharpness) and contrast (the difference between the average gray level of the cancer and the surrounding area) were found to be insightful in both comparisons. Time to peak was also significant in the comparison of Pure DCIS and invasive cancers, yielding an AUC value of 0.77. Round-robin evaluation of an LDA yielded AUCs of 0.85 and 0.74 distinguishing pure DCIS from invasive cancers and invasive cancers with a DCIS component, respectively.

CONCLUSION

Image-derived quantitative phenotypes, which indicate a likelihood of invasive disease of pure DCIS, could patient guide management of DCIS lesions, thus potentially reducing overtreatment.

CLINICAL RELEVANCE/APPLICATION
Image-derived quantitative phenotypes, which indicate a likelihood of invasive disease-of pure DCIS, could patient guide management of DCIS lesions, thus potentially reducing overtreatment.

SSQ02-04 ● Undetected Breast Cancers on Commercial Breast MRI CAD (Computer-aided Detection) System

Chae Hyun Kim (Presenter) ; **Seon Hyeong Choi** ; **Ji Yeon Park** ; **Yoonjung Choi** MD ; **Shin Ho Kook** MD

PURPOSE
To evaluate the immuno-histological factors of breast cancer not detected on breast MRI CAD system.

METHOD AND MATERIALS
The study included 327 preoperative breasts MRI of histologically proven breast cancer from July 2011 to February 2013. We retrospectively reviewed the MRI CAD results, corresponding immune-histopathologic features, lesion size and age to determine factors affecting MRI CAD detectability. We categorized tumors into two groups: detected and undetected groups.

RESULTS
Of the 327 cases, the CAD system marked 259 (79.2%) lesions correctly and 68(20.8%) were undetected on breast MRI CAD. The mean size and age were 18 mm (range:1-70) and 50.0 yo (SD:9.9) in the undetected group and 22.8 mm (range: 3-120) and 51.4 yo (SD: 10.7) in the detected group. Detectability rates for IDCs, DCIS were 86.7% (208 of 240) and 44.6 % (25 of 56), respectively. The tumor type was a significant (p
CONCLUSION
Though the commercial breast MRI CAD system showed good performance, about 20% of breast cancers were not detected on MRI CAD. DCIS, low nuclear grade, low Ki-76 percentage, and HER-2 negative influenced the breast MRI CAD detectability in breast cancer patients.

CLINICAL RELEVANCE/APPLICATION
DCIS, low nuclear grade, low Ki-67, and HER-2 negative can influence CAD detectability. So, radiologist should check immunohistologic profiles and original images when interpreting breast MRI CAD.

SSQ02-05 ● Immunohistological Factors Affecting the Breast Cancer Size Measurement by MRI Computer-aided Detection (CAD) System

Ji Yeon Park (Presenter) ; **Seon Hyeong Choi** ; **Yoonjung Choi** MD ; **Chae Hyun Kim** ; **Shin Ho Kook** MD

PURPOSE
To investigate immunohistological factors affecting the breast tumor size measurement discrepancy between the MRI CAD and the pathologic specimen.

METHOD AND MATERIALS
We retrospectively reviewed the 244 cases of breast MRI CAD images and pathologic findings of the 244 patients who underwent operation for breast cancer between July 2011 and December 2012. We compared the CAD generated tumor size with tumor size measured on pathologic specimen. We classified the tumors into three groups: underestimated, adequately measured and overestimated group. We investigated the statistical difference in histopathology including histologic type, presence of DCIS, extensive intraductal component, nuclear grade, ER, PR and HER-2, among the 3 groups.

RESULTS
Median tumor size on CAD and specimen were 20 mm (2-163 mm) and 17 mm (0.8-82 mm), respectively. Adequately measured group was 68.6% (n=168). Invasive ductal carcinoma (IDC) showed significantly more adequate measurement, compared with DCIS (p=0.025). Among IDC, the presence of extensive intraductal component was significantly higher in overestimated group (p
CONCLUSION
Size assessment using breast MRI CAD was accurately measured in 68.6%. On MR CAD, breast cancer size was frequently overestimated in cases of DCIS, the presence of extensive intraductal component, and HER-2(+).

CLINICAL RELEVANCE/APPLICATION
Accurate tumor size measurement is critical to surgical plan for breast conservation.
Size assessment by breast MRI CAD is accurate but it can be overestimated in cases of DCIS, EIC, and HER-2(+).

SSQ02-06 ● Quantitative MRI-based Phenotypes of Triple Negative Breast Cancers

Hui Li PhD (Presenter) ; **Maryellen L Giger** PhD * ; **Li Lan** ; **Hiroyuki Abe** MD ; **Michelle Lindgren** MD ; **Eric M Blaschke** MD ; **Gillian M Newstead** MD *

PURPOSE
To investigate the potential usefulness of quantitative image analysis on characterizing the molecular subtypes of breast cancer in order to better understand the difference between triple negative and other molecular subtypes of breast cancer

METHOD AND MATERIALS
Study was performed on 168 biopsy-proven breast cancer MRI studies acquired between November 2008 and August 2011, in which 40 cases were triple negative (ER-, PR-, and HER2-) breast cancers and 128 cases were of other molecular subtypes including Luminal A, Luminal B, and HER2. Quantitative MRI analysis included: 1) 3D lesion segmentation based on a fuzzy c-means clustering algorithm; 2) computerized feature extraction; 3) leave-one-out linear stepwise feature selection; and 4) discriminant score estimation using Linear Discriminant Analysis (LDA). The classification performance between triple negative and other molecular subtypes of breast cancer was evaluated using ROC analysis with area under the ROC curve (AUC) as the figure of merit.

RESULTS
The triple negative classification, in a round-robin evaluation, yielded AUC values of 0.90 (SE=0.05) and 0.67 (SE=0.05) on 3T and 1.5T MR scanners, respectively, in the task of distinguishing between triple negative and other molecular subtypes, statistically significantly higher than an AUC value of 0.5 (p-value
CONCLUSION
The results from this study indicate that quantitative MRI analysis shows promise in the discrimination of triple negative breast cancer from other molecular subtypes of breast cancer.

CLINICAL RELEVANCE/APPLICATION
Identification of the molecular subtypes of breast tumors is expected to allow for improved prognostic assessment and more effective cancer treatment plans.

SSQ02-07 ● Features of Undiagnosed Breast Cancers at Screening Breast MRI: Potential Utility and Limitation of Computer-aided Evaluation

Mirinae Seo MD (Presenter) ; **Nariya Cho** MD ; **Min Sun Bae** MD, PhD ; **Eun Bi Ryu** MD ; **Jung Min Chang** MD ; **Hye Ryoung Koo** MD ; **Su Hyun Lee** MD ; **Won Hwa Kim** MD, MS ; **Woo Kyung Moon** ; **Hye Mi Gweon** MD ; **A Jung Chu** MD

PURPOSE

To evaluate the features of undiagnosed cancers at prior screening breast MRIs in patients who subsequently developed breast cancers and the potential utility and limitation of computer-aided evaluation (CAE).

METHOD AND MATERIALS
Between March 2004 and March 2013, 65 pairs of dynamic contrast enhanced breast MRIs including prior negative screening MRIs and subsequent MRIs with developed cancers (mean interval 36.5 months, range 5.4 – 96.7 months) were identified. The mean histological sizes of developed cancers was 2.0cm (range 0.5 - 9.5 cm) for invasive cancers (n=44) and 1.9cm (range 0.5 - 4.1 cm) for DCIS (n=21). Visible findings, their maximum lesion size and actionability, as well as causes for overlooked cancers on prior MRI were determined and classified by two experienced radiologists in consensus. A commercially available CAE program was retrospectively applied to the prior MRIs with visible findings for generation of kinetic features including washout, plateau, and persistent enhancement proportions. Presence of a washout component on CAE was also described.

RESULTS
Of the 65 areas where cancer later developed, 51% (33 of 65) of prior MRIs had visible findings and their mean lesion size was 1.0cm (range 0.4 - 5.2 cm). Of these visible findings, 24% (8 of 33) were classified as actionable and 76% (25 of 33) as underthreshold. Causes for actionable findings were mimicking of physiologic enhancement (n=3), mismanagement after benign results of biopsy (n=3), and satisfaction of search (n=2). Those of underthreshold findings were small lesion size (n=6), moderate to marked background parenchymal enhancement (n=11), mimicking of post-op scar (n=7), and peripheral location (n=1). Twenty three of the visible findings were available for CAE and the washout component was found in 14. However, 4 of 14 lesions with a washout component were not marked due to marked background enhancement with multiple enhancing lesions with a washout component. CAE did not show the washout component in 9 of 23 lesions.

CONCLUSION
On prior screening breast MRIs in which cancer later developed, 51% (33 of 65) had visible findings (24% actionable, 76%underthreshold). The addition of CAE has the potential to identify 43% (10 of 23) of overlooked findings. Yet, there are still some limitations on CAE.

CLINICAL RELEVANCE/APPLICATION
When an enhancing lesion shows a washout component on MR-CAE of screening breast MRI, closer attention is warranted.

SSQ02-08 • Evaluation of a Commercial CAD System for Detecting Lesions at Breast Digital Tomosynthesis

Lia Morra PhD * ; **Silvano Agliozzo** PhD * ; **Luca A Carbonaro** MD * ; **Manuela Durando** (Presenter) ; **Barbara Pesce** MD ; **Giovanna Mariscotti** ; **Alberto Bert** PhD *

PURPOSE
To evaluate the performance of a commercial computer aided detection (CAD) system (CAD BREAST DTS, im3D S.p.A.) for detecting lesions at digital breast tomosynthesis (DBT) on an independent testing set.

METHOD AND MATERIALS
The CAD system was retrospectively tested on a set of 143 patients. Craniocaudal (CC) and mediolateral oblique (MLO) DBT projections were acquired with a Hologic Selenia Dimensions system and reconstructed with the Briona library (Real Time Tomography LLC). All patients signed an informed consent form. A total of 80 histologically confirmed malignant lesions (57 masses, 18 microcalcification clusters and 6 masses with associated microcalcifications) were detected and annotated by experienced radiologists who drew a 3D bounding box around each lesion view. CAD BREAST DTS yields both masses and microcalcification clusters candidates. For masses, a CAD true positive was registered when the CAD marking overlapped by at least 20% the radiologists marking; for microcalcification clusters, when at least two of the microcalcifications identified by CAD fell within the radiologists marking. A CAD false positive was registered in all other cases, to avoid chance matchings. Masses with associated microcalcifications were considered correctly identified if CAD marked at least a mass or a microcalcification cluster.

RESULTS
At the selected operating point, per-lesion sensitivity was 89% (95% C.I. 80-94%). The system detected 48/56 masses, 17/18 microcalcification clusters and 6/6 masses with microcalcifications. Mean number of false positives per view was 2.8 ± 1.9 (mean ±standard deviation), of which 2 were marked as masses and 0.8 as microcalcification clusters.

CONCLUSION
The DBT CAD sensitivity is comparable to that observed for 2D digital mammography CAD systems, with a fairly low number of false positives per view. Further work, especially on difficult cases such as screening interval cancers, and comparing reading with and without CAD, is needed to understand its role in clinical practice.

CLINICAL RELEVANCE/APPLICATION
A commercial CAD system for masses and microcalcification clusters detection is evaluated on an independent testing set.

SSQ02-09 • Quantitative MRI Morphological Features of Breast Cancer: Correlation with Immunohistochemical Biomarkers and Subtypes

Min Sun Bae MD, PhD (Presenter) ; **Mirinae Seo** MD ; **Woo Kyung Moon** ; **Nariya Cho** MD ; **Jung Min Chang** MD ; **Hye Ryoung Koo** MD ; **Won Hwa Kim** MD, MS ; **Su Hyun Lee** MD ; **Hye Mi Gweon** MD

PURPOSE
To investigate the correlation of the tumor roundness measured quantitatively at contrast-enhanced magnetic resonance imaging (MRI) and immunohistochemical biomarkers and subtypes in breast cancer.

METHOD AND MATERIALS
After IRB approval, we retrospectively reviewed 280 consecutive women (median age, 50 years; range, 28-79 years) with 282 invasive breast cancers (< 5 cm size). All patients underwent preoperative breast MRI. Images were assessed independently by the two radiologists who were unware of pathological findings. Tumor roundness was measured quantitatively by a software developed in-house and was calculated according to the following equation: roundness = 4? x A / P2 (A is the cross-sectional area of the tumor and P is the measured perimeter length of the tumor). The means of values measured by the two observers were recorded and interobserver variability was calculated. Associations between the tumor roundness (1-100 %) and biomarker (estrogen receptor [ER], progesterone receptor [PR], HER2, and Ki67) features were evaluated using Pearson's correlation coefficient and a multiple linear regression analysis. Tumor roundness was compared between breast cancer subtypes (luminal A, luminal B, HER2-enriched, and triple-negative).

RESULTS
Interobserver agreement for MRI measurements was moderate with intraclass correlation coefficients of 0.75 (95% confidence interval: 0.67-0.80). A moderate inverse correlation was observed between the ER score and tumor roundness (-0.408, P < .0001). PR score, Ki67 index, and tumor grade correlated with the tumor roundness (P < .0001). In multiple linear regression, ER score (P < .0001) and Ki67 index (P = .003) were independent factors determining tumor roundness. Triple-negative tumors showed the highest mean roundness score compared with other subtypes (67.3 for triple-negative vs. 55.9 for HER2-enriched, 53.8 for luminal B, and 51.7 for luminal A; P < .0001).

CONCLUSION
Tumor roundness measured quantitatively at MRI correlated with ER score and Ki67 index in breast cancer. Triple-negative tumors showed the highest mean roundness score compared with other subtypes.

CLINICAL RELEVANCE/APPLICATION
Our data may have implications for possibly stratifying breast cancer patients with different clinical outcomes by using MRI morphological features.

ISP: Informatics (Results and Reporting)

Thursday, 10:30 AM - 12:00 PM • S403A

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IN

SSQ11 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Scott Leroy Duvall , PhD *
Moderator
Gary H Danton , MD, PhD

SSQ11-01 • Informatics Keynote Speaker: The Role of Natural Language Processing in Reporting
Scott Leroy Duvall PhD (Presenter) *

SSQ11-02 • Conforming to Best Practice Standards: Development of a Software System to Provide Radiologists with Point-of-Care Decision Support for Recommendations

Tarik K Alkasab MD, PhD (Presenter) ; **H. B Harvey** MD, JD ; **David A Rosman** MD * ; **Keith J Dreyer** DO, PhD * ; **Daniel I Rosenthal** MD ; **Giles W**

Boland MD

CONCLUSION
Point-of-care CDS software tools can efficiently assist radiologists in the real-time application of standard imaging algorithms to achieve best practices.

Background
Evidenced-based algorithms exist that guide radiologists to make appropriate report recommendations. Yet, we have separately presented data suggesting poor compliance with these best practice guidelines. To address this problem, we have developed a workstation-integrated, point-of-care Clinical Decision Support (CDS) system that guides radiologists in applying best practices.

Evaluation
The CDS system is activated by radiologists when clinically appropriate and assists the radiologist to use structured descriptions and standardized recommendation language that conform to evidence-based guidelines. The system consists of three layers. First, at the server layer, a database-backed web application applies criteria-driven algorithms to case-specific imaging findings and applicable patient information, such as demographic data and clinical context extracted from the RIS and voice recognition system. Second, a client layer runs within a web browser to mediate the radiologist interaction with the system. Finally, a 'glue' layer integrates the system with the voice recognition software and inserts the standardized language into the "Findings", "Impression", and a separate "Recommendation" field. For the pilot trial, we deployed this CDS system on a subset of workstations in our abdominal imaging division and limited the application of the tool to consensus-backed criteria for adrenal and pulmonary nodules. Over the 23 week trial, radiologists used the tool to generate recommendations 330 times. Users reported that the CDS tool facilitated appropriate application of imaging criteria without negatively impacting efficiency.

Discussion
Point-of-care CDS software tools can efficiently assist radiologists in the real-time application of evidence-based algorithms and can be integrated into the reporting workflow. We expect that use of the tool will increase as more criteria-based algorithms are applied, resulting in improved consistency and accuracy of radiologist recommendations.

SSQ11-03 ● Development of the ViSion Ontology for Structured Reporting

David J Vining MD (Presenter) * ; **Usama I Salem** MBBCh, MSC ; **Cihan Duran** MD ; **Cristian Popovici** * ; **Andreea Pitici** * ; **Liming Jiang** MD ; **Chengqian Xuanzi** MD

CONCLUSION
ViSion is a multimedia structured reporting system that has the potential to become a global solution with its ability to operate in multiple languages and to provide an inexpensive method for coding radiologic observations/diagnoses for use in medical informatics applications.

Background
We describe an integrated ontology authoring tool that is used in a multimedia structured reporting solution, called ViSion, which is capable of automatically translating radiology reports to any language and coding reports for billing and data mining.

Evaluation
We developed a multimedia structured reporting solution, called ViSion, which allows a radiologist to capture key images, tag those images with metadata describing anatomical locations and radiological observations/diagnoses, and assemble a multimedia structured report with image findings organized by anatomical categories. The metadata used to tag image findings has been developed and maintained with an integrated ontology authoring tool. The anatomical terms in the ViSion ontology are organized in a hierarchy for each body section, and each anatomical term in this structure is associated with a pathology tree containing radiologic observations and diagnoses for that anatomical site. The pairing of an anatomy location with a radiologic observation/diagnosis comprises a specific diagnosis. Each diagnosis can be further described with secondary characteristics that provide granular detail. This ViSion ontology and its tree structures were assembled in English, but the ontology has been translated to multiple foreign languages including Chinese and Arabic. Furthermore, all of the diagnoses contained in the ViSion ontology have been crossed-referenced to other standardized medical ontologies (e.g., RadLex, SNOMED, ICD-10-CM) to facilitate data mining and electronic billing operations.

Discussion
The ViSion ontology has been created and is maintained by an authoring tool integrated with the system. The ontology currently consists of 918 anatomy terms and 1424 pathology terms that combined form 12,046 unique observations/diagnoses. Each of the terms has been translated to foreign languages and cross-referenced to other standardized ontologies.

SSQ11-04 ● Structured Radiology Reports Are More Complete and More Effective than Unstructured Reports

Peter A Marcovici MD (Presenter) ; **Catherine Stamoulis** PhD ; **Stephan D Voss** MD, PhD ; **George A Taylor** MD

CONCLUSION
Structured chest radiograph reports were rated to be more complete and more effective than unstructured chest radiograph reports, and calculated to be globally of higher quality.

Background
Radiology report completeness and effectiveness are important aspects of quality. Unstructured reporting involves dictating in a free-text manner, customizing content to each case. Structured reporting aims to standardize format and lexicon, which may increase completeness and/or effectiveness. Structured reporting may improve the communication of findings made, and may also improve the nature of exam interpretation itself. The goal of this study was to compare unstructured and structured chest radiograph reports, in terms of their completeness and effectiveness.

Evaluation
This study was approved by the institutional review board. Following an educational lecture on the background of structured reporting, radiology trainees were provided with a chest radiograph structured reporting template. For each of the twelve trainees who completed the study, five randomly selected unstructured and five randomly selected structured chest radiograph reports were independently scored by four blinded physicians raters. Structured reports were rated as more complete than unstructured reports, on a 5-point scale (mean 4.42, SD 0.24 versus 3.99, SD 0.35, p
Discussion
This study blindly compared 60 unstructured to 60 structured chest radiograph reports, in terms of their completeness and effectiveness. Structured reports were found to be more complete and more effective, as well of overall higher quality. The use of structured reports may improve the communication of findings perceived by the radiologist. The use of structured reporting templates may also improve exam interpretation, converting it from a largely intuitive process, to one that is cognitively more rational.

SSQ11-05 ● Automatic Integration of Joint Commission-required Critical Results Auditing into Institutional Peer Review Using a Software Tool

Tarik K Alkasab MD, PhD (Presenter) ; **H. B Harvey** MD, JD ; **Gloria M Salazar** MD ; **Daniel I Rosenthal** MD ; **G. Scott Gazelle** MD, PhD *

CONCLUSION
We have created and deployed a tool to integrate critical results auditing into the peer review efforts in our large, academic department. The process, as implemented, meets the regulatory requirements of the Joint Commission.

Background
To address compliance requirements and ensure the quality and consistency of non-routine communication for critical results in our department, we sought to integrate critical results auditing into our department's on-going process of peer review. We created and deployed add-ons to the COGR software tool to seamlessly integrate routine critical results auditing.

Evaluation
Our departmental peer review process, known as consensus oriented group review (COGR), involves groups of radiologists regularly meeting to review randomly selected cases and record consensus on the acceptability of the issued report, supported by a software tool. The COGR software tool accesses data from the department's radiology information system (Centricity, GE Healthcare) and PACS workstations (Impax; AGFA Healthcare). We extended the COGR software tool to integrate additional case-specific questions regarding critical results reporting including, whether a critical result was present in the report and, if so, whether institutional guidelines for critical results communication were followed. Department administrators are able to generate automated reports to document compliance with critical results auditing requirements as needed.

Discussion
The software tool has enabled our department to perform regular critical results auditing as an automatic component of group peer review. The described model posed the critical results questions in association with every case undergoing peer review from July 2012 through March 2013, resulting in over 5,000 cases audited across all divisions. The current system engages radiologists to detect critical results and assess the appropriateness of the timing and method of non-routine communication, per Joint Commission requirements. Recognizing the unique value of a group of radiologists engaged in peer review, we hope to use this model to implement other types of auditing questions without unduly weighing down the peer review process.

SSQ11-06 ● Application of ViSion Structured Reporting for C-RADS Reporting of CT Colonography Examinations

David J Vining MD (Presenter) * ; **Thomas Yang** MD ; **Usama I Salem** MBBCh, MSC ; **Andreea Pitici** * ; **Cristian Popovici** * ; **Adrian Prisacariu** * ;

Iulian Aghenitei * ; **Mihai Jurca** ; **Radu Rosu** *

CONCLUSION
The practice of radiology is undergoing a transition from narrative reporting to structured reporting. We have developed a unique structured reporting solution that has been modified for use in reporting CTC examinations. A benefit of structured data output is that it can facilitate data entry into national data registries such as the ACR's CTC Data Registry.

Background
Standardized reporting of CT Colonography (CTC) results is essential for the effective communication of diagnostic results and to support the American College of Radiology's (ACR) CTC Data Registry. Various image display and manipulation systems exist for analyzing CTC image data, but apart from coding the results of these examinations with C-RADS criteria, no standardized reporting method exists today. We present a multimedia structured reporting solution, called ViSion, which it is applicable to CTC and can be used to facilitate data entry into the ACR's CTC Data Registry.

Evaluation
We developed a multimedia structured reporting solution, called ViSion, which performs screen captures from any CTC image processing system and tags those key images with metadata describing anatomical locations, radiologic observations, and disease metrics. The ViSion software runs in parallel with the CTC program to perform screen captures of the 3D rendered images and to record the radiologist's voice descriptions of the image findings. The screen capture and voice data are uploaded to a cloud-based server where it was processed to extract metadata from the voice descriptions to tag the key images in a database. The ViSion system organizes the findings onto a graphic of a patient illustrating where particularly lesions were found in relation to the patient's anatomy. We have modified the output of the ViSion reporting system to facilitate the automatic uploading of structured data into the ACR's CTC Data Registry.

Discussion
We applied the use of ViSion to 75 CTC cases performed at our institution to generate structured reports that were then used to upload data into the ACR's CTC Data Registry.

SSQ11-07 ● Measuring How Perceived Meanings of Uncertainty Cues Differs with and without Sentence-level Context in Radiology Reports

Brian E Chapman PhD (Presenter) ; **James Y Chen** MD * ; **Asako Miyakoshi** MD ; **Wendy Chapman** PhD ; **Amilcare Gentili** MD

CONCLUSION
Showing radiologists the cues in context did not significantly change their probability assignments, overall. However, assertion cues changed more than negation cues. Evaluating probability assignments for lexical assertion, negation, and uncertainty cues may not require displaying the cues in context.

Background
Understanding how uncertainty is expressed in radiology reports is a critical task for natural language processing applications. pyConTextNLP is a natural language processing (NLP) package that uses predefined cues to determine whether a finding is negated, asserted, or uncertain. We measured how radiologists understanding of these cues differed when presented without context and with sentence-level context.

Evaluation
We created a set of 241 linguistic cues from pyConTextNLP and from translations from a Swedish corpus. Sentences containing the cues were identified in a separate corpus of 4727 de-identified CTPA reports. Focusing on the Impression section, we randomly selected up to five sentences containing the cue, resulting in 321 sentences containing cues modifying findings. Three radiologist assigned the probability of the finding's existence based on the sentence. The radiologists had previously provided probabilities (single-point and ranges) for each cue isolated from contextual information. We measured inter-radiologist discordance scores between contextual and non-contextual probability assignments and between single-point probabilities and probability ranges.

Discussion
There was an insignificant positive shift of 0.024 in probabilities when viewed in context (paired t-test, p=0.35). Cues that showed high disagreement among radiologists when viewed without context also showed high intra-radiologist inconsistency when viewed in context (Pearson's R=0.36,p=0.0006). Assertion cues changed more than negation cues when seen in context (Pearson 0.26, p=0.016).

SSQ11-08 ● Rapid Creation of a Structured and Itemized Radiology Report from a Brief and Disorganized Dictation

John Stewart MD (Presenter)

PURPOSE
To automatically convert a brief, disorganized radiology report into a high quality structured and itemized radiology report. This reduces dictation time while allowing the radiologist to focus their attention on the images under review rather than on the text of the dictation.

METHOD AND MATERIALS
A very brief header is inserted at the top of the dictation. The radiologist then dictates a report which consists of only pertinent positive and pertinent negative findings. Each finding is placed on a line by itself to aid in report processing. The order of the findings is not important. The use of macros is allowed but not required. No negative findings are dictated unless they are pertinent negative findings. The radiologist uses two simple keywords while dictating. If no keyword is inserted at the end of a finding, the finding is considered incidental and not included in the impression. Otherwise the finding is either copied into the impression or new text is dictated for the impression which pertains to this finding. In this way, the finding section and impression section are created simultaneously. Once the brief, keyword-encoded report is dictated, the software processes the dictation on a line-by-line basis using anatomic queues to determine if the finding belongs to a particular organ system. The best practices radiology report templates provided by the RSNA Radiology Reporting Initiative are used to create the structure of the report and the RadLex lexicon is followed for any non-dictated normal findings which are automatically inserted. An error check is performed on the final report and the radiologist is warned if a possible error is found (such as laterality errors) or if the report does not contain certain reporting requirements.

RESULTS
The ratio of dictated text to the text present in the final report (D/R ratio) is less than 50% for most reports. For reports with few or no pertinent findings the D/R ratio is less than 10%. This reduces dictation effort and increases report quality through the creation of standardized and itemized reports.

CONCLUSION
The software described significantly increases radiologist efficiency and report quality and is compatible with almost any speech recognition or word processing application.

CLINICAL RELEVANCE/APPLICATION
High quality standardized and itemized reports can be created without decreasing radiologist efficiency or distracting them from the review of images.

SSQ11-09 ● Radiologic Measurement Dictation and Transcription Error Rates in RECIST (Response Evaluation Criteria In Solid Tumors) Clinical Trials: A Limitation of the Radiology Narrative Report to Accurately Communicate Quantitative Data

Merlijn Sevenster PhD * ; **Paul J Chang** MD (Presenter) * ; **Jeffrey Bozeman** BA ; **Andrea Cowhy** BS ; **Joost Peters** * ; **Manish Sharma** MD ; **Adam R Travis** MD ; **Will Trost** BA ; **Lauren Wall** MS

PURPOSE
Image-based tumor measurements are generally performed by radiologists and reported using dictation software into a narrative report. At many institutions, lesion measurements are then manually transcribed by oncology personnel into worksheets that are used to compute treatment response. We aim to quantify measurement dictation and transcription error rates and the extent to which such errors impact treatment response computation.

METHOD AND MATERIALS
RECIST worksheets for over 100 patients were obtained. For every worksheet, and for each index lesion in each study recorded in the worksheet, we inspected the original measurement on the source image exam and then compared it to the radiologist-reported measurement and to the worksheet measurement. A discrepancy between the source image lesion measurement and the reported measurement was counted as a radiologist dictation error, while a discrepancy between the reported measurement (from the radiology report) and the oncology worksheet measurement was counted as an oncology transcription error.

RESULTS
A preliminary study of 12 RECIST worksheets comprising 58 exams and 155 measurements found 7 dictation errors (4.5%, CI: 1.8-9.1%), 4 of which were in the critical dimension (2.6%, CI: 0.7-6.5%) (long axis for tumors; short axis for lymph nodes). 3 out of these 4 dictation errors were propagated in transcription; 1 dictation error was corrected. 7 correctly dictated measurements were incorrectly transcribed (4.5%, CI: 1.8-9.1%]). In total, 10 measurements were incorrectly dictated and/or transcribed in the critical dimension (6.5%, CI: 3.1-11.5%). No error affected response computation; cumulative lesion measurement dictation-transcription error for affecting computed response ranged from 5mm to 41mm (avg: 18mm).

CONCLUSION
Communication of lesion measurements by manually consuming the radiology report narrative can propagate errors. While preliminary analysis showed no errors affected treatment response computation, the potential for such cannot be excluded. PACS-integrated tools for semi-automated lesion measurement management and electronic transmission to the oncology patient management system should be considered as an adjunct to the narrative report.

CLINICAL RELEVANCE/APPLICATION
PACS-integrated tools for semi-automated lesion measurement management and electronic transmission to oncology patient management systems should be considered as an adjunct to the narrative report.

Informatics - Thursday Posters and Exhibits (12:15pm - 12:45pm)

Thursday, 12:15 PM - 12:45 PM ●Lakeside Learning Center

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IN

LL-INS-THA •*AMA PRA Category 1 Credit* ™:0.5
Host
Tessa S Cook , MD, PhD

LL-INS-TH1A ● iPad with Retina Display™ for Primary 2D Visualization of CT Angiography Examinations of Patients with Suspected Gastrointestinal Bleeding: Performance Comparison with a Conventional Workstation

Emanuele Neri MD (Presenter) ; **Lorenzo Faggioni** MD, PhD ; **Irene Bargellini** MD ; **Paola Scalise** ; **Francesca Calcagni** ; **Francesca Turini** MD ; **Elena Bozzi** MD ; **Roberto Cioni** MD ; **Carlo Bartolozzi** MD

PURPOSE
To evaluate the effectiveness of the iPad with Retina Display as a mobile device for 2D reading of CT angiography studies performed in patients with suspected acute gastrointestinal bleeding.

METHOD AND MATERIALS
Twenty-five CT angiography (CTA) examinations of patients with suspected acute gastrointestinal bleeding confirmed by conventional angiography were retrospectively reviewed by two independent readers. One reader evaluated source axial images of all CTA datasets on a commercial workstation (Advantage Windows 4.5, General Electric, Milwaukee, WI) connected to our hospital PACS, whereas the other reader assessed the same images on an iPad with Retina Display 64GB (Apple Inc, Cupertino, CA). All images (including unenhanced and contrast-enhanced axial images and multiplanar reformatted series where available, but excluding Volume Rendering and Maximum Intensity Projection reconstructions) were wirelessly transferred on the iPad in JPEG lossless format using the Bonjour protocol. The time needed to complete reading of every CTA examination, detection of arterial blush, bleeding site and suspected feeding artery as assessed using the workstation and the iPad were recorded.

RESULTS

- The time needed to complete 2D reading of every CTA study was significantly shorter using the iPad than the workstation (153±101 vs 202±87 seconds, respectively; p=0.0203).
- Agreement on arterial blush detection occurred in 21/25 cases (84%), whereas out of the remaining 4 cases, 2 were iPad false negatives and 2 iPad false positives.
- Agreement on bleeding site and suspected feeding artery was 89.5% and 73.7%, respectively.

CONCLUSION
The iPad with Retina Display is effective for 2D reading of CT angiography studies of patients with suspected acute gastrointestinal bleeding.

CLINICAL RELEVANCE/APPLICATION
The iPad with Retina Display could be used by on-call interventional radiologists for immediate decision on percutaneous embolization in patients with suspected acute gastrointestinal bleeding.

LL-INS-TH2A ● Verify and Development of Practical Applications in the Cloud-based Real-time 3D Workstation

Hironobu Tomita MD (Presenter) ; **Hitoshi Yazawa** BS ; **Masakazu Shito** ; **Yosuke Kidokoro** ; **Natsuki Toyoda**

CONCLUSION
The results of development of this system and its usage in clinical practice suggest that practical usage is fully possible and that this system may be very useful in the medical field.

Background
In recent years, information technology (IT) in medicine is progressing remarkably. But we do not have any good tools for access to medical images from outside hospital. Therefore we set up 3D cloud server for provide real-time diagnostic imaging for their patients. I report demonstration test for practical use in December 2011 to March 2012.

Evaluation
We set up 3D cloud server with virtualization application system for create 3D images. Image transfer speed testing involved measuring the image transfer speed in-hospital to the cloud-based server and transmitting 250 5000 images worth of 3D image data (computed tomography [CT]) to the cloud-based server and varying the number of images, parallel load, and other aspects to analyze the actual time required. For including the actual usage assumptions, we used frames per second (FPS) measurements, wireless LAN, and WiMAX (Worldwide Interoperability for Microwave Access) for ordinary 3D creation processes to investigate the feasibility of processing in terms of the differences in operability.

Discussion
The transfer speed was equivalent to when the server system was installed inside the hospital (11.4 images/s in-hospital, 10.2 images/s with the server). The FPS was the highest in-hospital, at 17.8 frames/s and 16.5 frames/s with the server. Thus, we confirmed that FPS was within ranges that allowed for practical use in terms of operability.

LL-INS-TH3A ● Comparison of the Organ Dose to the Lens of the Eye to ICRP Threshold Values for Cataract Formation in the Sinus MDCT Protocol Optimization Process

Jenifer W Siegelman MD, MPH (Presenter) ; **Holly Lincoln** MA ; **Dustin A Gress** MS ; **Choonsik Lee** PhD ; **Daniel Valentino** PhD * ; **Alphonso Magri** PhD ; **Mark P Supanich** PhD *

CONCLUSION
Definition of quantifiable effect on lens dose in low CTDIvol range,can inform priority setting in the protocol optimization process, and aid risk communication in medical decision making.

Background
Definition of quantifiable effects on organ dose can inform decision in the protocol optimization process.Nearly optimized sinus CT protocols, in a multi-vendor environment, with and without iterative reconstruction, resulted in an average CTDIvol value that was one-fifth of the 50th percentile of ACR Dose Index Registry. This work aims to quantify how Sinus CT protocol optimization efforts impact organ dose to the eye lens, through direct measurement and Monte Carlo simulation, while considering ICRP threshold.

Evaluation
Scan parameters and average CTDIvol from the three scanners in one community health system were compiled using commercial software (Radimetrics Inc,Toronto,ON) (Scanner A: 100 kVp, 50 mAs; Scanner A: 120 kVp, 50 mAs; Scanner B: 120 kVp, 70 mAs; Scanner C: 100 kVp 70 mAs: no gantry tilt, length 13 cm). Lens dose was calculated via Monte Carlo radiation transport coupled with an adult computational human phantom with a realistic eye model including globe, lens, and orbit assessing direct dose as well as scatter. Direct measurement of air kerma was performed for each protocol using dosimeters including commercially available optically stimulated luminescence (OSL) strips (Landauer) calibrated at a mean energy of 65 kVp as well as a 0.6 cc ion chamber (Radcal) calibrated for diagnostic scanning placed on the eyelid of the Rando phantom (Alderson, Stamford, CT).With these diagnostic scans, performed at CTDIvol = 5.3-12.1 mGy, the estimated absorbed dose to the lens of the eye based on phantom simulation ranged from 4.2 - 9.6 mGy. The measured air kerma to the lens surrogate 0.6cc ion chamber more closely paralleled the CTDIvol for the scanner with values from 5.2 -12.2 mGy. Strip dosimeters resulted in a measured peak dose of 5.4 to 17.6 mGy.

Discussion
Diagnostic quality Sinus CT, performed at techniques less than 1/5 of the median CTDIvol reported in the ACR Dose Index Registry result in lens doses which are well below the threshold for tissue damage according to the ICRP.

LL-INS-TH4A ● A Robust Pathological Lung Segmentation Platform Using Fuzzy-Connectedness with Patient-specific Modeling

Awais Mansoor PhD (Presenter) ; **Ulas Bagci** PhD, MSc ; **Brent Foster** ; **Ziyue Xu** PhD ; **Jayaram K Udupa** PhD ; **Daniel J Mollura** MD

PURPOSE

To develop a fast and fully automated image segmentation method that automatically delineates the pathological lungs from computed tomography (CT) scans and provides precise quantitative analysis.

METHOD AND MATERIALS
With IRB approval, 200 CTs (with varying pathology levels) and 40 CT scans (healthy controls) were collected and used for the experiments. The pathological lungs were divided into 4 categories based on the pathological volume measured by participating expert radiologists during reference standard construction—control, minimum pathology, medium pathology, and heavy pathology. Our algorithm is based on the fuzzy connectedness image segmentation method integrated into a patient specific shape model. By this model creation, we identified the possible regions where segmentation may fail. For those regions, we refine our segmentation through a random forest machine learning algorithm by accurately labeling tissue types as normal or abnormal within the lungs. The flow diagram of the proposed method is provided in Fig. 1.

RESULTS
An average Dice Similarity Coefficient of >90% was obtained—100% indicates the reference standard provided by the expert radiologists. A user interface was designed for radiologists to use the proposed quantification and evaluation system in their daily tasks. To the best of our knowledge, this is the first fully automated, robust, and accurate method using patient specific shape model within the pathological lung segmentation literature.

CONCLUSION
We developed a novel fully automated segmentation technique for lung segmentation, the initial analysis show promising scope for the technique in accurately segmenting pathological and normal lungs in routine clinical environment.

CLINICAL RELEVANCE/APPLICATION
Our proposed method is an automated system with applications that can be used in clinics and provide accurate quantification of lung diseases for early prognosis or pre-op assessments.

LL-INS-TH5A • ONLIRA-A Semantic Knowledge Representation of Liver CT Images

Nadin Kokciyan ; **Rustu Turkay** MD ; **Suzan Uskudarli** ; **P?nar Yolum** ; **Burak Acar** PhD (Presenter) ; **Baris Bakir**

PURPOSE
We present an ontology (ONLIRA - Ontology of the Liver for Radiology) developed for semantic expression of liver CT images. ONLIRA expands the common vocabulary offered by RadLex with domain knowledge for the liver. Specifically, anatomical properties of the liver, and the liver lesions are described. Thus, semantic analysis beyond pure image based analysis of liver CT images can be achieved.

METHOD AND MATERIALS
The requirements for ONLIRA were determined via elicitation sessions with two expert radiologists. Each session consisted of three main threads: (1) questions and clarifications, (2) validation, and (3) tuning. During the first thread, we modeled the liver domain by interviewing the radiologists. Validation thread was used to assure the correctness of the developed liver model. The concepts represented by the ontology were refined in the third thread. The Prot—g— ontology editor was used for development of the ontology, consisting of 40 concepts, 12 relationships and 36 properties. In order to maintain the conformance with RadLex, all RadLex terms corresponding to an ONLIRA concept were referenced. The radiologists validated the ONLIRA components (concepts, properties, relationships) by using 30 real liver patient cases. The validation was based on subjective assessment of the accuracy and the completeness of ONLIRA based representation of the cases.

RESULTS
75% of the 30 radiology reports (cases) were covered completely by ONLIRA. Remaining cases could not be completely expressed because current version of ONLIRA doesn—t cover concepts about gallbladder calculi (seen in 4 cases), hepatic steatosis (3 cases), hepatectomy (2 cases), lesion with heterogeneous density (1 case).

CONCLUSION
The novel ONLIRA ontology, that conforms with RadLex, was proposed for the semantic representation of liver CT images. It was shown to be capable of representing the information in radiology reports in a preliminary study over 30 cases. It can potentially be used for semantic analysis of radiology reports, comparison of cases based on semantic similarity as well as structured reporting. ONLIRA can be accessed via the link http://www.vavlab.ee.boun.edu.tr/pages.php?p=research/CARERA/carera2.html

CLINICAL RELEVANCE/APPLICATION
Radiologists can use ONLIRA for structured reporting, and benefit from it in finding relevant patients similar to the image observations of a given patient.

LL-INE-TH6A • Computerized Large Scale Radiology Personnel Scheduling (Oceanetta): Challenges, Resolution and Automation

Shafiqul Abedin (Presenter) ; **Jules H Sumkin** DO * ; **Judith M Joyce** MD ; **Matthew T Heller** MD ; **Bethany U Casagranda** DO

Background
Scheduling over 200 Radiologists and 50 Residents for the Department of Radiology at the University Of Pittsburgh Medical Center (UPMC)is an onerous task and decreasing the effort to properly schedule and increasing radiologist productivity are essential in this demanding medical setting. An experimental platform (Oceanetta), was developed to deal with the stochastic nature of the schedule in a real operational environment. We view this presentation has having three contributions: (a) Provide an overview of challenges influencing design of the medical scheduling system, (b) Describe approaches taken to overcome those challenges and (c) Provide an auto-scheduling guideline and implementation mechanism catered towards the radiology community to improve tracking, sharing, automation and efficiency during staff scheduling.

Evaluation
After evaluating numerous Usability Engineering (UE) approaches during a literature search, we started with the Spiral Model but ultimately resorted to the Star life cycle for successful software development. We discovered specific challenges and solved (i.e. Intra scheduling conflict, Post Call conflict, Multiple schedule integration) for the abstract interface design. We took a "guided automation" approach to solve the combined task of manual and automated scheduling. The schedules were pre filled with special cases, after which, the automation populated the rest by maximizing the utility function for each physician. We did a NASA workload and satisfaction survey to evaluate the performance of the application.

Discussion
The satisfaction survey result revealed significant advantage in usability & tracking. The automation algorithm showed promise as demonstrated by one of our largest subspecialty divisions with 14 services and 30 Physicians when only an average of 14.74% changes were necessary compared to the manual process.

CONCLUSION
We have successfully designed and deployed a versatile scheduling system using the guidelines we set. Guided automation is a viable approach to complex physician scheduling. Utilizing our approach may be helpful to other radiology practices, especially with the increasing need for 24/7 subspecialized radiologist coverage.

LL-INE3231-THA • Web-based DICOM-SR Viewer for CAD Data of Multiple Sclerosis Lesions in an Imaging Informatics-based eFolder

Kevin C Ma BS (Presenter) ; **Jeffrey Zhang** ; **Heng Gao Zhong** ; **Brent J Liu** PhD

Background
Last year, we have demonstrated an imaging informatics-based multiple sclerosis eFolder with data storage, data analysis, and data mining solution designed and developed based on IHE workflow profiles. The eFolder integrates patient—s clinical data with MRI studies and a computer-aided detection algorithm for quantifying MS lesion characteristics (including lesion volume, lesion contour, locations, and sizes) in brain MRI studies. Quantitative CAD results need to be converted to DICOM-SR format for long-term storage in PACS and data query and display in a DICOM-compliant clinical setting, in accordance with IHE integration protocols. In order to display CAD results in DICOM-SR format on the web GUI, we have designed a web-based DICOM-SR viewer based on our existing DICOM wado viewer. The methodology including conversion of CAD data from native MATLAB format or any other CAD-specific software to DICOM-SR, and displaying DICOM-SR in a tabulated format along with the referenced images in the viewer will be shown. The viewer also displays lesion segmentation results in the DICOM format.

Evaluation
72 MRI studies have been analyzed by the CAD. All of the CAD results have been converted to DICOM-SR via dcmtk and customized XML templates. The generated SR are verified by XML-based SR validator in the PixelMed toolkit. The web-based DICOM-SR viewer will be integrated along with the eFolder GUI to allow users to view DICOM images, perform window/level/zooming tasks, and to view tabulated MS CAD results in the viewer. Users will also be able to select individual lesions for a more detailed lesion characteristic summary.

Discussion
We will present an effective way to convert quantitative imaging data into DICOM-SR, a web-based GUI to display DICOM-SR, and provide an example of how to utilize the DICOM standard and IHE integration profiles in a research setting.

CONCLUSION
We have presented an MS eFolder system to integrate patient—s clinical data with MRI and quantitative data from CAD. CAD data has been converted to DICOM-SR for display and long-term storage in a DICOM-compliant environment. A web-based DICOM-SR interface displays tabulated CAD lesion data,

segmentation results, and reference images.

LL-INE3188-THA ● Conventional and Unconventional CT Post-processing Software to Analyze Gunshot Injuries and Bullet's Ballistic in Firefights

Marco Matteoli MD (Presenter) ; **Claudia Scaringi** ; **Antonio Cremona** ; **Anna Macioce** ; **Lara Cristiano** MD ; **Marco Di Girolamo** MD ; **Vincenzo David** MD

PURPOSE/AIM
The purpose of this exhibit is to review the 'in vivo' applications of CT conventional and unconventional post processing softwares to evaluate injuries and terminal ballistic of bullets in firefights and to identify the most useful application in clinical and forensic practice.

CONTENT ORGANIZATION
-Utility of ballisitic analysis in firefights -CT morphology of bullets and gunshot injuries -Application of CT conventional and unconventional post processing techniques: 1)Two-dimensional Reformation

- Multiplanar Recontruction
- Minimum Intensity Projection.
- Maximum Intensity Projection

2)Three-dimensional Reformation

- Volume Intensity Projection.
- Three-dimensional VR.

3) Radiation therapy planning software -Head injuries: clinical cases and review of literature
-Trunk injuries: clinical cases and review of literature
-Limb injuries: clinical cases and review of literature

SUMMARY
The major teaching points of this exhibit are: -CT scan may guide 'in vivo' or 'post mortem' forensic analysis
-Gunshot tissues injuries are better identify in axial view and through conventional CT post-processing algorithms (MIP, MPR, VR)
-Bullet's ballistic is more clear after unconventional applications of radiation therapy planning software

LL-INE3227-THA ● Automatic Multi-organ Localizations on 3D CT Images by Using Machine-learning Approach Based on a Large Dataset

Xiangrong Zhou PhD (Presenter) ; **Huayue Chen** ; **Takeshi Hara** PhD ; **Ryujiro Yokoyama** ; **Masayuki Kanematsu** MD ; **Hiroshi Fujita** PhD

Background
Accurately and efficiently detecting the location of an object of interest (an organ, a lesion, etc.) plays an important role in medical image analysis. Machine-learning has demonstrated potentials for solving object detection problems in 3D CT image analysis. However, machine-learning requires a large number of samples for training and testing to show the real performance. As far as we know, few previous works reported performances on more than 1,000 CT scans and showed the possibility of the proposed algorithm for the localization of all the major organs on 3D CT images.

Evaluation
We proposed a machine-learning approach to accomplish the fast and automatic localization of the major organ regions on 3D CT scans. This approach combines object detections and the majority voting technique to achieve the robust and quick organ localization. We applied this approach to localizing 12 kinds of major organ regions independently on 1,300 torso CT scans. In our experiments, we randomly selected 300 CT scans for training, and then, applied the trained system to localize each of the target regions on the other 1,000 CT scans for the performance testing. The detection results were evaluated subjectively and quantitatively based on the ground truth from the human operators.

Discussion
Our evaluation based on 1,000 test CT cases showed that the heart location in 983 cases, liver location in 978 cases, stomach location in 952 cases, pancreas location in 943 cases, spleen location in 932 cases, left kidney location in 963 cases, right kidney location in 969 cases, left lung location in 992 cases, right lung location in 988 cases, bladder location in 984 cases, right femur head location in 578 cases, and left femur head location in 551 cases were correct. Those results showed that our approach can accomplish the localization tasks in over 94% CT cases except the femur heads. The failure of the femur head locations was due to the poor performance of the trained results.

CONCLUSION
An universal approach was demonstrated to localize 12 major organs automatically on 3D CT scans and its efficiency and accuracy were validated by using 1,300 clinical CT scans.

LL-INE3233-THA ● Retrieval of Reference Cases: For Which Cases Can Similar Cases be Useful?

Chisako Muramatsu PhD (Presenter) ; **Tokiko Endo** MD ; **Mikinao Ooiwa** ; **Misaki Shiraiwa** MD ; **Kunio Doi** ; **Hiroshi Fujita** PhD

Background
As digital mammography and monitor reading are becoming common practice, process for storing and retrieving images is much easier and faster. The vast data including diagnostic and pathologic images, clinical data, and treatment data can be effectively used as a reference and teaching materials. We have investigated an automatic retrieval of similar mammographic mass images and their effect on observers' differential diagnosis.

Evaluation
Observers' confidence ratings on a mass being malignant were recorded before and after the retrieval of reference images. The study included 48 benign and 50 malignant masses that were visible on two views. The majority of the benign cases were cysts and fibroadenomas, whereas the majority of the malignant cases were invasive ductal carcinomas. For each view, 5 most similar images were retrieved and a similarity map showing the distribution of the database was provided. Observers had to review both views before marking their confidence ratings. Eleven physicians who are routinely reading mammograms and eleven radiological technologists who were trained to read mammograms participated.

Discussion
Overall, the number of cases that were affected beneficially by the retrieval of reference images was larger than that were affected detrimentally for both groups of observers. There was no trend in pathologies of the beneficially affected cases, although it is difficult to draw a strong conclusion based on the small number of cases. When majorities of the reference images were from the same pathologic group, i.e., benign or malignant, as the inquiry on both views, they were likely to be beneficial. When discrepancy occurred between the views, the observers, especially the technologists, had tendency to follow the suspicious ones and increased their ratings.

CONCLUSION
It is important to understand how reference images can affect observers' confidence in order to improve an image retrieval system. Radiologists may effectively use such retrieval systems by understanding the system's behavior and the characteristics of retrieved images.

LL-INE3186-THA ● A DSC Digital Brain Phantom for Assessment of Leakage Correction Methods

Panagiotis Korfiatis PhD (Presenter) ; **Leland S Hu** MD ; **Zachary S Kelm** BS ; **Bradley J Erickson** MD, PhD *

Background
Cerebral blood volume (CBV) is an emerging magnetic resonance imaging biomarker used to differentiate between progression and pseudo progression in patients with glioblastomas (GBM), a challenging task even for experts. Dynamic susceptibility-weighted contrast (DSC) imaging is the most commonly used clinical technique for measuring CBV in brain tumors. However, accurate CBV quantification is difficult especially in cases of GBM, where the blood-brain barrier has been interrupted and contrast leakage occurs. Several software tools exist, allowing for semi-automatic calculation of relative CBV. Some of these software tools incorporate mathematical techniques to deal with contrast agent leakage. Assessing the accuracy and reliability of leakage correction methods can be achieved only with the use of an appropriate phantom. However, the development of digital phantoms that simulate contrast extravasation is an open research issue. The purpose of the current study is the development of a DSC-MRI digital phantom containing regions with a known amount of simulated contrast leakage, allowing evaluation of software tools.

Evaluation
The created phantom was successfully able to simulate contrast leakage effects on the time-concentration curves.

Discussion
An algorithm was developed, capable of producing a 4D digital phantom containing areas simulating white matter, gray matter, cerebrospinal fluid, and 4 regions with varying levels of contrast leakage. The time-concentration curves for each pixel were simulated based on the signal proposed by Liu *et al*[1]. The model utilized can describe the combined T1 and T2* effects from contrast agent leakage in the measured signal. The algorithm can produce datasets simulating various image acquisition parameters, such as TE, relaxation rate, and mean transit time, while also allowing addition of Gaussian noise.

CONCLUSION

The proposed digital phantom may be used in performance evaluation of clinically available software tools and may further enable the development and validation of algorithms aimed at CBV quantification leakage correction. References 1.Liu, H-L, et al. Med. Phys. 38: 2 (2011): 802–809.

LL-INE3229-THA • Quantitative Morphological Parameters of Diaphragm with Quadratic 3D Surface Fitting from Volumetric Chest CT in Patients with Chronic Obstructive Pulmonary Disease

Yongjun Chang (Presenter) ; **Jangpyo Bae** MS ; **Namkug Kim** PhD ; **Sang Min Lee** MD ; **Joon Beom Seo** MD, PhD

Background
In patients with chronic obstructive pulmonary disease (COPD), diaphragm function may be deteriorated because of reduced muscle fibre length, resulting in the morphological change of the diaphragm. Therefore, we developed a quantitative analysis method for the diaphragm for patients with COPD in 3D volumetric CT data.

Evaluation
Volumetric CT data for thirty patients with COPD were obtained from a 16-multi detector row CT scanner (Siemens Sensation 16) with in 0.75mm collimation. A threshold-based lung segmentation followed by the3D ray projection for the diaphragm segmentation was performed. Based on the resultant diaphragm data, the diaphragm was modeled with a quadratic 3D surface fitting. The segmentation result was evaluated by an expert thoracic radiologist. The overall accuracy of the segmentation was 95.58 ±2.52% (mean±SD).
To take into consideration shape features of the diaphragm, shape index on the apex (SIA) was obtained from principal curvatures on the apex on the fitted diaphragm surface (CA). The height (H) between the apex and the base plane determined by three points on the bottom of the diaphragm model was also evaluated. In addition, the diaphragm lengths along the x, y, and z axes (XL, YL, ZL), quadratic fitting diaphragm lengths on z axis (FZL), average curvature (C), and surface area (SA) were measured with in-house software. Quantitative morphological parameters including SIA, CA, H, XL, YL, ZL, FZL, C, and SA are 0.85±0.05, 0.01±0.00, 17.93±10.78, 129.80±11.66, 163.19±13.45, 71.27±17.52, 61.59±16.98, 0.01±0.00, and 34380.75±6680.06, respectively.

Discussion
The proposed method is especially useful in quantifying diaphragm characteristics including the reduced muscle fibre length and morphological change of diaphragm. This study could further be used for evaluating etiology and progress of COPD using 3D volumetric chest CT.

CONCLUSION
We proposed an automatic method for evaluating quantitative morphological parameters of the diaphragm with quadratic 3D surface fitting from volumetric chest CT data for patients with COPD. Our method may be useful for assessing the morphological diaphragm change of COPD patients.

LL-INE3190-THA • mQC: A Centralized Platform for Automated Mammography Quality Control

Stephen Smithbower ; **Rasika Rajapakshe** PhD (Presenter) ; **Janette Sam** RT ; **Nancy Aldoff** ; **Teresa Wight** ; **Christine M Wilson** MD

Background
Many of the required daily and weekly quality assurance procedures tend to be simple tests that involve a fair bit of manual work, such as selecting and measuring regions of interest and recording results in Excel. Such work can easily be automated by software, and the results of the tests stored in a centralized database in order to facilitate region-wide tracking of mammography unit performance. We propose a software platform, mQC, that utilizes British Columbia's province-wide PACS network to provide automated quality control measurement and recording. This report summarizes our development and implementation process.

Evaluation
The original mQC implementation was a local, stand-alone software package deployed on a workstation at each mammography center. This approach proved unmaintainable, due to IT issues (firewalls, administrative privaleges on workstations, difficulties in performing software updates). As a result, mQC was retrofitted as a centralized server residing in one location that would poll the BC Transfer Grid and automatically process pending images for all connected centers.

Discussion
mQC is currently servicing 19 different centers across British Columbia. Additional development is being done to expand the number of tests the platform provides, and to improve mQC's reporting capabilities. Work is also being done on the platform to allow deployment by third-parties, as there has been both commercial and provincial interest in mQC outside of British Columbia.

CONCLUSION
Our centralized, PACS-network aware automated quality control platform has been able to reduce the time spent by technologists to perform quality assurance tests on mammography units, while simultaniously improving the access to QA test results across the province by providing a centralized database. A website accompanies the platform, allowing technologists at any center to log in and view the results of their tests in real-time.

Using myRSNA®: Hands-on Workshop

Thursday, 12:30 PM - 02:00 PM • S401CD

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IN

ICIA52 • *AMA PRA Category 1 Credit* ™:1.5
John W Basco , MS

LEARNING OBJECTIVES
1) Understand the different tools and applications within myRSNA. 2) Log in to myRSNA and set up a personal profile. 3) Using the tools within myRSNA, highlight different use case scenarios.

National Library of Medicine PubMed: There's More to PubMed/MEDLINE: The Free My NCBI Tool

Thursday, 12:30 PM - 02:00 PM • S401AB

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IN

ICIW52 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Holly A Burt
Chris Childs , MS
Susan M Anderson , MS

LEARNING OBJECTIVES
1) Use My NCBI to personalize PubMed. 2) Understand how to save search strategies and create email alerts. 3) Use filters to link to library full-text articles and to focus PubMed searches. 4) Understand how to save collections of citations including a personal bibliography.
ABSTRACT
In this hands-on workshop session, explore the free My NCBI tool in PubMed. Discover how to save search strategies, create email alerts to keep up with the latest publications, create instant links to library full-text resources, and build permanent online bibliographies. Topics covered include creating a free My NCBI account, adding search and library filters to PubMed, using My Bibliography to create an online list of personal publications, and the link between the NIH Manuscript Submission System and PubMed. Important highlights on effectively searching will also be included. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov MEDLINE is a subset of PubMed.

Informatics - Thursday Posters and Exhibits (12:45pm - 1:15pm)

Thursday, 12:45 PM - 01:15 PM • Lakeside Learning Center

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IN

LL-INS-THB • *AMA PRA Category 1 Credit* ™:0.5

LL-INS-TH1B • Decision Support System for Breast Cancer Screening

Selin Carkaci MD (Presenter) ; **Barbaros S Erdal** DDS, PhD ; **Beatriz E Adrada** MD ; **Richard D White** MD

CONCLUSION
Breast cancer screening and surveillance should ideally be tailored to an individual's cancer risk and breast density. DSSBCS can assist radiologist and

referring physician in making the most appropriate imaging decision for supplemental breast cancer screening.

Background
There is increasing awareness of certain subpopulations of women for whom mammography alone has reduced performance, particularly those with dense parenchyma or with high risk of developing breast cancer. Integrating risk assessment into the daily practice of breast imaging, answering patients` questions and making appropriate imaging recommendations for screening remains challenging. Many practitioners are not intimately familiar with the various risk assessment models or with the ACR Appropriateness Criteria. A cost-effective, efficient, and reliable clinical decision tool to assist referring physicians in making the most appropriate imaging decision for breast cancer screening could prove to be useful in everyday practice.

Evaluation
Decision Support System for Breast Cancer Screening (DSSBCS) can be run as an independent standalone web application or as applications within Google Android, Apple iOS or Microsoft-based mobile platforms. Users of this system simply enter specific patient information into a user friendly tool which in return calculates the life-time risk for breast cancer, the age to start screening, and the most appropriate supplemental screening tool.

Discussion
Clinical decision support (CDS) systems are cost-effective, efficient and reliable methods for adjudicating the clinical indications of imaging studies by comparing those indications to evidence-based scores, and allowing physicians to recommend the most appropriate imaging for the patient. Several CDS systems are currently commercially available and use of such systems is being widely considered by health care systems, payers, and regulators. DSSBCS is a dedicated system designed to guide the radiologist and referring physician to the identification of women who may benefit from supplemental screening and to help to recommend when and which techniques to use for this additional screening.

LL-INS-TH2B ● Proposal of an IHE Integration Profile for the Electronic Storage of Shared Images within a Community Using DICOM KOS Documents

Minoru Hosoba PhD (Presenter)

PURPOSE
In the HIE (Health Information Exchange), shared images imported from other facilities are requested to storage legally if they are used for diagnosis in the local Enterprise according to the MHW guideline in Japan (i.e. Electronic storage). When HIE increases, a number of duplicated images may be stored in every Enterprises. To reduce such risks, only pointing information to shared images should be stored as the Electronic storage. In this paper, use of the DICOM KOS (Key Object Selection document so called "manifest") as pointing information is proposed for the Electronic Storage in a standardized way.

METHOD AND MATERIALS
DICOM KOS has been applied to the IHE XDS-I integration profile in the image sharing infrastructure. The Electronic storage workflow in local Enterprise for images imported from other facilities can be established with the implementation of XDS-I. KOS has UID information to link SOP instance and facility UID and it is possible to access original images consistently from anywhere. After diagnosis of selected images imported has been done, KOS is recreated from original imported KOS with SOP instance UID of related images and stored with SOP instance status AO(Authorized Original) attribute. KOS SOP instance status attribute is set to AO within the authorization operation for preventing deletion of the file. The facilities whose images are referenced from other Enterprises should keep related images safely according to the Electronic storage requirement of the MHW guideline in the case of outside storage of the facility. Notification about the results of pointing can be performed with KOS conveyed by XDR-I transactions.

RESULTS
This Integration profile can provide infrastructure of combining the fact of diagnosis using imported images from other Enterprise with KOS and realize the effective solution for the Electronic storage of shared images. In case of XDR and PDI, same scenario can be applied if KOS is generated previously and sent with the image.

CONCLUSION
The proposed integration profile can provide infrastructure of using imported images from other Enterprise and storing their pointing data called KOS for the Electronic storage and realize its effective solution for shared images.

CLINICAL RELEVANCE/APPLICATION
The proposed profile can be applicable to image sharing infrastructure for clinical image diagnosis and storage in a standardized measure.

LL-INS-TH4B ● Challenges in Radiology Reporting for Serial Tumor Assessment Using RECIST

Rony Kampalath MD (Presenter) ; **Apostolia M Tsimberidou** MD, PhD * ; **Roland Bassett** ; **David J Vining** MD *

PURPOSE
The purpose of this project was to conduct an audit of radiology reports to determine if radiologists at a major cancer hospital properly used Response Evaluation Criteria in Solid Tumors (RECIST) for the serial assessment of tumor response to anticancer treatments.

METHOD AND MATERIALS
Institutional Review Board (IRB) approval was granted for this retrospective data review. We analyzed baseline and subsequent computed tomography (CT) reports from 112 patients with advanced cancer treated in Phase I clinical trials at the MD Anderson Cancer Center to determine if radiologists (1) reported tumor measurements in their reports, (2) saved relevant annotated images in the institution's PACS system for later comparison of those metrics, and (3) whether there was correlation of tumor measurements between the serial CT examinations for each patient.

RESULTS
We analyzed radiology reports from 112 consecutive patients enrolled in Phase I clinical trials. Six patients were excluded due to the absence of follow up exams, and 9 were excluded due to no measurements being reported in the baseline studies. We then audited the baseline and subsequent CT reports from the remaining 97 patients (194 total reports) which revealed that radiologists reported tumor measurements in 92% of all cases but saved the relevant annotated images in PACS in only 34% of baseline and 42% of follow up examinations. A total of 314 (3.2/patient) tumors were measured and reported in the baseline examinations, of which 113 (35%) had measurements reported for the same lesions in subsequent examinations.

CONCLUSION
The consistent use of RECIST in radiology reporting is critical as the accurate and timely assessment of tumor response determines whether cancer patients enrolled in clinical trials are to continue treatments with an experimental agent(s). However, our study reveals that radiologists at a major cancer hospital failed to accurately apply RECIST. Potential solutions include better training of radiologists in how to utilize RECIST, quality audits to identify reporting deficiencies, and possibly the application of structured reporting methods to facilitate the continuity of radiological information for serial tumor assessment.

CLINICAL RELEVANCE/APPLICATION
Conventional radiology reporting for the application of RECIST needs to be improved with better training of radiologists and/or the use of structured reporting solutions.

LL-INS-TH5B ● Automatic Segmentation of the Thoracic Cage Using Rib and in the Volumetric CT Data

Jangpyo Bae MS (Presenter) ; **Namkug Kim** PhD ; **Joon Beom Seo** MD, PhD ; **Sang Min Lee** MD

PURPOSE
The accurate delineation of the thoracic cage region is vital for the various kinds of clinical applications including thoracic cage volumetry and mediastinum fat quantification of patients with chronic obstructive pulmonary disease (COPD). The purpose of this study is to develop and evaluate an automatic segmentation method for the thoracic cage.

METHOD AND MATERIALS
Volumetric CT scans of fifty one patients with chronic obstructive pulmonary disease (COPD) were performed by a 16-multi detector row CT scanner (Siemens Sensation 16) with in 0.75mm collimation. The thoracic cage region was separated from the other region by using the inner thoracic wall and the diaphragm surface by using a 3D surface fitting method. The inner thoracic wall can be composed of 4 exclusive quarter-surfaces of 3D closed thoracic cage made from threshold-based rib segmentation with the ray projection. In the case of diaphragm, the lower surface of each lung was used for input of the 3D surface fitting. Therefore, thoracic cage region was calculated from these five surfaces. Because accuracy of diaphragm surface is low, the supplementary segmentations of the heart and the surrounding fat of that heart were performed by a sphere shape prior level set and a typical level set method respectively with two manual points on the top and bottom of the heart. To assess the accuracy of the proposed algorithm, the segmentation results of 51 patients were compared with those of manual segmentation by an expert thoracic radiologist. Evaluation metrics for segmentation accuracy include volumetric overlap ratio (VOR), false positive ratio on VOR (FPRV), false negative ratio on VOR (FNRV), average symmetric absolute surface distance (ASASD), average symmetric squared surface distance (ASSSD), and maximum symmetric surface distance (MSSD).

RESULTS
Mean and SD of VOR, FPRV, FNRV, ASASD, ASSSD, and MSSD were 94.09±2.10%, 1.88±1.84%, 4.03±1.93%, 1.15±0.54 mm, 4.18±1.59 mm, and 42.56±13.12 mm, respectively.

CONCLUSION
We proposed the automatic thoracic cage segmentation method with rib, thoracic wall, diaphragm, and heart segmentation with 3D surface fitting in the 3D

volumetric CT data, which might be clinically applicable.

CLINICAL RELEVANCE/APPLICATION
Our method would be useful in the various kinds of clinical applications including thoracic cage volumetry, and mediastinum fat quantification of patients with chronic obstructive pulmonary disease.

LL-INE3191-THB ● Anonymization and Transmission of DICOM between PACS, Local and Remote XNAT Instances

Jenny Gurney MS (Presenter) ; **James Ransford** BS ; **Kenneth W Clark** MBA, MS ; **Matthew House** ; **Mikhail V Milchenko** PhD ; **Kirk Smith** BS ; **Daniel S Marcus** PhD *

Background
The XNAT imaging informatics platform is increasingly used in clinical translational research. A common requirement in this type of research is to transfer a large number of clinical studies from a DICOM-based PACS into XNAT. In the transmission process, researchers often need to blind the DICOM or anonymize it for public use. These tasks are typically time consuming and error-prone. This same workflow is also common in transferring data from one XNAT repository to another. The Joint Anonymization and Archive Transmission (JAAT) tool simplifies and automates this process for XNAT users by integrating several DICOM tools: XNAT Gateway, RSNA CTP, and DCMTK.

Evaluation
DICOM transmission involves various challenges. Typical PACS retrieval tools don't support bulk downloads. Mailing a hard drive is slow and has an increased risk of PHI exposure. PHI sent over the Internet must use a secure connection. DICOM anonymization often requires familiarity with the DICOM Standard as it applies to HIPAA as well as the expertise to implement the standard through methods like id remapping, sequence anonymization and date incrementing. Many research groups may not have the resources to anonymize and transmit DICOM properly. Through the integration of key technologies, JAAT aims to reduce the researcher's effort in DICOM transfer to the preparation of a single DICOM-XNAT metadata mapping spreadsheet.

Discussion
JAAT has been in operation since December 2012 at the Central Neuroimaging Data Archive (CNDA) at Washington University (WU), XNAT's flagship deployment. As of mid-March 2013, the tool has been used to anonymize and transmit over 1000 imaging studies for researchers. At WU, JAAT is used in three basic ways: 1. PACS-to-XNAT: Data transmission from the Barnes-Jewish and Children's Hospitals PACS into the CNDA. 2. XNAT-to-XNAT: Export of anonymized data from CNDA, a private repository, to XNAT Central, a public repository. 3. XNAT Project Cloning: Cloning of an existing CNDA project to a new project while anonymizing the DICOM for a specific audience.

CONCLUSION
JAAT enables researchers using XNAT to request bulk moves of DICOM data between repositories in an efficient, customized, and HIPAA compliant way.

LL-INE3232-THB ● Leveraging 'The Wisdom of Crowds' in Collaborative Image Diagnosis

David W Piraino MD (Presenter) * ; **Daniel W Palmer** PhD ; **Nancy A Obuchowski** PhD ; **Michael J Wang** MD ; **Jennifer Bullen** MSc

Background
The phenomenon described as "the wisdom of crowds" posits that a group of individuals working independently on a problem on which they have varying levels of knowledge, can perform better than most of the individuals alone. Their solutions must be aggregated to produce a single solution that can outperform those from experts. Because each individual has some knowledge and some bias, the combination of their solutions should reinforce the knowledge (because it is the same), but cancel out the biases (because they are different). In order for a crowd to exhibit 'wisdom', they must attain the characteristics of diversity, and independence. Diversity ensures that many different approaches are considered. Independence prevents specific biases from spreading across the collective. Radiological diagnosis of images, including consults, violate both of these characteristics. We designed an experiment to satisfy these conditions to evaluate whether this phenomenon could be applied to radiology.

Evaluation
Seventy four musculoskeletal images with surgical proof or proof by follow up imaging were included. One third were normal, 1/3 were abnormal but easy to diagnosis, and 1/3 were abnormal but considered difficult to diagnosis. Twelve musculoskeletal radiologists marked the location of the abnormality and provide a differential diagnosis. Each radiologist evaluated each image separately without knowledge of other responses. A consensus diagnosis was calculated by a computer algorithm. Sensitivities and specificities were calculated for each reader and the algorithmic consensus. The sensitivity of the consensus was greater than the sensitivity of all 12 readers and the consensus specificity was great than 10 of the readers and equal to the other 2.

Discussion
The algorithmic consensus derived from independent readers had a greater sensitivity than all readers (statistically significant for 4 readers using McNemar's test at 0.05 level) and had a specificity greater than or equal to all readers (statistically significantly for 4 readers using McNemar's test).

CONCLUSION
This experiment demonstrates that algorithmic aggregation of individual expert image diagnoses can perform better than individual experts.

LL-INE3189-THB ● 3D Deformable Registration of CT Lung Images Based on Point Set and Intensity Information

Wei Xia BEng ; **Xin Gao** PhD (Presenter) ; **Lei Wang** PhD ; **Zhiyong Zhou** ; **Ran Zhang** BEng

Background
Respiratory movement of the lung may bring trouble to radiation treatment planning and interventional treatment. A pulmonary respiration model needs to be established by 3D deformable registration of CT lung images. However, such registration process is a difficult and time-consuming task. This work's aim is to reduce registration time and improve accuracy.

Evaluation
Registration of lung regions was performed on CT images from 4 patients, including 2 patients with nodules and 2 patients without lung disease. Pulmonary surfactant and vessels were first segmented from the lung images. The two parts was represented by point set. Each set of points was registered using coherent point drift (CPD) to obtain corresponding point displacement vectors. Then the squared Euclidean distance between point displacement vectors and the transformation vectors obtained by cubic B-spline was minimized as an objective function by the L-BFGS-B method. In addition, the component of transformation vectors was restricted to a certain size to avoid the folding of the image. Finally, the transformation obtained by point set registration was used as the initial parameters of a intensity information based registration which used mutual information, cubic B-spline and L-BFGS-B. The final transformation is the combination of the transformation derived by point set registration and intensity-information registration. A semi-automatic landmark annotating system was used to generate the corresponding landmarks for evaluating the accuracy by calculating distance error. 150~250 landmarks were detected in each image pair.

Discussion
Compared with the method which was only based on mutual information, the experimental result showed that the proposed method reduced as much as 70% of the time consumption and had smaller (0.5%~13%) distance error.

CONCLUSION
The results demonstrated that the proposed method is able to accomplish deformable registration of 3D CT lung images with less time and better accuracy, which is useful to build pulmonary respiration model and localize the instrument in lung.

LL-INE3187-THB ● Perfusion Analysis Software Accuracy Evaluation: A Digital Phantom Based Study

Panagiotis Korfiatis PhD (Presenter) ; **Leland S Hu** MD ; **Zachary S Kelm** BS ; **Bradley J Erickson** MD, PhD *

Background
Perfusion analysis software is widely available in clinical practice, however it is often treated as a black box tool. The values produced are generally accepted, but validation is challenging. The purpose of the current study is to describe an evaluation framework we developed for the accuracy of relative cerebral blood volume (rCBV) measurements from these tools, as well as investigate their robustness to noise, i.e. their ability to perform measurements of data originating from different image acquisition protocols.

Evaluation
Boxplots analysis was performed to provides a visual representation of variation of rCBV values for each noise level considered in this study for tumor with and without leakage respectively. Moderate positive correlations (0.30.7) correction was found for 1 package. In most cases, correlation decreased as the noise level increased.

Discussion
We developed software that would create DSC images simulating a gadolinium bolus into a "brain" with gray matter, white matter, and 4 tumors with varying levels of contrast agent leakage. The software allows us to introduce varying levels of noise, and to alter the appearance of the bolus. For this study, we are only altering noise levels. rCBV quantification was performed using three commercially-available software packages (nordicICE, GE FuncTOOL and IB Neuro) on simulated brains with fifteen different levels of Gaussian noise. Furthermore, leakage correction was applied when it was available in the software. For each noise level, 21 simulations were performed. We computed errors in tumor rCBV and the Pearson correlation coefficient (r) was calculated to determine

the correlation between the output of each software

CONCLUSION
Increasing noise degrades the performance of all software packages, some more than others. Leakage-correction improved the accuracy of the rCBV calculation for tissues with contrast leakage. Further investigation is needed to evaluate the use of preprocessing methods as a means to provide robustness to noise.

LL-INE3228-THB ● Lung Lobar Segmentation Using an Anatomy-based Priority Knowledge in Low-dose Chest CT: Application to COPD Patients

Sang Joon Park (Presenter) ; **Jin Mo Goo** MD, PhD * ; **Jung Im Kim** MD ; **Hyun-Ju Lee** MD, PhD ; **Chang Hyun Lee** MD, PhD ; **Chang Min Park** MD, PhD ; **Sang Min Lee** MD

Background
Lung lobar segmentation in CT images is a challenging tasks because of the limitations in image quality from parenchymal diseases and CT image acquisition, especially low-dose CT for clinical routine environment. The purpose our study was to propose and explore an automatic segmentation technique for pulmonary lobes and to validate its performance with COPD cases

Evaluation
Thirty COPD patients were selected for investigating the performance of the lobar segmentation scheme in this study. The images were obtained with low-dose chest CT (40 mAs at 120 kVp) using soft reconstruction kernel (Sensation 16). A PC-based in-house software was developed for fully automated segmentation of the pulmonary lobes using the following steps: First, segmentation of airways, vessels and lungs were performed. Then we extracted minor and major fissures by using eigenvalues-ratio of the Hessian matrix. To enhance and recover the faithful 3-D fissure plane, our proposed fissure-enhancing filter were applied to the images. After finishing above steps, for careful smoothening of fissure planes, 3-D rolling-ball algorithm in xy and xz coordinate planes was performed, respectively.

Discussion
By using 30 chest CT data sets, two expert thoracic radiologists performed visual scoring with 5 scales (0: failure, 1: poor, 2: fair, 3: satisfactory, 4: excellent). The mean scores of right and left lungs were 3.63 ± 1.54 (90%) and 3.80 ± 1.09 (95%), respectively. Results show that our proposed scheme showed better results in the left lung than in the right lung. This is due to the fact that 3 cases included large incomplete fissures, another 1 case had a tuberculosis and the others showed fibrotic changes adjacent to the fissure planes in the right lung.

CONCLUSION
By using novel lobar segmentation steps comprising decomposition of fissure planes, we could segment the pulmonary lobes up to 95% success rate even if some cases showed difficult situations for identifying the normal fissures. This study can be a vital role as a preprocessing step for regional analysis including lobes and pulmonary segments in the lung parenchyma for various lung diseases in the clinical environment.

LL-INE3230-THB ● Multi-phase and Multi-planar Liver Segmentation for Living Donor Liver Transplantation in Abdominal Contrast-enhanced CT Images

Yu Jin Jang BEng (Presenter) ; **Helen Hong** PhD ; **Jin Wook Chung** MD *

Background
For liver donor liver transplantation, liver segmentation is difficult due to the variability of its shape across patients and similarity of the density of neighbor organs such as heart, stomach, kidney, and spleen. In this paper, we propose a multi-phase and multi-planar liver segmentation method in portal phase of abdominal contrast-enhanced CT images.

Evaluation
All CT datasets were acquired on ninety-nine living donors using a SIEMENS CT system. Each image had a matrix size of 512x512 pixels with in-plane resolutions ranging from 0.50 to 0.75mm. The slice thickness ranged from 2.0 to 5.0mm and number of images per scan ranged from 68 to 320. For extracting an optimal volume circumscribing a liver, lower and side boundaries are defined by positional information of pelvis, rib, and lungs. The upper boundary is defined by separating the lungs and heart from the liver. For extracting an initial liver volume, optimal liver volume is segmented using adaptively selected threshold through the histogram analysis in upper right-hand portion of the abdominal cavity. For removing neighbor organs from initial liver volume, morphological opening and connected component labeling are applied to multiple planes. For the restoration of missing areas in the liver volume of previous step, the location of missing area is automatically detected and boundary refinement technique is applied to the detected areas. The performance of proposed method was evaluated by visual scoring (1=worst, 5=best) of radiologist. The score was 4.89 for right lobe extraction, 4.12 for left lobe extraction, 4.55 for spleen and stomach elimination, and 4.42 for kidney elimination.

Discussion
Our optimal liver volume defines an optimal segmented region and minimizes the leakage of liver border to neighbor organs and abdominal wall. Our neighbor organ elimination based on multi-planar anatomy helps to separate liver region from neighbor organs such as heart, stomach, spleen, and kidney. Our liver boundary refinement technique allows the missing left lobe in previous step to be restored.

CONCLUSION
Our method can be used for the liver volumetry for the pre-surgery planning of living donor liver transplantation.

RadioGraphics' Publication Information for Potential Authors

Thursday, 01:30 PM - 02:45 PM ● E350

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IN

ICIX51 • *AMA PRA Category 1 Credit* ™:1.25 • ARRT Category A+ Credit:1.5
Jeffrey S Klein , MD
Kimberly L Franks
Theresa M Hahn , BA
Lucinda Foulke

LEARNING OBJECTIVES
1) Prepare a format- and content-compliant manuscript for possible publication. 2) Use ScholarOne Manuscripts to submit a manuscript for possible publication. 3) Become familiar with the RadioGraphics publication process.
ABSTRACT
Many hours are spent writing and organizing the manuscripts, and their accompanying images, submitted to RadioGraphics. This workshop is designed to assist potential authors in the preparation and submission of manuscripts for possible publication. This year, authors will be navigated through ScholarOne Manuscripts, our new online manuscript submission and processing site.

Proper attention to content elements, figure preparation, and format compliance not only reduces delays in processing, but also provides optimal opportunity for favorable reviews and less revision. This course will include a PowerPoint TM presentation that provides an overview of the publication process and the guidelines for submitting print-quality images, as well as a live demonstration of the ScholarOne Manuscripts site. It will conclude with a question and answer session.
URL's
http://dl.dropbox.com/u/81611/Radiology/Journals/RadioGraphics/RadioGraphics%20presentations/RG%20presentation%20RSNA%202012%20PIA%20course.ppt

Hot Topic Session: From Irene to Sandy: How to Keep a Digital Department Running during a Natural Disaster

Thursday, 03:00 PM - 04:00 PM ● S403A

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LM IN

SPSH55 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
David S Hirschorn , MD
Kamran Nasrullah
Michael P Recht , MD
Daniel P Link , MD *
David S Hirschorn , MD

LEARNING OBJECTIVES
1) Understand the challenges of natural disasters to a radiology department. 2) Learn about the dangers to patients, personnel and equipment posed by natural

disasters. 3) Explore methods to maintain operation of essential radiologic services during natural disasters. 4) Understand how to recover a radiology dept from natural disasters.

Medical Physics 2.0: Information Management and Display

Thursday, 04:30 PM - 06:00 PM • N229

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PH IN

RC721 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Co-Director
Ehsan Samei , PhD *
Co-Director
Douglas E Pfeiffer , MS *

RC721A • Information Management and Display Perspective

Ehsan Samei PhD (Presenter) *

LEARNING OBJECTIVES
1) To gain an appreciation for interaction between medical physics and information technology in modern medicine. 2) To understand how physics can add value to patient care in the area of information and image management and technology.

RC721B • Information Management and Display 1.0

Donald Peck PhD (Presenter)

LEARNING OBJECTIVES
1) Review the different areas of imaging informatics. 2) Understand the methodology for developing informatics standards and the role of physicists and radiologists in the process. 3) Review the current status of informatics standards 4) Review current technology for validating the function of these systems.

ABSTRACT
Imaging informatics is part of every radiology practice today. Imaging informatics covers everything from the ordering of a study, through the data acquisition and processing, display and archiving, reporting of findings and the billing for the services performed. The standardization of the processes used to manage the information and methodologies to integrate these standards is being developed and advanced continuously. These developments are done in an open forum and imaging organizations and professionals all have a part in the process. In this presentation the flow of information and the integration of the standards used in the processes will be reviewed. The role of radiologists and physicists in the process will be discussed. Current methods for validation of informatics systems function will also be discussed.

RC721C • Information Management and Display 2.0

Michael J Flynn PhD (Presenter)

LEARNING OBJECTIVES
1) Information management; a. Decision support for Radiology examination orders. b. Dose monitoring for radiographic, interventional, CT and Nuclear Medicine procedures. 2) Data storage and distribution; a. Enhanced DICOM objects. b. Vender neutral archives for enterprise image storage. c. Web distribution protocols. 3) Study viewing and report generation; a. Color calibration and presentation management. b. Structured reports.

Quantitative Imaging: Informatics

Thursday, 04:30 PM - 06:00 PM • E352

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PH IN BQ

RC725 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Director
Michael F McNitt-Gray , PhD *

RC725A • The Role of Informatics in Quantitative Imaging

Katherine P Andriole PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the role of informatics in quantitative imaging. 2) Be able to identify existing limitations in information technologies with respect to quantitative imaging, and conversely see how informatics may assist in filling some of the current gaps in quantitative imaging methods. 3) Become familiar with on-going efforts to address current challenges facing research into and clinical implementation of quantitative imaging applications.

ABSTRACT
Quantitative imaging is increasingly becoming an essential part of biomedical research as well as being incorporated into clinical diagnostic activities. Referring clinicians are asking for more objective information to be gleaned from the imaging tests that they order so that they may make the best clinical management decisions for their patients. Medical Physicists, Researchers, Imaging Scientists, and others may be called upon to identify existing issues as well as develop, validate and implement new approaches and technologies to help move the field further toward quantitative imaging methods. Biomedical imaging informatics tools and techniques such as standards, integration, data mining, cloud computing and new systems architectures, ontologies and lexicons, data visualization and navigation tools, and business analytics applications can be used to overcome some of the existing limitations. The RSNA's Quantitative Imaging Biomarkers Alliance (QIBA) is an initiative with international participation from medical physicists, clinicians, researchers, industry scientists, and government officials all interested in optimizing the potential of quantitative imaging. A major QIBA informatics activity, the imaging data warehouse is in progress. Current status and future plans will be described.

RC725B • Standards for Quantitative Imaging

David A Clunie MBBS (Presenter) *

LEARNING OBJECTIVES
1) Identify the importance of quantitative imaging principles in the setting of clinical trials. 2) identify the role of standards, including DICOM and others, in the successful application of quantitative imaging principles. 3) Analyze quantitative imaging techniques and apply this knowledge to protocol development in the setting of clinical trials.

RC725C • Clinical and Research Needs for Quantitative Imaging Informatics Tools

Bradley J Erickson MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Become familiar with the quantitative imaging tools that are available for clinical and research uses. 2) Become familiar with the clinical and research problems that are being addressed by quantitative imaging. 3) Become familiar with the clinical and research problems that might be addressed by quantitative imaging in the near future and how to prepare one's practice for these uses.

ABSTRACT
Quantitative imaging is more than just the measurement of structures in images. It is a new way of approaching diagnosis and therapy assessment. While simple linear measurements might qualify as quantitative imaging, it is important to think of QI in a much broader context. In addition to measuring spatial quantities like length, area, and volume, one can measure image values on functional imaging, which might represent a physiologic value. One can measure textures and edge properties, potentially replacing the "it just looks like it" answer to why an expert can diagnose a certain disease. Measuring change can also be more than just spatial. Spatial change detection is important, of course, and doing it well is a critical component of QI. Measuring change in non-spatial properties is likely to become more important in the future. Finally, while some might believe that genomics will largely replace imaging, there is currently much interest in the use of imaging to provide pervasive and non-destructive prediction of genomic, proteomic, and metabolomic properties that are likely to be of great value to patient care.

Decision Support in Clinical Practice

Thursday, 04:30 PM - 06:00 PM • N226

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IN

RC726 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Co-Moderator
Charles E Kahn , MD, MS *
Co-Moderator
Elizabeth S Burnside , MD, MPH *

LEARNING OBJECTIVES
ABSTRACT

RC726A • CPOE: Radiology Decision Support for the Clinician

Charles E Kahn MD, MS (Presenter) *

LEARNING OBJECTIVES
1) Define decision support systems and their role in radiology. 2) Describe widely used decision support technologies. 3) Explore how radiology decision support systems can improve patient care outcomes.

ABSTRACT
Decision support systems use knowledge -- ranging from books, to web sites, to real-time artificial intelligence systems -- to help physicians improve their decision making. This Refresher Course will review a number of systems that can help radiologists' decision making. We will describe tools for information retrieval and image retrieval, and systems that use rules or probabilities to help identify the most likely diagnosis. We will discuss how evolving technologies provide new ways to integrate advanced decision support into routine clinical practice, and how decision support systems can improve outcomes in patient care.

RC726B • Decision Support in Predicting Diagnosis and Outcomes

Elizabeth S Burnside MD, MPH (Presenter) *

LEARNING OBJECTIVES
1) Understand the potential role of informatics in predicting diagnosis and outcome based on variables derived from imaging. 2) Appreciate the important trade-offs that exist when developing or using predictive models. 3) Learn about the application and critical evaluation of different methodologies that can provide predictive information.

ABSTRACT

RC726C • Quantitative Image Analysis for Image Retrieval, Decision Support, and Knowledge Discovery

Sandy Napel PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand what quantitative image features are and the various ways in which they may be obtained. 2) Understand the concept of image similarity. 3) Understand several ways in which quantitative image features may be used to compute image similarity. 4) Learn about potential applications of quantitative image features, such as content-based image retrieval, decision support, and discovery of relationships between image features and molecular properties of disease.

URL's
http://snapg4.stanford.edu/~snapel/RSNA_QIA_2012.pdf

Leveraging Imaging Informatics to Improve Radiology Education: Beyond the Teaching File (An Interactive Session)

Thursday, 04:30 PM - 06:00 PM • S103AB

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IN ED

RC730 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Marc D Kohli , MD *

RC730A • Simulation Systems in Radiology Education

Kitt Shaffer MD,PhD (Presenter)

LEARNING OBJECTIVES
1) Describe two professional systems that currently use simulation extensively for teaching. 2) List three teaching situations in radiology where simulation could be integrated. 3) Describe three levels of training in radiology where simulation could play a role.

ABSTRACT
This interactive session will explore the role of simulation in all types of professional training outside of radiology, as well as potential educational, training, evaluation and quality improvement settings within radiology where simuluation may play a role in the future.

RC730B • Educational Tools for the Next Generation in Radiology

Richard E Sharpe MD, MBA (Presenter)

LEARNING OBJECTIVES
1) Explain factors that are changing the face of radiology education. 2) Contrast the educational tools used by past, present and future generations of radiologists. 3) Describe cutting edge innovative educational tools for diagnostic radiology training.

RC730C • Quality Improvement Tools in Education

Jason N Itri MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Define standards for evaluating the quality of an assessment method. 2) List quality-related educational outcomes for radiology trainees. 3) Describe IT tools that can be used to assess trainee performance and the impact of interventions. 4) Discuss educational and training interventions that improve quality-related outcomes.

ABSTRACT

RC730D • Taking Audience Response to the Next Level

Lonie R Salkowski MD (Presenter)

LEARNING OBJECTIVES
1) Demonstrate the ability to set-up, prepare and incorporate a presentation into an audience response system. 2) Determine methods for exporting and analyzing data from an audience response session. 3) Identify differences of using audience response systems on PC versus Mac platforms. 4) Identify techniques where the audience response system can be applied to active learning environments.

ABSTRACT
This session will demonstrate ways to incorporate audience response devices into learning environments, and assist users how to use the data that is collected behind the scenes within audience response systems.

Advanced Image Analysis, including Applications such as Automated Stent Planning and Multimodality Image Fusion and Treatment Planning (Hands-on Workshop)

Thursday, 04:30 PM - 06:00 PM • S401CD

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IN

RC753 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Gary J Wendt , MD,MBA *

LEARNING OBJECTIVES
1) To get hands-on experience using 3D / 4D tools to process huge data sets, specifically multislice CT and MR using data sets. 2) How to effectively deal with the following data: CT and MR angiograms, perfusion, and bone. 3) Getting hands on experience using 3D / 4D tools to process data in near realtime. 4) Introduce the basic 3D tools that are available and how they can be used both within radiology as well as how they apply to referring clinicians.
ABSTRACT
This course will focus on how to o get hands-on experience using 3D / 4D tools to process huge data sets, specifically multislice CT and MR using data sets. How to effectively deal with the following data: CT and MR angiograms, perfusion, and bone. It will also focus on providing hands on experience using 3D / 4D tools to process data in near realtime for emergencies like stroke work-up. It will also introduce the basic 3D tools that are available and how they can be used both within radiology as well as how they apply to referring clinicians

Using RADIANCE for CT Dose Monitoring and Quality Assurance: A Hands-on Course

Thursday, 04:30 PM - 06:00 PM • S401AB

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QA IN

RC754 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Tessa S Cook , MD, PhD
Adam H Kaye , MD
William W Boonn , MD *

LEARNING OBJECTIVES
1) Download and install RADIANCE. 2) Configure RADIANCE for their facility. 3) Set up RADIANCE to query and retrieve dose sheets automatically from PACS or another archive. 4) Use the RADIANCE reporting tools to review their institutional dose data. 5) Export dose data from RADIANCE for custom analysis using a spreadsheet or database.
ABSTRACT
RADIANCE is a freely-available, open source software packaged designed to facilitate dose monitoring, dose reporting and quality assurance for computed tomography (CT) examinations. It uses optical character recognition (OCR) to extract structured data from the image-based dose sheets that have been and continue to be produced by CT scanners worldwide. The structured data is parsed and useful dose-related parameters are extracted, including the x-ray tube voltage (kV), x-ray tube current (mA), volumetric CT dose index (CTDIvol) and dose-length product (DLP). In addition, information about the patient, type of study, scanner and performing institution are obtained from the DICOM study header. This aggregate of dose and exam data is stored in a relational database which can be used to perform quality assurance measures. Using the RADIANCE dashboard and scorecards, facilities can closely monitor their dose data, generate monthly reports for individuals and administrators, identify and investigate outliers and evaluate dose reduction and protocol optimization measures. With the development of radiation dose structured reports (RDSRs or Dose SRs), which are generated by newer scanners, facilities can participate in the American College of Radiology's Dose Index Registry (DIR). However, sites without the newest scanners or latest firmware, or those whose scanners will not be updated, can use RADIANCE to generate an RDSR from legacy (i.e., image-based) dose sheets and automatically send it to the DIR. Participants in this hands-on course will learn how to install and configure RADIANCE for optimal use at their facilities.
URL's
http://www.radiancedose.com

The Use of Business Analytics for Improving Radiology Operations, Quality, and Clinical Performance (In Association with the Society for Imaging Informatics in Medicine)

Friday, 08:30 AM - 10:00 AM • E350

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LM IN

RC826 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Katherine P Andriole , PhD

LEARNING OBJECTIVES
1) Understand what is meant by business analytics in the context of a radiology practice. 2) Be able to describe the basic steps involved in implementing a business analytics tool. 3) Learn how business analytics tools can be used for quality assurance in radiology, for maintenance of certification (MOC), and for practice quality improvement. 4) Be introduced to the capabilities of current and potential future business analytics technologies.
ABSTRACT
This course will provide an overview of the use of business analytics (BA) in radiology. How a practice manages information is becoming a differentiator in the competitive radiology market. Leveraging informatics tools such as business analytics can help a practice transform its service delivery to improve performance, productivity and quality. An introduction to the basic steps involved in implementing business analytics will be given, followed by example uses of BA tools for quality assurance, maintenance of certification (MOC) and pracitce quality improvement . The power of current business analytics technologies will be described, along with a look at potential future capabilities of business analytics tools.

RC826A • An Introduction to Business Analytics Demonstrating Use of an Open-Source Tool for Application to Radiology

Katherine P Andriole PhD (Presenter)

LEARNING OBJECTIVES
1) Gain an overview of business analytics tools and understand how they might be used in radiology. 2) Be able to describe the general steps involved in business analytics, including extract, transform, load (ETL) and key performance indicators (KPI). 3) See a demonstration implementation of an open-source business analytics tool using a radiology use case.

ABSTRACT
This session will provide a general overview of business analytics concepts and how they can be used in radiology. A walk through of the basic steps involved in implementation including identifying, collecting, transforming, and dynamically presenting key performance indicators (KPI) will be demonstrated. The extract, transform, load (ETL) steps will be shown using an example use case, and multiple database sources taken from a radiology practice.

RC826B • Business Analytic Tools for Quality Assurance, MOC and PQI

Paul G Nagy PhD (Presenter)

LEARNING OBJECTIVES
1) Discuss the importance of informatics tools for ABR MOC PQI and ACGME SBP quality efforts. 2) Identify the role of informatics in capturing, extracting, analyzing, and communication quality projects. 3) Illustrate graphical dashboarding examples to support quality efforts.

RC826C • Capabilities of Current and Future Business Analytics Technologies

Tessa S Cook MD, PhD (Presenter)

LEARNING OBJECTIVES
1) To gain familiarity with currently available business technologies and their relevance to radiology practice. 2) To consider how existing business technologies can support quality assurance in radiology. 3) To learn about business analytics features that may be available/desirable in the future to augment and support both the practice of radiology.

ABSTRACT

Current and Next Generation Health IT Tools To Enable Radiation Exposure Reduction - A Practical Guide

Friday, 08:30 AM - 10:00 AM • S403A

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QA IN

RC830 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Ramin Khorasani , MD *

RC830A • Before the Scan: Optimizing Dose Before the Patient Is On the Table

Rasu B Shrestha MD, MBA (Presenter) *

LEARNING OBJECTIVES
1) Number of CT scans is increasing annually. 2) Wider adoption/ availability of CT scanners. 3) Indications for CT use are increasing (without possible consideration for risks). 4) Rapid increase in number of protocols: Varying equipment leading to protocol variance. Children are at greater risk from a given dose of radiation compared with adults. A thorough look at the issues around radiation dose in children will also be provided.

ABSTRACT
The acceptance of the risks associated with radiation is conditional on the benefits to be gained from the use of radiation. The risks must be restricted and protected against by the application of radiation safety standards. A significant part of the challenge of patient dose management in CT arises from the fact that over-exposure in CT is frequently not detected. In contrast to film based radiography where overexposure results in a dark image, increasing dose in CT and in other digital imaging techniques results in images with: (1) less noise (improved visual appearance) and (2) fewer streak artifacts, (3) although not necessarily with greater diagnostic information. Image quality in CT often exceeds the clinical requirements for diagnosis. It is critical to have a thorough understanding of the basics of radiation dose in CT before we explore the multiple issues around opportunities to reduce these dose parameters. Furthermore, it is also critical to comprehend the role of newer technologies, innovations and developments that are rapidly taking place to address radiation dose reduction in CT - both on the vendor as well as on the private and academic communities. A through and comprehensive understanding of the quality and patient safety issues around this is also critical to making sound decisions around imaging on multiple levels. Different organs have different sensitivities to radiation. Tissue Weighted Factor, WT takes into account the risk to the person exposed to radiation that is not uniform over the entire body. As an example, if 1 mSv is received only by the lungs, this results in an effective dose to that person of 0.12 mSv. This means that 1 mSv received by the lungs poses approximately the same risk as 0.12 mSv to the entire body. Fundamentals such as these will be presented in easily digestible chunks in the refresher course. Also covered will be Protocol Optimization, Scanner Interfacing, Data Connectivity and Interoperability.

RC830B • During the Scan: Patient-Centric Imaging

William W Boonn MD (Presenter) *

LEARNING OBJECTIVES
1) Learn how modifications in CT scan protocol can affect image quality and radiation dose. 2) Understand how to optimize scanning protocols based on clinical indication and patient specific factors. 3) Learn how to measure and monitor protocols and dose to track and optimize performance.

RC830C • After the Scan: Data-Mining Dose Data for Improved Quality, Safety. and Outcomes

Aaron D Sodickson MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand available metrics of CT radiation exposure, and how they relate to patient dose. 2) Demonstrate methods to extract exposure data on a large scale. 3) Highlight quality improvement and patient safety applications of large radiation exposure databases.

Advanced Image Analysis, including Applications such as Automated Stent Planning and Multimodality Image Fusion and Treatment Planning (Hands-on Workshop)

Friday, 08:30 AM - 10:00 AM • S401CD

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IN IR
RC853 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Gary J Wendt , MD,MBA *

LEARNING OBJECTIVES
1) To get hands-on experience using 3D / 4D tools to process huge data sets, specifically multislice CT and MR using data sets. 2) How to effectively deal with the following data: CT and MR angiograms, perfusion, and bone. 3) Getting hands on experience using 3D / 4D tools to process data in near realtime. 4) Introduce the basic 3D tools that are available and how they can be used both within radiology as well as how they apply to referring clinicians.
ABSTRACT
This course will focus on how to o get hands-on experience using 3D / 4D tools to process huge data sets, specifically multislice CT and MR using data sets. How to effectively deal with the following data: CT and MR angiograms, perfusion, and bone. It will also focus on providing hands on experience using 3D / 4D tools to process data in near realtime for emergencies like stroke work-up. It will also introduce the basic 3D tools that are available and how they can be used both within radiology as well as how they apply to referring clinicians

Basic Tools and Tricks for Data Collection and Organization for Practice Quality Improvement Projects and for Research Data Management - A Step by Step Approach with Excel (Hands-on Workshop)

Friday, 08:30 AM - 10:00 AM • S401AB

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RS IN
RC854 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Andrea J Frangos , MPH
Jaydev K Dave , PhD, MS

LEARNING OBJECTIVES
1) Define the basic structure and functions of a spreadsheet. 2) Learn efficient techniques for data collection in a spreadsheet. 3) Demonstrate key data management skills. 4) Recognize differences between a spreadsheet and a database.
LEARNING OBJECTIVES

1. Learn efficient techniques for manipulating data and performing data analysis with a spreadsheet program.
2. Define the basic structure and functions of a database.
3. Learn how to create a simple database for data collection and analysis.
4. Recognize tasks that are more easily accomplished with a database than a spreadsheet.

ABSTRACT
A spreadsheet program is commonly employed to collect and organize data for practicing quality improvement, for research, and for other purposes. In this refresher course, we will demonstrate how to format and use a spreadsheet properly for data collection and analysis. We will define the essential structure and function of a spreadsheet and elaborate on the process to create a basic spreadsheet. We will review common errors during data acquisition that may be avoided for streamlining the acquisition process. We will then consider several functionalities of a spreadsheet program that facilitate data management. We will also highlight the differences between a spreadsheet and a database, so that the participants may be able to identify best applications for their tasks.
This course will accomplish its learning objective through hands-on tutorial demonstrations with Microsoft Excel ® a spreadsheet program. Familiarity with Microsoft Windows environment will be assumed, but no experience with Microsoft Excel spreadsheet program or formula is necessary.

National Library of Medicine PubMed: Find Articles You Need: Searching PubMed/MEDLINE Efficiently

Friday, 10:30 AM - 12:00 PM • S401AB

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IN
ICIW61 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Holly A Burt
Chezire Aclimandos
Annabelle Nunez , MA
Wendy Wu , MS

LEARNING OBJECTIVES

1) Understand how PubMed constructs a query and how to develop and refine effective search strategies in radiology. 2) Use PubMed tools including Clinical Queries, Related Articles, Single Citation Matcher and Loansome Doc. 3) Build focused searches using the Medical Subject Headings (MeSH) vocabulary for radiology and limit searches to radiology-oriented journals. 4) Understand how to save and download citations.

ABSTRACT
This hands-on workshop covers key searching techniques, changes to PubMed, and how to develop effective search strategies for PubMed and MEDLINE. Topics covered include: why keywords don't always give the results you expect, how to limit to specific journals, quick searches to find evidence-based citations, how to access full-text articles, and downloading citations to reference manger programs. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov). MEDLINE is a subset of PubMed which includes links to sites providing full text articles and to other related databases and resources.

Informatics (Segmentation, Measurement and CAD)

Friday, 10:30 AM - 12:00 PM • E353A

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IN

SST08 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Ayis T Pyrros , MD *
Moderator
Mohammed I Quraishi , MD

SST08-01 • Bag-of-Words Representation of White Matter in Diffusion Tensor Imaging and Its Application to Diagnosis of Schizophrenia

Chi Wai Cheung (Presenter) ; **Kin Yin Cheung** ; **Siu Ki Yu** PhD

PURPOSE
Diagnosis of Schizophrenia can be performed in Diffusion Tensor Imaging (DTI) by detecting the abnormalities in white matter. In this study, we propose a bag-of-words representation of white matter in DTI, apply it to diagnose Schizophrenia, and compare it with the Parzen window model.

METHOD AND MATERIALS
In a DTI scan, a diffusion tensor can be estimated for each voxel by a least-squares method. The affine-invariant scalar measures including Frobenius Norm (FN), Fractional Anisotropy (FA) and Mode (MD) describe the shape of the tensors. We define a word w as a triple of the quantized scalar measures of a voxel (i.e. w∋. The vocabulary size is therefore |N(FN) x N(FA) x N(MA)|, where N() is the number of the bins of a measure. A DTI scan is represented as a set of words and it is called a bag-of-words representation. This representation captures the correlations between scalar measures of diffusion tensors. To diagnose Schizophrenia, feature vectors specifying the occurrences of the words of white matter are calculated and used to train a classification function using Support Vector Machines, which is then used to classify the DTI scans. The public MIDAS/NAMIC Brain Multimodality dataset which contains DTI scans of 10 Normal Controls and 10 Schizophrenic cases was used to compare the classification function with a Parzen window model based on a probabilistic representation. We performed stratified random sub-sampling validation. In each trial, 30% of total samples are randomly selected as the testing samples and the remaining samples are the training samples. We performed 1000 trials in total and the results presented below are averaged over all trials.

RESULTS
For the Parzen window model, the sensitivity and specificity are 0.595 and 0.513 respectively. For the classification function based on our proposed presentation, the sensitivity and specificity are 0.717 and 0.59, giving 20.5% and 15% improvements respectively.

CONCLUSION
The results show that the classification function based on the proposed representation outperforms the Parzen window model based on the probabilistic representation for diagnosis of Schizophrenia using DTI.

CLINICAL RELEVANCE/APPLICATION
Bag-of-words Representation of White Matter in Diffusion Tensor Imaging gives high accuracy in diagnosis of Schizophrenia

SST08-02 • A Platform for the Comparison of Lung Nodule Segmentation Algorithms: Methods and Preliminary Results

Jayashree Kalpathy-Cramer MS, PhD (Presenter) ; **Binsheng Zhao** DSc ; **Dmitry Goldgof** PhD ; **Yuhua Gu** ; **Xingwei Wang** ; **Sandy Napel** PhD * ; **Robert J Gillies** PhD * ; **Hao Yang** ; **Yongqiang Tan** PhD

PURPOSE
Accurate and reproducible segmentation of lung nodules is an important step in the assessment of response to therapy in lung cancer patients. Four institutions, Massachusetts General Hospital (MGH), (Stanford University (SU), Moffitt Cancer Center (MCC), and Columbia University Medical Center (CUMC)), members of the NCI's Quantitative Imaging Network, sought to create and test a platform for comparing these algorithms on shared datasets.

METHOD AND MATERIALS
The data set used for this evaluation consisted of 52 tumors in 41 CT volumes from 5 collections available in The Cancer Imaging Archive (including the RIDER, LIDC and FDA phantom collections, as well as two collections from SU and MCC). CUMC, MCC, and SU provided the outputs for 3 runs (each initialized with unique seeds) of their own segmentation algorithms (SU=region growing with gray-value statistics; CUMC= marker-controlled watershed and active contours; MCC= ensemble segmentation using region-growing algorithm and automatically selected multiple seed points). We used the TaCTICS platform, which allows participants to submit results in a variety of formats (e.g., png, DICOM-seg), to perform statistical analysis and visualization of results, including bias (phantom volume estimates) and repeatability. Dice coefficients ('overlap') and Hausdorff distances ('surface distance') were calculated for all pairs of segmentations for each nodule.

RESULTS
Graphical display of all metrics allowed easy detection of outlying algorithms and challenging nodules. Average tumor volumes were between 33 and 56,641 ml. Dice coefficients for all pairwise comparisons varied from 0.54 to 0.97 (mean:0.85, s.d=0.17) with 1.0 being perfect. The intra-algorithm agreement was higher than the inter-algorithm agreement (average Dice: 0.95 vs 0.81), and was typically higher for larger volumes. Repeated measures ANOVA showed no statistically significant difference between algorithms in terms of repeatability.

CONCLUSION
Our platform allows for easy comparison of evolving segmentation algorithms, is easily generalizable to a wide range of tumor types and imaging modalities, and could speed the development of robust algorithms.

CLINICAL RELEVANCE/APPLICATION
This platform can facilitate advancement and evaluation of segmentation algorithms for lesions seen in medical image volumes, critical for precision diagnosis and assessment of treatment response.

SST08-03 • A Method for Segmenting Multi-focal Radiotracer Uptake in PET Images to Quantify Tuberculosis in Rabbits

Brent Foster (Presenter) ; **Ulas Bagci** PhD, MSc ; **Ziyue Xu** PhD ; **Awais Mansoor** PhD ; **Bappaditya Dey** ; **Brian Luna** ; **William Bishai** ; **Sanjay K Jain** MD ; **Daniel J Mollura** MD

PURPOSE
To develop a novel segmentation method that can identify and quantify diffuse and multi-focal uptake regions using small animal model PET images that have a diagnosis of a pulmonary infection.

METHOD AND MATERIALS
Our segmentation approach is based on affinity propagation (AP) clustering and uses a novel distance metric and a probability density function that is estimated from a smoothed histogram. An overview of the proposed method is as follows: (i) the PET image histogram was estimated and smoothed by using a diffusion based kernel density estimation, (ii) a novel similarity function was constructed to determine how similar the histogram data points are to each other, based on two constraints: probability based and intensity based constraints, with the assumption that points that are more similar are more likely to belong to the same classification, and (iii) the AP clustering was applied to the similarities between the data points in order to find optimal thresholding levels that can separate the significant uptake regions into several tissue labels. Our proposed method was tested using an infectious disease small animal model that consisted of imaging ten rabbits at weeks 0,5,10,15,20,30, and 38 with FDG-PET'and all rabbits were infected with an aerosolized Mycobacterium Tuberculosis. Two experts segmented the images to define the ground truth for comparison.

RESULTS
The Dice Similarity Coefficient (DSC) and the sensitivity and specificity were calculated between the segmentation regions that were found by the proposed method and then compared to expert delineations. An average DSC of 89.06±9.82% with a sensitivity of 97.87±7.09% and a specificity of 83.70±15.32% were achieved. The Pearson correlation coefficient between the delineation performances of the two expert observers was R2=0.85 (p
CONCLUSION
Current PET segmentation techniques focus on focal uptake regions and are not well suited for multi-focal uptake regions, commonly found in infectious lung

diseases. Our proposed segmentation method quantified the multi-focal uptake regions with high accuracy and within seconds&#65533;and it outperformed the state-of-the-art methods.

CLINICAL RELEVANCE/APPLICATION
This method can be used to segment diffuse and multi-focal FDG uptake normally seen in PET images from patients with infectious diseases like TB.

SST08-04 • Evaluation of a Novel Software for Fully Automated Detection of Osteoporosis in Abdominal MDCT Scans Performed for Other Clinical Indications, as an Aid to the Radiologist

Einat Blumfield MD (Presenter) * ; **Jay S Leb** MD ; **Anthony Blumfield** MSc *

CONCLUSION
The use of Radnostics software may increase early detection of OP in patients who have abdominal MDCT scans for other clinical indications.

Background
Osteoporosis (OP) is a common condition that increases the risk of fractures without significant trauma. Early detection and therapy may diminish fracture risk. While Screening with bone densitometry is considered the gold standard for diagnosing OP, the compliance for this test is low. OP may be detected in CT scans; however it is under-reported by radiologists. An automated method for detection of OP may improve the rate of early diagnosis. Novel software, for automated spine segmentation and OP detection was developed by Radnostics&#65533; (Scarsdale, NY). The software performs phantomless measurement of bone mineral density (BMD) in vertebral bodies and presents the radiologist with an image (figure) on PACS that includes average BMD and density values and a sagittal image of the spine. The process is fully automated and takes < 5 minutes per scan. The purpose of this study is to evaluate the efficacy of the software as an aid to the radiologist.

Evaluation
In this retrospective, IRB exempt study, 198 consecutive subjects (182F, 16M, age 34-89, mean-65.5+/-9 y) who had DXA and CT scans within a period of
Discussion
The use of the software resulted in a 275% increase in the rate of reporting osteopenia in abdominal CT scans with only 3 additional FP cases. The Radnostics software is efficient as an aid to the radiologist. It provides the radiologist with an image that contains data needed for evaluation of bone mineralization and does not require any manual intervention.

SST08-05 • Semi-automatic Quantitative Measurement of Breast Background Parenchymal Enhancement and Breast Cancer Risk

Ya Wang (Presenter) ; **Malcolm Pike** ; **Valencia King** MD ; **Janice S Sung** MD ; **Elizabeth A Morris** MD ; **Eve Burstein** ; **Erin E Onstad** ; **Jonine L Bernstein** ; **Jennifer Brooks** PhD ; **Joseph O Deasy** PhD

PURPOSE
Breast fibroglandular tissue (FGT) amount, as measured by mammographic density or breast MRI, is an established breast cancer risk factor. Our recent study found that background parenchymal enhancement (BPE) on MRI of an unaffected breast is also strongly associated with breast cancer risk. To significantly reduce the intra- and inter-reader variability inherent in visual FGT and BPE classification, we developed a semi-automatic quantitative method and tested it on the MRIs in the aforementioned study.

METHOD AND MATERIALS
Contrast-enhanced breast MRI sequences were obtained for 39 breast cancer cases and 78 for control group. Our segmentation algorithm was applied to the central slice images, providing an automatic classification of voxels into FGT and non-FGT. An &#65533;enhancement image&#65533; within the breast area was obtained by subtracting the baseline from the post-injection image. We defined a subtraction voxel with a signal intensity of 10 or greater as positive and the percentage of positive subtraction voxels within the FGT area (BPE-W) was calculated. The set of BPE-W from all cases and controls was then divided into quartiles. The lowest two and highest two quartiles were combined and a conditional logistic regression for matched case-control groups, adjusted for menopausal status, was used to calculate the relative risk of being a case in the high (versus low) BPE group. These results were compared to those from Reader 1 in the original study, who had used BI-RADS conventions to classify BPE as minimal, mild, moderate, or marked.

RESULTS
Our method successfully analyzed 31 of the 39 cases with at least one matched control apiece. The relative risk (RR) of being a case using BPE-W was significant ($p = 0.003$) and was estimated at 5.6. The RR calculated using Reader 1&#65533;s BI-RADS classifications for the same subset of cases and controls is 11.6 ($p = 0.001$).

CONCLUSION
The results from our semi-automatic quantitative method measuring BPE were similar to those obtained from visual classification of MRI&#65533;s using the BI-RADS system. The large and significant RR was obtained using only the central slice from the breast MRI, and our method is likely to produce even more informative results when entire breast is analyzed.

CLINICAL RELEVANCE/APPLICATION
Our semi-automatic quantitative method supports earlier results suggesting BPE as a risk factor for breast cancer, and shows better reproducibility by reducing inter- and intra-reader variability.

SST08-06 • Bi-ventricular Volume Estimation for Cardiac Functional Assessment

Zhijie Wang (Presenter) ; **Mohamed Ben Salah** ; **Ismail Ben Ayed** * ; **Ali Islam** MD ; **Aashish Goela** MD ; **Shuo Li** PhD *

CONCLUSION
We developed a nearly real-time method to estimate the volumes of both RV and LV with minimum user input. The method was tested on short-axis MR images of 35 subjects and was demonstrated as a promising tool that enables semi-automated functional assessment for RV as well as LV simultaneously.

Background
Estimation of the two cardiac ventricles&#65533; volumes is of significant clinical importance for the purpose of cardiac functional assessment. Although very powerful semi-automated solutions have been employed for the left ventricle (LV), the estimation task is still performed manually or visually for the right ventricle (RV) in routine clinical use. We have developed a semi-automated method to efficiently estimate the volumes of RV as well as LV simultaneously with neither manual nor auto contouring.

Evaluation
Following IRB approval, 35 patients (22 men, 13 women, avg 52±17 yrs) underwent cardiac cine MR images using 1.5T GE scanner with FIESTA image sequence. A subject sequence consists of 20 frames of 3D images in short-axis view. For each subject, only two landmarks were placed at the attachment spots of the right ventricular wall to the left ventricular septal wall in the first frame on each slice. Then our method simultaneously estimated the volumes of both RV and LV, and computed their ejection fractions. The results on the 35 subjects were compared with gold standard created by a human expert manually contouring the biventricular endocardia.

Discussion
A comprehensive validation on 35 subjects demonstrates that the estimated volumes of RV and LV are highly correlated to gold standard with correlation coefficients 0.9470 and 0.9812. Furthermore, the coefficient of the correlation between the RV/LV ejection fraction and gold standard are also as high as 0.8635 (RV) and 0.9676 (LV). Overall, the performance is lower on RV than on LV, which is expected due to the complex motion and geometry of RV. The whole bi-ventricular volume estimation process takes on average 1.26 seconds per subject and can be further optimized.

SST08-07 • Enhancement of CADx Accuracy by Using Multiple Slices from Various Views in 3D Liver Ultrasound

Ye-Hoon Kim (Presenter) ; **Moon Ho Park** ; **Junghoe Kim** ; **Baek Hwan Cho** ; **Yeong Kyeong Seong** PhD ; **Kyoung-Gu Woo** ; **Min Woo Lee**

CONCLUSION
3D US liver CADx using multiple slices in the vicinity of the lesion center and combination of their various views can enhance the diagnostic accuracy for liver cancer.

Background
The objective of this study is to enhance the performance of 3D US Computer-Aided Diagnosis (CADx) for liver cancer. The proposed 3D US liver CADx uses multiple slices and various views from 3D volume for diagnosis of benign and malignant tumors. Our CADx system segments the lesion and extracts the features and then classifies lesions as benign for cyst and hemangioma and as malignants for hepatocellular carcinoma.

Evaluation
2D (1024x768) and 3D (512x510x256) US images of liver lesions were acquired for this research from 44 patients (22 benign and 22 malignant cases) respectively by using 2D and 3D US probes from Feb. 2012 to Mar. 2013. The accuracy of our CADx was 1) 80.8% by only a 2D slice containing a lesion; 2) 81.9%, 78.8%, 74.4% by using a center slice of the lesion with three orthogonal views, respectively; 3) 81.8% by combining three orthogonal views of the lesion (total 3 slices); 4) 85.5%, 79.0%, 75.5% by using seven slices of the lesion for three orthogonal views, respectively; 5) 84.0% by combining seven slices of the lesion with their three orthogonal views (total 21 slices). The seven slices include a center slice which bisects a lesion and additional slices in the vicinity of the lesion center in 3D volume. 2D lesion contour for ground truth was obtained by a radiologist and 3D lesion volume was obtained

semi-automatically. Majority voting was used to classify lesions from the multiple slices and views. The 10-fold cross-validation and averaged accuracy of 100 iterations were used for performance evaluation.

Discussion
The combination of three orthogonal views only at the center of the lesion was less effective to improve the 3D CADx accuracy. However because our 3D US liver CADx can use additional information of the 3D volume, the combination of multiple slices and their different views outperformed the case of combining multiple views only at the center of the lesion (p

SST08-08 • SyN and ART: Quantitative Evaluation of Two Leading Open-source Image Registration Software Tools for Automatic Segmentation and Measurement of the Corpus Callosum on MR Images of Multiple Sclerosis Patients

Paxton Smith MEng (Presenter) ; **David K Li** MD * ; **Anthony Traboulsee** MD * ; **Roger Tam** PhD

PURPOSE
The emergence of robust neuroimage analysis software enables automatic volumetry of brain structures commonly associated with neurodegenerative disease such as multiple sclerosis (MS). However, the application of such software is not standardized, and it is unclear how much variability can be expected from the choice of tools. In our study, we demonstrate the use of two open-source, state-of-the-art image registration tools, namely SyN (Symmetric Normalization) and ART (Automatic Registration Toolbox), in the automatic measurement of the corpus callosum area (CCA) in the mid-sagittal plane (MSP). Our goal was to find whether significant differences in volumetry exist between the tools when applied to our task, to the extent that tool selection could impact the outcome of clinical studies.

METHOD AND MATERIALS
We randomly selected 100 3-D, T1-weighted axially acquired MR images of patient brains from a recent MS clinical trial. Image format was 256 x 256 x 180 with 0.976 mm x 0.976 mm x 1 mm voxel size and the AC-PC line manually centered in the volume during acquisition. Extra-cranial regions were deleted from the images using BET, and the CC was manually segmented in the MSP using ITKSNAP to provide ground truth. Patient brains were affinely registered to the MNI152 reference using FLIRT followed by non-linear transformations with SyN v1.9 and ART v2.0. The JHU CC label for the MNI152 atlas was then propagated to patient space using the corresponding inverse transformations.

RESULTS
The overlap between the automatic and manual segmentations was measured with the Dice coefficient (SyN = 0.764, ART = 0.769). The Wilcoxon test (p = 0.475) showed no significant difference between SyN and ART. The correlation of CCAs between automatic and manual segmentations was measured with Spearman's rank coefficient (SyN $\rho = 0.815$ $p = 9.41e10^{-24}$ vs. ART $\rho = 0.507$ $p = 1.60e10^{-7}$), showing that the SyN and manual segmentations were more strongly correlated.

CONCLUSION
SyN and ART perform very similarly for common metrics in ours and past studies; however, there is sufficient difference in the volumetric correlation to ground truth that they cannot be considered equivalent.

CLINICAL RELEVANCE/APPLICATION
Leading image registration tools, SyN and ART, perform similarly for most common metrics, but to compare results between clinical studies, standardization of the image analysis pipeline is critical.

SST08-09 • Fully Automated Segmentation of Multiple Organs in Contrast-enhanced Abdominal CT: Preliminary Study

Jing Liu (Presenter) ; **Qiang Li** PhD *

PURPOSE
Organ delineation in CT is a key component to computer-aided detection, radiotherapy planning, and pre-surgical planning. We developed a generic algorithm for fast and robust segmentation of multiple abdominal organs from contrast-enhanced CT scans.

METHOD AND MATERIALS
The fully automatic algorithm segments organs using a set of atlases, i.e., pre-learned abdominal organ shapes and inter-organ spatial relationship models. The algorithm consists of five major steps. First, a test image was filtered with an edge-preserving non-local-mean filter. Second, the centroid of an organ of interest (OOI) on the test image was identified by context-driven Generalized Hough Transform (cGHT) using organ atlases. Third, a probability map indicating the likelihood of being the OOI was assigned to image pixels according to the localized centroid and atlas of the OOI. Fourth, the initial organ segmentation was achieved by graph-cut method for maximizing the likelihood for the label assignment with a smoothness penalty. Finally, initial organ segmentation was refined by a fast adaptive erosion-dilation (AdaED) method. In this preliminary study, the algorithm was used for segmenting liver, spleen, left and right kidneys from 10 test CT scans. Livers, spleens and both kidneys on test images were manually segmented by two radiologists prior to the application of automatic algorithm and were used as reference standard. The segmentation algorithm was evaluated by Jaccard overlap scores between automatic segmentation and reference standard. The algorithm will be applied to the segmentation of more organs in more CT scans in the upcoming months.

RESULTS
The cGHT correctly localized all organs of interest on 10 test images. The Jaccard scores for segmentation of liver, spleen, left and right kidneys were 89.3±2.5%, 86.6±5.0%, 90.0±3.1% and 90.6±3.0%, respectively.

CONCLUSION
The use of cGHT, likelihood-based graph-cut and AdaED achieved, respectively, very efficient organ localization, initial segmentation and segmentation refinement in abdominal CT scans. The preliminary results showed that the automatic organ segmentation method is robust and accurate. We thank Drs. F. Li and C. Zhang for manual organ delineation.

CLINICAL RELEVANCE/APPLICATION
An automated segmentation algorithm greatly improves efficiency/consistency for organ contouring, and facilitates computer-aided detection, radiotherapy and pre-surgical planning in clinical practice.

Disclosure Index

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Aghenitei, I. - Employee, Eloquentix
Agliozzo, S. - Researcher, im3D SpA
Aoyagi, K. - Employee, Toshiba Corporation
Averkiou, M. A. - Consultant, Koninklijke Philips Electronics NV Consultant, Samsung Electronics Co Ltd
Avrin, D. E. - Stockholder, Amirsys, Inc Consultant, Amirsys, Inc
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B

Badano, A. - Research Grant, Barco nv Research Grant, Varian Medical Systems, Inc
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Bashir, M. R. - Research support, Bracco Group Research support, Siemens AG Consultant, Bayer AG Consultant, Siemens AG
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Boesen, M. - Advisor, Image Analysis Ltd
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Buurman, J. - Employee, Koninklijke Philips Electronics NV

C

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E

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F

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I

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Izhaky, D. - Employee, Real Imaging Ltd

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Morgan, P. - Employee, FUJIFILM Holdings Corporation
Morra, L. - Researcher, im3D SpA
Muralidhar, G. S. - Algorithm Engineer, VuCOMP, Inc.

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O'Connell, T. - President, Resolve Radiologic Ltd
O'Donnell, K. - Employee, Toshiba Corporation
Ohno, Y. - Research Grant, Toshiba Coporation Research Grant, Koninklijke Philips Electronics NV Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, Terumo Corporation Research Grant, Covidien AG Research Grant, FUJIFILM Holdings Corporation

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Poplack, S. P. - Research Grant, Hologic, Inc
Popovici, C. - Employee, Eloquentix
Pozniak, M. A. - Stockholder, Novelos Therapeutics, Inc
Prior, F. W. - Research collaboration, Siemens AG Research collaboration, Electrical Geodesics, Inc Consultant, OSEHRA
Prisacariu, A. - Employee, Eloquentix, Inc
Prokop, M. - Speakers Bureau, Bayer AG Speakers Bureau, Bracco Group Speakers Bureau, Toshiba Corporation Speakers Bureau, Koninklijke Philips Electronics NV Research Grant, Toshiba Corporation
Pyrros, A. T. - Research Consultant, Document Storage Systems, Inc

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Raja, A. - Medical Advisor, Diagnotion, LLC

Ratib, O. - Research Consultant, Koninklijke Philips Electronics NV
Reicher, J. J. - Medical Advisory Board, Health Companion, Inc Investor, Health Companion, Inc
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Rubin, D. L. - Grant, General Electric Company Grant, Siemens AG
Ruthman, G. - Consultant, McKesson Corporation
Rybicki, F. J. III - Research Grant, Toshiba Corporation Research Grant, Bracco Group

S

Safdar, N. M. - Shareholder, Montage Healthcare Solutions, Inc
Samei, E. - Research Grant, Siemens AG Research Grant, General Electric Company Research Grant, Carestream Health, Inc
Schaefer-Prokop, C. M. - Advisory Board, Riverain Technologies, LLC
Schalekamp, S. - Research Grant, Riverain Technologies, LLC
Seltzer, S. E. - Research Grant, Siemens AG Research Grant, General Electric Company Research Grant, Toshiba Corporation
Sevenster, M. - Employee, Koninklijke Philips Electronics NV
Seyal, A. R. - Grant, Siemens AG
Shabshin, N. - Consultant, Active Implants Corporation
Shepard, J. O. - Consultant, Agfa-Gevaert Group
Shih, G. L. - Consultant, Image Safely, Inc Stockholder, Image Safely, Inc Consultant, Vitesso, LLC Stockholder, Vitesso, LLC Consultant, Angular Health, Inc Stockholder, Angular Health, Inc Consultant, Merge Healthcare Incorporated
Shim, H. - Employee, Samsung Electronics Co Ltd
Shrestha, R. B. - Medical Advisory Board, General Electric Company Medical Advisory Board, Nuance Communications, Inc Medical Advisory Board, Toshiba Corporation Editorial Advisory Board, Anderson Publishing, Ltd Advisory Board, KLAS Enterprises LLC
Siegel, E. L. - Research Grant, General Electric Company Speakers Bureau, Siemens AG Board of Directors, Carestream Health, Inc Research Grant, XYBIX Systems, Inc Research Grant, Steelcase, Inc Research Grant, Anthro Corp Research Grant, RedRick Technologies Inc Research Grant, Evolved Technologies Corporation Research Grant, Barco nv Research Grant, Intel Corporation Research Grant, Dell Inc Research Grant, Herman Miller, Inc Research Grant, Virtual Radiology Research Grant, Anatomical Travelogue, Inc Medical Advisory Board, Fovia, Inc Medical Advisory Board, Vital Images Medical Advisory Board, McKesson Corporation Medical Advisory Board, Carestream Health, Inc Medical Advisory Board, Bayer AG Research, TeraRecon, Inc Medical Advisory Board, Bracco Group Researcher, Bracco Group Medical Advisory Board, Merge Healthcare Incorporated Medical Advisory Board, Microsoft Corporation Researcher, Microsoft Corporation
Sklair-Levy, M. - Shareholder, Real Imaging Ltd
Solomon, H. - Employee, General Electric Company
Sosna, J. - Consultant, ActiViews Ltd Research Grant, Koninklijke Philips Electronics NV
Steigner, M. L. - Speaker, Toshiba Corporation
Sugimura, K. - Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips Electronics NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group
Sumkin, J. H. - Scientific Advisory Board, Hologic, Inc
Summers, R. M. - Royalties, iCAD, Inc Grant, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc
Sun, M. R. - Investigator, Bracco Group
Supanich, M. P. - Research Grant, Siemens AG
Szczykutowicz, T. P. - Grant, General Electric Company Grant, Siemens AG

T

Takata, K. - Employee, Panasonic Corporation
Tarbox, L. R. - Stockholder, Siemens AG
Tellis, W. M. - Officer, EyePACS, LLC
Togashi, K. - Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, FUJIFILM Holdings Corporation Research Grant, Nihon Medi-Physics Co, Ltd Research Grant, Shimadzu Corporation Research Grant, Toshiba Corporation Research Grant, Covidien AG
Towbin, A. - Author, Amirsys Inc. Shareholder, Merge Healthcare Incorporated
Traboulsee, A. - Researcher, Angiotech Pharmaceuticals, Inc Researcher, Bayer AG Researcher, BioMS Medical Researcher, Johnson & Johnson Researcher, DAIICHI SANKYO Group Researcher, F. Hoffmann-La Roche Ltd Researcher, Merck KGaA Researcher, Schering-Plough Corporation Researcher, Teva Pharmaceutical Industries Ltd Researcher, sanofi-aventis Group Researcher, Transition Therapeutics Inc Consultant, sanofi-aventis Group
Trambert, M. A. - Medical Advisor, DR Systems, Inc
Tsimberidou, A. M. - Research funded, Teva Pharmaceutical Industries Ltd Research funded, sanofi-aventis Group Research funded, Celgene Corporation Advisory Board, Teva Pharmaceutical Industries Ltd Advisory Board, sanofi-aventis Group Consultant, CTI Consulting
Tsiouris, A. J. - Research Consultant, BioClinica, Inc

V

Valentino, D. - Vice President, Landauer, Inc Board Member, Medical Vision Systems, LLC Advisory Board, iCRco, Inc
Vining, D. J. - Royalties, Bracco Group CEO, VisionSR Stockholder, VisionSR
Viswanathan, C. - Consultant, Hollister Incorporated
Von Falck, C. - Grant, Siemens AG Grant, Pro Medicus Limited
Von Tengg-Kobligk, H. - Research Grant, W. L. Gore & Associates, Inc

W

Wacker, F. K. - Research Grant, Siemens AG Research Grant, Pro Medicus Limited
Wallace, M. J. - Speaker, Siemens AG Research support, Siemens AG
Wang, K. C. - Co-founder, DexNote LLC
Weadock, W. J. - Owner, Weadock Software, LLC
Wendt, G. J. - Medical Advisory Board, McKesson Corporation Stock Ownership, TeraMedica, Inc Medical Advisory Board, HealthMyne Owner, WITS, LLC
Whitfill, J. - President, Lumetis, LLC
Wilcox, A. - Speaker, Toshiba Corporation
Wolfman, J. A. - Scientific Advisory Committee, Hologic, Inc Travel support, Hologic, Inc
Wu, C. C. - Author, Amirsys, Inc

Y

Yamagata, H. - Employee, Toshiba Corporation
Yao, J. - Royalties, iCAD, Inc
Yoshida, H. - Patent holder, Hologic, Inc Patent holder, MEDIAN Technologies
Young, N. - President, ClearCanvas Incorporated CEO, ClearCanvas Incorporated

Z

Zabih, R. - Shareholder, Image Safely Consultant, Image Safely
Zaharia, R. - Consultant, RZ Software Services
Zalis, M. E. - Co-founder, QPID Inc Stockholder, QPID Inc