Informatics

IN001-EB-X

Bone Metastasis on Temporal Subtraction Images from Serial CT Scans

All Day Room: IN Community, Learning Center

Participants
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TEACHING POINTS

Computed tomography (CT) is now used as the primary modality for clinical follow-up of cancer patients; however, detecting bone metastasis on CT is a great burden towards radiologists. Recent advance in the image registration technique has made it possible to create temporal subtraction (TS) images of bone from serial follow-up CT, and it helps efficient detection of newly developed bone metastasis. In this exhibit, we review the various types of bone metastasis on TS images and discuss the usefulness and pitfall of bone TS images in comparison with other imaging modality.

TABLE OF CONTENTS/OUTLINE

1. Development of bone TS images2. Image quality of bone TS images2. Appearance of bone metastasis on TS images in comparison with other modalities4. Diagnostic pitfalls of bone TS images5. Conclusion and future prospects

IN002-EB-X

The Benefits and Problems Associated with Patient Dose Management Using DICOM: Improvement of Patient Dose Management Using an RIS

All Day Room: IN Community, Learning Center

Participants
Masakatsu Tano, Minato-Ku, Japan (*Presenter*) Nothing to Disclose
Koichi Chida, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

-To understand the benefits and limitations of DICOM-mediated patient dose management-To understand the difficulties associated with dose management, especially in general radiography-To demonstrate the utility of a new patient dose management system using an RIS and an MPPS interface (IF)

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-Patient dose management using DICOMDose management using DICOM header file is problematic. Some recent reports have described the usefulness of dose management using DICOM Structured Report (SR). However, the use of DICOM SRs in X-ray systems is currently very limited.***-Construction of a dose management system using an RIS and an MPPS IF***When using an MPPS IF, the RIS simultaneously accepts information from both the X-ray system and dosimetric data from the dose-area product meter. We tested this system in a clinical setting (general radiography) using more than 1000 cases.**SUMMARY:** To improve dose management, it is imperative to standardize DICOM header dose information. In addition, DICOM SRs are not yet widespread, particularly within general radiography. We have developed a dose managing system using an RIS and an MPPS IF. We have also confirmed the clinical benefit of the new dose management system through numerous general radiography tests. Furthermore, it is necessary to use a combination of an RIS and DICOM system.

IN003-EB-X

Deep Learning: What the Radiologist Needs to Know

All Day Room: IN Community, Learning Center

Participants
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TEACHING POINTS

Deep Learning has emerged as the next frontier in big data analytics, with broad applications that could fundamentally transform multiple industries, including healthcare. Deep Learning is rooted in machine learning and artificial neural networks, concepts which focus on teaching computers to learn to solve problems. The application of Deep Learning to radiology has potential to add significant value to the radiologist’s interpretation of complex images.

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History of Deep Learning Evolution of Big Data created need to analyze massive amounts of uncategorized raw data in order to draw meaningful interpretations. Current state of Deep Learning Deep Learning is a branch of machine learning that uses algorithms to train neural networks to automatically learn to generate complex representations from unstructured data. High commercial interest from major technology corporations creating funding and resource allocation to large scale efforts. Deep Learning in Radiology Deep Learning’s strength in image recognition creates opportunity to aid radiologists in pattern identification. Combined with clinical decision support, Deep Learning has potential to transform the radiologist’s ability to add value to medical diagnostic care continuum.

IN004-EB-X

Use of 3D Printed Tracheal Models in Surgical Planning for Children Undergoing Complex Airway Reconstruction

All Day Room: IN Community, Learning Center

Participants
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Paul Boesch, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

OVERVIEW: Life sized tracheal models were 3D printed from imaging data as surgical aids for children undergoing complex airway reconstruction. They were an integral part of multidisciplinary surgical planning.USE: Life size physical tracheal models demonstrating the ptients unique anatomy enhanced comprehension of complex airway anatomy.CLINICAL RELEVANCE: Tracheal surgey is difficult and high risk especially in young children. Life size physical models offer unique ways to understand the anatomy through both vision and touch and feel. They help in operative planning and improved communication with the surgical team. The models contribute to patient and family education.

TABLE OF CONTENTS/OUTLINE

1. Six children undergoing airwy reconstruction. Long segment tracheal stenosis with tracheal rings (2) Tracheal stenosis due to pulmonary sling Lung hypoplasia with tracheomalacia Tracheostomy with innominate artery compression.2. Creation of life size models Consultation with surgical team Image acquisition: Thin section chest CT with IV contrast Segmentation: Color coding of trachea, mediastinal vessels, and chest wall Material selection Printing of multiple copies for surgical team3. Delivery and review of model with surgical team4. Post surgical follow up

IN006-EB-X

First Step in 3D Printing of Anatomic Models: Optimal Acquisition and Reconstruction of Imaging Data, the Overlooked First Step

All Day Room: IN Community, Learning Center

Participants

Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose
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TEACHING POINTS

OVERVIEW: Acquisition and reconstruction of high resolution imaging data of critical anatomy is essential to create accurate 3D printed anatomic models. USE: Development of guidelines for optimal data acquisition and reconstruction for creation of patient specific anatomic models. CLINICAL RELEVANCE: Anatomic models, used as surgical aids in complex cases, depend on imaging data that highlights critical anatomy in high resolution for segmentation. Individual anatomic models aid in preoperative planning and contribute to improved patient care and outcomes.

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Laboratory Clinical Experience: 300 models in Radiology based 3D printing laboratoryClinical cases: Orthopedic, CV, OMF, Neuro, GI, GU,Imaging Data: CT and MR dataSegmentation software(Materialize) and 3D printer(Connex 350, 500, Stratasys) Parameters for Image AcquisitionSave raw imaging dataSlice thickness, reconstruction, overlapAlgorithm: sharp, softContrast timing:CTA, CTV, CT UrogramPatient position to simulate operative Imaging Tools to optimize image acquisitionMetal Artifact Reduction: Decreases artifact from dental fillings and hardwareDual Energy: Separates bone from contrast, virtual noncontrastTooth spacer: Separation of teeth MR: 3D volumetric image acquisition

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Terri J. Vrtiska, MD - 2016 Honored Educator

IN009-EB-X

Creating and Deploying a Multiuse Intranet Portal at an Academic Radiology Department, Strategies for Success

All Day Room: IN Community, Learning Center

Participants
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Jared S. Meshekow, MD, Camden, NJ (*Abstract Co-Author*) Nothing to Disclose
Alan Farr, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose
Arun Krishnaraj, MD, MPH, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

To review the steps in developing and implementing a multifaceted intranet portal created to serve as a resource for clinicians and ancillary staff within a department of radiology. In this exhibit we review the intranet portal architecture, expanding upon the user interface and illustrate each of the core components within the system necessary to create a successful locally hosted intranet resource for an academic radiology department.

TABLE OF CONTENTS/OUTLINE

Background: Health system intranet resources are often devoid of information specific to the needs of those within a radiology department. We sought to fill this void by creating a department specific infrastructure which allowed for the hosting of key data to facilitate information exchange between all stakeholders within our department (trainees, faculty, and staff). **Outline:**A. Generalized Site Map of the Intranet PortalB. Review of Portal Web Pages: Imaging Protocol Guidelines On-Call / Emergency Resources Educational Resources Contact Information Procedure Instructions and Guidelines Forms Computing Instructions and Troubleshooting Resident Policies and ProceduresC. Outline for implementation, instruction, and adoption of a customized radiology intranet portal.

IN012-EC-X

Online Web-based DICOM Viewer for Learning and Teaching

All Day Room: IN Community, Learning Center

Participants

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TEACHING POINTS

The purpose of this exhibit is to explain most features of this online-DICOM Tool and to show their efficiency in facilitating learning and teaching.

TABLE OF CONTENTS/OUTLINE

Dynamically extracting, editing and showing multidisciplinary knowledge on every anatomical structure or pathology displayed in DICOM-images was the main goal of our online web-based DICOM tool. This direct integration between different online resources and the structure on the image can efficiently reduce time and effort needed for looking up any required information. While scrolling through the DICOM images, this tool allows learners to have full access to resources in our database or other external resources with a single click or a touch on a certain structure.For teaching the user is allowed to build his own files for further use or lecturing, and this is aided by many auto recognition features like recognizing the same anatomical structure in a whole series and link it with the appropriate knowledge resource.Other features like social networking between the users, lecture presentation mode, tablet and mobile device mode, multi-touch capability, online case discussion, quick note system, have been implemented in the Tool.The user side controls of this project are based on HTML5 Canavas, Javascript and AngularJS. Server side are based on MySQL, PHP and Laravel.

IN013-EC-X

Utilization of Electroencephalogram Signals for Manipulation of Image Display in Operating Rooms

All Day Room: IN Community, Learning Center

Participants

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Natsumi Miki, Takasaki, Japan (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

In the past, we have developed an image display system by use of finger movement. However, physician needs to use one hand, and in the case of both hands tied up frequently, this system could not be used. We attempted to improve an image display system by using of electroencephalogram (EEG) signals in operation rooms. This EEG sensor provides various data such as alpha wave and beta wave which was analyzed by frequency analysis. This device can be attached to the head, and thus easy to use and to detect EEG signals. As EEG sensor, we used Mindwave Mobile mounted on a ThinkGear ASIC module (TGAM) (Neurosky Ltd., CA, USA). We could use this system in reading rooms. When a physician wants to zoom a part of the image, this can be done by paying an attention to look at that part. We investigated the average response time required for detection of eye-blink and the average detection rate.

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･Real-time demonstration of image display system by use of EEG sensor.･Operation of paging which can be controlled by operator’s eye blink and partial zooming which can be controlled by operator’s concentration on his/her mind.･The result of the average response time by use of EEG sensor.

IN014-EC-X

Mind in the Machine: A Radiology Primer on Machine Learning

All Day Room: IN Community, Learning Center

Participants
Akshay Goel, MD, New York, NY (*Presenter*) Nothing to Disclose
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TEACHING POINTS

1. To review the principles of machine learning as it applies to clinical radiology and imaging research. 2. To discuss current applications of machine learning.3. To illustrate a simplified schematic of fundamental steps used in commonly used machine learning algorithms including: logistic regression, support vector machines, artificial neural networks, supervised learning machines.

TABLE OF CONTENTS/OUTLINE

Defining machine learningApplications of machine learningOverview of fundamental steps in common machine learning algorithmsSample machine learning algorithms Future directions and summary

IN015-EC-X

Gamification in Sonography Education: Why, How and What

All Day Room: IN Community, Learning Center

Participants
Henner Bendig, Flensburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael Teistler, PhD, Flensburg, Germany (*Presenter*) Nothing to Disclose

TEACHING POINTS

Understand the motivation behind gamification in radiology education: Applying concepts of computer games to enhance learning outcome by increased motivation and immersion Learn about designing a learning game for sonography training Experience a game that was developed to improve understanding about spatial relationships in sonography

TABLE OF CONTENTS/OUTLINE

1. **Why:**Motivation behind gamification in radiology education2. **How:**a) Game design for an educational ("serious") game to support sonography trainingb) Utilization of a game engine for 3D and 2D visualization3. **What (Hands-On):**Play the sonography game: Use a 3d game controller as virtual ultrasound probe to solve various tasks, improve your skills, increase your score, go to the next level, have fun while learning

IN016-EC-X

Can't Touch This: New User Interface Approaches to Medical Image Viewing on Mobile Devices

All Day Room: IN Community, Learning Center

Participants
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Michael Teistler, PhD, Flensburg, Germany (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

The viewer of this exhibit canA. Experience novel user interaction concepts specifically designed for mobile devices, focusing on the most common functions like scrolling and changing window level & widthB. Compare these novel approaches with common user interface approaches for mobile devices that have originally been devised for non-medical applications

TABLE OF CONTENTS/OUTLINE

A. Motivation: Discussion of the increasing need for interactive image visualization on mobile devices, e.g. for emergency image access or for clinical referenceB. Disadvantages of common user interaction approaches: Obscuring image content with fingers, image quality reduction caused by smudged display, decreased usability due to limited screen spaceC. Novel user interaction approachC1. Dedicated protected screen area for image viewing without direct user interactionC2. Interactive multi-touch scout view for fast scrolling (with one finger) and for defining thickness of sliding subvolume maximimum intensity projections (MIP) (with two fingers)C3. Utilization of the built-in motion sensors for a) scrolling (slice-by-slice or cine mode), and b) for changing window level and widthC4. Virtual touchpad area as a general replacement tool for direct touch interactions (e.g. for annotations or measurements)

IN017-EC-X

The Essential Guide to Starting a Clinical 3DP Program

All Day Room: IN Community, Learning Center

Awards

Identified for RadioGraphics

Participants

Chris Letrong, Stanford, CA (*Presenter*) Nothing to Disclose
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Dominik Fleischmann, MD, Palo Alto, CA (*Abstract Co-Author*) Research support, Siemens AG;

TEACHING POINTS

Review process of 3D Printing (3DP) in medicine Discuss logistical challenges and solutions in implementing a 3DP program: resources, infrastructure and developing an efficient workflow Takeaways

TABLE OF CONTENTS/OUTLINE

Background Abundant but disparate information about 3DP in medical fields Realistic expectations and constraints of 3DP are not commonly discussed Resources and Infrastructure Identify need for 3DP program Educational, research, clinical needs, etc Survey technologies Conferences, vendors, training Develop infrastructure Printers Segmenting/refining software Personnel/training Develop Workflow Typical Process Define anatomy requirements and obtain image data (DICOM) Segment anatomical structures and prepare digital model (STL) Print physical model, post processing and delivery Division of Labor Leverage staff with specific skill sets; delegate appropriately Radiologists provide oversight and quality control Takeaways Scope of program relies on obtaining resources, personnel and tools to meet specific needs Time and cost constraints may significantly limit the scope and quality prints Expectation management and well-defined goals contribute to effective workflows

IN018-EC-X

Why DICOM GSDF Image Calibration is Important for using Portable Devices?

All Day Room: IN Community, Learning Center

Participants
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Michael Teistler, PhD, Flensburg, Germany (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

To review the need of image calibration.To compare image quality without calibration, using software and hardware calibration.

TABLE OF CONTENTS/OUTLINE

Learn the principle of DICOM Grayscale Display Function.Compare the image quality of test patterns.Compare the image quality of subtle clinical cases.

IN020-EC-X

RADSVRx (Radiology Advanced eDucational System with Virtual Reality eXperience)

All Day Room: IN Community, Learning Center

Participants
Eduardo Hernandez-Rangel, MD, Orange, CA (*Presenter*) Nothing to Disclose
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TEACHING POINTS

Online and mobile plarform that increase accessibility and cost-effectiveness of radiology education.Benefit underdeveloped countries with a lack of resources and contribute to more immersive radiology educational experiences.

TABLE OF CONTENTS/OUTLINE

RADSVRx is a Virtual Reality (VR)/Augmented Reality (AR) platform for the use with a vr mount for a mobile phone in the educational part of imaging. VR prototypes have proven to be a potential for Diagnostic Imaging, and it can be a great tool for the educational part of imaging. We are working on the beta version www.radsvr.org. It is divided in three Galleries: Images, videlectures, and library of cases & self assessment. Each gallery is subdivided by anatomical regions.RADSVRx emphasizes the importance of bringing cohesion and unprecedented depth to a radiology education in order to empower it users. The use of both VR and AR, educational objectives can be blended together (e.g. having the view of a working station) without sacrificing any details in the image. This program can potentially provide a gateway to academic breakthrough via the many possibilities of supplementing working stations and lessons in the classroom setting.

IN100-ED-X

What Happens to RSNA Education Exhibits Solicited for Publication in RadioGraphics?

All Day Room: IN Community, Learning Center

Participants
Paul M. Bunch, MD, Boston, MA (*Presenter*) Nothing to Disclose

PURPOSE

Education exhibits (EEs) are a major component of the Radiological Society of North America (RSNA) meeting. Subspecialty panels evaluate all EEs to identify those that would best translate into RadioGraphics (RG) articles. The authors of these select EEs are invited to submit manuscripts for possible publication in RG.The primary purpose of this study was to determine what percentage of EEs solicited by RG at the 2013 RSNA meeting have been subsequently published in MEDLINE-indexed journals.

METHOD AND MATERIALS

The 2013 RSNA meeting program (http://rsna2013.rsna.org/program/) was reviewed, and the titles and authors of all solicited EEs were recorded. The PubMed database (https://www.ncbi.nlm.nih.gov/pubmed/) was searched to identify peer-reviewed articles based upon EEs published in MEDLINE-indexed journals. Articles were judged to be based upon an EE if 1) acknowledgement of the EE was made in the article or 2) there were similarities in article and EE titles and commonalities in authorship. Data tabulation was performed using JMP Pro, Version 12.

RESULTS

Of 2213 EEs at the 2013 RSNA meeting, 219 (9.9%) were solicited by RG. As of 4/1/2016, 124 (56.6%) solicited EEs have been published as peer-reviewed articles in 23 MEDLINE-indexed journals. RG has published the most articles (n=81; 65.3%). Other journals that have published more than 1 article include American Journal of Roentgenology (n=6), Abdominal Imaging (n=6), Current Problems in Diagnostic Radiology (n=6), Pediatric Radiology (n=4), Clinical Neuroradiology (n=2), European Journal of Radiology (n=2), and Skeletal Radiology (n=2). EEs solicited from the Molecular Imaging section had the highest publication rate (100%), and EEs solicited from the Vascular/Interventional section had the lowest (35.7%).

CONCLUSION

As of 4/1/2016, 56.6% of 2013 EEs solicited by RG have been published in a MEDLINE-indexed journal. Most (65.3%) have been published in RG.

CLINICAL RELEVANCE/APPLICATION

Previous work has shown that up to 67% of orally-presented RSNA scientific abstracts are not published in MEDLINE-indexed journals within 5 years of presentation.The current study shows that more than 40% of EEs at the 2013 RSNA meeting designated by subspecialty panelists as having content worth publishing have not been disseminated via peer-reviewed publication within 28 months. Practicing radiologists and trainees might benefit from more frequent publication of quality EE content.

FIGURE

http://abstract.rsna.org/uploads/2016/16000207/16000207_ypra.jpg

IN101-ED-X

Artificial Neural Networks: A Machine Learning Algorithm for Image Analysis in Radiology

All Day Room: IN Community, Learning Center

Participants
Yi C. Zhang, MD, New York, NY (*Presenter*) Nothing to Disclose
Cheuk Ying Tang, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1. Neural networks are machine learning algorithms that use computational architectures inspired by the organization of the mammalian visual cortex.2. A convolutional network is a type of multi-layered neural network adapted for image recognition and classification tasks.3. Each neuron unit has a set of input links from the previous layer, output links to the next layer, and a means of computing the activation level for signal propagation.4. Training an artificial neural network is an iterative process of updating the weight values that multiply the inputs, with the goal of minimizing the errors of prediction.5. Google Tensorflow is an open-source software library for implementing artificial neural networks using multidimensional arrays known as tensors for data input.

TABLE OF CONTENTS/OUTLINE

I. Artificial neural network overview: single-layer vs. convolutional neural networksII. Building an artificial neural network
1. Input data format: training, validation, and test sets
2. Linear model: calculates logits from input values
3. Softmax function: transforms logits into probability distributions
4. Cross-entropy: minimize errors in predictionIII. Optimizer algorithms for cross-entropy computation
1. Stochastic gradient descent IV. Implementing a sample neural network using the Tensorflow API with DICOM input data.

IN103-ED-X

Informatics for Radiologists: What is DICOM?

All Day Room: IN Community, Learning Center

Awards
Certificate of Merit

Participants
Benjamin Mervak, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Bud Mckenzie, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
William J. Weadock, MD, Ann Arbor, MI (*Abstract Co-Author*) Owner, Weadock Software, LLC

TEACHING POINTS

1) DICOM is a vendor-neutral medical imaging standard that can facilitate the exchange of images and embedded information between imaging equipment, storage servers, software packages, and also between institutions.2) Using embedded data, DICOM files can be transferred between systems while guaranteeing that images remain associated with the correct patient, and carry information about how they were performed.3) Future applications for DICOM include Health Information Exchanges, structured reporting, and compatibility with goals of Integrating the Healthcare Enterprise (IHE).

TABLE OF CONTENTS/OUTLINE

What is DICOM?1) Background/History2) A vendor-neutral standard Conformance Statements: what do you get out of your equipment?**How can I use DICOM?**1) Current Transferring images/data between systems Optimizing workflow DICOM worklists Printing images2) Developing Integrating the Healthcare Enterprise (IHE) Health Information Exchanges DICOM Structured Report**How does DICOM function?** DICOM Part 10 / DICOM files Reading and using DICOM headers Services, objects, and service-object pairs Handshaking and data transfer TCP/IP as a backbone

IN104-ED-X

Virtual Reality in Healthcare: Using Medical Imaging as the Patient's Avatar

All Day Room: IN Community, Learning Center

Participants
Tatiana Kelil, MD, Brookline, MA (*Presenter*) Nothing to Disclose
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Ryan C. James, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Ahmed Hosny, MSc, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Dmitry Levin, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Beth A. Ripley, MD, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1. Virtual reality (VR) is a technology that allows immersive and interactive exploration of 3D computerized data using natural senses. 2. As the construction of VR utilizes medical imaging, radiologists must become familiar with the technology.3. Current applications of VR in healthcare include advanced image visualization and diagnosis, preoperative planning and simulation, intraoperative navigation, and education/training.4. Benefits of using VR for training of procedural skills outside of the operating room include; reduced cost, greater control over the frequency duration and level of training, defined metrics to assess proficiency and improved patient safety. 5. VR along with telemedicine and telementoring systems can be used to provide medical expertise in disadvantaged areas with limited access to care

TABLE OF CONTENTS/OUTLINE

1. Describe Virtual Reality 2. Overview of the different types of VR systems3. Describe steps involved in creating VR, from image acquisition to display in a VR system4. Explore current applications of VR in healthcare including image visualization, preoperative planning, surgical navigation, as well as education and training 5. Explore future directions including Virtual rehabilitation and autonomous surgical robots

IN105-ED-X

Graphic Illustration for the Radiologist: An Introduction to Using Original Illustrations in Medical Education

All Day Room: IN Community, Learning Center

Awards
Magna Cum Laude
Identified for RadioGraphics

Participants
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Piotr Golofit, MD, Koszalin, Poland (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1. To introduce vector and raster graphics.2. To discuss the tools used to create graphics.3. To demonstrate illustration programs and apps.4. To provide a conceptual basis for artistic decision making.5. To show how original illustrations may be used by radiologists.

TABLE OF CONTENTS/OUTLINE

Introduction. Shapes & points. Colors & fills. Tools. File formats. Software & apps. Assistive hardware. Artistic strategies. Uses in radiology.

IN106-ED-X

Troubleshooting Image Quality and Other Problems Using the DICOM Header

All Day Room: IN Community, Learning Center

Awards
Identified for RadioGraphics

Participants
William F. Sensakovic, PhD, Orlando, FL (*Presenter*) Officer, YellowDot Innovations, LLC
David R. Warden IV, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
Matthew C. Hough, MSc, Gainesville, FL (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

To review what the DICOM header is, how it can be viewed, what information it contains, and how to use that information to improve image quality and solve image-related problems.

TABLE OF CONTENTS/OUTLINE

What is the DICOM header? Overview of information contained in the DICOM header Troubleshooting poor quality Troubleshooting artifacts Accessing dose information

IN108-ED-X

The Role of Social Media in Your Radiology Practice: What You Need to Know and Why You Need to Know It

All Day Room: IN Community, Learning Center

Participants
Whitney Fishman Zember, MBA, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Pamela T. Johnson, MD, Baltimore, MD (*Abstract Co-Author*) Consultant, National Decision Support Company
Elliot K. Fishman, MD, Baltimore, MD (*Presenter*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company;

TEACHING POINTS

Social media use in Radiology has gone from an interesting topic of conversation to a critical part of practice in a few short years. This exhibit reviews: reasons why social media is important to a Radiology practice the role of some of the more important social media sites including Linkedin,Facebook, Twitter and YouTube opportunities social media provides for building and defining your practice potential issues with using social media a "how to" for adopting these web-based tools with focus on defining goals, such as target audience and user experience monitoring

TABLE OF CONTENTS/OUTLINE

What is social media and why it is important to a Radiology Group Major players in social media (LinkedIn, Facebook, Twitter, YouTube) and their specific advantages (education, marketing) Define goals including the target audience and target message to that audience Potential strategies and guidance from success stories (Mayo Clinic, RadiologyInfo.org) Potential pitfalls in content development Management and maintenance of your page Measuring activity, monitoring your site and using analytics to guide content expansion Summary and future directions

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Pamela T. Johnson, MD - 2016 Honored Educator
Elliot K. Fishman, MD - 2012 Honored Educator
Elliot K. Fishman, MD - 2014 Honored Educator
Elliot K. Fishman, MD - 2016 Honored Educator

IN109-ED-X

Early Implementation of Radiomics into Clinical Use: How Radiomic Data Can Change Clinical Care of Patients

All Day Room: IN Community, Learning Center

FDA Discussions may include off-label uses.

Participants
Brian M. Rodgers, MD, Rockville, MD (*Presenter*) Nothing to Disclose
Justin Kirby, Bethesda, MD (*Abstract Co-Author*) Stockholder, Myriad Genetics, Inc
John B. Freymann, BS, Rockville, MD (*Abstract Co-Author*) Nothing to Disclose
Lalitha K. Shankar, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Erich Huang, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Frank I. Lin, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Lori Henderson, PhD, Rockville, MD (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Findings from imaging exams now extend beyond what we see. Several published studies demonstrate how Radiomics data, especially when combined with carefully archived imaging data sets and clinical information, can provide important prognostic information. We also compete with laboratory testing in providing prognostic data.Strengths and weakness of laboratory blood / tissue bio marker assays and imaging assessment are reviewed.This will continue to be an area of significant investigation and change in the future. We expect that Radiomics will greatly change what Imaging and Imagers provide to patient care.

TABLE OF CONTENTS/OUTLINE

Visual factors used in current assessment of presumed tumorsBrief explanation of how Radiomics assessment works.Current areas of research and early results in Big Data / Radiomics: tumor imaging feature analysis and relation to genetic mutations. Prognostication.Early clinical trial results suggesting additional information from Radiomics could optimize patient management.Current means to incorporate Radiomics data into a final Imaging Consultation vs a more standard imaging report.Expected benefit to individual patients.

IN110-ED-X

Using PowerPoint to Store and Present Teaching Cases

All Day Room: IN Community, Learning Center

Participants
Bradley Gans, MD, Columbus, OH (*Presenter*) Nothing to Disclose

TEACHING POINTS

PowerPoint has powerful built-in features to allow the radiologist to save and present CT/MR/US exams in a scrollable fashion to simulate a PACS environment. No speical add-ons are required.This method allows for residents and faculty to share interesting cases with their colleagues in an anonymized, HIPAA compliant manner.

TABLE OF CONTENTS/OUTLINE

Creating a case presentation Prepare case in PACS system Adjust window/level settings to highlight the important findings Remove all patient identifiers and saved markups Export each series as a collection of image files Method varies by vendor, AGFA PACS is used in this example Import case into PowerPoint Use PowerPoint photo album feature Automatically creates one slide per image Create Navigation Menus How to build buttons and use them to help navigate the case. Buttons can Direct the user to the first slide of a series in an exam (i.e. axial soft tissue, axial lung) Direct the user to an individual image with pertinent findings. Reveal findings that are hidden from the user until they are ready to reveal the answer Direct the user to slides with more information after the images have all been reviewed Use "Master Slides" to create a "Return to Menu" button on all slides

IN112-ED-X

Ergonomics in Radiology: Improving Work Environment for Radiologists

All Day Room: IN Community, Learning Center

Participants
Kyungmin Shin, MD, Houston, TX (*Presenter*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Abstract Co-Author*) Book contract, Cambridge University Press

TEACHING POINTS

Understanding the importance of ergonomics in work stations. Review of what would be a good ergonomic set up for radiologists. Discuss appropriate work station set up catered to individual radiologist's needs.

TABLE OF CONTENTS/OUTLINE

What is ergonomics? Why is an ergonomic set of reading stations important for radiologists? Review of good example of work station set up and options Review of suboptimal work station set up How to set up work stations catered to individual radiologist's needs and fun ideas for such set ups How to improve the working environment away from sedentary life-style for healthier work and life-style choices: what has been tried and worked Summary

IN114-ED-X

Don't Be Subtle...Show Your True Colors

All Day Room: IN Community, Learning Center

Participants

Mohammad Helmy, MD, Orange, CA (*Abstract Co-Author*) Nothing to Disclose
Saema Said, BS , Orange, CA (*Abstract Co-Author*) Nothing to Disclose
Joseph E. Burns, MD, PhD, Orange, CA (*Presenter*) Nothing to Disclose

TEACHING POINTS

Assessment for subtle pathology by plain radiography is limited by current grayscale method of image presentation.Advanced image analysis methods have been developed in other fields such as astrophysics.Adjunctive application of these methods of image analysis to current accepted standard paradigms of image presentation in radiology has a potential to increase the efficiency of lesion detection, improve accuracy of interpretation, and decrease interobserver variability in the evaluation of subtle pathology.An alternative image processing, presentation, and evaluation model is demonstrated for assessment of subtle bone tumors.

TABLE OF CONTENTS/OUTLINE

A) Current state of PACS image display, analysis, and interpretation in clinical practiceB) Example of advanced methods of image analysis in astrophysicsC) Color mapping method of image data analysis -Examples of subtle bone tumors on plain radiography presented with standard grayscale display -Application of color map analysis to the same cases -Comparative assessment of speed of lesion detection, accuracy of image interpretation, and interobserver variability between grayscale and color mapped displaysD) Future applications of color mapping in image analysis and presentation

IN115-ED-X

From 2D to 3D: A Review of the 3D-Printing Experience in a Swiss University Hospital-A Case Series Hinting at the Potential of this New Medium

All Day Room: IN Community, Learning Center

Participants
Philipp Brantner, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose
Florian Thieringer, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Tobias Heye, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Learn about the broad application of 3d-printing to visualize radiologic data. Describe the general workflow on how to create a 3d-model with publicly available freeware. Understand its usefulness for visualizing complex anatomy for surgeons, for resident education and for patient education. Describe potential applications of this emerging technology in the future.

TABLE OF CONTENTS/OUTLINE

How does 3d-printing work - brief describtion of printing methods and systems Understanding the workflow - from "axials" to the 3rd dimension Overview of freeware software solutions available for postprocessing Presentation of a spectrum of cases highlighting their individual usefulness in clinical routine and demonstrating the broad variety of possible applications. Outlook - what to expect in the future

IN116-ED-X

Computational Fluid Dynamics for Patient-Specific Assessment of Blood Flow: A Step-by-Step Guide Illustrated Using CT-Based Fractional Flow Reserve (FFR-CT) as an Example

All Day Room: IN Community, Learning Center

Awards
Magna Cum Laude

Participants
Dimitris Mitsouras, PhD, Boston, MA (*Presenter*) Research Grant, Toshiba Corporation;
Andreas Giannopoulos, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Anji Tang, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

The learner will recognize that:1. CFD has a long history in clinical research and is increasingly used for patient care. 2. Performing CFD requires “boundary conditions” (BCs) for which to solve the equations of motion of blood. These are the arterial lumen geometry, blood properties (viscosity, density), and the forces driving flow (inlet/outlet BCs). 3. CTA, black-/bright-blood MRI, and invasive angiography with or without US or optical coherence tomography can provide the arterial lumen BC. 4. Newtonian (fixed viscosity) and non-Newtonian (viscosity dependent on flow) blood models exist and can be adjusted to a patient (eg, hematocrit). The quantity of interest (eg, wall shear stress [WSS] vs pressure) dictates model choice.5. Patient-specific inlet and outlet BCs are the most challenging element. The choice of model (eg, steady vs pulsatile flow, turbulent) depends on the application; estimating inflow rate and flow distribution to branches are key to successful medical applications.

TABLE OF CONTENTS/OUTLINE

1. Examples: coronary ESS & fractional flow reserve, aneurysms. 2. Imaging techniques and segmentation tools.3. Blood models. 4. Estimating flow BCs (Murray law, physiology, phase-contrast MR, etc)5. CFD tools: meshing and solver.6. Post-CFD tools: visualizing the value of interest.7. Future directions.

IN117-ED-X

Deep Learning with Convolutional Neural Networks for Radiologic Image Classification

All Day Room: IN Community, Learning Center

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Phillip M. Cheng, MD, MS, Los Angeles, CA (*Presenter*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To review recent research developments in "deep learning", particularly with respect to convolutional neural networks applied to image classification.2. To illustrate fine-tuning of pretrained convolutional neural networks to recognize basic categories of abdominal ultrasound images.

TABLE OF CONTENTS/OUTLINE

1. "Deep learning": a brief history of the renaissance of deep neural networks in machine learning2. Convolutional neural networks: how they work in image classification, and their increasingly accurate results outside of the medical domain3. Radiologic image classification: experience fine-tuning CaffeNet, a deep neural network with ~60 million parameters modeled after the winner of the ILSVRC12 competition, to accurately classify abdominal ultrasound images by anatomic location (e.g., transverse left hepatic lobe, longitudinal right kidney), using over 3000 training examples.

IN118-ED-X

Design and Implementation of a Milestone-based Assessment and Feedback Radiology Resident Dashboard

All Day Room: IN Community, Learning Center

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Ashimiyu Durojaiye, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Fiona Gispen, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Michael Cohen, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Gorkem Sevinc, Baltimore, MD (*Abstract Co-Author*) Co-founder, InSight Medical Technologies; Officer, InSight Medical Technologies
Paul G. Nagy, PhD, Baltimore, MD (*Abstract Co-Author*) Institutional license agreement, Analytical Informatics, Inc
Pamela T. Johnson, MD, Baltimore, MD (*Presenter*) Consultant, National Decision Support Company
Davood J. Abdollahian, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Assessment of residents has advanced beyond traditional end of rotation evaluations. Professional development is best guided by regular feedback that can be put into practice immediately for continuous performance improvement. This exhibit describes an online dashboard that was designed to provide feedback to residents using a number of assessment metrics. Readers will learn about efficiency of web-based, point-of-care online assessment forms used on tablet or smartphone utility of providing residents with comparative data about their performance relative to PGY mean

TABLE OF CONTENTS/OUTLINE

Design in accordance with ACGME milestonesData collection sources web-based evaluations completed on tablet or smartphone radiology information system for case interpretation data conference attendance swiper manual entry exam scoresDashboard components real-time case volumes for 12 imaging procedures targets based on ACGME case log or institutional goals comparison to PGY mean modified report rates with comparison to PGY mean critical finding communication rates with comparison to PGY mean end-of-shift diagnostic performance evaluations end-of-procedure forms with objective competency assessment 360 evaluations from imaging technologists inservice/CORE exam scores relative to PGY mean conference attendance

PDF UPLOAD

http://abstract.rsna.org/uploads/2016/16015379/16015379_o8wl.pdf

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Pamela T. Johnson, MD - 2016 Honored Educator
Paul G. Nagy, PhD - 2014 Honored Educator

IN119-ED-X

Deep Learning in Radiology: Recent Advances, Challenges and Future Trends

All Day Room: IN Community, Learning Center

Participants
Sarfaraz Hussein, Orlando, FL (*Presenter*) Nothing to Disclose
Harish Raviprakash, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
Uygar Teomete, MD, Coral Gables, FL (*Abstract Co-Author*) Nothing to Disclose
Ulas Bagci, PhD, MSc, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

To overview the recent breakthrough in artificial intelligence methods in radiology applications To provide past, present, and future of deep artificial neural networks for CAD systems To highlight the significance of deep learning techniques for variety of radiology applications

TABLE OF CONTENTS/OUTLINE

Introduction to Recent Artificial Intelligence Breakthroughs in Radiology Applications: Convolutional Neural Network Unsupervised deep learning:Auto-encoders Recurrent Neural Networks Long-short term memory networks 3D Convolutional Neural Network Deep learning Methodologies in Computed Tomography Automated Anatomy Analysis Multi-organ segmentation, surgery,therapy planning,image registration Lesion segmentation using deep networks Pathology identification and characterization such as lung nodules, lymph nodes, etc. Deep learning in MRI Brain Tissue Segmentation Brain tumor segmentation Brain network analysis using deep networks Overview of Past and Present of CAD systems Challenges in deep learning methodologies for radiology applications Data dearth, Data augmentation, Deep learning in conjunction with hand crafted features, Parameter Selection: Layer, nodes and learning rates Conclusion and future trends for deep learning in radiology

IN120-ED-X

Quantification of Tumor Viability Using Textures Analysis

All Day Room: IN Community, Learning Center

Awards

Certificate of Merit

Participants

Wenli Cai, PhD, Boston, MA (*Presenter*) Nothing to Disclose
Bhanusupriya Somarouthu, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Anand K. Singh, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Gordon J. Harris, PhD, Boston, MA (*Abstract Co-Author*) Medical Advisory Board, Fovia, Inc; Stockholder, IQ Medical Imaging LLC;

TEACHING POINTS

Tumor quantification is crucial for the assessment of treatment response and prediction of patient survival in the management of cancer patients. Texture analysis provides a new dimension to evaluate tumor viability. The teaching points of this exhibit are:1. New cancer therapies (such as targeted therapy and immunotherapy) may demonstrate different imaging findings as those treated with conventional cytotoxic therapy.2. Tumor viability is one of the important image biomarker to evaluate tumor inhomogeneity and assess treatment response.3. Textures extracted from spatial or temporal space may be used to quantify tumor viability and differentiation of tumor inhomogeneity.4. Texture quantification may provide an accurate biomarker for the prediction of overall and progression-free survival.

TABLE OF CONTENTS/OUTLINE

1. Explanation of the various texture analysis techniques: histogram texture, run-length texture, and GLCM textures, and temporal textures. 2. Development of quantification of tumor viability using textures extracted from images.3. Utilization of spatial textures on MDCT images in the assessment of tumor viability in lung cancer treated by immunotherapy.4. Utilization of temporal textures on multi-phase MCCT images in the assessment of tumor viability of hepatocellular carcinoma (HCC) treated by targeted therapy.

IN121-ED-X

3D Printing and Modeling for Structural Heart Interventions

All Day Room: IN Community, Learning Center

Participants

Beth A. Ripley, MD, PhD, Seattle, WA (*Presenter*) Nothing to Disclose
Dmitry Levin, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Tatiana Kelil, MD, Brookline, MA (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Perpetua, PhD,RN, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Mario M. Ramos, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
William P. Shuman, MD, Seattle, WA (*Abstract Co-Author*) Research Grant, General Electric Company
Mark Reisman, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

“Structural heart disease” refers to non-coronary cardiac disease processes such as aortic and mitral valvular disease, atrial and ventricular septal defects and left atrial appendages at risk for clot formation. Structural heart disease is increasingly being treated by minimally invasive catheter-based techniques. Advanced imaging, including cardiac CT, is an essential part of pre-procedural planning. 3D printed models facilitate understanding of complex anatomy by allowing physicians to physically interact with a patient’s anatomy prior to a procedure. 3D models may also aid in appropriate device selection and sizing. 3D printing technology will likely play a large role in the design and testing of new catheter-based interventions.

TABLE OF CONTENTS/OUTLINE

Overview of structural heart disease, including valvular disease, atrial and ventricular septal defects and left atrial appendage anatomy. Review of the steps necessary to create 3D models from cardiac CT data. Role of 3D printing in transcatheter aortic valve replacement (TAVR) and mitral valve percutaneous interventions, including transcatheter mitral valve implantation (TIMV) and Mitra-CLIP. Planning for transeptal puncture navigation and left atrial appendage occlusion. Valve in valve implantation complications and considerations.

IN122-ED-X

Applications of 3D Printing in Congenital Cardiovascular Anomalies- A Case-based Review

All Day Room: IN Community, Learning Center

Participants

Ravi Ashwath, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Anthony Konold, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

TEACHING POINTS

To review the techniques of 3D medical printing To discuss the need for 3D printing in complex congenital cardiovascular disorders. To review the techniques of 3D printing To illustrate the utility of 3D printing in cardiovascular disorders using a series of case examples

TABLE OF CONTENTS/OUTLINE

Introduction Process of medical 3D printing- Image acquisition (CT, MRI, 3d echo); Segmentation; 3d printing; Printer devices Types of 3D printing techniques Challenges of understanding cardiovascular anatomy based on 2 D imaging- Small hearts; spatial relationship; surgical planning based on 2 D data in limited time Advantages of 3D printing- Patient specific models; Education; Pre surgical/interventional planning (improved outcome; decreased surgical time) Clinical applications of 3D printing in congenital cardiovascular anomalies Case examples - Single ventricle

- Tricuspid atresia
- Dextrocardia with L-TGA, left atrial isomerism, interrupted IVC with azygos continuation
- Truncus, interrupted arch with VSD
- Post Fontan, Glenn
- D-TGA with baffle obstruction
- Double outlet right ventricle
- Partial anomalous pulmonary venous drainage
- Coarctation
- Tetralogy of Fallot
- Coronary artery anomalies Accuracy and limitations of 3d models Future directions

Honored Educators

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Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator

IN123-ED-X

Introduction to Informatics and Exposure to Imaging Informatics in Diagnostic Radiology Training Programs

All Day Room: IN Community, Learning Center

Participants
Eileen Delaney, MD, Worcester, MA (*Presenter*) Nothing to Disclose
Monique M. Tyminski, DO, Worcester, MA (*Abstract Co-Author*) Nothing to Disclose
J. Paul Nielsen, MD, Golden, CO (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1) Provide a brief introduction to informatics and its applications in radiology2) Discuss trainee exposure to and understanding of imaging informatics during radiology residency and fellowship, and to evaluate trainee perception of the importance of formal informatics training. This is achieved via results of a survey given to radiology trainees.

TABLE OF CONTENTS/OUTLINE

1)Introduction to Informatics and Applications in Radiologya) Modelsb) Informationc) Systemsd) Applications in Radiology / Imaging Informatics2) Informatics Education in Radiologya) Survey results demonstrating lack of exposure to informatics in radiology residencyb) Discussion of adding Informatics into radiology residency curriculum

IN125-ED-X

Understanding What a Radiology Image Represents on Your Computer: Bits, Bytes, and Pixels

All Day Room: IN Community, Learning Center

Participants

Michael Y. Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Seung Eun Jung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Eun Rha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joon-Il Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Moon Hyung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Soon Nam Oh, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Young Byun, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:1. To show and explain that radiology images are really numerical data.
2. To demonstrate that image data consists of numerical bits and bytes.
3. To explain the relationship between image data and how it is seen by radiologists on PACS workstations.
4. To educate radiologists on how workstations and research tools process radiology data.

TABLE OF CONTENTS/OUTLINE

1. The basics - Data is digital - What a radiology image truly consists of**2. DICOM images**- DICOM header and data - CT images and how they are really stored - Application to other image modalities - Difference between DICOM images and JPEG images**3. How do we see these pixel values?** - About monochrome and color monitors - Understanding how window and level values work**4. Visualization of radiology data** - Example of conversion of image data to excel data and vice versa - Parametric images - Color maps

IN126-ED-X

Medical Illustrations Have Never Been Easier. A Step-by-step Guide to Create Illustrations from Radiographs using PowerPoint

All Day Room: IN Community, Learning Center

Participants
Kinan Alhalabi, Scottsdale, AZ (*Presenter*) Nothing to Disclose
Sasan Behravesh, MD, MMed, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose
Christine O. Menias, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1. Explain the drawing tools in PowerPoint and how to use them to create medical illustrations from radiographs.2. Describe step-by-step how to change an image (CT, MRI) to a professional medical illustration.

TABLE OF CONTENTS/OUTLINE

Radiologists in all subspecialties often design their presentations for educational purposes. Most of them, ask for multimedia professionals to draw illustrations for them. In this presentation, we will show step-by-step how to transform CT images easily into drawings using the drawing tools integrated into new versions of PowerPoint and how to carry your educational presentation to a higher level of professionalism.

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Christine O. Menias, MD - 2013 Honored Educator
Christine O. Menias, MD - 2014 Honored Educator
Christine O. Menias, MD - 2015 Honored Educator
Christine O. Menias, MD - 2016 Honored Educator

IN127-ED-X

Hardware, Software, and Network Considerations for Multi-Site, Multi-Institution PACS Clinical Interpretation Workflows

All Day Room: IN Community, Learning Center

Participants

Travis Browning, MD, Dallas, TX (*Presenter*) Advisor, McKesson Corporation
Thomas J. O'Neill, MD, El Paso, TX (*Abstract Co-Author*) Nothing to Disclose
Jeannie K. Kwon, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Viswanathan Venkataraman, MS, MENG, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Ronald M. Peshock, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Review hardware requirements, costs and options to support multiple institution PACS clinical interpretation workflow. Review software requirements, costs and options to support multiple institution PACS clinical interpretation workflow. Understand the pros and cons as well as trade-offs between the different solution options

TABLE OF CONTENTS/OUTLINE

Introduction The Problem – Many radiology practices cover more than one imaging center, some supported under multiple related or unrelated operational entities. Options for covering such establishments for clinical interpretation exist beyond physically traveling to each imaging location. Technical access barriers, cost/space constraints, and administrative/support processes drive the nature of the best fit solution. "Finding the study" "Viewing the study" "Reporting the study" Costs and contract considerations Hardware Desk size and physical space Computer Monitors KVM switch Software PACS Multiple vendors Single vendor, multiple installations Single vendor, single installation Reporting Multiple vendors Single vendor, multiple installations Single vendor, single installation Workflow management engines Network considerations Domain access Study routing Query/Retrieve, Pre-fetching

IN128-ED-X

What Happens to My Report after Signoff? HL7 Primer for Radiologists

All Day Room: IN Community, Learning Center

Participants
Srinivas Kolla, MD, Brooklyn, NY (*Presenter*) Nothing to Disclose
Dennis Cummings, MD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose
Stephen A. Waite, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Brian D. Gale, MD, Bronx, NY (*Abstract Co-Author*) Managing Member, SaferMD, LLC
Scott A. Lehto, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1. To review basics of HL7 messaging in health network architecture2. To understand the conversion of a report to an HL7 document and the different destination pathways3. To discuss some of the connectivity and integration problems with HL7

TABLE OF CONTENTS/OUTLINE

Health Level 7 (HL7) Basics: Healthcare network communication standard Equivalent to Open Sysmtem Interconnection (OSI) network application layer 7 Most common standard used for integration and messaging in healthcare Conversion of reports to HL7Benefits: Interoperability local and national Standardized Cost effective and efficientDrawbacks: Does not support media or rich text content Latest versions might not be backward compatible Sensitive to specification variance

IN301

National Library of Medicine (NLM) Literature Searches Demonstration

All Day Room:

Participants

IN302

Computer Assisted Radiology and Surgery (CARS)

All Day Room:

Participants

IN303

The Society for Imaging Informatics in Medicine (SIIM)

All Day Room:

Participants

IN304

RSNA Image Share Booth

Participants

IN305

3D Printing Showcase

All Day Room:

Participants

PS10

Opening Session: Digital Revolution in Radiology - the Good and the Bad

Sunday, Nov. 27 8:30AM - 10:15AM Room: Arie Crown Theater

IN OT

AMA PRA Category 1 Credits ™: 1.75
ARRT Category A+ Credit: 1.00

Participants

Richard L. Baron, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Bruce H. Curran, MEng, Richmond, VA, (Bruce.Curran@vcuhealth.org) (*Presenter*) Nothing to Disclose
Jonathan B. Strauss, MD, Chicago, IL (*Presenter*) Nothing to Disclose

Sub-Events

PS10A Presentation of the Outstanding Educator Award

Participants
Kristen K. DeStigter, MD, Burlington, VT (*Presenter*) Medical Advisory Board, Koninklijke Philips NV; Luminary, McKesson Corporation; Research collaboration, Koninklijke Philips NV;

PS10B Presentation of the Outstanding Researcher Award

Participants
Clifford R. Jack JR, MD, Rochester, MN (*Presenter*) Stockholder, Johnson & Johnson; Research Consultant, Eli Lilly and Company; ;

PS10C Dedication of the 2016 RSNA Meeting Program to the Memory of Herbert L. Abrams, MD (1920-2016)

Participants

PS10D President's Address: Beyond Imaging: Ensuring Radiology Impact in Clinical Care and Research

Participants
Richard L. Baron, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Mitchell E. Tublin, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose

Abstract

Radiologists have remarkably impacted radiology and medical care through their participation in developing and advancing the modern day imaging modalities of US, CT, MRI, Nuclear Medicine, and Interventional image-guided therapies. Modern digital advances go beyond the amazing images themselves. The introduction of digital imaging communication and storage systems has enabled timely and impactful distribution of images that has put medical imaging and radiologists at the forefront of clinical care 24 hours a day. At the same time, this rise of information technology in medicine limits personal interactions between radiologists and clinicians, making collaboration between physicians difficult. While technologic imaging innovation continues to advance, the key to continuing radiology's success will lie in our dedication to delivering the best possible care to every patient. To do so, radiologists must think beyond the images they see in practice and stay abreast of advancing subspecialty medical knowledge and more actively collaborate with referring physicians to improve patient outcomes. Meaningful continuing education and interactive training will be necessary to ensure radiologists are proficient at the subspecialty level required by an ever-increasing subspecialty approach in the medical community at large. We must reach beyond imaging in radiologic research, building truly multidisciplinary teams to develop multicenter, multi-investigator prospective trials that impact outcomes for entire populations. Today's research will become tomorrow's clinical practice, requiring radiologists to develop and lead impactful clinical imaging research that will position us as an essential part of clinical care teams. And above all, we must look beyond imaging to gain a broader perspective on the patient experience. We have entered a new era in radiology and healthcare at large driven by changes to reimbursement models and an emphasis on value in patient care delivery. Radiologists must produce examination reports that provide the solutions sought by patients and referring physicians rather than simply describe findings. Ultimately, we should strive to consistently deliver the right examination at the right time by the right radiologist with the quality of the process and the report matching what we would expect for us or our family members. In doing so, we will better serve our patients and our specialty as we navigate an ever-changing healthcare environment.

PS10E When Machines Think: Radiology's Next Frontier

Participants
Keith J. Dreyer, DO, PhD, Boston, MA (*Presenter*) Medical Advisory Board, IBM Corporation
Richard L. Baron, MD, Chicago, IL (*Presenter*) Nothing to Disclose

Abstract

As computers outperform humans at complex cognitive tasks, disruptive innovation will increasingly remap the familiar with waves of creative destruction. And in healthcare, nowhere is this more apparent or imminent than at the crossroads of Radiology and the emerging field of Clinical Data Science. As leaders in our field, we must shepherd the innovations of cognitive computing by defining its role within diagnostic imaging, while first and foremost ensuring the continued safety of our patients. If we are dismissive, defensive or self-motivated - industry, payers and provider entities will innovate around us achieving different forms of disruption, optimized to serve their own needs. To maintain our leadership position, as we enter the era of machine learning, it is essential that we serve our patients by directly managing the use of clinical data science towards the improvement of care—a position which will only strengthen our relevance in the care process as well as in future federal, commercial and accountable care discussions. In this

session, we will explore the state of clinical data science in medical imaging and its potential to improve the quality and relevance of radiology as well as the lives of our patients.

PS10F Hope, Hype, and Harm as Medicine Enters the Digital Age: Lessons From (and For) Radiology

Participants
Robert M. Wachter, MD, San Francisco, CA (*Presenter*) Scientific Advisory Board, PatientSafe Solutions, Inc; Stock options, PatientSafe Solutions, Inc; Scientific Advisory Board, EarlySense; Stock options, EarlySense; Scientific Advisory Board, QPID Health, Inc; Stock options, QPID Health, Inc; Scientific Advisory Board, Amino Inc; Stock options, Amino Inc; Scientific Advisory Board, Twine Health, Inc; Stock options, Twine Health, Inc; Author with royalties, Wolters Kluwer nv ; Speaker, Wolters Kluwer nv ; Author with royalties, The McGraw-Hill Companies; Speaker, The McGraw-Hill Companies; Author with royalties, John Wiley & Sons, Inc; Speaker, John Wiley & Sons, Inc ; Investor, Smart Patients, Inc;
Richard L. Baron, MD, Chicago, IL (*Presenter*) Nothing to Disclose

Abstract

While radiology went digital nearly two decades ago, the wholesale switch from paper to computer in the rest of healthcare is a relatively recent phenomenon. While computerization has helped improve safety and quality, it has also had unanticipated consequences, many of them quite negative. Studies have shown, for example, that physician burnout has never been higher – and much of this is attributable to the electronic health record. Other studies have documents new types of medical errors, sometimes known as "e-iatrogenesis".
Dr. Robert Wachter spent a year studying the digitization of healthcare in researching his 2015 book, The Digital Doctor: Hope, Hype and Harm at the Dawn of Medicine's Computer Age. In this talk, he'll describe what we got right – and wrong – in our journey, and why radiology was, to a large degree, a canary in the digital coal mine. Ultimately, it's a hopeful story; the experience from other industries tells us that it often takes a decade or more to obtain the promised benefits from automation – and that these improvements emerge only after the technology improves and the work has been reimagined for a digital environment.
Wachter is Professor and Interim Chairman of the Department of Medicine at the University of California, San Francisco, where he also directs the Division of Hospital Medicine. Author of 250 articles and 6 books, he coined the term "hospitalist" in 1996 and is generally considered the "father" of the hospitalist field, the fastest growing specialty in the history of modern medicine. He is past president of the Society of Hospital Medicine and past chair of the American Board of Internal Medicine. In 2015, Modern Healthcare magazine ranked him as the most influential physician-executive in the U.S., his eighth consecutive year in the top 50.
The Digital Doctor was a New York Times science bestseller. In its review, the Times said, "Janus is the god of medicine these days, and it is the great strength of Wachter's eloquent new book that it has captured every one of these conflicting emotions, all powerfully felt and intelligently analyzed… Most previous authors have chosen sides, either mourning the old or hailing the new. Wachter is unusual for his equipoise. He is old enough to remember the way things used to work (or fail to work), young enough to be reasonably technology friendly… He is also an exceptionally good, fluent writer." He is currently heading a national review of IT strategy for England's National Health Service.

SSA12

Science Session with Keynote: Informatics (Education and Research)

Sunday, Nov. 27 10:45AM - 12:15PM Room: S403A

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

George L. Shih, MD, MS, New York, NY (*Moderator*) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Moderator*) Nothing to Disclose

Sub-Events

SSA12-01 Informatics Keynote Speaker: Medical Imaging Annotations for Reporting, Education and Machine Learning

Sunday, Nov. 27 10:45AM - 10:55AM Room: S403A

Participants
George L. Shih, MD, MS, New York, NY (*Presenter*) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;

SSA12-02 eContour.org Improves Contour Agreement and Knowledge of Radiographic Anatomy Among Radiation Oncology Residents in a Multi-Institutional Randomized Trial

Sunday, Nov. 27 10:55AM - 11:05AM Room: S403A

Awards
Student Travel Stipend Award

Participants
Neil Panjwani, BS, San Diego, CA (*Presenter*) Nothing to Disclose
Erin Gillespie, BS, MD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose
Daniel W. Golden, MD, Chicago, IL (*Abstract Co-Author*) Manager, RadOnc Questions LLC
Jillian R. Gunther, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Tobias R. Chapman, MD, MS, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Jeffrey V. Brower, MD, Gainesville, FL (*Abstract Co-Author*) Nothing to Disclose
Robert Kosztyla, PhD, Calgary, AB (*Abstract Co-Author*) Nothing to Disclose
Vitali Moiseenko, PHD, Surrey, BC (*Abstract Co-Author*) Speaker, Varian Medical Systems, Inc; Travel support, Varian Medical Systems, Inc
Julie Bykowski, MD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose
Parag Sanghvi, MD, Portland, OR (*Abstract Co-Author*) Nothing to Disclose
James D. Murphy, MD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

eContour improves contour agreement as well as knowledge of contour delineation and radiographic anatomy among radiation oncology residents. The usability of a web-based contouring atlas was high compared to existing resources. These data suggest that *eContour* has the potential to improve contour accuracy and ultimately impact quality of radiation delivery.

Background

The delivery of safe and effective radiation therapy increasingly relies on accurate target delineation in the era of highly conformal treatment techniques. Current contouring resources are fragmented and cumbersome to use. To overcome these limitations we created a free interactive web-based atlas called *eContour* (www.eContour.org). This study reports on the efficacy and usability of using *eContour* compared to existing contouring resources in a randomized trial among radiation oncology residents.

Evaluation

We enrolled 27 radiation oncology residents from 5 institutions for a two-phase contouring study. All residents contoured a T1N1 nasopharyngeal cancer case using currently available resources. Participants were then randomized to re-contour the case with (Group A) or without (Group B) access to *eContour*. Contour analysis was performed using conformation number and simultaneous truth and performance level estimation (STAPLE). At the completion of each contouring session, residents completed a multiple choice question (MCQ) knowledge test and a 10-item System Usability Scale (SUS).

Discussion

Twenty-four residents (89%) completed this study (11 in Group A and 13 in Group B). Residents using *eContour* showed greater agreement with both the consensus contour and the expert contour for the high-risk (59.4Gy) clinical target volume (0.63 vs. 0.52, $p<0.01$), as well as greater agreement with the expert contour for the right parotid (0.57 vs. 0.47, $p<0.005$) and right cochlea (0.34 vs. 0.18, $p<0.05$). Residents using *eContour* demonstrated greater knowledge of contour delineation and radiographic anatomy on 8 MCQs (89% vs. 77%, $p<0.05$). Usability of *eContour* was high compared to a contouring textbook (89 vs. 66, $p<0.0001$), which was used by the majority of residents (54%).

SSA12-03 From the Notebook to the Cloud: A Personal Web-based Management System for Radiological Cases

Sunday, Nov. 27 11:05AM - 11:15AM Room: S403A

Participants

Julia Calatayud, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Pablo Lopez, Madrid, Spain (*Presenter*) Nothing to Disclose
Diana Exposito, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Gabriel C. Fernandez, MD, Avila, Spain (*Abstract Co-Author*) Nothing to Disclose
Beatriz Alvarez De Sierra Garcia, MD, Mostoles, Spain (*Abstract Co-Author*) Nothing to Disclose
Daniel Castellon, MD, Fuenlabrada, Spain (*Abstract Co-Author*) Nothing to Disclose
Silvia Cisneros Carpio, MD, Durango, Spain (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

ARCASI is a new multilingual web-based application for a personal management of radiological cases, with the ability to access and share cases, images and references from anywhere.

Background

There are many classical ways of archiving interesting radiological cases that we all have used such as notebooks, Excel files or folders. None of them has allowed us to manage and share these cases in an optimal manner, promoting the development of technological-based storage systems. Thus arises ARCASI (ARchive CASes of Interest), a simple web application that allows archiving, managing and sharing cases easily.

Evaluation

ARCASI is a cloud-based multilingual application developed with open source technologies and compliant with web standards and HIPAA rules. It has been created focused on the radiologists and the main reasons to archive cases according to their interest such as learning, teaching, researching, committees, etc. The application was designed in order to classificate cases into radiology subspecialties, pathologies and localizations to facilitate searching and organization. Initial and confirmation diagnosis can be saved along with other attributes to keep track of open/closed and correct cases. Users can create tags according to their needs to organize cases by attaching one or many tags to them with the possibility to shared them with other users. Many images formats including DICOM can be added and viewed in an integrated viewer that runs on any device with a modern browser. Bibliography can be attached by uploading documents or referencing URLs. All these documents are automatically indexed by the application's search engine. ARCASI has been used in our institution over the last 3 months with more than 700 cases archived.

Discussion

The application has led to an increment in the cases archived by users as well as a continuous tracking of open cases. Full text search within the case and bibliography, classification and tags have allowed users to quickly find and organize related cases. Our solution ensures full access to archived cases from any device with Internet access. It is independent of any PACS while it provides a Restful API for interoperability and system integrations.

SSA12-04 RapRad - A New E-learning Concept with Rapid Case Reading and Instant Feedback to Reduce Chance in Radiology Education

Sunday, Nov. 27 11:15AM - 11:25AM Room: S403A

Participants
Philipp Brantner, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose
Fabienne Steiner, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Safak Korkut, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Sebastian Linxen, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Elmar M. Merkle, MD, Basel, Switzerland (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Research Grant, Bayer AG; Research Grant, Guerbet SA; Research Grant, Bracco Group
Tobias Heye, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The fast appreciation of the gist of a scene refers to the detection of essential imaging features in common pathologies. This skill is developed in radiology residency and greatly depends on the encountered spectrum of a certain pathology. However, the spectrum can vary greatly on a daily basis and depends on the type of radiology institution. To standardize radiology education in residency the e-learning platform RapRad was developed with a focus on fast and high-volume exposure to common pathologies combined with instant feedback in a gamification setting. This platform is intended to help residents train the whole spectrum of a pathology in a shorter time period. Secondary goals are to prepare residents for oncall shifts and to help them making a diagnosis with greater confidence and lower error rate.

METHOD AND MATERIALS

A server based, mobile e-learning platform with gamification elements, developed by the University of Applied Sciences Northwestern Switzerland was used. The user, represented by an avatar, has to answer question blocks in rapid succession in order to overcome obstacles and reach the next level. Each block contains the entire difficulty spectrum of one pathology. For each question the pathology (or its absence) has to be identified by placing a marker on its image location. The correct answer is given with a short feedback and the user rapidly proceeds to the next question. Pneumothorax and consolidation detection on chest x-rays were chosen as initial learning objectives.

RESULTS

With RapRad, a mobile web-platform was developed to train the entire spectrum of common radiological pathologies. Users are motivated by an engaging gamification setting and the ability to quickly read a large number of cases. The plattform is modular and while two pathologies were implemented for the initial phase, the platform is scalable and can be adapted for a variety of pathologies.

CONCLUSION

RapRad is a new concept in e-learning by simulating radiology workflow and experience through the means of repetitive and fast case reading with instant feedback.

CLINICAL RELEVANCE/APPLICATION

Modern e-learning apps deliver content through means of motiviation by gamification; we use this approach combined with rapid

Modern e-learning apps deliver content through means of motivation by gamification, we use this approach combined with rapid reading and instant feedback to reduce chance in radiology education.

SSA12-05 Defining Expertise: A Comparison Eye-Tracking Study of Radiologists and 1st Year Medical Students

Sunday, Nov. 27 11:25AM - 11:35AM Room: S403A

Participants
Max P. Rosen, MD, MPH, Worcester, MA (*Presenter*) Stockholder, Everest Scientific Inc; Consultant, PAREXEL International Corporation; Stockholder, Cynvenio Biosystems, Inc; Medical Advisory Board, Cynvenio Biosystems, Inc
Zachary R. Zaniewski, BA, Worcester, MA (*Abstract Co-Author*) Nothing to Disclose
Gregory DiGirolamo, PhD, Worcester, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We have previously demonstrated unconscious detection of lung nodules among radiologists (RADS). Here, we investigate this phenomenon, as well as eye movement metrics in untrained readers (1st year medical students). This work may lead to improved techniques for training of RADS.

METHOD AND MATERIALS

12 RADS and 12 MS interpreted 18 axial chest CT scans (9 normal and 9 abnormal). There were 16 lung nodules across the abnormal CT scans. An Eye-Link 1000 tracked the location and duration of each gaze. Visual dwell time on healthy tissue vs. on a lung nodule, the number of total eye movements (saccades) and the total number of images viewed were used to evaluate the efficiency of visual search patterns by both groups.

RESULTS

Among nodules consciously detected, both RADS ($p<0.007$) and MS ($p<0.03$) dwelled longer on the location of the nodule vs. healthy lung tissue. RADS ($p<0.03$) also dwelled longer on lung nodules vs. healthy tissue, even when not consciously detected. Unlike RADS, MS did not fixate longer on a lung nodule vs. healthy lung tissue ($t<1$) when not consciously detected. RADS scrolled through the image set 2.5 times more than MS ($p< 0.004$). RADS made significantly more saccades ($p< 0.0001$) than MS (Average= 376 vs. 215). However, RADS were significantly more efficient, making on average 0.46 saccades per image while MS made 0.62 ($p< 0.02$). MS bounced from one location to another across the entire image set and then moved on from that image and only rarely returned to an image they looked at previously.

CONCLUSION

Unlike RADS, MS do not show unconscious detection of lung nodules. The search pattern and efficiency of search were significantly worse for MS vs. RADS. These data suggest that during the process of radiological training, both conscious and unconscious learning is developed that influence the success of the search, the efficiency of the search, and the pattern in which the search is undertaken. Although some component of radiological learning is the result of specific training and conscious processes, additional unconscious learning likely occurs that influences radiological performance.

CLINICAL RELEVANCE/APPLICATION

Some component of unconscious learning likely contributes to the diagnostic abilities of a radiologist. Although, there is no consensus on perceptual search training, knowing what visual metrics make expert radiologists could help to better specify training protocols in the future.

SSA12-06 Are We "Hacking" the Curve? P-Curve Analysis of the Radiology Literature

Sunday, Nov. 27 11:35AM - 11:45AM Room: S403A

Awards
Student Travel Stipend Award

Participants
Jacob Lewis, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Duane Schonlau, MD, Ponte Vedra, FL (*Abstract Co-Author*) Nothing to Disclose
Marcus A. Kater, MD, Kansas City, MO (*Abstract Co-Author*) Nothing to Disclose
Daniel E. Wessell, MD, PhD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Within the scientific literature, it is widely recognized that current publication practices create strong incentives to publish statistically significant results. This leads to two major types of selection bias in the scientific record: publication bias (lower publication rates in studies with non-significant results) and inflation bias or "p-hacking" (researchers perform several different statistical analyses or alter the eligibility specifications for data and report only those that produce significant results). Due to these biases, the scientific record overestimates the size of effects. In this study, we assess for the presence of these biases in the radiology literature over the past decade.

METHOD AND MATERIALS

The top ten radiology journals, without subspecialty emphasis, were selected from a list of the radiology journals ranked by their impact factors for 2014. Using the web-based Scopus search engine, each journal was searched for articles published over the last decade (n = 26,035). The abstract of each article was downloaded from Scopus into a database. The database was then parsed using a text-mining program designed to extract all of the p-values listed within each abstract (n=28,259). A p-curve was then generated and analyzed. Pair-wise comparison sign tests were performed on bins of data to assess for statistically significant differences.

RESULTS

The generated p-curve demonstrated a large rightward skew for the data of $p < 0.05$, which is indicative of "evidential value" (non-zero true effect size). Additionally, the p-curve had a notable drop in the number of p-values per bin just above the "statistically significant" level of 0.05, highly suggestive of publication bias. Statistical analysis on the number of p-values per bin just below 0.05, reported to the thousandth decimal place, showed a local peak, which provides evidence of "p-hacking" in the radiology literature.

CONCLUSION

There is strong evidence that the recent radiology literature is founded on evidential value. There is also strong evidence of a publication bias for statistically significant results. Lastly, the p-curve suggests that there is "p-hacking" in the radiology literature.

CLINICAL RELEVANCE/APPLICATION

Analysis of the p-curve, based on recent radiology literature, shows that the literature is founded on evidential value and suggests the presence of both publication and inflation ("p-hacking") bias.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Daniel E. Wessell, MD, PhD - 2013 Honored Educator

SSA12-07 Why Women Shy Away from Radiology: Understanding Gender Preferences when Choosing a Medical Specialty

Sunday, Nov. 27 11:45AM - 11:55AM Room: S403A

Awards
Student Travel Stipend Award

Participants
Holly J. Jumper, MD, Little Rock, AR (*Presenter*) Nothing to Disclose
Roopa Ram, MD, Little Rock, AR (*Abstract Co-Author*) Nothing to Disclose
Sumera Ali, MBBS, Little Rock, AR (*Abstract Co-Author*) Nothing to Disclose
Shelly Lensing, Little Rock, AR (*Abstract Co-Author*) Nothing to Disclose
Philip J. Kenney, MD, Little Rock, AR (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate gender differences in factors influencing specialty choice in 4th year medical students choosing Radiology and other specialties.Women have historically been and continue to be underrepresented in diagnostic radiology. According to the AAMC 2012 Physician Specialty Data Book, women made up only 22% of the field of radiology in 2010. We aim to investigate how factors influencing specialty choices differ for medical female students planning to pursue a residency in radiology versus other specialties and examine gender differences within radiology.

METHOD AND MATERIALS

Data from the Association of American Medical College's (AAMC) Graduation Questionnaires (GQ) from 2011, 2012, 2013 and 2014 will be used. The GQ asks fourth year medical students to rate various aspects of their medical education and includes questions about clinical experiences and career intentions, including factors influencing their choice of specialty such as mentor, salary, debt, family considerations, and fit with interests/skills. We will use de-identified data to evaluate which factors influence a medical student's decision to pursue a career in radiology and which factor influences are affected by gender. The 10 largest specialty choices with at least 1,000 respondents each will be comparison groups. Females choosing radiology will be compared to females in each of the other specialties in terms of factors influencing choice of specialty. Females will also be compared to males choosing radiology. The UAMS IRB determined this study has exempt status.

RESULTS

We will report our analysis of student data as categorized by gender and then specialty with a focus on radiology.

CONCLUSION

Findings will be useful for understanding the gender gap in radiology.

CLINICAL RELEVANCE/APPLICATION

Based on the results of this study, we aim to identify factors that influence specialty choice. With this information, strategies can be employed within the field of radiology to close the gender gap.

SSA12-08 Targeted QA: Creating a PACS based Teaching File using Pareto Analysis of Trainee Discrepancies

Sunday, Nov. 27 11:55AM - 12:05PM Room: S403A

Participants
Hriday Shah, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
John Mongan, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Spouse, Employee, Thermo Fisher Scientific Inc
Eric C. Ehman, MD, Pacifica, CA (*Abstract Co-Author*) Nothing to Disclose
Javier Villanueva-Meyer, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Soonmee Cha, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Jason F. Talbott, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Data Safety Monitoring Board, StemCells, Inc

PURPOSE

To develop a high yield PACS based teaching file using Pareto Analysis of our institutional QA Module

METHOD AND MATERIALS

A retrospective analysis of all preliminary interpretations from the the institutional quality assurance (QA) database was conducted for data between July 1, 2010 - June 30, 2015. All cases were categorized by a board-certified radiologist as "No Discrepancy", "Questionable discrepancy", "Minor Discrepancy-unlikely to affect management" or "Major Discrepancy-likely to affect management". All CT related "Major Discrepancies" were reviewed and sub-classified into 3 primary specialties (Chest Imaging, Abdominal Imaging, Neuroradiology) to create a Pareto chart. MSK QAs were excluded due to rare frequency. Additionally, all major discrepancy errors were classified as being related to interpretation (finding seen but misinterpreted) versus perception (finding not seen).

RESULTS

Of the 78,256 studies (all modalities) reviewed on our institutional QA module over a five-year period, the questionable discrepancy rate was 1.2%, the minor discrepancy rate was 3.1%, and the major discrepancy rate was less than 0.5%. 76% of errors were related to perception and 24% were related to interpretation. Sub-classification of discrepancies was performed for Pareto analysis. 50% (95% CI: 40.7-58.6) of neuroradiology discrepancies related to hemorrhage, post-operative complications or ischemic infarcts on head CT. 49% (95% CI: 36.5-62.0) of abdominal imaging discrepancies related to bowel, vascular findings or thoracic findings. 80% (95% CI: 63.0-92.1) of chest imaging discrepancies related to pulmonary emboli, cardiac findings or aortic pathology. A list of high yield cases was generated based on Pareto analysis. These cases were anonymized using the RSNA CTP anonymization tool and made available for review on the in-hospital PACS as well as a web-based PACS.

CONCLUSION

QA related Pareto analysis can be successfully used to create a high yield PACS based teaching file. At our institution, this anonymized PACS based teaching file has been fully implemented as part of a pre-call preparatory curriculum.

CLINICAL RELEVANCE/APPLICATION

Pareto analysis of discrepancies allows identification of high yield discrepancies, which can subsequently be reviewed in an anonymized fashion on PACS as part of a pre-call preparatory curriculum.

SSA12-09 Radiology-Pathology Correlation within the PACS

Sunday, Nov. 27 12:05PM - 12:15PM Room: S403A

Participants
Jonelle M. Petscavage-Thomas, MD, MPH, Hummelstown, PA (*Presenter*) Consultant, Medical Metrics, Inc
Eric A. Walker, MD, MHA, Hummelstown, PA (*Abstract Co-Author*) Research Consultant, Medical Metrics, Inc
Teresa Ganz, Hershey, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Radiologists perform image guided procedures to obtain tissue for histological evaluation. Typically there is no direct linkage between the radiology and pathology reporting systems. The radiologist must keep a log of the biopsies performed and manually search the EMR to obtain final pathologic diagnosis. This is inefficient and shows a lack of enterprise information integration. The purpose of our study was to implement a method of providing final pathology reports directly to the PACS queue of the radiologist who performed the procedure.

METHOD AND MATERIALS

A list was created of all RIS procedure codes. This list was used to identify cases wherein a pathology report would be generated. This list was submitted to a 3rd party system that has an established API to our PACS. In the radiology-pathology correlation workflow, the 3rd party system receives a copy of the pathology result HL7 feed ('ORU' message type) sent to the EMR. When received, it is evaluated for 1) a matching patient in the RIS based on MRN, visit number, and specimen receive date is +/- 3 days of the radiology exam date, and 2) exam code matching the RIS list. When the criteria match, a RadMail is sent to the radiologist in the PACS with the pathology report text and a link to the images. Over a four week period, a log of sent Radmails was recorded and a list was run of all radiology procedures with pathology generated. The two lists were compared to determine percentage of pathology reports successfully being automatically sent to the radiologist.

RESULTS

A total of 120 radiology procedures were performed over the four week period. 88 (73.3%) of these cases had a confirmed RadMail. Radiologist feedback was positive, with comments including that, "the system was nicely integrated", "was only one mouse click", "saved them time", and "was helpful to relaunch the images in context of the pathology report." In the failed cases, issues included the RIS missing new examination codes and date match between the pathology specimen date and the RIS examination date was outside of the +/- 3 days range.

CONCLUSION

The set-up with the HL7 messages between IT systems was successful and could easily be replicated by other radiology departments

CLINICAL RELEVANCE/APPLICATION

Radiology-Pathology correlation within the PACS is an effective way of providing more complete patient care, saving radiologist time, and integrating enterprise IT systems effectively.

RCA11

Creating Vector-based Drawings for Presentations and Publications with Adobe Illustrator (Hands on)

Sunday, Nov. 27 11:00AM - 12:30PM Room: S401AB

ED IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sarah C. Abate, BS, Ann Arbor, MI, (sabate@med.umich.edu) (*Presenter*) Nothing to Disclose
Elise Van Holsbeeck, DO, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss why we use vector based programs. 2) Explain how to use the tools in Illustrator. 3) Demonstrate how to import and label an image. 4) Demonstrate how to make one's own line drawing. 5) Demonstrate how to color and shade drawing. 6) Demonstrate how to export an image for print, PowerPoint, and Internet.

Active Handout:Sarah C. Abate

http://abstract.rsna.org/uploads/2016/16005083/ACTIVE RCA11 Illustrator_FINAL.pdf

RCB11

Using Keynote: An Alternative to Power Point (Hands-on)

Sunday, Nov. 27 11:00AM - 12:30PM Room: S401CD

ED IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Shawn D. Teague, MD, Denver, CO, (sdteague@gmail.com) (*Presenter*) Stockholder, Apple Inc

LEARNING OBJECTIVES

1) Modify the master slides used in a template. 2) Change the aspect ratio for a presentation from 4:3 to 16:9. 3) Utilize movies in a presentation.

RCC11

Principles and Practice of 3D Printing

Sunday, Nov. 27 11:00AM - 12:30PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Moderator*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

This course will introduce medical 3D pritning to the RSNA community. The technologies will be described, and creation of medical models from volumetirc radiology data will be introduced. The session will also highlight clinical scenarios that have been positively impacted by 3D printing.

ABSTRACT

3D printing/additive manufacturing is a growing industry. Within the medical field there is growing interest in this technology and its impact on patients lives. In this talk we will discuss the basics of 3D printing and how they can be incorporated into medical uses from surgical design of implants to anatomic modeling of complex surgery.

Sub-Events

RCC11A 3D Printing for the Radiologist: A Primer and Introduction to Sessions

Participants

Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To become familiar with 3D printing technologies. 2) To have an introduction of materials used to create 3D-printed anatomical models and how they can be used in medical applications. 3) To be exposed to the process of 3D printing and those realized and potential clinical benefits in radiology, stratified by organ section.

ABSTRACT

While advanced visualization in radiology is instrumental for diagnoses and communication with referring clinicians, there is an unmet need to render DICOM images as three-dimensional (3D) printed models capable of providing both tactile feedback and tangible depth information of both anatomic and pathologic states.3D printed models, already entrenched in the non-medical sciences, are being rapidly embraced in medicine as well as in the lay community. Incorporating 3D printing from images generated and interpreted by radiologists presents particular challenges including training, materials and equipment, and guidelines. The overall costs of a 3D printing lab must be balanced by clinical benefits.The RSNA 2016 program includes 6 hours of didactic lectures that review and summarize numerous studies that support such benefits from 3D printing, as it is expected that the number of 3D printed models generated from DICOM images for planning intervention and fabricating implants will grow exponentially. The program also includes multiple hands-on courses that will enable radiologists, at a minimum, to become familiar with 3D printing software and hardware as it relates to our field.Readers are strongly encouraged to review two articles published in RadioGraphics. Familiarity with these two educational resources will provide background information and enable conference participants to optimize their experience at the annual meeting:1. Mitsouras D et al, Radiographics. 2015 Nov-Dec;35(7):1965-88. doi: 10.1148/rg.20151403202. Matsumoto JS et al, Radiographics. 2015 Nov-Dec;35(7):1989-2006. doi: 10.1148/rg.2015140260Readers slated to participate in the Hands-on Training are strongly encouraged to review the training manual for the 2015 Hands-on session at the following link:http://threedmedprint.springeropen.com/articles/10.1186/s41205-015-0002-4In addition, the 2014 Hands-on session can be found in the Appendix of Reference 1 (Mitsouras et al) above.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RCC11B Implementing 3D Printing into a Clinical Practice

Participants

Jonathan M. Morris, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn the basics of 3D printing technologies. 2) Discuss how these can be used clinically. 3) Discuss the current limitations of this technology as it relates to health care. 4) Use case examples to define current uses of this technology in surgical and medical specialties.

ABSTRACT

3D printing/additive manufacturing is a growing industry. Within the medical field there is growing interest in this technology and its impact on patients lives. In this talk we will discuss how we incorporated this technology into a quaternary referral center as a real

time clinical service. We will specifically discuss the advantages as well as limitations of this technology as it relates to the medical/surgical field. We will discuss "How we do it" and what resources are needed to develop a service. As the impact of this technology is growing we will also discuss what evidence will we need to have global acceptance as a clinical service and why it should be housed in radiology.

RCC11C 3D Printing Technologies

Participants
Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the basic principle of Additive Manufacturing (3D Printing) and how it differs from subtractive technology. 2) Understand the principles of the software needed to convert Medical Images into three-dimensional printed models and what factors contribute to the quality of each model. 3) Become familiar with the different types of Additive Manufacturing (3D Printing) technologies.

ABSTRACT

This presentation will provide a novice to Additive Manufacturing the general knowledge applicable to the medical field. The basic principles of Additive manufacturing (3D Printing) will be discussed along with the different technologies which encompass the field. The steps of converting radiographic images into three-dimensional printable files and the differences between the multitude of additive manufacturing techniques will be the primary focuses.

RCC11D Techniques for Current 3D Printing

Participants
Gerald T. Grant, MD, MS, Louisville, KY, (gerald.grant@louisville.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the development of the use of Additive manufacturing in Customized reconstruction and rehabilitation. 2) Be familiar with type of additive manufacturing used in healthcare. 3) Be familiar with new materials and current advances in 3D print technology for patient care. 4) Exposure to practical workflow in the use of Additive manfucaturing in patient care.

ABSTRACT

The applciation of digital imaging, design, and manufacturing of medical devices has proven to be a valuable tool in custom patient care, especially in reconstruction and rehabiliation. These applications have extended past the early adoption of the technology in Craniofacial reconstruction and Orthopedics, to cardiology, neurology, pedicatrics and a host of other disciplins, contributing to custom. A brief history on the developemnt of the use of AM technologies, a discussion on the technology, the materials, and the application of Advanced Digital Technologies in healthcare will be presented.

INS-SUA

Informatics Sunday Poster Discussions

Sunday, Nov. 27 12:30PM - 1:00PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

Participants
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Moderator*) Nothing to Disclose

Sub-Events

IN200-SD-SUA1 Automated Annotation of a Large Scale Radiology Image Database Using Deep Learning

Station #1

Awards
Trainee Research Prize - Fellow

Participants
Xiaosong Wang, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Le Lu, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Hoo-Chang Shin, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Lauren M. Kim, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Isabella Nogues, BA, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Jianhua Yao, PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc
Ronald M. Summers, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc; ;

PURPOSE

Obtaining semantic labels on a large scale radiology image database is a prerequisite yet bottleneck to train highly effective deep convolutional neural network (CNN) models for image classification and many Computer Aided Detection tasks. Nevertheless, conventional methods for collecting image labels (e.g., Google search followed by crowd-sourcing) are not applicable due to the limited number of expert observers with the requisite medical training. Here we present an iterative optimization framework for automatic category discovery and labelling of visually coherent and clinically semantic image clusters.

METHOD AND MATERIALS

The framework begins by extracting deep CNN features based on transfer learning from a CNN model pretrained on the ImageNet dataset. Next, the deep feature clustering with k-means is exploited. By evaluating the purity between discovered clusters, the system either terminates the current iteration (which leads to an optimized clustering output) or takes the refined cluster labels as the input to fine-tune the CNN model for the following iteration. Once the visually coherent image clusters are obtained, the system further extracts semantically meaningful text words (by ranking the frequency) for each cluster. All corresponding patient reports per category cluster are adopted for the Nature Language Processing.The image database used in this work contains a total of 216K 2D key-images which are associated with 62K unique patients' radiology reports.

RESULTS

270 visually coherent image categories are produced with associated clinically semantic key word labels for each category. Sample images and labels from 4 out of 270 categories are shown in the attached Figure. Furthermore, the CNN trained based on the resulting category labels achieves Top-1 classification accuracy of 81.09% and Top-5 accuracy of 94.12% for the testing set respectively.

CONCLUSION

The proposed framework is capable of generating visually coherent and semantically meaningful text labels for a thematically grouped cluster of radiology images and thereby serves as a potential alternate method of time and cost-intensive task of data labelling.

CLINICAL RELEVANCE/APPLICATION

The labelled image database and the trained CNN model are a potentially valuable addition to the Computer Aided Detection research community.

IN201-SD-SUA2 Software Attributable Dimensional Variability in Threshold Segmentation and Binary Volume Iso-surface Extraction

Station #2

Participants
James Shin, MD, MSc, Stony Brook, NY (*Presenter*) Nothing to Disclose
George L. Shih, MD, MS, New York, NY (*Abstract Co-Author*) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;
Mark E. Schweitzer, MD, Stony Brook, NY (*Abstract Co-Author*) Consultant, MMI Munich Medical International GmbH Data Safety Monitoring Board, Histogenics Corporation

PURPOSE

To evaluate and quantify differences between open-source and commercial segmentation and binary volume iso-surface extraction algorithms.

METHOD AND MATERIALS

Subsequent to IRB approval, non-contrast CT images of the face (64-slice GE Lightspeed, 1.25mm) and contrast-enhanced cardiac CT images (320-slice Toshiba Aquillon, 1mm) were retrospectively collected and de-identified. Facial bones were segmented by a radiologist using a one-way attenuation threshold in open-source (3D Slicer 4.5) and commercial (Mimics 17) post-processing environments. Cardiac blood pool was similarly segmented. 3D models were generated using maximum settings, without smoothing or mesh decimation. 3D models were co-registered and compared, including comparison with initial segmentation.

RESULTS

Iso-surface extraction of facial bones resulted in a mesh of 2,325,020 polygons with open-source, and 2,518,652 polygons with commercial (irrespective of interpolation method). Corresponding blood pool counts were 1,069,0350 and 1,060,352; respectively. Dice index for open-source and commercial segmentation by global thresholding was 1, regardless of anatomy. Maximum Hausdorff distances between the models was 14.05mm for facial bones and 0mm/incalculably small for blood pool, with mean distances of 0.081mm and 0mm; respectively. 95% agreement occurred within distances of 0.149mm and 0mm, respectively. Compared to initial facial bone segmentation, Dice indices were 0.9841 for commercial and 0.9940 for open-source. Corresponding blood pool indices were 0.9989 and 0.9989, respectively.

CONCLUSION

Threshold segmentation is a straightforward means to extract anatomy with characteristic attenuation, and the examined software performed identically. Iso-surface extraction based on marching cube's algorithm performed similarly to derivative commercial algorithms modified for interpolation. Model discrepancies were minimal for facial bones and virtually non-existent for blood pool. Agreement with initial segmentation was high in each case.

CLINICAL RELEVANCE/APPLICATION

In general, the cost to integrate 3D printing into routine patient care has decreased significantly over the past few years. In sharp contradistinction is a potentially dramatic increase in post-processing cost. Demonstrating performative equivalence of open-source software for clinical 3D printing is a key step toward further progress and accessibility, and is demonstrated here with regard to the examined upstream steps.

IN202-SD-SUA3 Developing an Augmented Virtual Reality Application for Interventional Procedures in Neuroradiology

Station #3

Awards
Student Travel Stipend Award

Participants
Sergios Gargalas, MD, Oxford, United Kingdom (*Presenter*) Nothing to Disclose
Jonathan O. Jones, MBBS, Plymouth, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Pre-intervention planning using augmented reality approach allows for enhanced 3D visualisation and empowers the interventionist with novels tools for planning the procedure and visualisation of implant placement. We forsee wider future applications in endovascular planning, surgical planning, training and education.

Background

Radiology is unique to other medical specialties in it's ability to rapidly absorb technological innovations and set innovation agenda. We strongly believe in the Radiologist's role to drive technological innovation. There is a growing number of 3D visualisation techniques used in surgical specialties and Radiology that are utilised in pre-intervention planning. They tend to be expensive, difficult to use and provide limited functionality. We describe an approach that uses Virtual/ Augmented Reality technology to alleviate many of these issues.

Evaluation

We have developed a virtual reality application on the basis of the Oculus platform and Samsung Gear VR headset, that allows precise and cost-effective planning of interventional procedures. During preparation for aneurysm coiling, the interventionist can access stereoscopic reproduction of CTA-derived vessel geometry, perform measurements and practice behaviour expected during the procedure through added visualisations. The added controls and sensors, such as gyroscope and accelerometer allow for a more natural experience during pre-intervention planning. This technology also allows simultaneous visualisation of several imaging modalities, including DSA at the same time and reduces cumbersome selection between modalities.

Discussion

Comparing to other available techniques for 3D planning, our approach is considerably less expensive, easier to set up, more precise and easier to use. We also highlight the potential for other applications, such as intervention simulation for training, vascular anatomy tutorials etc. We are also conducting a study of inter-rater reliability and a questionnaire allowing for quantitative assessment of using this technology. The results of this study will be available by September 2016.

IN203-SD-SUA4 From Research to Patient Care: Accelerating Medical Innovation by Creating the World's Largest Open-Indexed Clinical Research Platform

Station #4

Participants
Elad Benjamin, Shefayim, Israel (*Presenter*) CEO, Zebra Medical Vision Ltd

CONCLUSION

Algorithm development time has decreased significantly by using the Research Platform. Months of data curation turn to minutes, costly storage and computing infrastructure are provided at no cost, and researchers are able to focus purely on development and validation of algorithms and clinical applications, significantly accelerating time to market of clinical innovation.

Background

Advanced clinical research is fueled by access to data. New techniques, such as Deep Learning, have shown significant improvements over traditional methods, however they require extremely large, annotated data sets to train upon.Unfortunately, accessing hospital data directly is difficult, requiring approvals, integration, anonymization, storage and correct indexing. This process, and the barriers associated with it, make it difficult for most researchers to move forward with meaningful research. It also limits research only to those in academic medical institutions, where some of those barriers are slightly easier to manage.

Evaluation

We have created the largest publically available, anonymized medical research platform globally. The aim is to create a streamlined, web based, hosted, scalable research platform and enable accelerated timelines between research, development and deployment of clinical insights and algorithms. By providing the platform and all ancillary research needs in one place, we believe medical research will be able to take faster, larger leaps forward.

Discussion

The Research platform contains over 12M imaging studies, 1M pathology results, 3M lab results, 2M Admission, Transfer and Discharge data points – all correlated across a 4.5M patient population. Data is indexed and searchable through a web based interface, allowing researchers to create specific datasets, including outcomes data, in preparation for research activities. The platform provides built in tagging and annotation tools which are query-able and persistent across data types to allow tailor made data annotation for specific research interests. It is our belief that adoption of this research warehouse by the clinical research community will create improved algorithms and clinical applications that will ultimately improve patient care.

IN204-SD-SUA5 Analysis of Seven Years of Radiology Resident Errors on Call: Evidence Based Blind Spots to Target Resident Education

Station #5

Awards
Student Travel Stipend Award

Participants
Jane L. Hur, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Brendan J. Barnhart, MS,MA, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Richard J. Gorniak, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Identify trends in errors made on on-call resident preliminary reports which may be useful to target resident education.

METHOD AND MATERIALS

A database of feedback sent from attendings to residents on call at a level 1 trauma center was examined. Feedback sent from 3/1/2008 to 12/31/2015 and categorized as a missed finding was included. Erroneously included cases, feedback with missing information, and duplicate feedback were excluded.Modality, procedure code, and feedback text was examined. Using OpenRefine, a word facet was applied to the feedback text to determine commonly used words within each examination and guide coding. Finally, feedback text, when present, was coded based on finding type and location. Locations of frequently occurring findings were plotted on a representative study.

RESULTS

There were 1,802 cases of feedback regarding missed findings. Residents received the most feedback on head CTs (339 cases), cervical spine CTs (124), chest radiographs (113), facial CTs (96), and abdominopelvic CTs (70).For head CTs, most of the missed findings concerned a mass, followed by regional hypoattenuation, focal hypoattenuation, fracture, and subdural hemorrhage. A graphic summary of location of missed findings was plotted.On cervical spine CTs, common misses were masses/nodules, fractures, disc herniations, malalignment, and epidural hematomas. For chest XR, commonly missed findings were pneumonias, nodules, fractures, mediastinal abnormalities, and pleural effusions.Common missed findings on facial CT were fracture, mass, and dental disease.Common misses on abdominopelvic CTs were found to be renal stones, enteritis, adnexal masses, colitis, and fractures.The top 5 miss categories in the top 5 studies accounted for 523 cases (30%).

CONCLUSION

Attending feedback regarding missed findings can be categorized into common categories and locations. This may be useful in selecting high impact training cases. Additionally, a graphic summary of prior miss locations can be generated, illustrating areas where trainees should direct attention.

CLINICAL RELEVANCE/APPLICATION

By targeting the five most common miss types in the five studies most commonly erred on, 30% of on call discrepancies could potentially be avoided.

IN022-EC-SUA Support Effects of a Similar-image Retrieval System for Image Interpretation of Lung Lesions on Computed Tomography

Custom Application Computer Demonstration

Participants
Kotani Tomoya, MD, Moriguchi, Japan (*Presenter*) Research collaboration, Panasonic Corporation
Yo Ushijima, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Kenji Kondo, Fukui, Japan (*Abstract Co-Author*) Employee, Panasonic Corporation
Kazutoyo Takata, Fukui, Japan (*Abstract Co-Author*) Employee, Panasonic Corporation
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Daigo Miwa, Moriguchi, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshitomo Nakai, Moriguchi, Japan (*Abstract Co-Author*) Nothing to Disclose

Kensuke Wakasugi, Soraku-gun, Japan (*Abstract Co-Author*) Employee, Panasonic Corporation
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Masato Tanaka, PhD, Yoshida-gun, Japan (*Abstract Co-Author*) Research Consultant, Panasonic Corporation

CONCLUSION

Based on our results, reference to similar cases is useful for image interpretation of lung lesions on CT.

FIGURE

http://abstract.rsna.org/uploads/2016/16005861/16005861_luq4.jpg

Background

Daily clinical operations generate a vast amount of medical images, increasing radiologists' workloads. We previously proposed a similar-image retrieval system for supporting image interpretation. Here, we evaluated the effects of this system for image interpretation of lung lesions on computed tomography (CT).

Evaluation

We conducted two experiments. In experiment 1, subjects were nine doctors, of whom five were radiologists. First, each subject wrote an interpretation report for three test cases without references. Second, each subject modified his report with reference to similar cases. In experiment 2, subjects were seven doctors, of whom three were radiologists. First, each subject wrote an interpretation report for six test cases with reference to usual medical texts. Second, each subject modified his report with reference to similar cases.In both experiments, we evaluated number of correct diagnoses and accuracy rate of definite diagnosis. For each test case, approximately 20 similar cases were presented, of which roughly 30% had correct diagnoses. Each similar case contained a key image and definite diagnosis. In experiment 2, similar cases for one-third of the test cases contained no correct diagnosis to investigate the negative influence when the system could not retrieve appropriate similar cases.In experiment 1, number of correct diagnoses increased to 40% with reference to similar cases. The accuracy rate of definite diagnosis improved from 59% to 67%. In experiment 2, the accuracy rate of definite diagnosis improved from 71% to 76%. Further, similar cases containing no appropriate disease had no negative influence on the reports.

Discussion

In experiment 1, the correlation coefficient between image finding accuracy and the increase in correct diagnosis with reference to similar cases was 0.6. Thus, reference to similar cases is especially suitable for users who can interpret findings correctly. In experiment 2, reference to similar cases improved the precision of definitive diagnosis compared with consulting medical texts.

IN008-EB-SUB Analysis of 3D Printing Accuracy with Geometric and Patient Specific Kidney Phantom

Hardcopy Backboard

Participants
Guk Bae Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hyun Kyung Song, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Haekang Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yoon Soo Kyung,, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Choung-Soo Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Stockholder, Coreline Soft, Inc

CONCLUSION

3DP methods with multi-materials have been widely used, but their printing accuracies are still not well-known on medical purposes. Sometimes, medical applications may not need higher accuracy. However, in case of a surgical guide, 3DP accuracy is critical to attach the corresponding organ and guide surgical line. This printing error in accuracy would lead to attention of clinicians to use 3DP technology.

FIGURE

http://abstract.rsna.org/uploads/2016/16015095/16015095_fvna.jpg

Background

Three-dimensional printing (3DP) technologies have been applied to various fields of medicine. In partial nephrectomy, our recent 3DP application using patient-specific kidney phantoms with renal cell carcinoma has been used to help surgeons performing more accurate and easier surgery during operations. For a further study developing a surgical guide for partial nephrectomy, however, significant printing discrepancy has been found, caused by 3DP error and instability of materials. In this study, we systemically investigated morphological errors between reconstructed digital models and 3D printed phantoms using patients-specific kidneys and reference artificial geometry models.

Evaluation

EvaluationEight patient-specific kidneys for partial nephrectomy and three reference models of cube, dumbbell and abstracted kidney were evaluated (Fig. 1). All the patient-specific kidney phantoms were manufactured by a 3D printer of PolyJet type with multi-materials of VeroTM color and TangoTM Family. For the comparison study, the reference phantoms were 3D printed by PolyJet type and multi-jet printing (MJP) type. We measured representative lengths of X-axis, Y-axis, Z-axis and volume, and then compared each other.

Discussion

In the kidney phantoms, there are significant discrepancy from the digital models and to the 3DP phantoms in all the lengths and the volume (Table 1); Y-axis length was elongated (p-value < 0.01), but the length in X-axis and the building-directional length (Z-axis) were shorten (p-value < 0.01). The volume of the 3DP phantom also showed statistically significant increased by 5.15%. The reference phantoms also showed unconformity between the digital model and the phantoms in lengths and volume according to 3DP type and material (Table 2 and 3).

IN005-EB- 3D Printing for Endovascular Splenic Artery Aneurysm Repair Planning

SUA

Hardcopy Backboard

Participants
Anish Ghodadra, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
Rakesh K. Varma, MBBS, MD, Monroeville, PA (*Abstract Co-Author*) Nothing to Disclose
Ernesto Santos, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Often tortuous in course, the splenic artery is an ideal candidate for 3D printing. Our early experiences illustrate that solid and hollow lumen 3D printed models of splenic artery aneurysms created onsite using consumer grade 3D printers can aid in procedure planning.

FIGURE

http://abstract.rsna.org/uploads/2016/16002333/16002333_ure6.jpg

Background

First described by Itagaki in 2015, 3D printed models of arterial vasculature can aid in planning the repair of complex splenic artery aneurysms. Here we present our early experience using 3D printed models for the endovascular repair of splenic artery aneurysms.

Evaluation

First we present a 36 year old male with a 3.2 cm distal splenic artery aneurysm. In addition to a tortuous splenic artery, the inferior spleen blood supply arose from an outflow of the aneurysm and an aberrant accessory artery suppled the superior spleen, arising from the proximal main splenic artery and also feeding the aneurysm. We created a clear, hollow-lumen model of the splenic artery using a Form 1+ stereolithography printer. With the model as a guide, coiling of the distal most aspect of the accessory splenic artery allowed preservation of flow to the superior spleen.Next we present a 69 year old male with a 2.8 cm mid-splenic artery aneurysm. A solid lumen model was created and printed on a Zortrax M200 fused deposition modeling printer. Given the position of the aneurysm, placement of a stent to preserve flow to the spleen was preferred. On CT images, the tortuosity of the splenic artery combined with the moderately steep-appearing angle of the celiac trunk relative to the aorta appeared to prohibit the use of the stent via femoral approach. When working with the model, it became apparent that the steep angle of the celiac trunk would allow passage of a stent via a superior approach. The patient underwent successful axillary-approach stenting of the splenic artery aneurysm.

Discussion

The above cases illustrate that 3D printed models can aid in endovascular procedure planning. Our first case illustrates the model's ability to maximize preservation of splenic blood flow when treating complex aneurysms with aberrant blood supply, while our second case illustrates a model's role in guiding alternative vascular approaches in treatment.

INS-SUB

Informatics Sunday Poster Discussions

Sunday, Nov. 27 1:00PM - 1:30PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants

Luciano M. Prevedello, MD, MPH, Dublin, OH (*Moderator*) Nothing to Disclose

Sub-Events

IN205-SD-SUB1 Lung Pattern Classification for Interstitial Lung Diseases Using a Deep Convolutional Neural Network

Station #1

Participants
Andreas Christe, Bern, Switzerland (*Presenter*) Nothing to Disclose
Stavroula Mougiakakou, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Marios Anthimopoulos, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Stergios Christodoulidis, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Lukas Ebner, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Deep learning techniques have recently achieved impressive results in a variety of computer vision problems, raising expectations that they might be applied in other domains, such as medical image analysis. We propose and evaluate a convolutional neural network (CNN), designed for the classification of interstitial lung disease (ILD) patterns.

METHOD AND MATERIALS

The proposed network consists of 5 convolutional layers with 2×2 kernels and LeakyReLU activations, followed by average pooling with size equal to the size of the final feature maps and three dense layers. The last dense layer has 7 outputs, equivalent to the classes considered: healthy, ground glass opacity (GGO), micronodules, consolidation, reticulation, honeycombing and a combination of GGO/reticulation. To train and evaluate the CNN, we used a dataset of 14696 image patches, derived by 120 CT scans from different scanners and hospitals. A comparative analysis proved the effectiveness of the proposed CNN against previous methods in a challenging dataset.

RESULTS

The classification performance (~85.5%) demonstrated the potential of CNNs in analyzing lung patterns. Pattern-sensitivities reached from 99% (consolidation) to 69% (honeycombing). The individual "true positive" and "false negative" results for each pattern is demonstrated in the Figure.

CONCLUSION

The CNN showed very promising results in lung pattern recognition outperforming many state-of-the-art methods. Future work includes, extending the CNN to three-dimensional data provided by CT volume scans.

CLINICAL RELEVANCE/APPLICATION

Integrating the proposed method into a CAD system helps providing a differential diagnosis for ILDs as a supportive tool for radiologists.

IN206-SD-SUB2 Detection of Liver Fibrosis from MRI Using Histogram of Peak Strains

Station #2

Participants
Yasmine A. Safwat, BSC,BSC, Giza, Egypt (*Abstract Co-Author*) Nothing to Disclose
Rasha S. Hussein, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose
Ahmed S. Fahmy, Giza, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ayman Khalifa, Helwan, Egypt (*Abstract Co-Author*) Nothing to Disclose
Heba Abdallah, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ahmed S. Ibrahim, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ahmed Samir, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

A method is presented to detect liver fibrosis using tagged MR images. The method is based on extracting a set of features representing the liver deformations induced by the heart motion. These features are then used to classify normal from patients with liver fibrosis. Results from data of 34 subjects (15 normal, 19 patients) showed sensitivity and specificity of 89%, and 80% respectively.

METHOD AND MATERIALS

ECG-gated tagged MRI was performed on 15 volunteers and 19 patients (with fibrosis stage from F1 to F3 diagnosed by Fibroscan and/or liver biopsy). Sagittal cross-sections (1-3 slices) were acquired with tag spacing=7mm, voxel size =1.18×1.18×8mm, 11-20 frame/cardiac cycle.Lagrangian strain tensors of all the points within the liver were calculated using phase-based tracking methods [1].Then, at each timeframe, the strain in the superior-inferior direction (major direction of motion), P1(t), and the strain in the perpendicular direction, P2(t), were computed. At each liver point, the peak tissue strain throughout the cardiac cycle is calculated to yield PP1 and PP2. The histogram of the peak strains within the liver is calculated for both directions to yield two feature vectors HOPS1 and HOPS2. Both vectors are also concatenated to form one feature vector, HOPS. Support Vector Machines classifier was used to classify the feature vectors. A leave-one-out cross-validation is used, by leaving one case as testing set and the remaining cases as training set. The process is repeated until testing all datasets.Ref 1 Osman, et al.Cardiac motion tracking using Cine HARP MRI

RESULTS

Figures 1 and 2 show the peak strain maps (PP1 and PP2) in a volunteer and a patient. Not only the peak strain value differs but also the distribution of the strain values. Table 1 summarizes the performance of the classifier when using the histogram of only one strain direction (HOPS1 or HOPS2) or both directions (HOPS) as feature vectors. The table, shows that the proposed method results in an accuracy of 85% when HOPS2 is used as a feature vector.

CONCLUSION

A new method for detecting liver fibrosis using tagged MRI images was presented. The results show accuracy of 85% for patients with moderate fibrosis (stages from F1 to F3).

CLINICAL RELEVANCE/APPLICATION

Based only on the inherent heart motion, with no need for external source of mechanical force, tagged MRI can be used to accurately detect liver fibrosis in early and moderate stages .

IN207-SD-SUB3 Simulation of Patient-specific Kidney Model Fabricated by a 3D Printer with Volumetric CT for Partial Nephrectomy

Station #3

Participants
Haekang Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Stockholder, Coreline Soft, Inc
Guk Bae Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yoon Soo Kyung,, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Choung-Soo Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The goal of partial nephrectomy is to remove renal cell carcinoma completely with preserving normal renal parenchyma maximally within 20 minutes. Because surgeons depend on anatomical information of a patient specific kidney from pre-operative CT image, it is sometimes difficult to localize tumor location and incision line, especially for tumor size < 2cm. Therefore, in this study, patient-specific 3D printed models have been developed and applied to partial nephrectomy to prove the clinical applicability.

METHOD AND MATERIALS

Nine patients successfully underwent partial nephrectomy with complete excision of the suspicious renal cell carcinoma by open (N=7) or robotic assisted laparoscopic (N=2) approach. Volumetric CT scan were performed to evaluate renal mass. All renal units with renal mass were modelled to 3D images and measured each volume using A-view software (Asan Medical Center, Seoul, South Korea). The virtual resection simulation followed a safety margin with 5 mm offset from the renal mass. 3D printed kidney model was fabricated with Objet 500 CONNEX3 (Stratasys, CO, USA). Kidney model composed of parenchyma, artery, vein, ureter, tumor and safety margin, which were discriminated by color coding (Fig. 1). This 3D printed kidney model was used for self-training for patients specific anatomy variation, patient explanation, paramedic discussion, pre-surgical planning, etc.

RESULTS

The renal mass could be visualized and differentiated from blood vessels and renal collecting system in this model. (Fig. 1) The mean tumor size 2.2 cm, mean tumor volume 7.65 cm3 and the renal nephrometry score ranges 5-9. 3D printed kidney model has an advantage in the discussion with operating room staff to obtain an incision line and depth of dissection. Additionally, it could measure tumor volume and predict remain renal parenchymal volume after operation. Therefore, these models could be useful for predicting renal function after nephrectomy.

CONCLUSION

The use of a patient-specific 3D printed kidney model simplified partial nephrectomy for both the surgeon and patients, because it facilitated better preoperative planning and understanding of the intra-operative orientation of risk structure.

CLINICAL RELEVANCE/APPLICATION

(dealing with partial nephrectomy) "The application of patient-specific 3D printed kidney model which facilitates better recognition of renal tumor is recommendable for planning and operating the partial nephrectomy."

IN208-SD-SUB4 Decoding Neural Circuits: A Color-Coded 3D Printed Atlas of Top Ten Clinically Relevant White Matter Tracts from MR Diffusion Tensor Fiber Tractography

Station #4

Participants
Ramin Javan, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Gaurav V. Watane, MBBS, MD, Amravati, India (*Presenter*) Nothing to Disclose
Ahmad Shafiei, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Erli Mingomataj, BS, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Alexander Cho, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Paul J. Albertine, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

A modular design was developed for the physical 3D printed models of fiber tractography, which may add a new dimension to the

A modular design was developed for the physical 3D printed models of fiber tractography, which may add a new dimension to the increasing applications of diffusion tensor imaging in neurosurgical procedures, research and education.

Background

The use of MR diffusion tensor fiber tracking, which allows for delineation of multiple interconnecting white matter fiber tracts in the brain, has expanded in the clinical realm especially for pre surgical planning. Proper interpretation of this information requires understanding complex 3D relationships, beyond that required for conventional cross-sectional neuroimaging. With the recent surge in rapid prototyping technologies, new opportunities have emerged for discovering innovative applications through low-cost 3D printers, which use virtual 3D datasets to construct solid forms in a layer-by-layer technique. We propose that this technology may offer additional advantages in the visualization of white matter tracts, in settings such as neurosurgical planning, patient counseling and resident training.

Evaluation

The ten clinically important fiber tracts chosen include the corpus callosum, corticospinal tract, temporal and parietal optic radiations, superior longitudinal fascicles (part of which is the Arcuate fasciculus), inferior longitudinal fasciculus, uncinate fascicles as well as the anterior and posterior thalamic radiations.

Discussion

The challenge in the case of tractography lies in the fact that the tracts are derived from tensor data, represented as eigenvalues and eigenvectors. This results in splines, directional lines in 3D space describing a curve, as opposed to 3D meshes, that is, a collection of surface triangles created through reconstruction of data from voxel based cross-sectional imaging. Methods for converting splines into 3D meshes for 3D printing purposes were investigated. Successful conversion was achieved by utilizing Amira software, which allows export of tractography splines as DXF (AutoCAD Drawing Exchange Format), which was imported into advanced graphic design software Autodesk 3DStudio Max. Subsequently, multicolor 3D printing was performed through a commercial website using gypsum based material with cyanoacrylate finish.

IN209-SD-SUB5 Efficacy of an Automatic Decision Support System in Facilitating Diagnosis of the Thyroid Diseases

Station #5

Participants
Sharbell Y. Hashoul, MD,MBA, Haifa, Israel (*Abstract Co-Author*) Employee, IBM Corporation
Sameer Kassem, MD,MPH, Haifa, Israel (*Abstract Co-Author*) Nothing to Disclose
Afif Nakhleh, MD, Haifa, Israel (*Abstract Co-Author*) Nothing to Disclose
Algit Walach, Haifa, Israel (*Abstract Co-Author*) Employee, IBM Corporation
Pavel Kisilev, Haifa, Israel (*Abstract Co-Author*) Researcher, IBM Corporation
Ella Barkan, Haifa, Israel (*Abstract Co-Author*) Researcher, IBM Corporation
Guy Amit, PhD, Haifa, Israel (*Abstract Co-Author*) Employee, IBM Corporation
Rami Ben-Ari, PhD , Haifa, Israel (*Abstract Co-Author*) Employee, IBM Corporation
Vadim Ratner, PhD, Haifa, Israel (*Abstract Co-Author*) Employee, IBM Corporation
Flora Gilboa, Haifa, Israel (*Abstract Co-Author*) Employee, IBM Corporation
Eugene Walach, PhD, Haifa, Israel (*Presenter*) Employee, IBM Corporation

PURPOSE

This paper explores the clinical applicability of a novel Decision Support System (DSS) developed for the domain of nuclear imaging of thyroid.

METHOD AND MATERIALS

The input to the DSS combines both clinical data and radiology semantic descriptions of nuclear thyroid images. Clinical inputs include history of the present illness (shortness of breath, palpitations, etc.), laboratory tests (TSH levels, FT3 levels, etc.) and more. Radiological descriptor inputs include image characteristics derived from the standard radiology report (diffused/focal/multifocal, increased/decreased uptake of radioactive iodine). The system's output includes the diagnosis and the differential diagnosis.In order to test the clinical applicability of this system, we have used an independent benchmark of 36 thyroid disease cases. We have covered a relatively wide gamut of diseases including Hashimoto, Graves, Silent Thyroiditis, etc.We have administered this benchmark to the automatic DSS, and to the two senior endocrinologists working in two different hospitals. The number of successes were counted in two manners: a) TOP: agreement with the correct diagnosis, b) DIF: agreement with the differential diagnosis. Cochran's Q test was used to assess the statistical significance of the results.

RESULTS

Success rates of both endocrinologists and DSS are shown below. Note that, in both measurement modes, DSS outperformed expert physicians. However, only for the correct diagnosis mode , the difference was statistically significant ($p=0.01$).

CONCLUSION

The automatic DSS outperforms experienced senior endocrinologists with a significant statistical margin.

CLINICAL RELEVANCE/APPLICATION

The practical use of our system would be in assisting radiologists in adding clinical considerations to their radiological reports. Another potential use case would be in assisting endocrinologists in patient management and treatment decisions.

IN102-ED-SUB6 A Shiny New World: Creating Your Own Radiology Decision Support Webapps Using R

Station #6

Participants
Jennifer J. Wan, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
John Mongan, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Spouse, Employee, Thermo Fisher Scientific Inc
Devin Incerti, PhD, Oakland, CA (*Abstract Co-Author*) Nothing to Disclose
Jesse L. Courtier, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1. Existing radiology-related applications and websites are currently in the format of interactive encyclopedias or cases. Creating an interactive web application to help generate a differential diagnosis is a fun and easy way to help radiologists provide value to their clinical colleagues.
2. R is a free open-source programming language and environment traditionally used for statistical computing, data analysis, and graphic output. As a simple and effective programming language, its function can be expanded with the use of add-on packages.
3. Shiny is an open source R package for making interactive web applications. Unlike most web apps, R shiny apps can be deployed with no knowledge of HyperText Markup Language (HTML), Cascading Style Sheets (CSS), or JavaScript while still allowing more advanced developers the added flexibility of writing in these languages. This is a potential method for creating decision support applications to help radiologists identify appropriate differential diagnoses.

TABLE OF CONTENTS/OUTLINE

Introduce current use of web/mobile apps in radiology Introduce R and Shiny What and how is it used? Basic concept of R and Shiny package Available platforms Basic terms/commands Step-by-step example and explanation for creating decision support app How to deploy the app and host on server

IN023-EC-SUB Data-driven Imaging Biomarker: Uncovering Diagnostic Features from Large-scale Medical Images Using Deep Learning

Custom Application Computer Demonstration

Participants
Anthony S. Paek, PhD, Seoul, Korea, Republic Of (*Presenter*) CEO, Lunit Inc
Hyo-Eun Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Lunit Inc
Sangheum Hwang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Lunit Inc
Meejin Cho, MD,JD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Lunit Inc
Minhong Jang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Officer, Lunit Inc
Kyunghyun Paeng, Seoul, Korea, Republic Of (*Abstract Co-Author*) Co-founder, Lunit Inc
Jungin Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Officer, Lunit Inc
Jihoon Jeong, MD,PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

We present the potential use of data-driven imaging features as novel imaging biomarkers. Unlike the conventional CAD designs, DIB learns radiologic features from large-scale medical images without any human annotation. This approach gives a possibility to discover latent imaging features that are hard to be categorized by human visual system. Well-trained DIBs will play an important role in advancing computer-aided diagnosis as well as quantitative imaging.

FIGURE

http://abstract.rsna.org/uploads/2016/16019376/16019376_17if.jpg

Background

Deep learning has been gaining more attention as it shows outstanding performances in various cognitive tasks. Given a large number of training data, deep convolutional neural network can learn a set of multi-layered imaging features that is obtained in a fully data-driven manner. This feature learning capability has a great potential to be used in a development of novel imaging biomarkers, namely data-driven imaging biomarker(DIB).

Evaluation

We developed a training system of DIB that consists of two parts: deep convolutional neural network and feature activation map generator. We intentionally avoided the use of lesion-annotation to maximize the chance of novel feature discovery. The DIB is visually represented in the feature activation map that provides user experience similar to that of molecular/functional imaging. We evaluated this method in abnormality screening tasks with two datasets: 9,757 digital mammograms and 102,885 chest radiographs.

Discussion

The DIBs achieved AUC of 0.814 and 0.948 for each task respectively and showed reasonable lesion localization agreement with human readers. Quantitative evaluation of lesion localization performance is required. Extended experimentation with additional data is expected to show more improvements in screening performance.

Addressing the Clinical Need for 3D™ Breast Biopsy Technologies: Prone and Upright Solutions: Supported by Hologic Inc

Sunday, Nov. 27 1:30PM - 3:00PM Room: S101AB

Participants

PARTICIPANTS

Alejandro Tejerina, MD, Madrid, Spain Linda Greer, MD, Phoenix, AZ

PROGRAM INFORMATION

Session will begin at 1:45pm. Sign in will occur 15 minutes prior to session. This 75- minute session focuses on the need for tomosynthesis imaging for guiding breast biopsy when managing complex, subtle and difficult-to-access lesions. Dr. Linda Greer of Phoenix, AZ and Dr. Alejandro Tejerina of Madrid, Spain will provide their clinical perspectives on the use of 3D™ breast biopsy technology using the Affirm™ Upright Breast Biopsy Guidance System and the Affirm™ Prone Breast Biopsy System. This course is intended for radiologists interested in learning more regarding how this technology can provide the ability to conduct 2D or 3D™ breast biopsies using the most exceptional imaging currently available. CME credit is available through a third party. This CME activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of World Class CME and Hologic, Inc. World Class CME is accredited by the ACCME to provide CME for physicians. They will offer ARRT credit in addition to CME credit.

RSVP

http://worldclasscme.com/RSNA2016

CLAIM CME CREDIT

http://worldclasscme.com/RSNA2016

RC118

Multidisciplinary Communication in Cancer Care: Talking the Same Language

Sunday, Nov. 27 2:00PM - 3:30PM Room: E353A

OI IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

RC118A Structured Reporting in Oncology: Pearls and Pitfalls

Participants
Hebert Alberto Vargas, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with the definition of "structured reporting" and the differences between structure and accuracy of reports' content. 2) Discuss the advantages of structured reporting emphasizing its impact of clear and effective communication of imaging findings. 3) Emphasize the importance of standardizing terminology and the expression of diagnostic certainty in structured reports.

ABSTRACT

RC118B The Impact of Subspecialty Reading on Patient Management

Participants
Fergus V. Coakley, MD, Portland, OR, (coakleyf@ohsu.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the importance and context of radiology interpretation to patient management. 2) Describe the available data on the incremental benefit of subspecialist interpretation.

ABSTRACT

RC118C Proliferation of Tumor Boards: Should Radiology Departments Support Them All?

Participants
Giles W. Boland, MD, Boston, MA (*Presenter*) Principal, Radiology Consulting Group; Royalties, Reed Elsevier

RC123

Digital Information Security and Medical Imaging Equipment: Threats, Vulnerabilities and Best Practices

Sunday, Nov. 27 2:00PM - 3:30PM Room: E350

IN PH SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

LEARNING OBJECTIVES

1) Understand the changing environment of network and internet connected devices and software. 2) Be aware of the motivations and tatics of current threat actors. 3) Understand common security issues found in medical devices. 4) Know simple actions that can decrease risk. 5) Understand the vulnerabilities of imaging system modalities to security and privacy breaches. 6) Determine ways to protect and secure imaging systems from internal and external threats. 7) Describe institutional best-practices to maintain protection yet provide necessary accessibility for imaging modalities.8) Do medical devices contain cybersecurity vulnerabilities, and do they affect patient safety? 9) Are medical devices subject to ransomware threats? 10) What is the role and capabilities of the DHS ICS-CERT (Industrial Control Systems Cyber Emergency Response Team) in medical device security? 11) What are some steps that can be taken to protect medical devices?

Sub-Events

RC123A Medical Device Security in a Connected World

Participants

LEARNING OBJECTIVES

1) Understand the changing environment of network and internet connected devices and software. 2) Be aware of the motivations and tatics of current threat actors. 3) Understand common security issues found in medical devices. 4) Know simple actions that can decrease risk.

ABSTRACT

Medical devices are increasingly becoming dependent on technology and network connectivity, at a time that the electronic environment is becoming more dangerous. Because of this medical devices and systems can become easy targets for attackers attempting to access PHI, disrupt patient care or even harm a patient. When tested, these devices have been shown to have multiple vulnerabilities. These vulnerabilities range from hardcoded passwords, publically available service passwords and no encryption of patient data. Because of this institutions using these devices need to work with their vendors to improve the security of medical devices and take actions themselves to help protect their environment and patients.

RC123B Knowing if Your Imaging Systems are Secure and Keeping Them That Way

Participants
J. Anthony Seibert, PhD, Sacramento, CA, (jaseibert@ucdavis.edu) (*Presenter*) Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) Understand the vulnerabilities of imaging system modalities to security and privacy breaches. 2) Determine ways to protect and secure imaging systems from internal and external threats. 3) Describe institutional best-practices to maintain protection yet provide necessary accessibility for imaging modalities.

ABSTRACT

Handout:J. Anthony Seibert

http://abstract.rsna.org/uploads/2016/15002845/Making sure your systems are safe_Seibert2016_final.pdf

RC123C The US Government and Medical Device Security

Participants
Kevin Hemsley, Idaho Falls, ID (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Do medical devices contain cybersecurity vulnerabilities, and do they affect patient safety? 2) Are medical devices subject to ransomware threats? 3) What is the role and capabilities of the DHS ICS-CERT (Industrial Control Systems Cyber Emergency Response Team) in medical device security? 4) What are some steps that can be taken to protect medical devices?

ABSTRACT

This session will discuss the current and emerging cyber threat landscape from the perspective NCCIC/ICS-CERT, including current and anticipated impact on healthcare; the ICS-CERT's role in coordinating vulnerabilities in medical devices and hospital equipment and providing incident response to US critical infrastructure. The role of the Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) and how healthcare constituents can connect with ICS-CERT for assistance as well as informational and educational resources.

RC153

Next Generation Infrastructure for Medical Imaging (In Association with the Society for Imaging Informatics in Medicine)

Sunday, Nov. 27 2:00PM - 3:30PM Room: S105AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Moderator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) The participant will be introduced to the importance of information system integration and interoperability to support modern imaging informatics 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 imaging informatics workflow requires consumption, choreography, and orchestration of content from multiple disparate information systems that do not natively “talk to each other.” Without optimal integration and interoperability amongst these systems, humans are required to serve as “integrating agents:” 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.

Sub-Events

RC153A Interoperability and Integration-from HL7, DICOM, IHE, to SOA

Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

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 “talk to each other.” Without optimal integration and interoperability amongst these systems, humans are required to serve as “integrating agents:” 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.

RC153B Image Sharing-A Fond Farewell to CDs

Participants

David S. Mendelson, MD, Larchmont, NY (*Presenter*) Spouse, Employee, Novartis AG; Advisory Board, Nuance Communications, Inc; Advisory Board, General Electric Company; Advisory Board, Toshiba Medical Systems Corporation; Advisory Board, Bayer AG

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. Specific projects including The RSNA Image Share Validation program will be discussed.

ABSTRACT

The safe and secure exchange of heatlhcare information is of paramount importance in delivering the highest quality of care to our patients. The realm of Health Information Exchange while nascent is undergoing explosive growth. The exchange of radiologic exams and reports must be tightly integrated into this process. Radiological images have historically presented some unique challenges. This session will focus on existing solutons for image exchange/interoperability and discuss how it is expected to evolve over the next few years through the use of internet based technologies. The RSNA Image Share Validation program is a new effort to ensure vendors deliver products that comply with accepted standards.

RC153C Vendor Neutral Archives vs Archive Neutral Vendors: Towards the Next Generation Archive

Participants
Richard L. Kennedy, MSc, Sacramento, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the differences between vendor neutral archives, archive neutral vendors, 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.

RC154

Optimizing PowerPoint Slides

Sunday, Nov. 27 2:00PM - 3:30PM Room: E351

ED **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC
Sarah C. Abate, BS, Ann Arbor, MI, (sabate@med.umich.edu) (*Presenter*) Nothing to Disclose

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!

RCA12

Data Collection, Organization and Analysis with Excel - A Hands-On Tutorial (Hands-on)

Sunday, Nov. 27 2:00PM - 3:30PM Room: S401AB

IN RS

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Jaydev K. Dave, PhD, MS, Philadelphia, PA, (jaydev.dave@jefferson.edu) (*Presenter*) Nothing to Disclose
Raja Gali, MS, Philadelphia, PA, (raja.gali@jefferson.edu) (*Presenter*) Nothing to Disclose
Manish Dhyani, MBBS, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe techniques for creating a spreadsheet to allow trouble-free data analysis. 2) Demonstrate key data management skills. 3) Describe tools for performing basic descriptive statistics. 4) Identify how to perform simple statistical tests and perform these tests with a sample dataset. 5) Understand how bad data (or bad data acquisition techniques) may corrupt subsequent data analyses. 6) Practice data plotting/representation techniques. 7) Identify differences between a spreadsheet and a database. 8) Identify statistical tasks that require more sophisticated software.**Pre-requisites:**
Familiarity with Microsoft Windows and Microsoft Excel environment will be assumed

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 to a user, familiar with Microsoft Excel environment, how this spreadsheet program may be used for such purposes. The course will begin with describing efficient approach for data acquisition and highlight key data management skills; and with reviewing commons errors that may be avoided during data logging. Then we will provide a brief introduction on basic descriptive tests before proceeding with a hands-on tutorial using a sample dataset to calculate basic descriptive statistics, and to perform basic statistical tests like t-test, chi-square test, correlation analysis, etc. Effect of corrupted data on such analysis will also be demonstrated. The final hands-on component for this course will include data plotting and representation including the use of pivot tables. The course will conclude with a discussion on identifying differences between a spreadsheet and a database, limitations of a spreadsheet program and avenues where a dedicated statistical software program would be more beneficial. A list of some of these dedicated statistical software programs for analyses will also be provided.**Pre-requisites:**
Familiarity with Microsoft Windows and Microsoft Excel environment will be assumed

RCB12

Making the Most of Google Docs: Docs, Slides, Forms, and Sheets (Hands-on)

Sunday, Nov. 27 2:00PM - 3:30PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Ross W. Filice, MD, Washington, DC (*Presenter*) Nothing to Disclose
Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose
Andrew B. Lemmon, MD, Atlanta, GA, (alemmon@emory.edu) (*Presenter*) Nothing to Disclose
Thomas W. Loehfelm, MD, PhD, Palo Alto, CA (*Presenter*) Nothing to Disclose
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the benefits and drawbacks of using Google tools for collaborative editing. 2) Explain issues related to storing protected health information in Google Drive. 3) Demonstrate the ability to use the Google productivity applications for collaboration on document, spreadsheet, online form and presentation creation.

ABSTRACT

Note: Attendees should have or create a Google account prior to coming to the session.In today's busy environment, we need tools to work smarter, not harder. Google's suite of productivity applications provides a platform for collaboration that can be used across and within institutions to produce documents and presentations and to obtain and work-up data with ease. However, with increased sharing, security concerns need to be addressed. At the end of the session, learners should be able to demonstrate creating, sharing, and editing a document as a group.

RCC12

Imaging 3.0: Informatics Tools to Improve Radiologists' Productivity, Quality and Value

Sunday, Nov. 27 2:00PM - 3:30PM Room: S501ABC

IN LM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
J. Raymond Geis, MD, Fort Collins, CO (*Moderator*) Shareholder, Montage Healthcare Solutions, Inc; Advisor, Nuance Communications, Inc;

LEARNING OBJECTIVES

1) Understand how an IT-savvy radiology practice will gain a competitive advantage. 2) See how to use IT solutions to demonstrate radiologists' value. 3) Learn of Imaging Informatics tools that improve radiologists' productivity and efficiency.

ABSTRACT

Imaging 3.0 imaging informatics tools and processes help radiologists to be faster and better, and then help them demonstrate, with hard data, how valuable they are. This session will demonstrate IT tools to help radiologists be more productive; deliver a higher quality product; and better measure and demonstrate their value to payers, healthcare enterprises and patients. We also will discuss how to implement IT to get the most value from it.

Sub-Events

RCC12A ACRSelect - Using Informatics to Complying with PAMA: CDS Image Ordering Legislation

Participants
Keith J. Dreyer, DO, PhD, Boston, MA (*Presenter*) Medical Advisory Board, IBM Corporation

LEARNING OBJECTIVES

1) Be informed of the new federal legislation requiring the use of Clinical Decision Support (CDS) for the ordering of medical imaging required by CMS in 2017. 2) Understand the challenges of implementing CDS in the hospital and imaging center environments. 3) Learn the value of embedding CDS into the EHR and CPOE ordering process. 4) Learn methods to use CDS to manage the utilization of medical image appropriateness. 5) Become familiar with methods to implement CDS in an ACO environment.

RCC12B Radiology Assist: Informatics Tools to Produce a More Valuable Report and Still Report Fast

Participants
Tarik K. Alkasab, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the motivations for integrating clinical decision support (CDS) into the clinical practice of radiologists. 2) Understand how CDS modules can be defined for use in radiologist reporting. 3) Understand what it looks like for a CDS system to be integrated with radiologist reporting. 4) Understand the challenges associated with deploying CDS for radiologists.

ABSTRACT

RCC12C Use Your Data to Reduce Costs and Demonstrate Your Value to the Hospital

Participants
Woojin Kim, MD, Philadelphia, PA (*Presenter*) Officer, Nuance Communications, Inc

LEARNING OBJECTIVES

1) Understand the role of business intelligence (BI) tools in providing value-based care. 2) Understand how BI can provide effective monitoring of various components of the imaging value chain, including imaging appropriateness, modality operations, image interpretation and reporting, and report communication. 3) Learn how data mining can improve report quality by ensuring proper documentation and reducing errors. 4) Learn how one should implement a BI system and learn about potential problems to consider.

ABSTRACT

The goals of improving population health at a lower cost and higher quality are placing increased emphasis on value-based care over volume-based approach. Imaging 3.0™ is ACR's call to action for radiologists to take a leadership role in shaping America's future healthcare system through 5 key pillars, which are imaging appropriateness, quality, safety, efficiency, and satisfaction. With the aims of delivering better value to patients, Imaging 3.0 has outlined what it calls "imaging value chain" where each link of this chain represents a discrete number of unique value opportunity activities. The imaging value chain includes following components: imaging appropriateness and patient scheduling, imaging protocols, modality operations, image interpretation and reporting, and report communication and referring physician interaction.In the center of the imaging value chain, inter-connected with every link, lie data mining and business intelligence (BI). Timely analysis and appropriate modification using data mining and BI tools are critical to the effective monitoring of all components of the imaging value chain. As a result, it is a critical component of your Imaging 3.0 informatics toolkit. Effective use of BI will allow access to right information at the right time for right decision.This presentation will discuss the basics of BI and its benefits. Specifically, attendees will learn how data mining and BI can monitor adherence to imaging appropriateness guidelines, modality capacity, patient throughput, radiation dose exposure, and report standardization and quality including detection of errors and compliance with various reporting requirements including documentation of proper report communication. In addition, attendees will learn how one should implement a BI system, what are some potential problems to

consider, and various tips for getting BI right.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Woojin Kim, MD - 2012 Honored Educator

RCC12D Using Workflow Software to Improve Efficiency and Profitability

Participants
Bradley J. Erickson, MD, PhD, Rochester, MN, (bje@mayo.edu) (*Presenter*) Stockholder, OneMedNet Corporation; Stockholder, VoiceIt Technologies, LLC; Stockholder, FlowSigma

LEARNING OBJECTIVES

1) Become familiar with workflow technologies that are available and being used in other industries. 2) See how workflow terminologies can be applied in practice. 3) See how workflow engines have been applied in radiology.

ABSTRACT

Workflow is a critical element of safe and efficient practices. Workflow is usually supported by using relational databases, which tends to force a linear workflow into practice. SQL queries are also not optimal for detecting and handling error conditions.Workflow engines are used in other industries for exactly those reasons--they help enforce an agreed upon optimal pathway of events, and make it easy and clear how to deal with error and exception conditions. While they have been applied in healthcare, those experiments have usually failed because the implementation did not handle error conditions well, and did not completely model the richness and complexity of healthcare. Radiology tends to be more straightforward, and may be a good area to use workflow engines. In this session, we will describe one implementation in a clinical practice, as well as use in research and clinical trials.As we have begun to use workflow engines, it became apparent that agreeing on the names for key steps in the workflow would be helpful. Such a common lexicon would help us to assure that workflow was done in the same way in different locations. It could also allow us to measure the efficiency of workflows. This latter aspect was perceived to be of great value to practices accross the world, and led to the creation of the SIIM Workflow Initiative in Medicine (SWIM) lexicon, which is now a part of RadLEX. The basic concepts of SWIM and its connection toe IHE and the practice will be described.

RCA13

Man vs Machines: How to Use Machine Learning and Medical Images (Hands on)

Sunday, Nov. 27 4:00PM - 5:30PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Bradley J. Erickson, MD, PhD, Rochester, MN, (bje@mayo.edu) (*Presenter*) Stockholder, OneMedNet Corporation; Stockholder, VoiceIt Technologies, LLC; Stockholder, FlowSigma
Timothy L. Kline, PhD, Rochester, MN (*Presenter*) Nothing to Disclose
Panagiotis Korfiatis, PhD, Rochester, MN (*Presenter*) Nothing to Disclose
Zeynettin Akkus, PhD, Rochester, MN, (akkus.zeynettin@mayo.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with commonly used machine learning algorithms, including Perceptrons, neural nets, support vector machines, and Naive Bayes. 2) Become familiar with how to use IPython and scikit-learn to implement some of the common machine learning algorithms. 3) Learn how to read image data into python to use iwth machine learning.

ABSTRACT

In this course, we will review som eof the commonly used machine learning algorithms, describing the strengths and weaknesses of each. We will the demonstrate how to access these algorithms using IPython and scikit-learn. IPython is an interactive development environment for Python programming. The Scikit-learn library is a comprehensive machine learning library for the python programming language. We will also show how to read DICOM images into your program, extract features from those images, and then input those features into the machine learning algorithm.

RCB13

Intro to Statistics with R (Hands-on)

Sunday, Nov. 27 4:00PM - 5:30PM Room: S401CD

IN RS

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Joe C. Wildenberg, MD,PhD, Philadelphia, PA, (joe.wildenberg@gmail.com) (*Presenter*) Nothing to Disclose
James E. Schmitt, MD, PhD, Philadelphia, PA, (james.schmitt@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Install and launch the R software package. Understand how to search for and download external packages to extend R's functionality. 2) Load data from external files such as txt, csv, and xlsx. 3) Perform basic mathematical operations and utilize data structures to manipulate data. 4) Use loops to perform more complex operations over the data, including true/false logic. 5) Understand the basics of creating plots and histograms. 6) Perform common statistical tests including correlation, Chi-square, and ANOVA.

ABSTRACT

RCC13

Creation of Radiology Reports

Sunday, Nov. 27 4:00PM - 5:30PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.00

Participants

Curtis P. Langlotz, MD, PhD, Menlo Park, CA, (langlotz@stanford.edu) (*Presenter*) Shareholder, Montage Healthcare Solutions, Inc; Spouse, Consultant, Novartis AG;
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC
David B. Larson, MD, MBA, Los Altos, CA (*Presenter*) License agreement, Bayer AG; Potential royalties, Bayer AG

LEARNING OBJECTIVES

1) Learn about the history of radiology reporting. 2) Review the attributes of a high-quality radiology report. 3) Understand key shortcomings of radiology report style and how to address them. 4) Learn what you can do today to improve your radiology reports.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

David B. Larson, MD, MBA - 2014 Honored Educator

RC218

Have RADS Gone Wild? Remaining Challenges of Standardized Reporting and Data Systems

Monday, Nov. 28 8:30AM - 10:00AM Room: S504AB

OI **IN** **SQ**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

RC218A BI-RADS: Why Bother?

Participants
Carol H. Lee, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the rationale behind the development of BI-RADS. 2) Comprehend the application of BI-RADS in clinical practice. 3) Recognize the contribution of BI-RADS in improving patient outcomes.

ABSTRACT

RC218B LI-RADS: Pros, Cons and Solutions

Participants
Claude B. Sirlin, MD, San Diego, CA (*Presenter*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Guerbet SA; ;

LEARNING OBJECTIVES

1) To review the advantages, challenges, solutions, and future directions for standardized reporting of liver imaging examinations using LI-RADS.

RC218C PI-RADS: What Is the Supporting Evidence?

Participants
Hebert Alberto Vargas, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the rationale for PI-RADS. 2) Highlight the updates included in PIRADS v2. 3) Discuss the evidence basis for PI-RADS and present the literature highlighting its strengths and limitations.

ABSTRACT

The Prostate Imaging Reporting and Data System (PI-RADS), published in 2012, was one of the first well-orchestrated efforts focused on "integration, reporting and communication of multi-parametric prostate MRI". The guideline was updated in 2015 (PI-RADS v2) to address some of the limitations of the original version. This session will cover the highlights of PI-RADS v2 and discuss the published evidence supporting or questioning the recommendations included in this guideline.

RC232

Value-Added Initiatives for a Healthcare System

Monday, Nov. 28 8:30AM - 10:00AM Room: N226

IN LM SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

RC232A Quality, Value and Outcome Metrics in Diagnostic Radiology - A New Frontier

Participants
Richard E. Heller III, MD, Chicago, IL, (richard.heller@radpartners.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of quality measures in health care and radiology. 2) Identify the two main components of total value in radiology. 3) Assess the differences between the status quo metrics and idealized measures.

ABSTRACT

RC232B Imaging Informatics

Participants
Keith J. Dreyer, DO, PhD, Boston, MA (*Presenter*) Medical Advisory Board, IBM Corporation

RC232C Leveraging IT to Optimize Quality in Radiology

Participants
Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

RC253

Leveraging Your Data: Informatics Approaches and Solutions to Improve Imaging Care Delivery

Monday, Nov. 28 8:30AM - 10:00AM Room: E353A

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Arun Krishnaraj, MD, MPH, Charlottesville, VA, (arunk@virginia.edu) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify unmet needs of current and future practices with regards to emerging and existing informatics tools. 2) Apply existing and emerging informatics applications to improve report generation. 3) Demonstrate an understanding of how best to achieve consistency of radiologists' recommendations.

ABSTRACT

Existing and emerging informatics applications have the potential to markedly improve the quality of imaging care delivery. Much of the inefficiency and inconsistency of report generation could be potentially solved with the appropriate informatics application. In this session, the learner will gain an apprecation of the unmet needs of current and future pracitces and discover how novel applications developed at various institutions across the country are seeking to plug these voids and improve imaging care delivery.

Sub-Events

RC253A The Unmet Needs of Current and Future Practices

Participants
Michael E. Zalis, MD, Boston, MA (*Presenter*) Co-founder, QPID Health Inc Chief Medical Officer, QPID Health Inc Stockholder, QPID Health Inc

LEARNING OBJECTIVES

1) Describe some of the external mandates and requirements facing practicing radiologists. 2) Describe gaps in function that exist between these requirements and the functionality provided by EHR & PACS systems. 3) Provide example approaches and example solutions to bridge these gaps.

ABSTRACT

RC253B Augmenting Image Interpretation through the Use of Advanced Health Record Technology

Participants
Arun Krishnaraj, MD, MPH, Charlottesville, VA, (arunk@virgnia.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Appreciate the current state of Electronic Health Record (EHR) technology and adoption in the United States. 2) Identify areas where EHR integration into the daily workflow of Radiologists is lacking. 3) Demonstrate an understanding of the importance of incorporating data contained in the EHR to generate high quality reports. 4) Understand the consequences of under utilizing data contained in the EHR.

ABSTRACT

Advanced heath information technologies, specifically EHR systems, are undergoing rapid dissemination and widespread adoption spurred by initiatives in the American Recovery and Reinvestment Act of 2009. When properly integrated into clinical workflow, an EHR can improve both the quality and efficiency of care delivery. Radiology has long been at the forefront with respect to information technology (IT), however the integration of EHR data into radiolgists' workflow is lacking which affects the efficiency, safety, and costs of Imaging. Emerging advanced heatlh record technologies which incorporate natural language processing and semantic search allow the radiologists to retrieve and incorporate relevant clinical data when generating reports thereby improving both efficiency and quality. In this session, the learner will explore how one such health intelligence platform, known as QPID (Queriable Patient Inference Dossier), allows for the creation of search queries tailored to the workflow of an abdominal radiologist.

RC253C Decision Support Tools Integrated into Clinical Workflow

Participants
Cree M. Gaskin, MD, Keswick, VA, (cree@virginia.edu) (*Presenter*) Author with royalties, Oxford University Press; Author with royalties, Thieme Medical Publishers, Inc; Research Grant, Carestream Health, Inc; ;

LEARNING OBJECTIVES

1) Review concepts for contemporary decision support tools for diagnostic radiologists. 2) Discuss bone age and skeletal atlas decision support tools integrated into clinical diagnostic workflow via context sharing.

ABSTRACT

There are numerous references available to radiologists to aid image interpretation or provide guidance on management of imaging findings. Given the vast amounts of information we are expected to know and the speed with which we are expected to perform our clinical work, it is helpful to have quick and easy access to relevant resources at our point-of-care (e.g., during image

interpretation and reporting). Such resources should be available in electronic format on our diagnostic workstations and, when relevant, be integrated with our clinical applications. Our Radiology Information System (RIS), PACS, and/or Electronic Health Record (EHR) can share study and patient context information with decision support tools to facilitate our diagnostic workflow. Examples to be shared include modern remakes of classic printed atlases in pediatric skeletal imaging, updated to contemporary electronic tools integrated with PACS and EHR applications to expedite workflow and reduce error. At a more basic level, decision support for image interpretation could be as simple as an automated feed of relevant clinical information from the electronic health record.

RC253D Advanced Decision Support Tools for the Radiologists

Participants
Giles W. Boland, MD, Boston, MA (*Presenter*) Principal, Radiology Consulting Group; Royalties, Reed Elsevier

LEARNING OBJECTIVES

View learning objectives under main course title.

RC254

Precision Medicine through Image Phenotyping

Monday, Nov. 28 8:30AM - 10:00AM Room: S404AB

CA **CH** **VA** **BQ** **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Ella A. Kazerooni, MD, Ann Arbor, MI, (ellakaz@umich.edu) (*Moderator*) Nothing to Disclose
Ella A. Kazerooni, MD, Ann Arbor, MI, (ellakaz@umich.edu) (*Presenter*) Nothing to Disclose
Eliot L. Siegel, MD, Baltimore, MD, (esiegel@umaryland.edu) (*Presenter*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;
John J. Carr, MD, MS, Nashville, TN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn what the term precision medicine means. 2) To understand how informatics intersects with clinical radiology to enable precision medicine in practice. 3) To learn through concrete examples how informatics based radiology precision medicine impacts health

ABSTRACT

Biomarkers have been emrabced by both the scientific and regulatory communities as surrogates end points for clinical trials, paving the way for their widespread use in medicine. The field of imaging biomarkers has exploded, and the their integration into clinical practice relies heaving on and intersects with the field ofbioinformatics.. Once specific biomakers are show to have value, easily integrating them into the digital environment of the radiologist and communcating them to the health care providers and or directly to patients effeiciently and seamlessly is important for their value and impact on health to be realized. Culturally, it is taking radiologists from the era of description and largely qualitative reporting, into a quantitative future state, and leveraging informatics to extract information from imaging alone ot together with data available in the electronic medical record is essential for future sucess in this new world. To get there, understanding the impact of this approach as a value of our services, and standardization of imaging technques along the lines of what the RSNA QIBA initiative is designing, are essential, so that imaging biomarkers are robust, accurate and reprodicbile. Embraching this approach enables and facilitates new appracohes, relationships of imaging and IT researchers, vendors and consumers, to fully realize the possiblities. This course willdiscuss and describe the overall constructs, and use tangible exams of using this in practice today and for the future.

Honored Educators

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Ella A. Kazerooni, MD - 2014 Honored Educator

RCB21

Hands-On Basic DICOM with Horos/Osirix

Monday, Nov. 28 8:30AM - 10:00AM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Simon Rascovsky, MD, MSc, Bogota, Colombia (*Presenter*) Officer, eDx Tecnologia en Salud SAS
Ross W. Filice, MD, Washington, DC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe basic DICOM object metadata structure. 2) Demonstrate familiarity with Osirix/Horos DICOM viewer functions including image display, and measurements. 3) Use Osirix/Horos to send/receive DICOM objects. 4) Name several common dcm4che toolkit tools, and describe their purpose.

RCC21

Interoperability - Imaging and Beyond: IHE, Standards and The RSNA Image Share

Monday, Nov. 28 8:30AM - 10:00AM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

David S. Mendelson, MD, Larchmont, NY (*Moderator*) Spouse, Employee, Novartis AG; Advisory Board, Nuance Communications, Inc; Advisory Board, General Electric Company; Advisory Board, Toshiba Medical Systems Corporation; Advisory Board, Bayer AG
David S. Mendelson, MD, Larchmont, NY (*Presenter*) Spouse, Employee, Novartis AG; Advisory Board, Nuance Communications, Inc; Advisory Board, General Electric Company; Advisory Board, Toshiba Medical Systems Corporation; Advisory Board, Bayer AG
Mariann Yeager, MBA, Maclean, VA (*Presenter*) Nothing to Disclose
Doug Watt, Toronto, ON (*Presenter*) Vice President, eHealth Ontario

LEARNING OBJECTIVES

1) Understand the importance of interoperability throughout healthcare. 2) Understand the importance of standards to ensure interoperability. 3) Understand the role of IHE profiles in defining workflows and the applicable standards including XDS and XDS-I. 4) Learn about real world implementations including Health Information Exchanges (The Sequoia Project) and focused Radiology solutions (Canada HealthInfoway) including Personal Health Records (The RSNA Image Share). 5) Learn the status of the RSNA Image Share and the RSNA Image Share Validation Program (To be announced at this meeting).

ABSTRACT

This course will focuson HIT inteoperability and its importance in providing for the optimal care of patients. The session will start with a review of standards and the role of IHE. The discussion will then move to a discussion of HIEs via The Sequoia Project (Heatlheway and Carequality) and in Canada where the Canada HealthInfoway project is underway.

RCA22

PowerPoint Tips (Hands-on)

Monday, Nov. 28 10:30AM - 12:00PM Room: S401AB

ED **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC
Sarah C. Abate, BS, Ann Arbor, MI, (sabate@med.umich.edu) (*Presenter*) Nothing to Disclose

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) Review features to enhance live presentations. 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. Discussion of live presentation tips. 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!

RCB22

Learn Image Segmentation Basics with Hands-on Introduction to ITK-SNAP (Hands-on)

Monday, Nov. 28 10:30AM - 12:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Philip A. Cook, PhD, Philadelphia, PA, (cookpa@mail.med.upenn.edu) (*Presenter*) Nothing to Disclose
Paul Yushkevich, PhD, Philadelphia, PA, (pauly2@upenn.edu) (*Presenter*) Investigator, KinetiCor, Inc
Joe C. Wildenberg, MD,PhD, Philadelphia, PA, (joe.wildenberg@gmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To use a free interactive software tool ITK-SNAP to view and manipulate 3D medical image volumes such as multi-parametric MRI, CT and ultrasound.2) To label anatomical structures in medical images using a combination of manual and user-guided automatic segmentation tools.

ABSTRACT

Quantitative analysis of medical imaging data is increasinly relevant in a growing number of radiological applications. Almost invariably, such quantitative analysis requires some structures of interest (organs, tumors, lesions, etc.) to be labeled in the image. Labeling anatomical structures is a complex task, particularly when the imaging data is complex, such as in the case of multi-parametric MRI or fusion of different imaging modalities. ITK-SNAP is a free, open-source, and easy to use interactive software tool that allows users to view multiple image volumes of the same anatomy and label structures using information from all volumes concurrently. For example, ITK-SNAP allows users to label tumors (core, edema, necrosis) using a combination of T1-weighted, contrast-enhanced T2-weighted, T2-weighted and FLAIR MRI. ITK-SNAP provides easy to use user-guided automatic segmentation functionality rooted in statistical machine learning and deformable modeling algorithms, as well as built in tools for manual editing and correction of segmentations. ITK-SNAP runs on Windows, MacOS and Linux platforms. During this hands-on course, the participants will use ITK-SNAP to label organs and tumors in various imaging modalities. After completing the course, participants will be well equipped for performing quantitative analyses of medical image data using ITK-SNAP and other compatible free software tools.

Handout:Paul Yushkevich

http://abstract.rsna.org/uploads/2016/16005010/handout_exercises.pdf

RCC22

Value-based Imaging in the ACO Model

Monday, Nov. 28 10:30AM - 12:00PM Room: S501ABC

HP **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

James Whitfill, MD, Scottsdale, AZ, (jwhitfill@shpcare.com) (*Moderator*) President, Lumetis, LLC;
Rodney S. Owen, MD, Scottsdale, AZ (*Presenter*) Nothing to Disclose
Gary H. Dent, MD, Macon, GA (*Presenter*) Officer, Radius LLC; Stockholder, Radius LLC; Advisory Board, Datalyst LLC;

LEARNING OBJECTIVES

1) Review the forces at work which are pushing the US Healthcare system to adopt value based care models. 2) Learn the mechanisms currently used to contract for value based care contracts. 3) Learn how imaging and radiology currently relate to new value based care models. 4) Hear from radiologists who are active leaders in value based models in their community.

ABSTRACT

SSC08

Informatics (Image Processing and Analysis)

Monday, Nov. 28 10:30AM - 12:00PM Room: S402AB

MR IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Asim F. Choudhri, MD, Memphis, TN (*Moderator*) Nothing to Disclose
Srini Tridandapani, MD, PhD, Atlanta, GA (*Moderator*) Co-founder, CameRad Technologies, LLC
Gary J. Wendt, MD, MBA, Middleton, WI (*Moderator*) Medical Advisory Board, McKesson Corporation; Medical Advisory Board, HealthMyne, Inc; Stockholder, HealthMyne, Inc; Co-founder, WITS(MD), LLC; ;

Sub-Events

SSC08-01 Radiogenomic Analysis of The Cancer Genome Atlas (TCGA)/The Cancer Imaging Archive (TCIA) Head and Neck Squamous Cell Cancer (HNSCC) Cohort: Correlations between Genomic Features and Quantitative Imaging Features

Monday, Nov. 28 10:30AM - 10:40AM Room: S402AB

Awards
Student Travel Stipend Award

Participants
Aasheesh Kanwar, Houston, TX (*Presenter*) Nothing to Disclose
Yitan Zhu, PhD, Evanston, IL (*Abstract Co-Author*) Nothing to Disclose
Abdallah S. Mohamed, MD, MSc, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Justin Kirby, Bethesda, MD (*Abstract Co-Author*) Stockholder, Myriad Genetics, Inc
Yao Ding, MS, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Jay C. Shiao, BS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Jay Messer, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Andrew Wong, BS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
David I. Rosenthal, Houston, TX (*Abstract Co-Author*) Advisory Board, Bristol-Myers Squibb Company Advisory Board, Merck KGaA Research support, Merck KGaA
Rivka R. Colen, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Heath Skinner, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Jayashree Kalpathy-Cramer, MS, PhD, Charlestown, MA (*Abstract Co-Author*) Nothing to Disclose
Laurence E. Court, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Yuan Ji, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Clifton D. Fuller, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Radiogenomics is the study of the association between genomic features and imaging phenotypes, aiming to enhance the molecular drivers for image phenotypes of biological samples. With publicly available data from TCGA and TCIA on the same set of tumor samples, we assessed pathway-specific alterations as potential correlates of radiomics features in matched cases from TCGA/TCIA HNSCC database(s).

METHOD AND MATERIALS

Segmented gross tumor volumes from pretreatment CT scans in DICOM-RT format were processed in IBEX, yielding 360 radiomic features characterizing different tumor image phenotypes. TCGA genomic data of the same tumors including whole-genome gene expressions, copy number variations (CNV), DNA methylations, miRNA expressions, somatic mutations, and expressions of cancer-related proteins, were processed using TCGA-Assembler. We used regression analysis and gene set enrichment methods to identify individual genomic features and genetic pathways that are associated with tumor radiomic features, adjusting for known prognostic variables such as patient age, smoking status, tumor stage and subsite.

RESULTS

A total of 126 patient samples was analyzed. Most samples were AJCC stage IV (n=83) with tumors of the oral cavity (n=67), larynx (n=35), and oropharynx (n=20). Mean age was 59.8 (SD=11.35) and most were current (n=51) or former smokers (n=44). We identified 20, 154, 3, 438, 8641, and 814 statistically significant (Benjamini-Hochberg-adjusted p-value ≤ 0.05) associations involving miRNA expressions, mutated genes, protein expressions, promoter region DNA methylations, transcriptional activities and CNVs of genetic pathways, respectively. Clinically relevant pathway associations have been identified, including the positive association between the expression level of ERK2 (a kinase important for cell proliferation and differentiation) and tumor size. All significant associations have been collected into a database for open-access querying/dissemination.

CONCLUSION

We identified a cohort of statistically significant associations between various genomic features and multiple kinds of radiomic phenotypes for HNSCC. These findings not only confirm known pathways, but may develop new knowledge about the genomic underpinnings of tumor imaging phenotypes.

CLINICAL RELEVANCE/APPLICATION

Quantitative analysis of standard-of-care images may inform upon tumor genomic status and identify pathway-depdendent features for risk/therapy stratification.

SSC08-02 Quantitative MR Imaging Biomarkers to Assess Early Response of Breast Cancers to Neoadjuvant

Chemotherapy (NACT)

Monday, Nov. 28 10:40AM - 10:50AM Room: S402AB

Participants
Ruth H. Bonini, MD, PhD, Campo Grande, Brazil (*Presenter*) Nothing to Disclose
Eva C. Gombos, MD, Boston, MA (*Abstract Co-Author*) Royalties, Reed Elsevier
Sona A. Chikarmane, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Vivek Narayan, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Judy Garber, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Jayender Jagadeesan, PHD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Initial results show correlation with multiple MR heterogeneity metrics to PR. The imaging biomarkers may be helpful to predict the NACT response in breast cancer patients after first cycle of NACT, early in the course of treatment, before usual size measurements would indicate response.

Background

To assess tumor response after the first cycle of neoadjuvant chemotherapy (NACT) using imaging biomarkers that quantify the tumor heterogeneity on MRI and further correlate these metrics to pathological response (PR).

Evaluation

45 biopsy proven breast cancers were evaluated using MRI on baseline and first post-NACT and compared with the PR (complete or significant PR [pCR] = tumor loss > 90% vs partial or no PR [non-pCR]). The average time between baseline and first post-NACT MRI was 30 days. The first post-NACT MRI was done 8-14 days after the first cycle of treatment. A breast-imaging radiologist segmented the cancer on pre-contrast and first post-contrast images of baseline and first post-NACT MRI in the 3D Slicer software. 57 metrics that quantify the shape, morphology, distribution statistics, geometry and texture were obtained for each cancer using the HeterogeneityCAD module in 3D Slicer. Statistical correlation of the PR was performed with the % change in metrics evaluated from baseline and first post-NACT cycle MRI using Mann-Whitney test.

Discussion

Percentage change in 26/57 metrics on pre-contrast and 28/57 metrics on post-contrast MRI showed significant difference between the pCR and non-pCR groups ($p<0.05$). Mean representative metrics for non-pCR on post-contrast MRI (as %): Energy: 22.9, Entropy: 33.2, Variance: 5.4, Uniformity: 26.6, Auto correlation: 42.0, Dissimilarity: 44.6. Mean of Metrics for PCR (as %): Energy: 44.1, Entropy: 55.2, Variance: 25.0, Uniformity: 45.7, Auto correlation: 68.9, Dissimilarity: 69.0. Standard morphological metrics such as volume, surface area, maximum 3D diameter and compactness do not show significant differences between the pCR and non-pCR groups.

SSC08-03 Transport-Based Morphometry on Structural MRI Enables Reliable Differentiation of 16p11.2 Duplication and Deletion Carriers

Monday, Nov. 28 10:50AM - 11:00AM Room: S402AB

Awards
Trainee Research Prize - Medical Student

Participants
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Gustavo Rohde, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Copy number variants (CNVs) in the 16p11.2 chromosomal locus (BP4-BP5) are associated with several neurodevelopmental disorders. This study aims to determine whether 16p11.2 deletion and duplication carriers can be differentiated based on structural MRI of the brain using Transport-Based Morphometry (TBM), and if so, whether regional white matter morphological changes that enable differentiation shed light on the underlying neurobiology of 16p11.2 CNVs.

METHOD AND MATERIALS

T1-weighted imaging was performed on 235 subjects (51 deletion carriers, 53 duplication carriers, 131 control subjects), including adults and children of both genders (4 – 63 years, mean age 22.4 ± 14.7; M:F ratio = 1.35). Deletion and duplication carriers had a range of neurodevelopmental diagnoses. Statistical Parametric Mapping (SPM12) was used to coregister and segment the white matter. Subsequently, TBM was applied to generate transport maps characterizing individual spatial tissue distribution compared to a common template image. Principal components analysis (PCA) was then applied for dimensionality reduction, and classification was performed using penalized linear discriminant analysis (PLDA) combined with a k-nearest neighbor (KNN) classifier ($k = 15$). Test accuracy was evaluated using leave-one-subject out cross-validation.

RESULTS

TBM enabled 100% test accuracy in predicting group membership (duplication, deletion, control) using white matter (100% sensitivity/specificity, Cohen's kappa = 1) and 95.7% using gray matter appearance alone (sensitivity = 96.1%, specificity = 98.9%, Cohen's kappa = 0.928). We identified a characteristic increase in white matter density (deletion carriers>controls>duplication carriers) in the following regions: occipital, splenium of corpus callosum, frontoparietal, inferior frontal, superior vermis of cerebellum, cerebellar hemispheric. Conversely, a decrease in the inferior temporal (duplication carrier>controls>deletion carriers) white matter was also observed.

CONCLUSION

TBM enables robust prediction of 16p11.2 CNVs using T1-weighted images alone. Furthermore, for the first time, characteristic white matter morphology differences that enable sensitive classification were visualized.

CLINICAL RELEVANCE/APPLICATION

TBM reveals structural changes in white matter caused by 16p11.2 CNVs, associated with many neurodevelopmental disorders, yielding new insight and potential biomarkers to monitor disease and treatment.

SSC08-04 A Novel Bi-Input Convolutional Neural Network for Deconvolution-Free Estimation of Stroke MR Perfusion Parameters

Monday, Nov. 28 11:00AM - 11:10AM Room: S402AB

Participants
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Corey W. Arnold, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Perfusion magnetic resonance (MR) images are often used in conjunction with diffusion weighted images during the assessment of acute ischemic stroke to distinguish between the likely salvageable tissue and infarcted core. Methods such as singular value decomposition have been developed to approximate perfusion parameters from these images. However, studies have shown that existing deconvolution algorithms can introduce distortions that influence the measurements. In this work, we present a novel bi-input convolutional neural network (bi-CNN) to approximate perfusion parameters without deconvolution. We applied the trained bi-CNN to approximate cerebral blood volume (CBV).

METHOD AND MATERIALS

MR perfusion data was collected retrospectively for a set of 11 patients who had acute ischemic stroke. The ground truth perfusion maps (i.e., CBV) and arterial input functions (AIFs) were generated from ASIST-Japan perfusion mismatch analyzer, with the resulting CBV values ranging between 0-201 ml/100g. A set of 87,600 training patches with associated AIFs and CBVs were randomly sampled from the source perfusion data. Each patch had a size of 3 x 3 x 70 (width x height x time), and the center of the patch was the voxel of interest for estimation.Our bi-CNN is a 5-layer model with two parts: 1) two separate 3D convolutional and nonlinear layers for the training patch and its AIF, and 2) three fully-connected layers that combine the output of the first part to produce an estimated CBV. The model was trained with batch gradient descent, with a momentum of 0.9.

RESULTS

A leave-one-brain-out validation was performed to estimate voxel-wise CBV values. The bi-CNN achieved an average mean squared error (MSE) of 3.799 ml/100g +/-3.715. CBV deficits (< 2.5 ml/100g) could be identified from the bi-CNN estimated maps.

CONCLUSION

Our patch-based bi-CNN model is capable of estimating CBV in stroke patients. The model can be potentially extended to other disease domains, such as perfusion analysis in cancer. Future work includes experimenting on a larger dataset and estimating other important perfusion parameters, such as time-to-maximum (Tmax).

CLINICAL RELEVANCE/APPLICATION

Convolutional neural networks can be trained to approximate stroke MR perfusion parameters (e.g., CBV) and are a potential alternative method for automated quantification of perfusion abnormalities.

SSC08-05 Radiomic Response Assessment for Recurrent Glioblastoma Treated with Bevacizumab in the Brain Trial

Monday, Nov. 28 11:10AM - 11:20AM Room: S402AB

Participants
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Patrick Y. Wen, MD, Boston, MA (*Abstract Co-Author*) Research support, Agios Pharmaceuticals, Inc Research support, Angiochem Inc Research support, AstraZeneca PLC Research support, Exelixis, Inc Research support, F. Hoffmann-La Roche Ltd Research support, GlaxoSmithKline plc Research support, Karyopharm Therapeutics, Inc Research support, Novartis AG Research support, sanofi-aventis Group Research support, Regeneron Pharmaceuticals, Inc Research support, Vascular Biogenics Ltd Advisory Board, AbbVie Inc Advisory Board, Cavion Advisory Board, Celldex Therapeutics, Inc Advisory Board, Merck & Co, Inc Advisory Board, F. Hoffmann-La Roche Ltd Advisory Board, Midatech Pharma PLCAdvisory Board, Momenta Pharmaceuticals , IncAdvisory Board, Novartis AG Advisory Board, NovoCure Ltd Advisory Board, Sigma-Tau Pharmaceuticals, Inc Advisory Board, Vascular Biogenics Ltd Speaker, Merck & Co, Inc
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PURPOSE

To develop radiomic biomarkers for non-invasive response assessment of Bevacizumab (Avastin; Genentech) treatment in recurrent glioblastoma multiforme (GBM).

METHOD AND MATERIALS

We analyzed prospectively acquired data from the BRAIN trial. For 167 patients, we extracted 71 radiomic features each from normalized post-contrast T1-weighted and fluid attenuation inversion recovery (FLAIR) sequences at baseline (pre-treatment) and at first follow-up (six weeks post-treatment). For every imaging modality at baseline, we selected 10 comprehensive features using an unsupervised feature selection approach that did not take clinical outcomes into account to limit overfitting. We investigated these features in terms of prognostic value for overall survival (OS), progression-free survival (PFS), as well as early (<3 month) and late (>9 month) progression.

RESULTS

T1 and FLAIR features showed only low pairwise correlation at baseline (mean positive and negative Pearson correlation of 0.3 and -0.13) indicating complementary effects of imaging modalities at the radiomic level. Features derived from T1 scans generally showed higher prognostic performances as compared to FLAIR (Fig. 1). A T1 derived textural-heterogeneity feature (gray-level non-uniformity) stratified patients into early and late progressors significantly at baseline (AUC 0.67, p=4.8x10-4); Kaplan-Meier analysis of this feature for OS showed moderate prognostic value at baseline (HR=1.8, p=7.2x10-4) and follow-up (HR=2, p=4x10-4). A multivariate Cox-regression model of supervised selected features stratified early and late progressors significantly at follow-up T1 scans in independent validation data (HR=2.8, p=5.8x10-4) after correcting for age, sex, and Karnofsky performance status.

CONCLUSION

For the first time, our study allows the definition of radiomic response phenotypes of Bevacizumab treatment in recurrent GBM by leveraging high-quality prospective trial data. Importantly, our data suggests the increased benefit of measuring radiomic patient profiles longitudinally after treatment has been initiated to monitor progression and resistance for immediate intervention and treatment adaptation.

CLINICAL RELEVANCE/APPLICATION

Through to the development of non-invasive imaging biomarkers predicting the effect of Bevacizumab treatment for patients with recurrent GBM, our study contributes to the promotion of precision medicine in oncology.

SSC08-06 Radiogenomics Mapping of Non-small Cell Lung Cancer Shows Strong Correlations between Semantic Image Features and Metagenes

Monday, Nov. 28 11:20AM - 11:30AM Room: S402AB

Participants
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Sandy Napel, PhD, Stanford, CA (*Abstract Co-Author*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc; Scientific Advisor, RADLogics, Inc
Sebastian Echegaray, MS, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Ann N. Leung, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Olivier Gevaert, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To present a radiogenomic map linking RNA sequencing data with semantic image features for patients with non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS

Under IRB approval, we studied 113 patients with NSCLC who had preoperative CT scans and tumor tissue collected between 04/07/2008 and 09/15/2014 at two medical centers. A thoracic radiologist annotated the CT of each tumor with 89 semantic image features using a template with a controlled vocabulary, reflecting radiologic features in tumor shape, margin, and texture as well as background lung characteristics. Next, total RNA was extracted from these tissue samples and converted into a library for paired-end RNA sequencing on Illumina Hiseq. The RNA sequencing data were clustered into 56 high quality metagenes and filtered for metagene homogeneity in five external, public gene expression cohorts totaling 1227 NSCLC patients. We updated a radiogenomics map between metagenes and semantic image features by using Pearson correlation metric with the False Discovery Rate (FDR). In addition, we established the prognostic relationship of metagenes using Cox proportional hazards modeling in five external cohorts.

RESULTS

We identified the top ten metagenes with the highest cluster homogeneity in consensus from five external cohorts. The defined metagenes are highly coexpressed genes to capture important biological processes including hypoxia, cell cycles, and immune response. Correlating metagenes and semantic features, we found 34 significant associations (P<0.05 and FDR<0.01). Ground glass opacity (P=0.005 and FDR<0.001) and nodule attenuation (P=0.008 and FDR=0.003) are strongly correlated with the metagene 19 that defines EGFR pathway. In addition, semantic features capturing presence of centrilobular emphysema (P=0.03) and emphysema severity (P=0.015) are both found to be significantly associated with survival outcomes of patients with NSCLC.

CONCLUSION

We built a radiogenomics map linking ten high-level metagenes capturing canonical pathways of NSCLC to observable imaging characteristics providing a strong association with survival.

CLINICAL RELEVANCE/APPLICATION

Semantic image features capturing tumor phenotypic characteristics can be used to non-invasively associate with molecular properties of NSCLC with prognostic implications.

SSC08-07 Effect of Input Parameters on the Use of Convolutional Neural Networks in Distinguishing Between Malignant and Benign Breast Lesions Across Two Breast Imaging Modalities

Monday, Nov. 28 11:30AM - 11:40AM Room: S402AB

Participants
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PURPOSE

To investigate the effect of image formats on the use of deep convolutional neural networks (CNNs) in the task of distinguishing between benign and malignant lesions on FFDM and breast ultrasound images

METHOD AND MATERIALS

Datasets included 1125 breast lesions [2393 regions of interest (ROIs)] on breast ultrasound and 219 breast lesions [607 ROIs] on full-field digital mammography (FFDM). Ultrasound ROIs were categorized as benign solid, benign cystic, or malignant; FFDM ROIs as either benign or malignant. Output from image ROIs subjected to pre-trained CNNs were classified in the diagnostic task using support vector machines (SVM). In order to fit the image size requirements of the pre-trained CNN, ultrasound ROIs were resized by various different scaling and padding methods, with classification performance being assessed for the different padding options. Performance levels of the deep learning were also compared to that obtained using 'traditional' CADx human-designed features. Five-fold cross validation (by lesion) was used to assess performance in the task of distinguishing between benign and malignant breast lesions, with area under the ROC curve (AUC) as the index of performance.

RESULTS

Mirror-padding resulted in the best performance (AUC=0.90 (Std Error=0.01)) compared to zero-padding (AUC=0.79 (SE=0.02)) and average-padding (AUC=0.81 (SE=0.01)). Also, extracted CNN features demonstrated rotational invariance despite the view-based asymmetry of ultrasound ROIs. The pre-trained CNN methods yielded similar diagnostic performance levels as compared to the conventional CADx methods (AUC = 0.90 vs 0.90 (SE = 0.01) for ultrasound; AUC = 0.81 vs 0.80 (SE = 0.01) for FFDM).

CONCLUSION

Deep learning demonstrated, across two breast imaging modalities, similar performance levels as compared to CADx in the diagnostic task. However, optimal choice of input ROIs in the CNN structure appears crucial in assuring high performance.

CLINICAL RELEVANCE/APPLICATION

Deep learning techniques show extreme promise in computer-aided diagnosis, however, performance levels are dependent on the type of pre-processing.

SSC08-08 Development of a Novel Bayesian Network Interface for Radiology Diagnosis Support and Education

Monday, Nov. 28 11:40AM - 11:50AM Room: S402AB

Participants
Po-Hao Chen, MD, MBA, Philadelphia, PA (*Presenter*) Nothing to Disclose
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Emmanuel J. Botzolakis, MD,PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

A prototype web-based interface (ARIES) was developed that streamlines interaction of radiologists with BNs. With further development and validation, we anticipate this could provide Radiology diagnosis and educational support.

Background

Bayesian networks (BNs) are forms of artificial intelligence that have shown promise for Radiology diagnosis support. Taking as input imaging and clinical key features (KFs) extracted by radiologists, BNs can output probability-ranked differential diagnoses (DDx) and suggest further imaging or testing to constrain the DDx. Moreover, because BNs illustrate probabilistic relationships between KFs and DDx, they offer a unique approach to Radiology education that emphasizes "bottom-up" diagnostic reasoning (i.e., DDx given KFs), as opposed to more traditional "top-down" approaches (i.e., KFs given DDx).

Evaluation

To translate BNs into clinical and educational practice, we developed ARIES (Adaptive Radiology Interpretation and Education System), an open-source, web-based interface that allows Radiologists to interact with expert-developed BNs representing various imaging domains (e.g., Neuroradiology). ARIES utilizes a commercially available BN backend (Netica, Vancouver, Canada) wrapped in a Java server, and was created using JavaScript, JQuery, and HighCharts. ARIES was developed in close collaboration with practicing radiologists, intended for use alongside a traditional PACS workstation.

Discussion

In Clinical Mode, ARIES displays buttons corresponding to relevant KFs. As KFs are selected, two sets of probability-ranked DDx are continuously updated ("radiographic DDx," based on imaging KFs alone, and "clinical DDx," using both disease prevalence and clinical KFs). Embedded sensitivity analysis highlights the next most discriminating KFs after each selection. In Education Mode, trainees are prompted to review clinically proven cases from an internal teaching file. After entering KFs and providing a DDx, automated feedback is provided comparing agreement between trainee- and expert-extracted KFs, and between trainee- and BN-generated

DDx. ARIES also offers machine learning functionality, updating BN probability tables in real-time as cases are submitted to the interface.

SSC08-09 Multiparametric Magnetic Resonance Imaging of the Prostate with Computer Aided Detection as the First Reader: Effect on Experienced Observer Performance

Monday, Nov. 28 11:50AM - 12:00PM Room: S402AB

Participants
Valentina Giannini, PhD, Candiolo, Italy (*Presenter*) Nothing to Disclose
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Salvatore Pedalino, Candiolo, Italy (*Abstract Co-Author*) Nothing to Disclose
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Daniele Regge, MD, Torino, Italy (*Abstract Co-Author*) Speakers Bureau, General Electric Company

PURPOSE

To assess if the detection of prostate cancer (PCa) at multiparametric Magnetic Resonance Imaging (mp-MRI) is improved when Computer aided detection (CAD) is adopted as the first reader (FR-CAD) by the experienced radiologists. Secondary aims of this study are to assess if CAD reduces reading time and interobserver variability.

METHOD AND MATERIALS

3 experienced radiologists searched for PCa in 89 mp-MRI studies. First, radiologists reported the examinations by using the FR-CAD paradigm. In this case, they were asked to analyze the probability map of the CAD superimposed to the T2w, and to confirm those CAD marks that they consider to be PCa. After 6 weeks, cases were re-ordered randomly and readers reported them without the support of the CAD system (unassisted reading), by scrolling all MR sequences (i.e. T2w, DW and DCE). Lesion size, PIRADS (only in the unassisted reading), a five-point confidence score and interpretation time was recorded for both reading modalities. Per-patient and per-lesion sensitivity, and specificity were computed for both procedures and compared using the McNemar test. Inter-observer agreement between reviewers was evaluated using Fleiss Kappa statistics.

RESULTS

The dataset comprised 35 patients having at least 1 clinically significant tumor (39 lesions) and 54 negative patients (at least 1 year follow up). Mean per-patient sensitivity of FR-CAD and unassisted reading did not differ significantly when considering lesion of all size and GS (81% vs 88%, p=0.105), while with the FR-CAD sensitivity increased significantly for patient having a GS>6 (81% vs 91%, p=0.046) and a maximum lesion diameter≥10 mm (80% vs 95%, p = 0.006). Specificity increased not significantly when using the FR-CAD (75.3% vs 78.4%, p = 0.25). The average reading time strongly decreased with the FR-CAD (220 s vs 60 s, p<0.0001). The inter-reader agreement also increased in the FR-CAD paradigm for both per-patient (0.55 vs 0.60) and per-lesion (0.46 vs 0.55) analysis.

CONCLUSION

This preliminary study shows that FR-CAD can (I) improve sensitivity in detecting PCa with GS>6 and lesion diameter ≥ 10 mm, (II) increase inter-reader agreement and (III) reduce reading time.

CLINICAL RELEVANCE/APPLICATION

FR-CAD for prostate cancer may be an attractive reading strategy into the routine clinical environment, especially if mp-MRI prostate imaging will be introduced to select patients candidate to biopsy.

INS-MOA

Informatics Monday Poster Discussions

Monday, Nov. 28 12:15PM - 12:45PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Christopher R. Deible, MD, PhD, Allison Park, PA (*Moderator*) Nothing to Disclose

Sub-Events

IN218-SD-MOA1 Additive Manufacturing Models of Fetuses built from Three-dimensional Ultrasound, Magnetic Resonance Imaging and Computed Tomography Scan Data

Station #1

Participants
Heron Werner, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose
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Jorge Lopes, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Gerson Ribeiro, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Tatiana M. Fazecas, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
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Leise Rodrigues, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To generate physical fetal models using images obtained by three-dimensional ultrasonography (3DUS), magnetic resonance imaging (MRI) and, in some cases, computed tomography (CT) to guide additive manufacturing technology.

METHOD AND MATERIALS

Images from 32 pregnant women, including 5 sets of twins, were used. Scans were performed using high-resolution 3DUS. In cases of abnormalities, MRI and CT, were performed on the same day as 3DUS. The images obtained with 3DUS, MRI or CT were exported to a workstation in DICOM format. A single observer performed slice-by-slice manual segmentation using a digital high-definition screen. Software that converts medical images into numerical models was used to construct virtual 3D models, which were physically made using additive manufacturing technologies.

RESULTS

Physical models based upon 3DUS, MRI and CT were successfully generated. They were similar to the postnatal appearance of the aborted fetus or newborns, especially in cases with pathology.

CONCLUSION

The use of 3DUS, MRI and CT may improve our understanding of fetal anatomical characteristics, and these technologies can be used for educational purposes and as a method for parents to visualize their unborn baby. The images can be segmented and applied separately or combined to construct 3D virtual and physical models.

CLINICAL RELEVANCE/APPLICATION

The techniques described in this study can be applied at different stages of pregnancy and constitute an innovative contribution to research on fetal abnormalities. We believe that physical models will help in the tactile and interactive study of complex abnormalities in multiple disciplines. They may also be useful for prospective parents because a 3D physical model with the characteristics of the fetus should allow a more direct emotional connection to their unborn child.

IN211-SD-MOA2 Reading Chest X-Rays Using Deep Learning: Recurrent Neural Cascade Model for Automated Image Annotation

Station #2

Participants
Hoo-Chang Shin, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
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PURPOSE

Automated medical image annotation has a great potential to make the radiology big data in hospital databases more accessible. A vast amount of images can be retrieved by searching for the keywords describing the images. Additionally, it can be useful for large-scale patient screening. We propose an approach to automatically learn to annotate images from a dataset of radiology images and reports.

METHOD AND MATERIALS

A publicly available dataset of chest x-rays and reports were used in order to promote community efforts in solving this challenging

A publicly available dataset of chest x-rays and reports were used in order to promote community efforts in solving this challenging problem. The anonymized data consist of 3955 radiology reports and 7283 associated chest x-rays. Moreover, the radiology reports were labeled using Medical Subject Headings (MeSH) according to pre-defined grammar to annotate the images. Summarizing radiology reports to the standardized MeSH terms with pre-defined grammar rules helps remove the ambiguity found in radiology reports. Convolutional neural networks and recurrent neural networks were then trained on the chest x-ray and MeSH annotation pairs, to generate "human-like" text diagnosis on new chest x-ray cases. Given a patient image, not only can the presence/absence of a disease be detected but also its context can be automatically generated, such as the location, size, and severity.

RESULTS

A total of 217 MeSH terms were used, where the number of terms (N) describing a disease ranges from 1 to 8, with a mean of 2.56 and standard deviation of 1.36. The number of images used for training/validation/testing was 6316/545/422. The rate of predicting the words matching the true annotation words in training/validation/testing were 0.90/0.62/0.79, and the rate of two- and three-consecutive predicted words matching the true annotation words were 0.62/0.30/0.14 and 0.79/0.14/0.05, respectively. This is a promising first step towards more comprehensive automated medical image understanding using radiology images and reports.

CONCLUSION

We present an effective framework to learn, detect disease, and describe their contexts from patient chest x-rays and their accompanying radiology reports with MeSH annotations. To the best of our knowledge, this is the first system to generate "human-like" annotation from radiology images.

CLINICAL RELEVANCE/APPLICATION

This work has a greater potential to be developed into a clinically useful system, e.g. as a pre-screening tool in developing countries where limited clinical resources are available.

IN212-SD-MOA3 Preliminary Results Using Deep Learning Artificial Intelligence to Estimate Bone Mineral Density on Abdominal CT Exams for Screening Osteoporosis

Station #3

Participants
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Joon-Il Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Jae Young Byun, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine whether deep learning artificial intelligence can be used to automatically estimate and screen for osteoporosis on abdominal CT exams.

METHOD AND MATERIALS

A total 4,203 pairs of lumbar spine dual-energy X-ray absorptiometry (DXA) exams and abdominal CT exams taken within 60 days of the same patient were included in this study. The median age of patients was 54 (IQR: 48-60), and the 3,973 (94.5%) of the cases had the DXA and CT exams on the same day (mean 0.4 days). The L1-L4 mean bone mineral density (BMD) values were used as a reference standard, and 3,783 (90%) randomly selected cases were used for deep learning artificial intelligence training using a convolutional neural network model (VunoNet, Seoul, Korea). The other 420 (10%) of cases were excluded from training and used to evaluate the deep learning results. Cutoff values for using deep learning estimated BMD to screen osteoporosis were analyzed. Osteoporosis for determining cutoff values in this study was defined as cases with BMD T-scores of less than or equal to -2.5, with T-scores calculated only using lumbar spine DXA BMD results using reference population BMD T-score tables without compensating for weight.

RESULTS

The median DXA BMD and median deep learning estimated BMD were 1.159 (IQR: 1.042-1.271) and 1.171 (IQR: 1.055-1.286). A high linear correlation (r2 = 0.714) between deep learning estimated BMD values and DXA BMD values were noted. When using a deep learning estimated BMD cutoff value of less than or equal to 0.929 g/cm2 for screening osteoporosis, a sensitivity of 94.4% and specificity of 97.0% could be achieved when using lumbar spine DXA results as a gold standard, with a high AUC of 0.990.

CONCLUSION

Deep learning artificial intelligence for estimating BMD on abdominal CT exams has the potential to be used to automatically screen for osteoporosis in routine abdominal CT exams.

CLINICAL RELEVANCE/APPLICATION

This study shows the potential for using deep learning artificial intelligence to fully automate screening for osteoporosis in routine abdominal CT exams taken for other reasons.

IN213-SD-MOA4 First Computer-Aided Diagnosis of Neural Foramina Stenosis

Station #4

Participants
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Olga Shmuilovich, MD, London, ON (*Abstract Co-Author*) Nothing to Disclose
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Shuo Li, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Neuro Foramina Stenosis (NFS) is a leading cause of lower back pain and has the risk of disability. However, clinical diagnosis of NFS is a highly laborious and time-consuming task for physicians. In this study, a fully automated CAD of NFS was firstly developed and validated in clinic against manual diagnosis.

METHOD AND MATERIALS

A new label-supervised feature learning algorithm was used to transfer the experts' knowledge to computer, and then neural foramina diagnosis is automatically reported . Following IRB approval, spine magnetic resonance images from 110 subjects (58 women, 52 men, 56±12 yrs) were collected to validate the proposed CAD against manual diagnosis by two expert physicians. The performance was evaluated via the diagnostic accuracy, specificity, and sensitivity, using a leave-one-subject-out strategy.

RESULTS

High diagnostic accuracy of the proposed CAD has demonstrated by 98.52% accuracy with specificity as 100.00% and sensitivity as 97.96%.

CONCLUSION

This study demonstrated that the developed CAD has a comparable accuracy and sensitivity with the expert physicians. These findings provide an effective way to relieve the heavy burden of physicians, pay more attention to high-level clinical tasks, and offer an efficient clinical tool for neural foramina stenosis.

CLINICAL RELEVANCE/APPLICATION

Computer-aided diagnosis based on supervised feature learning offers an automated and accurate clinical tool for aiding physicians in providing efficient clinical diagnosis and timely treatment.

IN214-SD-MOA5 A Feasibility Study of Deep Learning Technique in Distinguishing Normal Lungs, Pulmonary Tuberculosis and Non-tuberculous Mycobacterial Lung Disease on Chest CT: The 'Alpha Radiologist' is Beginning?

Station #5

Participants
Joon Chul Ra, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Semin Chong, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Myungjoo Kang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyungmin Song, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sangyeon Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Min Jae Cha, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yang Soo Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The computer-assisted CT image classification using a deep learning technique might be a complimentary or problem solving tool for characterization and discrimination of the pulmonary TB and NTM lung disease as well as normal lungs in the future.

Background

Our purpose is to evaluate the diagnostic performance of deep learning technique in distinguishing normal lungs, pulmonary tuberculosis (TB) and non-tuberculous mycobacterial (NTM) lung disease on chest CT.

Evaluation

All CT data were obtained in 329 patients with normal lungs (n = 113), pulmonary TB (n = 115) and NTM lung disease (n = 101). From these CT data, we included 11641 CT images of normal lungs, 5851 CT images of pulmonary TB and 5963 CT images of NTM lung disease in the training and test sets. We used the VGG (visual geometry group)-16 network, which is one of the most popular networks currently for classifying images and won the second place on the ILSVRC (ImageNet Large Scale Visual Recognition Challenge) 2014 competition. It has enough layers and parameters for finding features in large complex images. We used the pre-trained parameters trained on the ILSVRC classification task before fully connected layers and got feature vectors for each image. Each image turn into 4096 length feature vectors and passed through one hidden layer and output layer for classifying the image belongs to normal, TB and NTM groups. We trained with 17255 CT images consist of 6917 normal images, 5393 TB images and 4945 NTM images. After training, we tested 6200 CT images which were not included in the training set. We also trained and tested for normal group versus abnormal group consisting of TB and NTM.

Discussion

The test result showed an overall accuracy of 68.3% in the three groups (75.9% in normal, 60.0% in TB and 36.8% in NTM); whereas 80.6% in the two groups (79.6% in normal group and 83.8% in abnormal group). Our study revealed that the deep learning technique may have potential and good feasibility for distinguishing normal lung images with abnormal lung images. However, we think that many more sample sizes should be tested and the improvement of deep learning technique may be required in order to enhance its diagnostic performance.

IN215-SD-MOA6 Intra- and Interobserver Reliability on a Quantitative CT Analysis of Ground-glass Opacity Nodules: Manual versus Automated Segmentation

Station #6

Participants
Hyein Kang, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Semin Chong, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Min Jae Cha, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Joon Chul Ra, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yang Soo Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the intra- and inter-observer reliability on quantitative CT parameters of ground-glass opacity nodules (GGN) estimated by manual and automated segmentation

METHOD AND MATERIALS

Fifty GGNs were segmented manually by two observers (Obs 1 and 2) on image analysis software, which were repeated two times. All GGNs were also segmented twice repeatedly using by our house software, which we called "Isocontour" based on a modified Marching Squares algorithm. The quantitative CT characteristics of GGNs were estimated by the following 12 parameters: mean HU (Mean), median HU (Median), maximum HU (Max), minimum HU (Min), standard deviation (SD), skewness and kurtosis; area, perimeter, Feret's diameter (Feret), circularity and aspect ratio (AR). On the manual and automated segmentation, the inter- and intra-observer reliability on the quantitative CT parameters was assessed by the intraclass correlation coefficient (ICC) with two-way fixed model with absolute agreement. The ICC values were interpreted as excellent(≥0.75), good(0.60-0.74), fair(0.40-0.59), and poor(<0.40).

RESULTS

On the manual segmentation, the intra- and interobserver reliability were excellent in 7 parameters such as Mean, Median, Max, SD, skewness, Feret, perimeter and area; whereas fair to good in kurtosis and poor to good in Min, circularity, AR. Regarding the automated segmentation using the Isocontour software, intra-observer reliability on all 12 parameters was excellent in Obs 1 and good to excellent in Obs 2. Inter-observer reliability was excellent for all 12 quantitative CT parameters. Comparing manual and automated segmentation, Obs 1 had excellent agreement in 5 parameters such as Mean, Median, Max, perimeter and area; whereas poor to good agreement in other parameters. Obs 2 had excellent agreement only in 3 parameters such as Mean, Median, and Area; whereas fair to good agreement in others parameters.

CONCLUSION

The automated segmentation of GGN showed more stable intra- and interobserver reliability of quantitative CT characteristics than the manual segmentation in both observers. Particularly, the reliability of Mean, Median, Max and area were constantly good to excellent in every settings.

CLINICAL RELEVANCE/APPLICATION

When a GGN will be segmented by either manual or automated methods, the highly reproducible parameters should be selected and analyzed by the practiced radiologist in the segmentation.

IN216-SD-MOA7 Structural Considerations for 3D Printing the Skeletally Immature Craniocervical Junction

Station #7

Participants
James Shin, MD, MSc, Stony Brook, NY (*Presenter*) Nothing to Disclose
C. Douglas Phillips, MD, New York, NY (*Abstract Co-Author*) Stockholder, MedSolutions, Inc Consultant, Guerbet SA
Mark E. Schweitzer, MD, Stony Brook, NY (*Abstract Co-Author*) Consultant, MMI Munich Medical International GmbH Data Safety Monitoring Board, Histogenics Corporation

CONCLUSION

Skeletal immaturity can present segmentation and modeling challenges not present for adults. Structural integrity of non-contiguous ossified components can be achieved with basic CAD techniques, however variable ossification patterns must be anticipated and carefully considered in order to apply them appropriately, as areas of inadequate fusion or subtle non-contiguity may be inapparent on a digital model. Familiarity with potential ossification patterns is thus critical to ensuring structural integrity of a 3D printed bone model, especially so at the craniocervical junction.

Background

Robust segmentation and iso-surface extraction algorithms have facilitated maturation of 3D printing workflows using CT image data. While these techniques are extensible to the immature skeleton, achieving structural integrity of non-contiguous osseous anatomy requires additional structural geometries. This represents a significant departure from routine post-processing. In addition to familiarity with basic CAD tools, understanding the full range of potential ossification patterns and their variable progression is critical to fabrication of a patient model representative of anatomic position, as imaged.

Evaluation

De-identified CT images of a skeletally immature skull base were processed in 3D Slicer (4.5) using standard threshold segmentation and iso-surface extraction algorithms. An initial threshold was chosen to ensure contiguity of the segmented skull base. A subsequent lower threshold was chosen to segment the spine more inclusively. Support rods were fused by Boolean addition at a diameter of 3.5mm in Meshmixer (11.0), determined by trial and error with a bias toward minimization.

Discussion

Type 3a anterior/type B posterior C1 arches were identified. This represents a non-typical ossification pattern, and could introduce additional structural requirements that may be subtle depending on stage of maturation, though not in this case. 5 ossification centers of C2 were partially fused and structurally adequate by analysis of the digital model, with the exclusion of the chondrum terminale. Midline supports from C2 to C5, and anterior arch C1 to dens, were added. Lateral masses were anchored to the occipital condyles and C2 lateral neural arches.

IN217-SD-MOA8 **Fully-Automated Multi-Atlas Lobe Based Lung Segmentation of Lung Perfusion MR Images Using Machine Learning Techniques in COPD Patients**

Station #8

Participants
Hinrich B. Winther, MD, Hannover, Germany (*Presenter*) Nothing to Disclose
Christoph P. Czerner, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Hundt, DIPLPHYS,PhD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Till F. Kaireit, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Frank K. Wacker, MD, Hannover, Germany (*Abstract Co-Author*) Research Grant, Siemens AG; Research Grant, Pro Medicus Limited; Research Grant, Delcath Systems, Inc;
Hoen-Oh Shin, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
Jens Vogel-Claussen, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

This study illustrates the first practical method for a lobe based lung segmentation of MRI lung perfusion images using machine learning techniques.

Background

The World Health Organization lists chronic obstructive pulmonary disease (COPD) as the third most common cause of death. 4D dynamic contrast-enhanced (DCE) MRI can reliably quantify lung parenchymal perfusion, providing clinically relevant information. However, this technique currently requires human interaction, running the risk of high inter-observer variability and binding valuable human resources.

Evaluation

MRI and CT data sets of 11 COPD participants were acquired on the same day. On each CT dataset lobar segmentation was performed by a human expert, yielding the ground truth. The CT images were registered onto the corresponding DCE-MRI of the same patient. The resulting MRI segmentation was accepted as ground truth under the assumption that no significant interval changes have occurred.In machine learning ensemble methods were employed to boost predictive performance. This study uses this concept by performing a multi-atlas image registration of the other MRIs onto the target MRI. Majority label voting was employed as label fusion algorithm.Using this technique, a lung overlap of 92.36±2.52 (mean±sd in %) for each lung (right and left) and an overlap of 85.23±3.79 on a lobar level was achieved by employing 9 atlases. Overlap is defined as $(A \cap B)=(A \cup B)$ where A is the predicted segmentation and B the ground truth.

Discussion

Machine learning was successfully applied for fully-automated lobe-based segmentation of DCE-MR images of the lung eliminating the need for human interaction. Previously a study (doi:10.1007/s11548-014-1090-0) has performed total right and left lung segmentation only with an overlap between human experts of 94%. This is comparable to the presented results achieved by the proposed method.This method will drastically reduce the associated costs, making lobe based MRI lung segmentation feasible without the need for CT for large scale research studies and future clinical routine.

IN007-EB-MOA **Methods of Advanced 3D Printing from Medical Scans Using Freeware and Low-Cost Printers**

Hardcopy Backboard

Participants
Michael W. Itagaki, MD, MBA, Seattle, WA (*Presenter*) Owner, Embodi3D, LLC

TEACHING POINTS

1) Understand how free and open-source software can be used to design complex anatomic models for 3D printing.2) Understand how low-cost consumer 3D printers can be used to create large anatomic models with fine detail.

TABLE OF CONTENTS/OUTLINE

3D printing from medical imaging scans is increasingly used for medical education, device testing/development, and presurgical planning. Use of large, expensive 3D printers and high-cost proprietary design software are major barriers to more widespread adoption of 3D printing in hospitals. Large and expensive printers are required to manufacture parts equivalent in size to those found in the human body. We have developed a robust workflow that allows the creation and design of complex anatomic models using free open-source software. Furthermore, large models can be made on small, low-cost consumer 3D printers. Unrestricted by requirements for proprietary software and physically large printers, the cost of starting an in-hospital 3D printing lab can be greatly reduced, with an initial outlay of approximately $5000. This vastly expands the number of institutions that can offer 3D printing services.A) Conversion of DICOM data sets to STL filesB) Editing and modification of STL filesC) 3D printing of STL files on consumer 3D printersD) Postprocessing of 3D prints and fusion to create large models

Lunch & Learn: Evolution of Value-Based Care: Where Does Radiology Fit? Supported by Fujifilm (invite-only)

Monday, Nov. 28 12:30PM - 1:30PM Room: S403A

Participants

PARTICIPANTS

James Whitfill, MD, Phoenix, AZ

PROGRAM INFORMATION

This course does not offer CME credit.

RCA23

3D Printing (Mimics) (Hands-on)

Monday, Nov. 28 12:30PM - 2:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Moderator*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Presenter*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Presenter*) Nothing to Disclose
Dimitris Mitsouras, PhD, Boston, MA, (dmitsouras@alum.mit.edu) (*Presenter*) Research Grant, Toshiba Corporation;
Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Taryn Hodgdon, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Carlos H. Torres, MD,FRCPC, Ottawa, ON, (catorres@toh.ca) (*Presenter*) Nothing to Disclose
Ai-Li Wang, Ottawa, ON (*Presenter*) Nothing to Disclose
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Gerald T. Grant, MD, MS, Louisville, KY (*Presenter*) Nothing to Disclose
Satheesh Krishna, MD, Ottawa, ON, (dr.satheeshkrishna@gmail.com) (*Presenter*) Nothing to Disclose
John P. Lichtenberger III, MD, Bethesda, MD, (john.lichtenberger@usuhs.edu) (*Presenter*) Author, Reed Elsevier
Ashish Gupta, MD, Ottawa, ON (*Presenter*) Grant, Medtronic plc
Elizabeth George, MD, Boston, MA (*Presenter*) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Amy E. Alexander, BEng, Rochester, MN (*Presenter*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To become familiar with the computational processing of cross-sectional images required to enable 3D printing using practical examples. 2) To learn to use software to identify and extract anatomical parts from cross-sectional images using manual and semi-automated segmentation tools, including thresholding, region growing, and manual sculpting. 3) To gain exposure to techniques involving model manipulation, refinement, and addition of new elements to facilitate creation of customized models. 4) To learn the application of tools and techniques, including 'wrapping' and 'smoothing' to enable the accurate printing of the desired anatomy, pathology, and model customizations using Computer Aided Design (CAD) software. 5) To become exposed to Standard Tessellation Language (STL) file format and interfacing with a 3D printer.

ABSTRACT

'3D printing' refers to fabrication of a tangible object from a digital file by a 3D printer. Materials are deposited layer-by-layer and then fused to form the final object. There are several 3D printing technologies that share similarities but differ in speed, cost, and resolution of the product. Digital Imaging and Communications in Medicine (DICOM) image files cannot be used directly for 3D printing; further steps are necessary to make them readable by 3D printers. The purpose of this hands-on course is to convert a set of DICOM files into a 3D printed model through a series of simple steps. Some of the initial post-processing steps may be familiar to the radiologist, as they share common features with 3D visualization tools that are used for image post-processing tasks such as 3D volume rendering. However, some are relatively or completely new to radiologists, including the manipulation of files in Standard Tessellation Language (STL). It is the STL format that is read by the 3D printer and used to reproduce a part of the patient's anatomy. This 90 minute session will begin with a DICOM file and review the commonest tools and techniques required to create a customized printable STL model. An extensive training manual will be provided before the meeting. It is highly recommended that participants review the training manual to optimize the experience at the workstation.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RCB23

Using Keynote: An Alternative to Power Point (Hands-on)

Monday, Nov. 28 12:30PM - 2:00PM Room: S401CD

ED **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Shawn D. Teague, MD, Denver, CO, (sdteague@gmail.com) (*Presenter*) Stockholder, Apple Inc

LEARNING OBJECTIVES

1) Modify the master slides used in a template. 2) Change the aspect ratio for a presentation from 4:3 to 16:9. 3) Utilize movies in a presentation.

ABSTRACT

RCC23

3D Printing: Clinical Applications I

Monday, Nov. 28 12:30PM - 2:00PM Room: S501ABC

CA NR ED IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Shi-Joon Yoo, MD, Toronto, ON (*Moderator*) Owner, 3D HOPE Medical; CEO, IMIB-CHD;
John P. Lichtenberger III, MD, Bethesda, MD (*Moderator*) Author, Reed Elsevier

LEARNING OBJECTIVES

Sub-Events

RCC23A Introduction to 3D Printing

Participants
J. Elliott Brown, MD, New Haven, CT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Define 3D Printing and understand the basic terminologyUnderstand the steps to 3D printingUnderstand the software that can be used to prepare a 3D print

ABSTRACT

Active Handout:J. Elliott Brown

http://abstract.rsna.org/uploads/2016/16005043/RCC23A RSNA handout Intro to 3D printing.pdf

RCC23B Role of 3D Printing in Congenital Heart Disease

Participants
Shi-Joon Yoo, MD, Toronto, ON (*Presenter*) Owner, 3D HOPE Medical; CEO, IMIB-CHD;

LEARNING OBJECTIVES

1) Understand 3D printing process for heart models. 2) Know how 3D printing helps pediatric cardiac surgery, with case examples. 3) Know the future directions of 3D printing for cardiac surgery.

ABSTRACT

Using rapid prototyping or 3D printing, physical replicas of the hearts can be provided to surgeons before their surgical decision and procedure. The replicas fill the gap between the imagination from the medical images and the reality. By having the replicas in hands, the surgeons can make optimum surgical decision and simulate the intended procedures on the replica prior to the procedure. This allows precise surgical procedures with reduced procedure and anasthesia time. In cases in the grey zone for biventricular versus univentricular repair, the replicas are tremendously helpful in a binary decision. The presentation will include a few clincal cases where 3D printing played a crucial role in surgical decision making.

RCC23C 3D Printing in Maxillofacial/ Orthopedic Surgery

Participants
Edward J. Caterson, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

RCC23D Creating a 3D Printing Lab in Radiology

Participants
Kent R. Thielen, MD, Rochester, MN, (thielen.kent@mayo.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Gain basic understanding of the resources and infrastructure utilized in creating a collaborative 3D Printing Lab in Radiology. 2) Understand potential patient and organizational benefits of a centralized 3D Printing Lab. 3) Recognize potential limitations / barriers to creating a centralized 3D Printing Lab.

ABSTRACT

INS-MOB

Informatics Monday Poster Discussions

Monday, Nov. 28 12:45PM - 1:15PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Christopher R. Deible, MD, PhD, Allison Park, PA (*Moderator*) Nothing to Disclose

Sub-Events

IN210-SD-MOB1 Performance Assessment of Data-driven Imaging Biomarker for Screening Pulmonary Tuberculosis on Chest Radiographs

Station #1

Participants
Hee Jin Kim, MD, Cheongju-si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyunghyun Paeng, Seoul, Korea, Republic Of (*Presenter*) Co-founder, Lunit Inc
Sangheum Hwang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Lunit Inc
Hyo-Eun Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Lunit Inc
Chul-Bum Lee, Cheongju-si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Minhong Jang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Officer, Lunit Inc
Anthony S. Paek, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) CEO, Lunit Inc

PURPOSE

The aim of the study was to investigate the performance of screening tuberculosis (TB) lesion based on data-driven imaging biomarker (DIB), which is an imaging biomarker that is derived from large-scale medical image data by using deep learning technology. Especially, we assessed DIB for TB screening in chest radiographs (DIB-TB) in various race groups and different scales of training sets.

METHOD AND MATERIALS

We constructed experiments on two different datasets which consist of 10,848 (7,020 for normal, 3,828 for TB) and 45,621 (22,202 for normal, 23,419 for TB) cases, respectively. The ground truth diagnosis results only include whether each case is TB or not. DIB-TB was trained based on deep convolutional neural networks. Two independent DIB-TBs trained based on two different datasets were used for demonstrating the impact of the number of training samples. In order to evaluate the performance of DIB-TB, we used three datasets; Shenzhen, Montgomery (public dataset) and in-house validation set (10% of the entire dataset was randomly selected for validation). Especially, two public datasets were used to show the robustness of DIB-TB in various race groups. Shenzhen dataset consists of 326 normal and 336 TB cases, and Montgomery dataset consists of 80 normal and 58 TB cases.

RESULTS

DIB-TB trained on the first (small-scale) dataset achieved viable TB screening performance; 0.964, 0.926, 0.884 in terms of AUC and 0.903, 0.837, 0.674 in terms of accuracy for in-house, Shenzhen, and Montgomery datasets, respectively. In DIB-TB trained on the second (large-scale) dataset, screening performance was significantly improved; 0.973, 0.963, 0.931 in AUC and 0.915, 0.894, 0.848 in accuracy for the same order. The best accuracy, sensitivity, specificity were 0.902 (at probability threshold 0.4), 0.863, 0.942 for Shenzhen set, and 0.855 (at probability threshold 0.45), 0.810, 0.863 for Montgomery set, respectively.

CONCLUSION

The screening performance of DIB-TB can be significantly improved as the number of training samples increases. Additionally, we showed that DIB-TB is robust against the various race groups; DIB-TB trained from the dataset with specific race group can be used for different races with high screening performance.

CLINICAL RELEVANCE/APPLICATION

DIB-TB based on a large-scale chest radiographs can significantly improve the performance of TB screening. And, it can be applied for other race groups.

IN219-SD-MOB2 A Path to Affordable 3D in Radiology - Applied 3d-printing and Low-cost Virtual Reality in a University Hospital Setting

Station #2

Participants
Philipp Brantner, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose
Florian Thieringer, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Tobias Heye, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

While radiologists are used to interpret images “by slice” and to communicate through a written report, it may not be the most powerful method to convey information to non-radiologists including patients. With the advent of new visualization tools, the presentation of medical imagery may return to the third dimension through virtual reality and 3D printing. An outline of a low threshold approach to bring medical imagery back into the true and virtual third dimension is presented.

METHOD AND MATERIALS

The basis of creating a 3d-model is a cross sectional imaging study (CT/MRI). Common radiology post-processing software is used to extract the intended 3D model by thresholding and segmentation. After export as STL-file, post-processing (smoothing, defect-filling and consistency checking) is performed in freely available software e.g. Blender, Meshlab or Meshmixer. 3d-models are then printed on standard commercially available fused filament fabrication (FFM) consumer 3D printers, ranging from 500-4000$. Virtual visualisation of the model is achieved by utilizing the identical 3D model file on a 3D web platform (sketchfab.com). This allows for a low cost virtual reality setup by using google cardboard, a $5-10 box housing lenses and a smartphone. The smart phone creates dynamic stereoscopic imagery on screen oriented by its sensors positional information.

RESULTS

The described workflow proved to be a feasible and robust way to create 3D models in a reasonable time frame with low financial investments of approx. $3500. The created 3D models were well received by referring physicians in particular pediatric cardiology, cranio-maxillofacial, vascular and cardiac surgery as well as urology. According to the referring physicians, 3D models facilitate surgical planning, understanding of complex pathology, communicating pathological findings to patients and teaching students or residents.

CONCLUSION

A robust and feasible workflow to bring medical images back into the virtual and true third dimension is demonstrated. The presented approach allows any radiology departement to perform “first steps” in this expanding technology with a low financial and organizational threshold.

CLINICAL RELEVANCE/APPLICATION

3D printing and virtual reality are becoming important ways to communicate image findings. Radiology needs to master this technology to maintain its leading role as a technology driven specialty.

IN220-SD-MOB3 Developing Multi-resolution Convolutional Neural Networks for Lung Nodule Segmentation

Station #3

Participants
Shuo Wang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Mu Zhou, PhD, Mountain View, CA (*Abstract Co-Author*) Nothing to Disclose
Di Dong, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Yali Zang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Zhenyu Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Olivier Gevaert, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Jie Tian, PhD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To develop a data-driven approach for automated lung nodule segmentation in CT images to facilitate computer-aided diagnosis of lung cancer.

METHOD AND MATERIALS

Lung nodule segmentation in CT images remains challenging due to the fact that nodules can be attached to lung wall or vessel and various nodule sizes pose an additional challenge. We propose a framework utilizing convolutional neural networks (CNN) to distinguish lung nodule and healthy tissues. Our data-driven approach defines multi-resolution lung nodule patches by extracting 0.34 million patches centered on nodules (21x21, 45x45, and 65x65 pixel sizes) from coronal, median sagittal, and axial views. We train three CNN models separately corresponding to the three views to generate probability scores for pixel classification. We achieve the ultimate segmentation by applying a logistic regression to integrate probability outcomes obtained from three trained CNN models. Segmentation performance was evaluated on 893 lung nodule cases (450 for training and 443 for testing) from LIDC-IDRI dataset. We report segmentation accuracy on the testing set by comparing outcomes against ground-truth contours with Average Dice Score (ADS(%)) and Average Hausdorff Distance (AHD).

RESULTS

The proposed CNN approach achieved encouraging segmentation results (ADS=80.20%, AHD=3.83), outperforming conventional graph cut method (ADS=68.97%, AHD=7.78) on 443 testing nodules. In particular, we reported superior results for segmenting tumors attached to the lung wall (124 cases) with ADS 79.53% and AHD 4.31. We additionally showed outcomes given various tumor diameters (D). For the 350 nodules with D<12 mm, our CNN achieved ADS=79.30% and AHD=3.31. For the remaining 93 nodules with D>=12mm, the ADS is 83.59% and AHD is 5.83. Overall, our results revealed superior outcomes of segmenting nodules given a variety of lung nodule locations and sizes.

CONCLUSION

Developing computerized segmentation technique is a crucial step in computer-aided lung cancer diagnosis. We presented a data-driven CNN model for lung nodule segmentation that is able to deal with nodules attached to lung wall and nodules with various sizes.

CLINICAL RELEVANCE/APPLICATION

The proposed automated lung nodule segmentation holds promise to accelerate follow-up lung nodule CT diagnosis (e.g., survival, TNM staging) with growing number of lung nodule CT sequences.

IN221-SD-MOB4 A Manufacturer-independent Ultrasound Strain Elastography Module: Phantom and Clinical Study

Station #4

Participants
Mohamed Abdelhafez, Giza, Egypt (*Abstract Co-Author*) Nothing to Disclose
Mohamed Salaheldien, Giza, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ahmed M. Sayed, PhD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

Hanan S. Gewefel, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ahmed M. Mahmoud, PhD,MSc, Giza, Egypt (*Presenter*) Nothing to Disclose

PURPOSE

Ultrasound strain elastography has been widely used to assess tissue mechanical properties. We develop and assess a novel manufacturer-independent elastography ultrasound module that can be integrated with commercially available gray-scale ultrasound machines to introduce strain elastography using freehand quasi-static compression.

METHOD AND MATERIALS

Conventional grayscale ultrasound images were acquired from, at least, 10 ultrasound machines of 7 manufacturers. Cine-loops (n> 200) of breast elastography phantom were collected while applying freehand compression (1-5%) using the transducer. The phantom included solid masses two times stiffer than background. Video signals were acquired via a high-definition video capture device. Frame-to-frame displacements were calculated using a novel hierarchy recursive displacement tracking technique. Strain was calculated as displacement spatial derivative, and was then superimposed on gray-scale images to provide both anatomical and mechanical information. Under Internal Review Board and consented forms, cine-loops of female breasts (n=27) were acquired while applying freehand compression. 14 women underwent double readings and their BI-RADS was classified.

RESULTS

Using the module, strain elastography was reconstructed successfully form all machines. The stiffer phantom masses exhibited low strain compared to the background tissue-mimicking material with a strain ratio of 2.52±0.29 between background and harder masses. A strain signal to noise ratio (SNR) of 7.50±3.01 and contrast to noise ratio (CNR) of 5.21 ± 1.58 were measured. Elastograms reconstructed using the module showed good match with those of a commercial machine. Strain images were reconstructed successfully for clinical breast data and masses were observed, however, lower values of SNR and CNR were measured.

CONCLUSION

This study showed the feasibility of a vendor-independent strain elastography module via both phantom and clinical data. Quantitative strain values measured using the module integrated with 10 different ultrasound machines exhibited good match with known phantom mechanical stiffness. This add-on module may provide a cost-effective and standardized ultrasound strain elastography complementary tool for the diagnosing and monitoring of tumors.

CLINICAL RELEVANCE/APPLICATION

This vendor-independent elastography add-on module can be integrated with gray-scale ultrasound machines to assess the mechanical tissue changes such as breast and thyroid tumors.

IN222-SD-MOB5 Open-source and Commercial Software Applications for Clinical 3D Printing

Station #5

Participants
James Shin, MD, MSc, Stony Brook, NY (*Presenter*) Nothing to Disclose
George L. Shih, MD, MS, New York, NY (*Abstract Co-Author*) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;
Mark E. Schweitzer, MD, Stony Brook, NY (*Abstract Co-Author*) Consultant, MMI Munich Medical International GmbH Data Safety Monitoring Board, Histogenics Corporation

CONCLUSION

Common to all applications related to 3D visualization is the need for post-processing of image data. 3D printing introduces new geometric constraints to existing clinical workflows, and familiarity with available CAD tools is prerequisite to successful integration of this technology into patient care.

Background

3D modeling for 3D printing is intrinsically different from clinical post-processing such as surface rendered reconstructions, and introduces new model constraints - most notably the concept of manifold geometry. Other novel and important characteristics include face normals, compactness, and polygon counts. These play a critical role in fabrication of a patient model. Expertise in other fields routinely address these needs with CAD software tools, and we have an opportunity to develop analogous medical imager-specific workflows for 3D printing. As the full library of open-source and commercial options may not be widely known, this work seeks to demonstrate how myriad combinations of such tools may be used to achieve the common aim of translating medical image data into a physical object.

Evaluation

We limit this work to post-processing of CT image data into a printable 3D model. This invariably includes initial review of images, threshold segmentation, and modeling in a CAD environment.

Discussion

Several DICOM viewers include tools for post-processing and threshold segmentation. Label maps are generated according to attenuation parameters and/or region seeds, and used to triangulate polygons into a surface mesh. This must satisfy manifold geometric requirements to be represented in physical space. Non-manifold geometries commonly include edges with multiple adjoining faces or result from self-intersecting faces, and are limited to mathematical representation. Models should also satisfy the requirement of compactness, referring to a closed Euclidean space, violations of which commonly include holes or flipped normals. These model characteristics are addressed efficiently in a CAD environment, with automated and semi-automated tools. The final surface mesh representing the anatomy of interest is then translated into printing instructions, often specific to each 3D printing technology and sometimes proprietary.

IN223-SD-MOB6 PET/CT In Lung Cancer: An Automated Imaging Tool for Decision Support

Station #6

Participants
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Raymondo Endozo, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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Mike Hayball, Cambridge, United Kingdom (*Abstract Co-Author*) Director, TexRAD Limited; Director, Cambridge Computed Imaging Ltd; Director, Feedback PLC; Shareholder, Feedback PLC;
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James Crawshaw, MBBS, Surrey, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
John Hall, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Ashley M. Groves, MBBS, Hitchin, United Kingdom (*Abstract Co-Author*) Investigator, GlaxoSmithKline plc Investigator, General Electric Company Investigator, Siemens AG
Andrew Nisbet, PhD, Guildford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Lung cancer (LC) accounts for 12.7% of the world's total cancer incidence. PET/CT plays a central role in LC diagnosis and staging. Powerful quantitative techniques e.g. CT texture analysis (CTTA) can enhance the diagnostic utility of PET/CT by providing information on tumor aggression & resistance. Such techniques however cannot be used in busy clinics where the analysis remains time-consuming & prone to user error. This preliminary study assesses the performance of an automated PET/CT analysis in lung cancer and compare against experienced imaging reporting.

METHOD AND MATERIALS

Patients: 44 consecutive patients (age:68.7+/-10.3 years, 32 males) with LC who underwent FDG-PET/CT (GE Discovery) were analyzed retrospectively. Average follow up was 22.7+/-16.1 months. Clinical stage information was available in 42 patients (I:1, II:9, III:28, IV:4). Reader analysis: Two clinically qualified readers analyzed the patients independently; manually segmenting the tumor on the CT slice corresponding to the most avid lesion on PET. Unenhanced CTTA using the filtration-histogram technique (TexRAD Ltd, www.texrad.com, part of Feedback Plc, Cambridge, UK) was employed. Automated analysis: Automated algorithm uses both CT and PET to auto-segment the lung and lesion. Statistics: 1) Inter-user agreement for ROI area was assessed with Bland-Altman (BA) statistics & Intra-class correlation (ICC). 2) Algorithm segmentation accuracy (ROI area) against ground-truth (mean reader area) was assessed with BA statistics. 3) Survival analysis was performed using Kaplan-Meier analysis log-rank test.

RESULTS

Automated approach was successful in 41/44 (93%). 1) Inter-reader agreement for ROI area revealed a mean difference of 372mm2, 95% limits of agreement (LoA) of 2671mm2 across a data range of 328mm2 to 4735mm2 (ICC=0.32). 2) ROI area of algorithm and ground-truth demonstrated a mean difference of 11mm2, 95% LoA of 1030 mm2 across a data range of 433mm2 to 4426mm2 (ICC=0.85). 3) CTTA from automated analysis predicted survival (Kurtosis,p=0.028).

CONCLUSION

The automated approach requires no user intervention and represents a repeatable method for lung identification, lesion segmentation and texture-analysis on PET/CT in lung cancer.

CLINICAL RELEVANCE/APPLICATION

Automated PET/CT lung cancer tool may standardize clinical performance whilst allowing access to quantitative texture analysis to improve prognostication and fit within clinical workflow.

IN111-ED-MOB7 Deep Learning: A Primer for Radiologists

Station #7

Awards
Cum Laude
Identified for RadioGraphics

Participants
Gabriel Chartrand, BEng, Montreal, QC (*Presenter*) Research intern, Imagia Cybernetics Inc
Eugene Vorontsov, Montreal, QC (*Abstract Co-Author*) Intern, Imagia Cybernetics Inc
Mathieu Flamand, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Simon Turcotte, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Christopher Pal, PhD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Samuel Kadoury, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
An Tang, MD, Montreal, QC (*Abstract Co-Author*) Advisory Board, Imagia Cybernetics Inc

TEACHING POINTS

1. To review the key concepts of deep convolutional neural networks (DCNN), an artificial intelligence technique2. To illustrate applications of deep learning techniques for lesion detection, classification, and monitoring3. To discuss the potential benefits of computer assisted diagnosis with deep learning techniques

TABLE OF CONTENTS/OUTLINE

-Clinical applications: lesion detection, segmentation, classification, image interpretation, prioritization and monitoring.-Classification of computer vision techniques: deformable models (active contour, level-set, statistical shape models), graph-cut, machine learning (support vector machines, random forest algorithms, deep learning).-Comparison: advantages and limitations of each computer vision technique.-Illustration of key ideas behind neural networks: biological inspiration, artificial neural networks, hidden layers, learning process.-Illustration of key concepts of deep learning: multiple stacked layers, convolution applied to images, pooling, activation functions.-Technical requirements: supervised (labelled), semi-supervised and unsupervised learning; training dataset; hardware (GPU).-Pitfalls: size of training dataset, quality of ground truth, spectrum of disease, architecture of neural network.-Future directions: natural language processing, caption generation.

IN024-EC-MOB Exact Mapping of Medical Images Inside a Patient Body Using Three-Dimensional Printing Surgical Guides: Evaluation for Guiding Breast Cancer Margin

Custom Application Computer Demonstration

Participants
Sang-Wook Lee, BS, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Guk Bae Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Beom Seok Ko, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jongwon Lee, MD, Export, PA (*Abstract Co-Author*) Nothing to Disclose
Sei Hyun Ahn, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Stockholder, Coreline Soft, Inc

CONCLUSION

The surgical guide for breast cancer resection using 3DP could be used for more exact and conserving surgery. This quantitative mapping of MRI information into a patient body lets surgeons securing tumors' surgical margin, and promises shorter operation time and convenience as well.

FIGURE

http://abstract.rsna.org/uploads/2016/16012109/16012109_elln.jpg

Background

Partial resection of breast cancer recently has been achieved even though a tumor size is relatively small. To identify the cancer position, a method of clip or h-wire with ultrasonography has been usually provided, but it causes patient's pain as well as cost. In addition, no exact guidance for cancer margin makes surgeons determine relatively larger surgical exclusion. However, it would be subjective. Therefore, the objective of this study is developing a patient-specific three-dimensional printing (3DP) surgical guide enabling quantitatively to map cancer margin on a patient body and evaluating its clinical usage.

Evaluation

From MRI images, morphological shapes of breasts and tumors were modelled (Fig. 1A and 1B). The surgical margin including safety area was designed, and then the margin was projected onto the surgical guiding surface, fitting to the breast surface. Here, morphology of breast and nipple became landmarks for tailored guidance. We proposed two types of surgical guides including a skin marking type (Fig. 1C and fig. 2A) to enable drawing a line on skin and a hybrid type (Fig. 2B) providing a guide line on skin and columns for guiding dye-injections into tissue, which had each different lengths for needle targeting on the exact surgical margin in-depth. The prepared models was saved in STL format and then exported to a 3D printer. The manufactured surgical guide was used in operation room after the sterilization.

Discussion

Four patients enrolled from December 2015 to January 2016. Median age was 46.5 years. After surgery using the developed surgical guide, the distances from the tumor to the margins were measured. Pathological complete remission occurred in two patients. All patients had clear resection margins (Fig 2C). The median distance from the tumor to the margins was 1.2 cm.

IN025-EC-MOB Web Browser Based Cloud System for Generating and Sharing 3D Models for 3D Printing with Workflow Management, Hybrid Visualization and Mobile Interfaces in Hospital

Custom Application Computer Demonstration

Participants
Namkug Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Stockholder, Coreline Soft, Inc
Jaeyoun Yi, Seoul, Korea, Republic Of (*Presenter*) Officer, Coreline Soft Inc
Semyeong Jang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Guk Bae Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Haekang Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sang-Wook Lee, BS, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joon Beom Seo, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

We developed web browser based cloud system for generating and sharing 3D models for 3D printing for collaborations among image processing specialists, radiographer, radiologist, physician, patients, and operation room staffs

FIGURE

http://abstract.rsna.org/uploads/2016/16015490/16015490_rsbl.jpg

Background

Three dimensional modeling for 3D printing needs very complicated communication workflow and collaborations among image processing specialists, radiographer, radiologist, physician, patients, and operation room staffs. Especially, 3D visualization of models is not easy in conventional communication environment including e-mail, chatting program, etc. Therefore, it is very important to develop web browser based cloud system from production to sharing of 3D models for 3D printing.

Evaluation

For workflow of 3D modelling and printing, many collaborators with diverse specialties including image processing specialists, radiographer, radiologist, physician, patients, and operation room staffs needs to be involved and collaborated in synchronous and/or asynchronous manner. For effective communication and collaboration in clinical environment, a platform to support and manage the 3D model data workflow is needed with new technical features including web based cloud system, hybrid rendering (surface and volume rendering) and mobile interface. In addition, advanced techniques for semi-automatic image segmentation including graph cut and volume sculpt and mutli-atlas based segmentation. For 3D modelling with different modalities including MRI, multiphase CT, etc, various registrations including level-set based, optical flow based, b-spline based registrations were implemented. Workflow including 3D models generated by image processing specialists and radiographer, confirmed by radiologist and physician, shared with patient and operation room staffs is flexibly defined and managed by this could system. Measurements (x-axis, y-axis, a-axis, volume) of eight patient-specific kidneys by this system are 61.87±4.56mm, 120.64±9.03 mm, 55.38±10.62 mm, 226.45±67.95 cm3, respectively.

Discussion

For communication and collaborations, there should be a platform to support and manage the 3D model data workflow and collaboration in the real clinical environment in effective manner.

RCA24

3D Printing Hands-on with Open Source Software: Introduction (Hands-on)

Monday, Nov. 28 2:30PM - 4:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Michael W. Itagaki, MD, MBA, Seattle, WA (*Moderator*) Owner, Embodi3D, LLC
Beth A. Ripley, MD, PhD, Seattle, WA, (bar23@uw.edu) (*Presenter*) Nothing to Disclose
Tatiana Kelil, MD, Brookline, MA, (Tkelil@partners.org) (*Presenter*) Nothing to Disclose
Anish Ghodadra, MD, Pittsburgh, PA, (aghodadramd@gmail.com) (*Presenter*) Nothing to Disclose
Hansol Kim, MD, Boston, MA (*Presenter*) Nothing to Disclose
Steve D. Pieper, PhD, Cambridge, MA (*Presenter*) CEO, Isomics, Inc; Employee, Isomics, Inc; Owner, Isomics, Inc; Research collaboration, Siemens AG; Research collaboration, Novartis AG; Consultant, Wright Medical Technology, Inc; Consultant, New Frontier Medical; Consultant, Harmonus; Consultant, Stryker Corporation; Research collaboration, gigmade;
Dmitry Levin, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about basic 3D printing technologies and file formats used in 3D printing. 2) To learn how to segment a medical imaging scan with free and open-source software and export that anatomy of interest into a digital 3D printable model. 3) To perform basic customizations to the digital 3D printable model with smoothing, text, cuts, and sculpting prior to physical creation with a 3D printer.

ABSTRACT

"3D printing" refers to fabrication of a physical object from a digital file with layer-by-layer deposition instead of conventional machining, and allows for creation of complex geometries, including anatomical objects derived from medical scans. 3D printing is increasingly used in medicine for surgical planning, education, and device testing. The purpose of this hands-on course is to teach the learner to convert a standard Digital Imaging and Communications in Medicine (DICOM) data set from a medical scan into a physical 3D printed model through a series of simple steps using free and open-source software. Basic methods of 3D printing will be reviewed. Initial steps include viewing and segmenting the imaging scan with 3D Slicer, an open-source software package. The anatomy will then be exported into stereolithography (STL) file format, the standard engineering format that 3D printers use. Then, further editing and manipulation such as smoothing, cutting, and applying text will be demonstrated using MeshMixer and Blender, both free software programs. Methods described will work with Windows, Macintosh, and Linux computers. The learner will be given access to comprehensive resources for self-study before and after the meeting, including an extensive training manual and online video tutorials.

Active Handout:Michael Ward Itagaki

http://abstract.rsna.org/uploads/2016/14003455/active RCA24-34 Intro to Open Source 3D Printing.pdf

RCB24

Teaching Congenital Heart Disease with 3D Printed Models (Hands-on) I: Double Outlet Right Ventricle

Monday, Nov. 28 2:30PM - 4:00PM Room: S401CD

CA IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Shi-Joon Yoo, MD, Toronto, ON (*Presenter*) Owner, 3D HOPE Medical; CEO, IMIB-CHD;
Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Presenter*) Nothing to Disclose
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC
Cynthia K. Rigsby, MD, Chicago, IL, (crigsby@luriechildrens.org) (*Presenter*) Nothing to Disclose
Hyun Woo Goo, MD, Seoul, Korea, Republic Of, (hwgoo@amc.seoul.kr) (*Presenter*) Nothing to Disclose
Andreas Giannopoulos, MD, Boston, MA, (andgiannop@hotmail.com) (*Presenter*) Nothing to Disclose
Taylor Chung, MD, Oakland, CA (*Presenter*) Travel support, Koninklijke Philips NV;
Rajesh Krishnamurthy, MD, Houston, TX (*Presenter*) Nothing to Disclose
Whal Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the terms used in describing the pathology of double outlet right ventricle. 2) Understand the pathologic and surgical anatomy of various forms of double outlet right ventricle. 3) Develop ideas how to image the patients with double outlet right ventricle for surgical management.

ABSTRACT

Congenital heart diseases are the most common significant birth defects requiring surgical treatment in the majority of cases. Understanding of pathologic anatomy is crucial in surgical decision and performing optimal surgical procedures. Learning cardiac morphology has relied on the pathologic specimens removed from dead patients or at the time of transplantation. However, the pathologic specimens are rare and hardly represent the whole spectrum of diseases. 3D print models from the CT and MR angiograms of the patients with congenital heart disease are great resources for teaching and can revolutionize education. In this hands-on session, 3D print models of hearts will be used for comprehensive understanding of various morphologic spectrum of double outlet right ventricle. The session will consist of 15-minute introductory lecture, 60-minute hands-on observation and 15-minute discussion and evaluation. Experts on congenital heart disease pathology will be available for guidance and answering questions throughout the session.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RCC24

Health IT Entrepreneurship

Monday, Nov. 28 2:30PM - 4:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Curtis P. Langlotz, MD, PhD, Menlo Park, CA, (langlotz@stanford.edu) (*Moderator*) Shareholder, Montage Healthcare Solutions, Inc; Spouse, Consultant, Novartis AG;

LEARNING OBJECTIVES

1) Learn the pros and cons that should be considered when deciding to start a new radiology-related health IT business venture. 2) Understand key intellectual property and tech transfer issues related to health IT businesses. 3) Prepare for the variety of fundraising strategies, growth trajectories, and pivots that may affect small health IT businesses. 4) Examine the factors that lead to the success or failure of health IT startups.

Sub-Events

RCC24A Tales of a Health IT Entrepreneur: From Concept to Startup to Small Business Venture

Participants
William W. Boonn, MD, Penn Valley, PA (*Presenter*) Officer, Nuance Communications, Inc; Shareholder, Nuance Communications, Inc

LEARNING OBJECTIVES

View learning objectives under the main course title.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

William W. Boonn, MD - 2012 Honored Educator

RCC24B Health IT Startup Becomes Large Company with Successful Exit

Participants
Paul J. Chang, MD, Chicago, IL (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

LEARNING OBJECTIVES

View learning objectives under the main course title.

RCC24C Starting a Health IT Consulting Company

Participants
Donald Dennison, Waterloo, ON, (don@dondennison.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understanding the author's journey from a role in the vendor community to an independent consultant. 2) Deciding if a career in consulting is right for you. 3) Defining the services you will provide. 4) Marketing yourself and your abilities. 5) Keeping your knowledge current and relevant. 6) Lessons learned along the way.

ABSTRACT

RCC24D Health IT Startup Ceases Operations

Participants
Curtis P. Langlotz, MD, PhD, Menlo Park, CA, (langlotz@stanford.edu) (*Presenter*) Shareholder, Montage Healthcare Solutions, Inc; Spouse, Consultant, Novartis AG;

LEARNING OBJECTIVES

1) Understand some of the pitfalls of starting a Health IT business. 2) Learn the secrets of successful failure. 3) Review some of the difficult aspects of running a small Health IT business.

Imaging and the 'Dark Art' of Machine Learning: GE Vendor Workshop

Monday, Nov. 28 3:00PM - 3:30PM Room: Booth 5528

Participants

PARTICIPANTS

Christopher Austin, MD

PROGRAM INFORMATION

Radiology has quickly emerged as healthcare's top target for proving the value of artificial intelligence applied to imaging data. Is the future of radiology paved with algorithms? Or will machine learning prove to be more of a placebo than a panacea? Join Dr Christopher Austin, MD, GE's Healthcare Director of Imaging Analytics, for a global perspective on the realities and possibilities for machine intelligence in imaging.

Registration

http://ge.cvent.com/events/ge-breast-health-advantage-workshop/event-summary-b904d22132614dc2b7633ee3b34f22de.aspx

SSE02

Breast Imaging (Quantitative Imaging and CAD)

Monday, Nov. 28 3:00PM - 4:00PM Room: E450A

BR BQ DM IN

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Sungheon G. Kim, PhD, New York, NY (*Moderator*) Nothing to Disclose
Robert M. Nishikawa, PhD, Pittsburgh, PA (*Moderator*) Royalties, Hologic, Inc; Research Consultant, iCAD, Inc;

Sub-Events

SSE02-01 Concurrent CAD for Digital Breast Tomosynthesis

Monday, Nov. 28 3:00PM - 3:10PM Room: E450A

Participants
Richard A. Benedikt, MD, San Antonio, TX (*Presenter*) Nothing to Disclose
Cynthia A. Swann, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Aaron D. Kirkpatrick, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Alicia Toledano, DSc, Kensington, MD (*Abstract Co-Author*) Consultant, iCAD, Inc
Senthil Periaswamy, PhD, Nashua, NH (*Abstract Co-Author*) Director of Research, iCAD, Inc
Justin E. Boatsman, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Jonathan Go, Nashua, NH (*Abstract Co-Author*) Sr. Vice President, iCAD, Inc
Jeffrey W. Hoffmeister, MD, Nashua, NH (*Abstract Co-Author*) Employee, iCAD, Inc; Stockholder, iCAD, Inc

PURPOSE

Digital Breast Tomosynthesis (DBT) is more accurate than Full-Field Digital Mammography (FFDM) alone, but prolongs reading time. A reader study evaluated the concurrent use of a Computer-Aided Detection (CAD) system to shorten reading time, while maintaining performance.

METHOD AND MATERIALS

A CAD system was developed to detect suspicious soft tissue lesions (masses, architectural distortions and asymmetries) in DBT planes. Rather than marking lesions, detected locations are extracted from the DBT planes and blended into the corresponding 2D synthetic image. Thus, lesions can be efficiently viewed in a CAD-enhanced 2D synthetic image without overlapping tissue. Twenty (20) radiologists retrospectively reviewed 240 cases in a multi-reader, multi-case (MRMC) crossover design. An enriched DBT sample included 67 malignancies in 60 patients and compared reading with CAD versus without CAD. All readers reviewed all cases with and without CAD in 2 visits separated by a memory washout period of at least 4 weeks. Radiologist performance was assessed by measuring Area Under the Receiver Operating Characteristic (ROC) Curve (AUC) for malignant lesions with CAD versus without CAD. Reading time, sensitivity, specificity and recall rate were also assessed.

RESULTS

Reading time improved 29.2% with use of CAD (95% CI: 21.1%, 36.5%; p < 0.01). Reader performance was non-inferior with CAD, for non-inferiority margin delta = 0.05. Average AUC increased by 0.007 (95% CI: -0.013, 0.028; non-inferiority p < 0.01), from 0.839 without CAD to 0.846 with CAD. Average sensitivity increased with CAD from 0.847 without CAD to 0.870 with CAD (95% CI: -0.006, 0.053); showing a 0.032 increase in average sensitivity for soft tissue densities (95% CI: -0.002, 0.066), from 0.837 without CAD to 0.869 with CAD. Average specificity decreased from 0.525 without CAD to 0.507 with CAD (-0.018; 95% CI: -0.041, 0.005), and average recall rate for non-cancers increased from 0.476 without CAD to 0.494 with CAD (0.018; 95% CI: -0.005, 0.041).

CONCLUSION

Concurrent use of CAD results in a 29.2% faster reading time with non-inferiority of radiologist performance compared to reading without CAD.

CLINICAL RELEVANCE/APPLICATION

Concurrent use of CAD maintains high performance of DBT with a significant reduction in reading time.

SSE02-02 Dynamic Textural Analysis of Pre-treatment DCE-MRI Predicts Pathological Complete Response to Neoadjuvant Chemotherapy in Breast Cancer

Monday, Nov. 28 3:10PM - 3:20PM Room: E450A

Awards
Student Travel Stipend Award

Participants
Nathaniel Braman, Cleveland, OH (*Presenter*) Nothing to Disclose
Maryam Etesami, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Prateek Prasanna, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Christina Dubchuk, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Abstract Co-Author*) Research Grant, Hologic, Inc;
Anant Madabhushi, PhD, Piscataway, NJ (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Fewer than 30% of breast cancer patients who undergo neo-adjuvant chemotherapy (NAC) prior to surgery achieve pathological complete response (pCR). A pre-treatment dynamic contrast-enhanced MR imaging (DCE-MRI) biomarker predictive of pCR would enable more precise prognosis assessment and NAC targeting. We explore radiomic analysis of computer-extracted dynamic texture features at two DCE-MRI enhancement phases as a means of predicting breast cancer NAC response from baseline imaging.

METHOD AND MATERIALS

75 1.5T DCE-MRI scans prior to NAC were retrospectively analyzed. 22 patients had histology-confirmed pCR, while 53 had partial or non-response (NR). Computer-extracted texture features (Haralick, Co-occurrence of Local Anisotropic Gradient Orientations (CoLlAGe), and Laws) were separately extracted from initial and peak enhancement phases. The 5 most distinguishing features were selected by interaction capping and used to train a random forest classifier in a 3-fold cross-validation setting. Ability to predict pCR was assessed by area under the receiver operating characteristic curve (AUC) among all patients and within luminal (ER/PR+, 9 pCR, 41 NR) and non-luminal (triple-negative and HER2+, 13 pCR, 12 NR) patient subgroups.

RESULTS

Initial post-contrast phase texture features were effective in predicting pCR within luminal lesions (AUC = .863 ± .051), as well as identifying responders without separation by subtype (.831 ± .044). Prediction of pCR from initial phase was less reliable within the non-luminal group (AUC = .743 ± .087), yet peak contrast features better entified non-luminal responders than within luminal or all subtype groups (.831± .060 vs. .732 ± .054 and .679 ± .043). Top distinguishing features for the luminal group were homogeneity-based: standard deviation of CoLlAGe energy and sum variance, Haralick inverse difference moment. Non-luminal studies were partially identified by similar homogeneity features like CoLlAGe energy, but also by Laws energy features that detect "spottiness" and edges.

CONCLUSION

Dynamic textural analysis of DCE-MRI phases was shown to successfully predict pCR to NAC in luminal and non-luminal breast cancers.

CLINICAL RELEVANCE/APPLICATION

The ability to identify patients who will achieve pCR to NAC from baseline DCE-MRI texture features may provide a pre-treatment indicator of pathological complete response to neo-adjuvant chemotherapy, avoiding both under and over treatment of breast cancer subtypes.

SSE02-03 Could 'Deep Learning' Reduce Unnecessary Biopsies of Mammographic Microcalcifications?

Monday, Nov. 28 3:20PM - 3:30PM Room: E450A

Participants
Karen Drukker, PhD, Chicago, IL (*Presenter*) Royalties, Hologic, Inc
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PURPOSE

To investigate whether a machine learning technique known as deep learning, which selects image pixel data directly (rather than human-designed features) in the extraction of image descriptors, has potential to reduce breast biopsies of benign mammographic microcalcifications without associated findings.

METHOD AND MATERIALS

The HIPAA compliant dataset contained diagnostic mammography images of biopsy-sampled BIRADS 4 and 5 lesions in 107 patients for whom the lesion was visible only as microcalcifications. There were 21 patients with breast cancer (7 invasive and 14 in situ), and 86 with benign lesions. For each image a 256x256 region of interest containing the microcalcification was selected by an expert radiologist. The region of interest was used directly as input to a deep learning method trained on a very large independent set of non-medical images. The image descriptors thus extracted were subsequently used in a nested leave-one-out-by-case (i.e., patient) model selection and classification protocol. The number of benign breast biopsies that could be avoided at zero loss in sensitivity to diagnose cancer was evaluated for the deep learning method and compared to that obtained based on a subjective probability of malignancy assigned by an expert radiologist as part of this study. Here, bootstrapping was used to assess statistical significance.

RESULTS

At 100% sensitivity, on average, the numbers of benign biopsies that could be avoided were 38 of 86 by the deep learning-based method and 11 of 86 based on the probability of malignancy assigned by the radiologist. The deep learning-based method operated at 44% specificity (95% confidence interval [34-55%]) and the study radiologist at 13% [6-20%] ($p<.001$). Note that clinical specificity for this dataset was zero since all lesions underwent biopsy.

CONCLUSION

There seems to be great potential for the application of deep learning methods as an aid to radiologists in the analysis of medical images.

CLINICAL RELEVANCE/APPLICATION

Reducing the number of unnecessary breast biopsies without loss in diagnostic sensitivity is an important step towards improved breast cancer diagnosis and cost reduction.

SSE02-04 Quantitative Characteristics of Background Parencymal Enhancement in Longitudinal Breast DCE-MRIs of Healthy Women

Monday, Nov. 28 3:30PM - 3:40PM Room: E450A

Participants
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Wendie A. Berg, MD, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Rachel Jankowitz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Jules H. Sumkin, DO, Pittsburgh, PA (*Abstract Co-Author*) Institutional research agreement, Hologic, Inc; Advisory Board, General Electric Company
Shandong Wu, PhD, MSc, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Breast DCE-MRI background parenchymal enhancement (BPE) has been reported to be associated with breast cancer risk. It became clinically important to understand key characteristics of BPE in developing it as a potential risk biomarker. In this study we investigated quantitative statistics and temporal variations of BPE in a longitudinal breast DCE-MRI dataset acquired from healthy women.

METHOD AND MATERIALS

We retrospectively identified 251 longitudinal breast DCE-MRI scans (earliest on Sep 2004 and latest on Dec 2015) from 93 women (31% have BRCA1/2 mutations) who underwent high-risk breast MRI screening at our institution (2-6 sequential scans per woman). For all the 251 scans, the average age-at-scan was 48.8±7.2 YO (range 26-67), the average between-scan time was 419±165 days (range 171-1605), and 134 (53%) were pre-menopausal with the rest post-menopausal. All 93 women remain breast cancer-free at the time of analysis. Fully automated computerized methods were applied to quantify BPE from the first post-contrast sequence at both bilateral and unilateral level. A quantitative BPE measure (BPE%) was derived as the percentage of the volume of enhanced voxels (at least 20% relative enhancement) over the fibroglandular tissue relative to the volume of fibroglandular tissue. A set of descriptive statistics were computed for BPE%, and variability of BPE% between sequential scans was measured by the intraclass correlation coefficient (ICC) in a linear mixed effects model.

RESULTS

For all 251 scans, mean BPE% was 25.1% ±13.7 (range 1.1% - 83.9%); the Pearson's correlation coefficient of BPE% between left (mean 27.4%±14.7) and right breasts (mean 24.2%±14.1) was 0.85; mean BPE% was 29.7%±15.0 (range 9.2% - 83.9%) for pre-menopausal and 20.9%±10.9 (range 1.1% - 67.0%) for post-menopausal scans (unpaired t-test $p<0.0001$). For 71 (or 48) women who had at least 2 (or 3) sequential scans, ICC of BPE% was 0.63 (or 0.46), and temporal variations of BPE% between longitudinal scans are shown in the figure.

CONCLUSION

In longitudinal DCE-MRI scans of breast cancer-free women, BPE% is highly correlated bilaterally, significantly higher among pre-than post-menopausal women, and the mean value decreases with aging.

CLINICAL RELEVANCE/APPLICATION

Quantitative characterization of BPE in longitudinal MRIs of healthy women will help determine BPE's temporal variability and reproducibility, building baseline measures for its use as a risk biomarker.

SSE02-05 Applying Data-driven Imaging Biomarker in Mammography for Breast Cancer Screening

Monday, Nov. 28 3:40PM - 3:50PM Room: E450A

Participants
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Hyo-Eun Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Lunit Inc
Bong Joo Kang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Minhong Jang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Officer, Lunit Inc
Anthony S. Paek, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) CEO, Lunit Inc

PURPOSE

To assess feasibility of data-driven imaging biomarker (DIB; an imaging biomarker that is derived from large-scale medical image data by using deep learning technology) in mammography and evaluate its potential for detection of breast cancer.

METHOD AND MATERIALS

We collected 9,757 digital mammograms from five institutions. 3,228 cancer cases were confirmed by pathology. 6,529 normal cases were defined by BIRADS final assessment category 1 without developing malignancy for 2 years. Each case includes 4 views of mammograms. 800 cases were randomly chosen as validation (n=400) and test (n=400) sets, and the remainder (2428 for cancer, 5,729 for normal) were used for training. The core algorithm of DIB-M (DIB for mammography) is deep convolutional neural network; a deep learning algorithm specialized for images. It learns discriminative features directly from training data according to the final task (cancer detection). For each case in training data, the probability of cancer inferred from DIB-M is compared with the ground-truth diagnosis result (cancer: 1, normal: 0). Then the model parameters for DIB-M are updated based on the error between the prediction and the ground-truth. Training proceeds to minimize the prediction error of the entire training set, and the final DIB-M performed the best on the validation set is used for evaluation. We performed the experiment with 3 different random-split datasets to verify performance consistency.

RESULTS

AUC was 0.813 and 0.814 for the validation and test sets, respectively. Accuracy at threshold 0.5 was 72.9% (validation) and 73.4% (test). Sensitivity (specificity) according to different thresholds for the test set is: 0.940 (0.383), 0.810 (0.635), 0.690 (0.778), 0.505 (0.903), and 0.313 (0.983) with respect to the thresholds 0.1, 0.3, 0.5, 0.7, and 0.9. ROC curves according to 3 random sets were similar (Fig.1).

CONCLUSION

This research showed the potential of DIB-M as a screening tool for breast cancer. Further studies using a large number of high-quality data including benign cases are needed to further investigate its feasibility as a screening tool.

CLINICAL RELEVANCE/APPLICATION

Unlike previous computer-aided detection (CAD) algorithms, DIB-M is purely based on data-driven features from a large-scale mammography data instead of manually designed features. With further validation, DIB-M may help radiologists to diagnose breast cancer with higher accuracy and efficiency.

SSE02-06 Computer-Aided Detection (CAD)-Generated Kinetic Features of Preoperative Breast MR Imaging: Association with Disease-Free Survival of Patients with Invasive Breast Cancer

Monday, Nov. 28 3:50PM - 4:00PM Room: E450A

Participants
Jin You Kim, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Seung Hyun Lee, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Tae Hong Lee, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To retrospectively investigate whether the kinetic features of breast cancers assessed with computer-aided detection (CAD) at preoperative magnetic resonance (MR) imaging are associated with disease-free survival in patients with invasive breast cancer.

METHOD AND MATERIALS

This is an institutional review board-approved retrospective study, with a waiver of informed consent. Between January 2012 and February 2013, 330 consecutive women (mean age, 52.9 years; age range, 32-88 years) with newly diagnosed invasive breast cancer who had undergone preoperative MR imaging and curative surgery were identified. We retrospectively reviewed all preoperative MR images using a commercially available CAD system and noted the following kinetic parameters for each lesion: peak enhancement (the highest pixel signal intensity in the first post-contrast series), angio-volume (the total volume of the enhancing lesion), and delay enhancement profiles (the proportions of washout, plateau, and persistent-enhancing component within a tumor). Cox's proportional hazards modeling was used to identify associations between CAD-generated kinetic features and disease-free survival, after controlling for clinicopathological variables.

RESULTS

A total of 31 recurrences developed at a median follow-up time of 42 months (range, 3-50 months). The mean peak enhancement was significantly higher in patients with recurrences than in those who remained disease-free (553.65 ± 686.59 vs. 249.89 ± 263.25, P=0.020). Multivariate Cox's analysis showed that a higher peak enhancement (hazard ratio [HR]=1.001, 95% confidence interval [CI]=1.000-1.002, P=0.009) and presence of lymphovascular invasion (HR=2.433, 95% CI=1.086-5.449, P=0.031) were independently, and significantly, associated with poorer disease-free survival.

CONCLUSION

A higher CAD-measured peak enhancement at preoperative breast MR imaging was independently associated with poorer disease-free survival of patients with invasive breast cancer.

CLINICAL RELEVANCE/APPLICATION

Kinetic features assessed by applying computer-aided detection (CAD) to preoperative breast MR images can be used to identify a subgroup of breast cancer patients at high risk of recurrence.

SSE13

Informatics (3D Printing)

Monday, Nov. 28 3:00PM - 4:00PM Room: S404CD

IN

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants

Rasu B. Shrestha, MD, MBA, Pittsburgh, PA (*Moderator*) Advisory Board, General Electric Company; Editorial Advisory Board, Anderson Publishing, Ltd; Advisory Board, KLAS Enterprises LLC; Advisory Board, Peer60; Board, Pittsburgh Dataworks; Board, Omnyx, LLC;
Safwan Halabi, MD, Stanford, CA (*Moderator*) Nothing to Disclose
David J. Harvey, MBBCh, Swansea, United Kingdom (*Moderator*) Shareholder, Medical Connections Ltd; Managing Director, Medical Connections Ltd

Sub-Events

SSE13-01 A 3D Printed Simulator for Training Thoracoscopic Surgery for Esophageal Atresia with or without Trachea-Esophageal Fistula (EATEF) with Volumetric CT and Patient Specific Modelling

Monday, Nov. 28 3:00PM - 3:10PM Room: S404CD

Participants
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Semyeong Jang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

This 3D printed simulator used for effective training and planning VATS on EATEF. It is obvious to have advantages to resolve limitations of non-patient specific and unrealistic simulator with a difficult access. Moreover, the 3D printed simulator could be extended to adult patients and other diseases that require VATS.

Background

Esophageal atresia with or without trachea-esophageal fistula (EATEF) is found shortly after birth. Even though noble techniques and instrumentations for endoscopic surgery, such as video-assisted thoracoscopic surgery (VATS), have been introduced, surgical operation for neonates remain difficult. Thus, we fabricated a patient-specific thoracoscopic simulator for training VATS for EATEF by 3D printed phantom modelling from pediatric chest volumetric CT and for planning a demanding surgery effectively.

Evaluation

A 3-years old patient with EATEF underwent pediatric chest CT. Skin, muscle, bone, esophagus lumen, airway and lung, which were semi-automatically segmented by a region growing method and thresholding, were reconstructed into 3D model (fig. 1) of STL (Stereolithography) format (A-view, Asan Medical Center, Seoul). The wall of the airway and esophagus was modeled by outside offset of 2mm and the fistula invisible on CT was created using Meshmixer (Autodesk, Inc., Toronto, Canada). Subsequently, 7 holes among each rib (3rd~ 8th) were built for VATS ports. The scale of model was reduced to 80% for matching with that of 9-12 month old baby in Korea and the port-hole diameter was set as 12 mm. EATEF simulator was fabricated with Object 500 Connex 3 (Stratasys, CO, USA). The mechanical properties of all components were evaluated by two surgeons in consensus (fig. 2).

Discussion

To modify softness of the organs, mixtures of soft and hard materials were tested with varying the proportion of soft material from 60% to 100% with 10% increment (Table 1). Hard materials with colors were used to distinguish the anatomic components, while the soft material was semi-transparent. The simulator was used for training VATS on EATEF by two surgeons and qualitatively assessed as being very useful for training and reflecting clinical situation than the conventional simulator (fig.3).

SSE13-02 Implementation of a Radiology 3D Printing Quality Control Program

Monday, Nov. 28 3:10PM - 3:20PM Room: S404CD

Awards
Student Travel Stipend Award

Participants
Anish Ghodadra, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
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Ernesto Santos, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

As 3D printing expands in Radiology, implementation of a robust quality control program can ensure high repeatability and reliability in the manufacture of patient-specific models for procedure planning and education.

Background

The advent of low-cost, consumer-grade printers has made 3D printing practical for day to day clinical use. However, as Radiology

The advent of low-cost, consumer-grade printers has made 3D printing practical for day to day clinical use. However, as Radiology begins to expand into manufacturing of patient-specific models for procedure planning and education, care must be taken to establish a quality control system to ensure the fidelity of this complex process. Here, we present our implementation of the engineering principles of design verification and validation in a Radiology 3D printing program.

Evaluation

High quality 3D printing in Radiology begins with a consistent process for high quality image acquisition. This includes proper contrast bolus timing, signal to noise ratio and resolution. Second, a consistent process for training regarding segmentation must be established. Ideally, the final segmentation should be approved by a Radiologist to ensure relevant anatomy is properly segmented. Next, a proper protocol for creation of a 3D model file, or STL, must be established. Subsequently, the steps performed in model refinement and mesh repair should be assessed and standardized. Prior to printing, virtual measurements of the final model must be performed and compared to the original imaging. Finally, validation of final 3D printed model dimensions must be confirmed with the original imaging. On a regular basis, the process chain from CT scan to final 3D printed model must be assessed with standard phantoms.

Discussion

We discuss our implementation of the above system as well as the optimal parameters for each step of the manufacturing process. We present our refined standard operating protocol to ensure that 3D printed models of patient anatomy are created in a reproducible and reliable way. We also discuss our implementation of quality control at the various steps in the 3D printing process. Finally, we present challenges and opportunities for improvement in the manufacturing chain.

SSE13-03 Post-processing Guidelines for Clinical 3D Printing: Process Overview, Fabrication Constraints, and Ordinal Modeling Considerations

Monday, Nov. 28 3:20PM - 3:30PM Room: S404CD

Awards
Student Travel Stipend Award

Participants
James Shin, MD, MSc, Stony Brook, NY (*Presenter*) Nothing to Disclose
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Mark E. Schweitzer, MD, Stony Brook, NY (*Abstract Co-Author*) Consultant, MMI Munich Medical International GmbH Data Safety Monitoring Board, Histogenics Corporation

CONCLUSION

Taking print service limits as targets for model complexity, suggested post-processing guidelines are: Avoid upstream smoothing whenever possible to limit defeaturing and shrinkage. Initial iso-surface decimation should only be applied when necessary to facilitate post-processing, and not fall below service limits. Remeshing should be considered a repair tool, and not be used in service to aesthetics or polygon counts.

Background

Clinical 3D printing entails several independently complex processes, bridging expertise for which is uncommon. Streamlining this concatenated toolchain is necessary for process efficiency and accessibility, and identification of existing constraints is the point of origin from which this effort extends.

Evaluation

Hardware and processing times are not considered here. The primacy of representational accuracy is maintained irrespective of cost or time efficiency.

Discussion

Constraints on model complexity are predominantly practical. Large models from unprocessed DICOM exceeding tens of millions of polygons are extremely taxing on workstations, without necessarily contributing to accuracy. Iso-surfaces extracted from smaller regions of interest however may never approach this level of complexity.Print service constraints are a relevant and practical point of reference. Several services include Shapeways (64MB / 1,000,000 polygons), Sculpteo (50MB / 1,000,000 polygons), and i.materialise (100MB). Many provide simplification tutorials prompting use of mesh decimation, a process inversely complementary to interpolation whereby a surface contour is filtered and downsampled. Several techniques offer file size or polygon count as target parameters, limiting undue compromise to accuracy. Decimation is also commonly applied with initial iso-surface extraction to facilitate post-processing. Remeshing is an alternate simplification akin to shrink-wrapping contours with a lower polygon mesh, and more commonly a CAD tool.Unlike decimation and remeshing which aim to preserve topology, smoothing improves aesthetics by minimizing topological irregularities. This can lead to small feature loss and shrinkage. Smoothing can be applied to 2D label maps, extracted iso-surfaces, and in innumerable CAD implementations.

SSE13-04 Structural Considerationsfor 3D Printing the Skeletally Immature Craniocervical Junction

Monday, Nov. 28 3:30PM - 3:40PM Room: S404CD

Participants
James Shin, MD, MSc, Stony Brook, NY (*Presenter*) Nothing to Disclose
C. Douglas Phillips, MD, New York, NY (*Abstract Co-Author*) Stockholder, MedSolutions, Inc Consultant, Guerbet SA

CONCLUSION

Skeletal immaturity can present segmentation and modeling challenges not present for adults. Structural integrity of non-contiguous ossified components can be achieved with basic CAD techniques, however variable ossification patterns must be anticipated and carefully considered in order to apply them appropriately, as areas of inadequate fusion or subtle non-contiguity may be inapparent on a digital model. Familiarity with potential ossification patterns is thus critical to ensuring structural integrity of a 3D printed bone model, especially so at the craniocervical junction.

Background

Robust segmentation and iso-surface extraction algorithms have facilitated maturation of 3D printing workflows using CT image data. While these techniques are extensible to the immature skeleton, achieving structural integrity of non-contiguous osseous anatomy requires additional structural geometries. This represents a significant departure from routine post-processing. In addition to familiarity with basic CAD tools, understanding the full range of potential ossification patterns and their variable progression is critical to fabrication of a patient model representative of anatomic position, as imaged.

Evaluation

De-identified CT images of a skeletally immature skull base were processed in 3D Slicer (4.5) using standard threshold segmentation and iso-surface extraction algorithms. An initial threshold was chosen to ensure contiguity of the segmented skull base. A subsequent lower threshold was chosen to segment the spine more inclusively. Support rods were fused by Boolean addition at a diameter of 3.5mm in Meshmixer (11.0), determined by trial and error with a bias toward minimization.

Discussion

Type 3a anterior/type B posterior C1 arches were identified. This represents a non-typical ossification pattern, and could introduce additional structural requirements that may be subtle depending on stage of maturation, though not in this case. 5 ossification centers of C2 were partially fused and structurally adequate by analysis of the digital model, with the exclusion of the chondrum terminale. Midline supports from C2 to C5, and anterior arch C1 to dens, were added. Lateral masses were anchored to the occipital condyles and C2 lateral neural arches.

SSE13-05 The Impact of 3D Printed Bone Neoplasm Models on Surgical Excision Planning

Monday, Nov. 28 3:40PM - 3:50PM Room: S404CD

Awards
Student Travel Stipend Award

Participants
Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Taryn Hodgdon, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To explore the impact of the use of patient specific 3D printed bone neoplasm models on surgical planning for bone neoplasm excision, specifically the nature of the procedure, surgeons' confidence, and patient satisfaction with consent.

METHOD AND MATERIALS

We evaluated a total of 20 patients whose assessment was requested by orthopedic surgeons for operative planning of bone neoplasm resection. Diverse neoplasms were included, with metastatic and primary bone lesions. CT images with IV contrast were acquired for all patients and reconstructed with isotropic voxels and axial slice thickness of 1.25mm. Resultant DICOM images were segmented using Materialize software (Leuven, Belgium) to identify neoplasms, as well as to delineate the involved neurovascular structures. Models produced in this segmentation were printed using Objet260 printer (Stratasys, Eden Prairie MN). Two orthopedic surgeons with no prior knowledge of the patients were then asked to provide a preliminary resection plan using only PACS software and rate their confidence, followed by exposure to a 3D printed model. They were then asked to rate their confidence on a Likert scale after modifying their plan, if necessary. All surgical plans were then computationally converted to resection volumes and digitally compared. Finally, in obtaining informed consent for neoplasm excision, patients were asked to rate their satisfaction with consent before and after exposure to 3D models of their disease, on a Likert scale.

RESULTS

A total of 20 diverse neoplasm models, including metastatic (n=15) and primary (n=5), were successfully fabricated and used in preoperative planning. Exposure to 3D printed models significantly increased surgeons' confidence in their plans and substantially altered surgical plans in all cases as identified by volume comparison. Patients exposed to 3D models of their disease reported overall higher satisfaction.

CONCLUSION

Within the limits of this study, tangible, interactive 3D printed models of bone neoplasms in the context of vital proximal neurovascular structures were demonstrated to have a significant objective and subjective impact on improving surgical planning.

CLINICAL RELEVANCE/APPLICATION

Traditional bone neoplasm resection planning may benefit from the guidance provided by 3D printed models of patient-specific disease while improving patient satisfaction with informed consent.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

SSE13-06 Metal Artifact Reduction Techniques for 3D Printing of Patient Models with Dental Fillings

Monday, Nov. 28 3:50PM - 4:00PM Room: S404CD

Participants
Roy Marcus, MD, Rochester, MN (*Presenter*) Institutional research agreement, Siemens AG; Research support, Siemens AG

Jane S. Matsumoto, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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Thomas J. Vrieze, RT, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Ahmed Halaweish, PhD, Rochester, MN (*Abstract Co-Author*) Employee, Siemens AG
Lifeng Yu, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG
Shuai Leng, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the optimal combination of metal artifact reduction techniques for 3D printing of patient models with dental fillings.

METHOD AND MATERIALS

A denture incorporating metal fillings was placed in a 20 cm water phantom mimicking the attenuation of the head. Data were acquired on a 128-slice CT scanner (SOMATOM Edge, Siemens) at 120kV, 135 quality reference mAs and 128x0.6mm collimation; an additional scan was performed at 140 kV. The phantom was positioned using the following settings/positions: 1. Horizontally; 2. Tilted by 15°; 3. Horizontally with a synthetic spacer placed between the upper and lower jaw; 4. Tilted by 15° with the jaw spacer in place. Images were reconstructed with filtered-back-projection (FBP) and iterative metal artifact reduction (iMAR) with 8 settings. Image quality was evaluated in consensus.

RESULTS

The use of iMAR enhanced the overall image quality by effectively reducing metal artifact, compared to standard FBP. Among 8 settings, one setting (dental) provided the best image quality in the sense of metal artifact reduction. Increasing the tube voltage to 140 kV did not improve the image quality compared to 120 kV. The separation of both jaws by the introduced spacer resulted in a splitting of the artifacts, enabling a more dedicated evaluation of non-affected areas and easier segmentation between the jaws. Tilting the head led to a reduced number of metal objects scanned on the same plane, hence additionally reducing the severity of metal artifacts.

CONCLUSION

Methods such tilting the head, introducing a jaw spacer, and using a dedicated metal artifact reduction algorithm reduce metal artifacts and enhanced the image quality in CT of the mandible/maxilla. This image quality improvement substantially improve the accuracy of segmentation, consequently the accuracy of 3D printed models. In addition, substantial time savings are expected without having to perform time-consuming manual steps to remove metal artifacts.

CLINICAL RELEVANCE/APPLICATION

Metal artifact reduction techniques improve efficiency and accuracy of image segmentation in 3D printing.

RCA25

Learning and Using the Open Source MIRC Teaching File System (Hands-on)

Monday, Nov. 28 4:30PM - 6:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Michael R. Cline, MD, Ann Arbor, MI, (micline@med.umich.edu) (*Presenter*) Nothing to Disclose
Andre M. Pereira, MD, Toronto, ON (*Presenter*) Nothing to Disclose

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.

ABSTRACT

MIRC (Medical Imaging Resource Center) or TFS (Teaching File System) is a component of RSNA's CTP (Clinical Trials Processor), a suite of tools developed by RSNA to optimize research in radiology mainly with emphasis on workflow and security of patient information. It is offered free of charge by RSNA.
Simply put, MIRC can be used to build a radiology teaching file, be it for an individual of for an institution with many simultaneous users.
Development started in 2000 and the project has been kept alive along the years, funded by RSNA, with great support both from RSNA and from the community of users.
Installation is very streamlined and available for virtually all plataforms and operational systems. All files necessary for installation are available at the download session of RSNA's own MIRC server (http://mirc.rsna.org).
This course is aimed to cover basic and some advanced authoring tools.
After finishing this course the attendee will be proficient in authoring and uploading cases, and also be familiar with the resources for installation and administration of MIRC.

Active Handout:Andre Martins Pereira

http://abstract.rsna.org/uploads/2016/16005101/ACTIVE RCA25 MIRC_handout_2016_b.pdf

RCB25

Intro to Texture Analysis (Hands-on)

Monday, Nov. 28 4:30PM - 6:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Luciano M. Prevedello, MD, MPH, Dublin, OH (*Presenter*) Nothing to Disclose
Barbaros S. Erdal, PhD, Columbus, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn what image texture analysis is and recognize some of its applications in Radiology through practical examples.2) Understand how to extract imaging texture features from various imaging modalities. 3) Learn how to visualize and analyze results.

ABSTRACT

During this course, an introduction to image texture analysis will be provided through hands on examples. Participants will interact with open source as well as freely available commercial platforms in order to achieve tasks such as segmentation, registration and image feature extraction. Imaging samples will include both 2D and 3D datasets from a variety of anatomical regions and modalities (CT, MR). First, a brief generic introduction will be given and concepts related to algorithm development will be discussed. Participants will then be exposed to DICOM and various visible light based formats. After hands on exercises on texture extraction, visualization of results will be covered. Finally, various quantization methods for storage and analysis will be presented.

RCC25

Mission Critical: How to Increase Your Value By Mastering the Intersection of Quality Improvement and Informatics

Monday, Nov. 28 4:30PM - 6:00PM Room: S501ABC

IN SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Richard E. Sharpe JR, MD, MBA, Denver, CO, (RichSharpeJr@gmail.com) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1)The emerging healthcare marketplace demands radiologists focus considerable resources to demonstrating improvements in value, quality, and patient outcomes. Informatics tools are a powerful resources to realize these expected improvements. Process improvement requires mastery of the intersection of quality and informatics. 2) Identify the required structural framework necessary for improving quality, describe the improvements facilitated by a range of commercially available informatics tools, and implement a radiologist based quality improvement process in their own department.

ABSTRACT

Sub-Events

RCC25A Using Information Systems to Facilitate Improvement While Keeping Your People Engaged

Participants

David B. Larson, MD, MBA, Los Altos, CA (*Presenter*) License agreement, Bayer AG; Potential royalties, Bayer AG

LEARNING OBJECTIVES

1) Understand the organizational aspects of performance improvement. 2) How they complement the use of information systems. 3) How to utilize informatics tools without disrupting the organization.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

David B. Larson, MD, MBA - 2014 Honored Educator

RCC25B What Quality Improvement Tools are Currently Available, and How Can You Leverage Them to Improve Quality and Demonstrate Value?

Participants

Samir B. Patel, MD, Mishawaka, IN, (spatel@rad-inc.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Informatics tools can enhance the ability of radiologists to increase the value they provide to patients, referring providers, and administrators. Participants will learn a framework for categorizing radiology value and how commercially available informatics tools can assist in improving the quality of work they provide and the value they bring to healthcare by discussing specific examples of quality and value improvement initiatives in a community hospital practice.

Active Handout:Samir B. Patel

http://abstract.rsna.org/uploads/2016/16005040/RCC25B RSNA 2016-SPATEL MD (1).pdf

RCC25C Examples of Informatics Quality Project Successes and Future Opportunities

Participants

Alex Towbin, MD, Cincinnati, OH, (alexander.towbin@cchmc.org) (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Siemens AG;

LEARNING OBJECTIVES

At the complation of this talk, attendees should be able to:1. describe how informatics tools can be used to drive quality improvement projects2. give 3 examples of quality improvement projects enhanced by informatics

ABSTRACT

Honored Educators

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Alex Towbin, MD - 2014 Honored Educator

RCC25D How to Create a Culture of Continuous Quality Improvement Using Existing and Free Resources

Participants
Richard E. Sharpe JR, MD, MBA, Denver, CO, (RichSharpeJr@gmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Radiologists are the key quality improvement resource in many radiology groups. 1) Learn how to empower radiologists to lead performance, interpretation and system improvements, and 2) Create a culture of continuous quality improvement using existing or available free resources.

ABSTRACT

RC353

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

Tuesday, Nov. 29 8:30AM - 10:00AM Room: S404CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Marc D. Kohli, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

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.

ABSTRACT

Sub-Events

RC353A A Patient's Journey through Imaging Informatics

Participants
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the three major systems used in radiology departments and their function. 2) Provide details regarding the HL7 and DICOM standards including how they are important in radiology workflow. 3) Describe the function of an interface engine in a modern healthcare system.

ABSTRACT

Understanding how the basic systems in a radiology department interact to provide complete workflow is and important building-block for radiologists interested in informatics. This presentation will outline the RIS, PACS, and Voice recognition systems and illustrate how they interact as we follow a patient through the radiology department.

RC353B Challenges in Enterprise Imaging

Participants
Alex Towbin, MD, Cincinnati, OH, (alexander.towbin@cchmc.org) (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Siemens AG;

LEARNING OBJECTIVES

1) Describe the concept of an enterprise imaging archive. 2) Describe the differences between DICOM-based imaging and non-DICOM-based imaging. 3) Identify the unique challenges associated with incorporating non-DICOM images into an enterprise imaging archive.

ABSTRACT

Over the past 20 years, the field of radiology has built an impressive digital infrastructure, automating many portions of the imaging process from the time of order entry through image distribution. With the advent of small, low-cost, high quality digital cameras, other medical specialties have turned to imaging to visualize and document disorders yet, they have not implemented the same type of digital infrastructure as radiology. Today, thousands of medical images are obtained in hospitals each day. With the increasing reliance on imaging, there is a greater need to build systems and processes to obtain, store, and distribute these images across the enterprise so that health care providers can better care for their patients. Even though many of these problems have been solved in radiology, the solutions are not easily transferred to other specialties due to the differences in imaging hardware and the image acquisition workflow. The purpose of this talk is to describe the problems facing hospitals as they begin to build enterprise imaging archives and to discuss potential solutions to these problems.

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Alex Towbin, MD - 2014 Honored Educator

RC353C Breaching the Moat: Current Concepts in IT Security

Participants
James Whitfill, MD, Scottsdale, AZ (*Presenter*) President, Lumetis, LLC;

LEARNING OBJECTIVES

1) Understand how the changing nature of security threats requires a new approach to security within the healthcare enterprise. 2)

Understand how changes from HIPAA and HITECH affect managing breaches and leaks of PHI.

ABSTRACT

The role of security continues to be elevated as more organizations find themselves victims of hacking and breaches. Banks, retail organizations, insurers and even Children's Hospitals have all been victims of security breeches. While efficient workflow for healthcare providers remains a key focus of imaging informatics, the growing threats from international hacking require greater and greater focus by IT and Healthcare organizations. In response to these developments, an increasing regulatory burden exists to report and mitigate against such breeches. Managing both of these challenges will take increasing amounts of resources in the near future.

RC354

Preparing your Radiology Practice and IT Department for Big Data

Tuesday, Nov. 29 8:30AM - 10:00AM Room: S404AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Moderator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) The potential of applying "Big Data" approaches to radiology will be discussed. 2) The participant will be introduced to the importance of developing a comprehensive IT architecture and capability beyond the EMR in order to effectively use "Big Data" tools. 3) Strategies for preparing IT for "Big Data" will be discussed.

ABSTRACT

Current and near future requirements and constraints will require radiology practices to continuously improve and demonstrate the value they add to the enterprise. Merely "managing the practice" will not be sufficient; groups will be required to compete in an environment where the goal will be measurable improvements in efficiency, productivity, quality, and safety. This will require optimally leveraging IT enabled business intelligence, analytics, and data driven workflow. In many ways, this challenge can be described as a "Big Data" problem, requiring the application of newer "Big Data" approaches and tools. Unfortunately, many have discovered that an "EMR centric" IT perspective may severely limit the ability for the enterprise to maximally leverage these newer tools to create differentiable value. This session will provide an introduction to the importance of developing a comprehensive architectural strategy to augment the existing EMR to more effectively consume "Big Data" tools.

Sub-Events

RC354A Getting Your IT Infrastructure Ready for Big Data

Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) The potential of applying "Big Data" and noSQL approaches to radiology will be discussed. 2) The participant will be introduced to the importance of developing a comprehensive IT architecture and capability beyond the EMR in order to effectively use "Big Data" tools. 3) Strategies for preparing IT for business intelligence and analytics will be discussed.

ABSTRACT

Current and near future requirements and constraints will require radiology practices to continuously improve and demonstrate the value they add to the enterprise. Merely "managing the practice" will not be sufficient; groups will be required to compete in an environment where the goal will be measurable improvements in efficiency, productivity, quality, and safety. This will require optimally leveraging IT enabled business intelligence, analytics, and data driven workflow. In many ways, this challenge can be described as a "Big Data" problem, requiring the application of newer "Big Data" approaches and tools. Unfortunately, many have discovered that an "EMR centric" IT perspective may severely limit the ability for the enterprise to maximally leverage these newer tools to create differentiable value. This session will provide an introduction to the importance of developing a comprehensive architectural strategy to augment the existing EMR to more effectively consume "Big Data" approaches and fully leverage business intelligence and analytics.

RC354B NoSQL Approaches: Beyond the Traditional Relational Database

Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) The distinction between the traditional relational (SQL) database and "NoSQL" approaches will be discussed. 2) The attendees will be given a basic introduction to how "NoSQL" tools, such as Hadoop, MapReduce, MongoDB can be complementary to existing approaches. 3) NoSQL applications and their relevance to radiology will be discussed.

ABSTRACT

Current and near future requirements and constraints will require radiology practices to continuously improve and demonstrate the value they add to the enterprise. Merely "managing the practice" will not be sufficient; groups will be required to compete in an environment where the goal will be measurable improvements in efficiency, productivity, quality, and safety. This will require optimally leveraging IT enabled business intelligence, analytics, and data driven workflow. These approaches will require the ability to consume and utilize all available enterprise data, including unstructured reports, multimedia objects, etc. Other industries have realized that traditional IT approaches, such as the relational (SQL) database, cannot optimally address these "difficult" data objects. Many outside of the medical domain have successfully augmented traditional approaches by newer "Big Data" and "NoSQL" methodologies, such as Hadoop, MapReduce, MongoDB, etc. In this session, an introduction to these newer tools will be presented.

RC354C Deep Learning: An Example of Big Data Applications

Participants
William W. Boonn, MD, Penn Valley, PA, (wboonn@gmail.com) (*Presenter*) Officer, Nuance Communications, Inc; Shareholder, Nuance Communications, Inc

LEARNING OBJECTIVES

1) A technical overview of machine learning and deep learning will be presented. 2) Applications of machine learning and deep learning in radiology will be illustrated. 3) Challenges in deploying machine learning and deep learning in radiologist workflow and productivity demands will be discussed.

ABSTRACT

Computers in radiology have often promised to deliver faster clinical decisions, more accurate diagnoses, and transformative visualizations. Computer aided diagnostics (CAD) has been deployed to guide radiologists in their detection of abnormalities and identification of disease. Historically, CAD has been based on domain-driven heuristics, and more recently used simple machine learning on structured data. Both of these require extensive manual engineering making them very slow to build, limited in their flexibility, and less accurate than we would like. Deep learning is a new paradigm that offers a transformative solution. Instead of demanding countless human hours of painstaking feature generation and selection, deep learning automatically discovers clinically-relevant features by first architecting a hierarchy of patterns (loosely modelled on the brain's own neural neural networks) and then updating those patterns upon observing examples. As radiology requires complex associative pattern recognition, deep learning is the ideal companion tool. Enlitic is developing a deep neural network of the entire human body that will offer a new way forward in which the radiologist has immediate access to the most relevant clinical information. In this talk, we will present a technical overview of machine learning and deep learning, illustrate its applications in radiology, and detail some of the challenges improving radiological workflow using deep learning poses.

Honored Educators

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William W. Boonn, MD - 2012 Honored Educator

RCB31

Hands-on Introduction to Social Media (Hands-on)

Tuesday, Nov. 29 8:30AM - 10:00AM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants

Amy L. Kotsenas, MD, Rochester, MN, (kotsenas.amy@mayo.edu) (*Presenter*) Nothing to Disclose
Neil U Lall, MD, Cincinnati, OH, (nulall@gmail.com) (*Presenter*) Nothing to Disclose
Tirath Y. Patel, MD, Houston, TX (*Presenter*) Nothing to Disclose
Tessa S. Cook, MD, PhD, Philadelphia, PA, (tessa.cook@uphs.upenn.edu) (*Presenter*) Nothing to Disclose
Saad Ranginwala, MD, Cincinnati, OH, (sranginwala@gmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Appreciate the professional relevance of social media for radiologists. 2) Understand the differences between social media in personal and professional roles. 3) Understand the differences between and advantages/disadvantages of multiple social media networks. 4) Set up and use a Twitter account. 5) Understand the purpose of hashtags, lists, and DMs. 6) Get acquainted with other radiologists and radiology organizations on Twitter. 7) Use a variety of social media venues to share images for educational purposes. 8) Understand the difference between and utility of professionally oriented social networking sites such as Doximity and LinkedIn. 9) Understand how to safely /securely communicate via social media while maintaining HIPAA requirements.

ABSTRACT

URL

http://bit.ly/RSNASocialMediaIntro

Active Handout:Amy Louise Kotsenas

http://abstract.rsna.org/uploads/2016/11035016/RCB31 RSNA16 Hands On Social Media - Twitter Kotsenas.pdf

Active Handout:Tessa S. Cook

http://abstract.rsna.org/uploads/2016/11035016/RCB31 socialmedia-handout-cook.pdf

RCC31

Imaging Informatics: Year in Review (RSNA/AMIA/SIIM Joint Sponsorship)

Tuesday, Nov. 29 8:30AM - 10:00AM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants
Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Moderator*) Nothing to Disclose
William Hsu, PhD, Los Angeles, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the year's most significant advances in imaging informatics. 2) Understand current directions in biomedical informatics research of importance to radiology, including ontologies, data mining, natural language processing, reporting systems, and decision support. 3) Describe recent advances in image processing and analysis, and their applications in radiology, including image reconstruction, filtering and post-processing, pattern recognition, computer-aided detection and diagnosis, and visualization.

ABSTRACT

The field of imaging informatics is rapidly advancing in its ability to address challenges related to clinical big data and harnessing this information for precision medicine. In the past year, the field has experienced growth in a variety of areas including radiomics (the generation of high dimensional features from images), development of new ontologies and standards for capturing information from images and reports, and unsupervised learning from images to predict the course of a disease and treatment response. In addition, we have seen a remarkable growth in novel approaches that go beyond pixel data by integrating imaging with other biomedical data, standardizing imaging workflows, and improving the quality and utility of image-derived information in clinical practice. This session, developed in partnership with the American Medical Informatics Association (AMIA) and the Society of Imaging Informatics in Medicine (SIIM), highlights the year's most important advances in imaging informatics. This course provides a comprehensive "Year in Review" of informatics in medical imaging.

URL

http://www.rsna.org/Informatics/2016/

RCA32

3D Printing (Mimics) Hands-on

Tuesday, Nov. 29 10:30AM - 12:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Moderator*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Presenter*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Presenter*) Nothing to Disclose
Dimitris Mitsouras, PhD, Boston, MA, (dmitsouras@alum.mit.edu) (*Presenter*) Research Grant, Toshiba Corporation;
Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Taryn Hodgdon, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Carlos H. Torres, MD,FRCPC, Ottawa, ON, (catorres@toh.ca) (*Presenter*) Nothing to Disclose
Ai-Li Wang, Ottawa, ON (*Presenter*) Nothing to Disclose
Ekin P. Akyuz, BSc, Ottawa, ON (*Presenter*) Nothing to Disclose
Nicole Wake, MS, New York, NY (*Presenter*) Nothing to Disclose
Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Gerald T. Grant, MD, MS, Louisville, KY (*Presenter*) Nothing to Disclose
Satheesh Krishna, MD, Ottawa, ON, (dr.satheeshkrishna@gmail.com) (*Presenter*) Nothing to Disclose
John P. Lichtenberger III, MD, Bethesda, MD, (john.lichtenberger@usuhs.edu) (*Presenter*) Author, Reed Elsevier
Ashish Gupta, MD, Ottawa, ON (*Presenter*) Grant, Medtronic plc
Elizabeth George, MD, Boston, MA (*Presenter*) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Amy E. Alexander, BEng, Rochester, MN (*Presenter*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To become familiar with the computational processing of cross-sectional images required to enable 3D printing using practical examples. 2) To learn to use software to identify and extract anatomical parts from cross-sectional images using manual and semi-automated segmentation tools, including thresholding, region growing, and manual sculpting. 3) To gain exposure to techniques involving model manipulation, refinement, and addition of new elements to facilitate creation of customized models. 4) To learn the application of tools and techniques, including "wrapping" and "smoothing" to enable the accurate printing of the desired anatomy, pathology, and model customizations using Computer Aided Design (CAD) software. 5) To become exposed to Standard Tessellation Language (STL) file format and interfacing with a 3D printer.

ABSTRACT

"3D printing" refers to fabrication of a tangible object from a digital file by a 3D printer. Materials are deposited layer-by-layer and then fused to form the final object. There are several 3D printing technologies that share similarities but differ in speed, cost, and resolution of the product. Digital Imaging and Communications in Medicine (DICOM) image files cannot be used directly for 3D printing; further steps are necessary to make them readable by 3D printers. The purpose of this hands-on course is to convert a set of DICOM files into a 3D printed model through a series of simple steps. Some of the initial post-processing steps may be familiar to the radiologist, as they share common features with 3D visualization tools that are used for image post-processing tasks such as 3D volume rendering. However, some are relatively or completely new to radiologists, including the manipulation of files in Standard Tessellation Language (STL). It is the STL format that is read by the 3D printer and used to reproduce a part of the patient's anatomy. This 90 minute session will begin with a DICOM file and review the commonest tools and techniques required to create a customized printable STL model. An extensive training manual will be provided before the meeting. It is highly recommended that participants review the training manual to optimize the experience at the workstation.

Honored Educators

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Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RCB32

Getting Stuff Done: A Hands-on Technology Workshop to Enhance Personal Productivity (Hands-on)

Tuesday, Nov. 29 10:30AM - 12:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Matthew B. Morgan, MD, Sandy, UT (*Presenter*) Consultant, Reed Elsevier
Puneet Bhargava, MD, Shoreline, WA, (bhargp@uw.edu) (*Presenter*) Editor, Reed Elsevier
Dushyant V. Sahani, MD, Boston, MA (*Presenter*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc
Amanda Lackey, MD, Columbus, OH (*Presenter*) Editor, Reed Elsevier

LEARNING OBJECTIVES

1) Introduce the concept of “Getting Things Done”. 2) Learn the concepts of Inbox Zero and other email management techniques. 3) Using tools such as note-taking applications, citation and password managers.

ABSTRACT

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Puneet Bhargava, MD - 2015 Honored Educator
Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator
Dushyant V. Sahani, MD - 2016 Honored Educator

RCC32

Initiatives to Support Quality Measurement and Effectiveness Research in Radiology

Tuesday, Nov. 29 10:30AM - 12:00PM Room: S501ABC

IN SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe current Federal incentive payment systems and their impact on radiology. 2) Learn how radiology data registries are being used to support research and performance-based payments to radiologists. 3) Discover new radiology informatics tools to facilitate participation in data registries. 4) Gain an overview of progress in using registries to measure quality.

Sub-Events

RCC32A Overview and Current Status of Federal Health IT Programs and Payment Incentives

Participants

Jeffrey Smith, MPP, Bethesda, MD, (jsmith@amia.org) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe how major regulations will impact their practice in the near-term. 2) Understand the role Congress plays in setting policy after legislation passes, and how they impact regulation without legislation. 3) Learn how health informatics policy is evolving to meet a constant set of challenges in healthcare.

ABSTRACT

While headlines depict contentious election year politics and constant gridlock in the nation's Capital, it's far from the whole story. Significant activities inside the Beltway by both the Obama Administration and Congress have shifted how healthcare is delivered and paid for across the country. Join AMIA Vice President of Public Policy, Jeffery Smith, M.P.P., for a review of what policies are driving Washington, DC and what's in store for the clinical community over the next several months.

RCC32B Current Use of Registries in Radiology

Participants

Richard L. Morin, PhD, Jacksonville, FL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

RCC32C New Radiology Informatics Tools Designed to Facilitate Registry Participation

Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

Honored Educators

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Charles E. Kahn JR, MD, MS - 2012 Honored Educator

RCC32D Progress Toward the Use of Registries to Measure Quality

Participants

Douglas Fridsma, MD, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

SSG07

Informatics (Results & Reporting)

Tuesday, Nov. 29 10:30AM - 12:00PM Room: S402AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Arnon Makori, MD, Chicago, IL (*Moderator*) Medical Advisory Board, Carestream Health, Inc
Tejas S. Mehta, MD, MPH, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSG07-01 Radiology Examination Orders Lacking a Meaningful Reason for Exam Increases Suggestion for Clinical Correlation by Over 50%

Tuesday, Nov. 29 10:30AM - 10:40AM Room: S402AB

Participants
Pritesh Patel, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Merlijn Sevenster, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Igor Trilisky, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Darren B. Van Beek, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Melvy S. Mathew, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Paul J. Chang, MD, Chicago, IL (*Abstract Co-Author*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

PURPOSE

General consensus is that radiologist access to meaningful patient information improves diagnostic accuracy and report quality. Radiologists typically rely on the reason for exam (RFE) provided by the referring physician, which we have previously documented to be frequently sparse, especially when computerized order entry (CPOE) is used. We study the effect of lack of meaningful RFE on report quality, in particular on hedging language, in a large retrospective report corpus.

METHOD AND MATERIALS

A corpus of 44,162 anonymized reports and associated RFEs was obtained from an academic hospital. Three radiologists manually rated the 250 most frequent RFEs, accounting for > 10% of RFEs, as contextually meaningful (yes/no). Conflicting ratings were adjudicated by a senior radiologist. A natural language processing pipeline was used to detect sentences within the report impression suggesting the need for clinical correlation. A 2 x 2 matrix was created counting the number of reports with/without meaningful RFE and with/without at least one sentence suggesting the need for clinical correlation. We tested whether reports without meaningful RFE were more likely to suggest clinical correlation (Fisher's exact test).

RESULTS

Average inter-rater agreement for assessing RFE meaningfulness was kappa = 0.53. Of RFEs, 12.9% (5,716/44,162) were not meaningful. Of the reports, 0.8% (359/44,162) suggested clinical correlation. In reports with meaningful RFE, 0.8% suggested clinical correlation. In reports without meaningful RFE, 1.2% suggested clinical correlation. Thus, reports without meaningful RFE are 57.9% more likely to suggest clinical correlation than reports with meaningful RFE (P = 0.001).

CONCLUSION

Our study shows that in an uncontrolled environment, lack of meaningful RFE increases the prevalence of hedging language in radiology reports. This may be an unanticipated consequence of computerized physician order entry systems that focuses on data completeness for billing purposes rather than optimal information delivery to the radiologist. Novel software solutions that automatically synthesize patient history from the electronic medical record may assist the radiologist in producing high-quality reports.

CLINICAL RELEVANCE/APPLICATION

The clinical relevance of reason for examination ordering may impact the quality of radiology interpretation.

SSG07-02 Initial Effectiveness of a Monitoring System to Correctly Identify Inappropriate Lack of Follow-up for Abdominal Imaging Findings of Possible Cancer

Tuesday, Nov. 29 10:40AM - 10:50AM Room: S402AB

Participants
Hanna M. Zafar, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
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PURPOSE

To explore the initial effectiveness of a monitoring system to correctly identify inappropriate lack of follow-up for abdominal imaging findings of possible cancer determined through direct provider contact.

METHOD AND MATERIALS

We identified 298 inpatients, emergency department (ED) patients and outpatients with standardized abdominal radiology reporting codes indicating possible cancer at our tertiary care hospital in July 2013; of these 67 had no documented pathology or imaging follow-up or clinical rationale for lack of follow-up on chart review. Miscoded cases were excluded and providers caring for these patients were e-mailed and telephoned to determine their awareness of the finding and whether follow-up was appropriate (i.e. clinically indicated and completed or not clinically indicated) or inappropriate (i.e. clinically indicated but incomplete). Patient and provider characteristics were collected.

RESULTS

The monitoring system overestimated inappropriate lack of follow-up for abdominal imaging findings of possible cancer in 63% of patients (42/67), mainly due to radiologist miscoding (34%, 23/67) and incomplete chart documentation of appropriate follow-up (24%, 16/67). One in ten patients (7/67) were correctly identified as inappropriately lacking follow-up. Only half of providers caring for correctly coded patients were successfully contacted (51%, 21/41); this was largely attributable to the absence of a documented outpatient provider among inpatient and ED patients (24%, 10/41) half of whom were uninsured or on Medicaid.

CONCLUSION

During the first month, the monitoring system overestimated inappropriate lack of follow-up for imaging findings of possible cancer in over half of patients. The two largest sources of error were incorrect coding of imaging findings and incomplete chart documentation of appropriate follow-up.

CLINICAL RELEVANCE/APPLICATION

Provider feedback is needed to select patients with true inappropriate lack of follow-up for imaging findings of possible cancer among all patients identified by the monitoring system. Thus, the system may increase disparties in inappropriate follow-up among patients with and without listed outpatient providers.

SSG07-03 Extraction of Acute Communicable Findings from Head CT Reports Using Natural Language Processing and Machine Learning: Inter-Reader Agreement and Accuracy of Three Methods

Tuesday, Nov. 29 10:50AM - 11:00AM Room: S402AB

Participants
Falgun H. Chokshi, MD, Marietta, GA (*Presenter*) Nothing to Disclose
Andrew B. Lemmon, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Jinho D. Choi, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

NLP and machine learning methods show promise for data mining radiology head CT reports. Further tailoring of methods, larger training annotated data sets, and continued comparisons of techniques should increase machine accuracy.

Background

Recent advances in natural language processing (NLP) using machine learning offer an opportunity to data mine radiology reports at a large scale. Our purpose was to test the accuracy of three document classification methods on a set of 500 head computed tomography (CT) reports for acute and communicable findings.

Evaluation

To analyze study feasibility & establish a human reference standard, two radiology attendings evaluated 20 head CT reports together to standardize annotation. Next, each reader annotated the same 500 head CT reports for 5 parameters: acute intracranial bleed, mass effect, acute stroke, hydrocephalus, and overall study severity using a scale of 0 to 2 (0=not present, 1=present but now new, 2=new or worsening). We then analyzed the inter-reader agreement (Cohen's kappa) and accuracy. Accuracy was measured by dividing agreed annotations by the total annotations. We then built three different baseline methods using NLP and machine learning techniques to determine how accurately the software could predict the values for these categories (using radiologists' rating as "truth"). Five-fold cross validation was used for evaluation. Method 1: bag-of-words, unweighted. Method 2: Bag-of-words, weighted by term frequencies. Method 3: Bag-of-words, weighted by term frequencies, regularized by dual averaging. Our open source NLP software is available at https://github.com/emorynlp.

Discussion

The two readers agreed 81-94% of the time and kappa scores were between 0.667 and 0.762, showing substantial agreement. Even with the small amount of pilot data and the minimalistic NLP and machine learning techniques, accuracies for the methods were as follows: Method 1, 78-89%, Method 2, 79-90%, and Method 3, 81-90%. More importantly, the results paralleled those of our radiologists (i.e., high for acute stroke and low for mass effect), suggesting the software is using similar information as humans.

SSG07-04 iWonder - Automated System to Notify Diagnostic Radiologists When Pathology Results are Available

Tuesday, Nov. 29 11:00AM - 11:10AM Room: S402AB

Participants
Thomas W. Loehfelm, MD, PhD, Palo Alto, CA (*Presenter*) Nothing to Disclose
Daniel L. Rubin, MD, MS, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Annotating plain text reports using comprehensive structured ontologies can facilitate quality control and continuing medical education.

Background

Introduction: Following up on cases is cumbersome and requires periodic manual review of the medical record. An automated system that correlates pathology results with imaging studies can streamline follow-up and identify cases where pathology is discordant with radiology, facilitating continuing medical education.**Design:** We retrieved radiology and pathology reports along with anonymized patient identifiers. Radiology impression and pathology specimen and diagnosis fields were annotated using the NCBO BioPortal Annotator to identify anatomy and pathology terms from the SNOMEDCT ontology. Reports were considered linked if the radiology report preceded the pathology report and if related anatomic terms were used in the impression and specimen description. Pathology terms in the impression were also mapped to anatomy using the "Finding site:" relationship in SNOMEDCT. For example, "cholecystitis" can be linked to "gallbladder" because the finding site of cholecystitis is defined as the gallbladder in SNOMEDCT.

Evaluation

Data: 36142 pathology reports between 2015-07-01 and 2016-04-01 had both a specimen and diagnosis indicated. 25020 were preceded by at least one radiology report. 103233 SNOMEDCT concepts were identified in 23955 pathology diagnoses, and 42911 concepts were identified in 17850 specimen descriptions.70333 radiology reports preceded pathology reports. We have annotated 2400 report impressions, identifying 8182 SNOMEDCT anatomy concepts.Cross-referencing the anatomy terms from report impressions and pathology specimens using a transitive closure table yields 708 study matches. A web front end allows radiologists access to their personal list of radiology-pathology links. Users curate their list by acknowledging the pathology result, saving the study to a list, or discarding the match.

Discussion

In the future we plan to explore annotating other sections of the radiology report, remove negated statements before annotating pathology terms, and attempt to determine the degree of confidence in a particular diagnosis expressed by the radiologist.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Daniel L. Rubin, MD, MS - 2012 Honored Educator
Daniel L. Rubin, MD, MS - 2013 Honored Educator

SSG07-05 Using Artificial Intelligence to Improve Communication of Critical Results

Tuesday, Nov. 29 11:10AM - 11:20AM Room: S402AB

Participants
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Presenter*) Nothing to Disclose
Barbaros S. Erdal, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Richard D. White, MD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

By expediting the initial recognition of critical imaging findings, Deep Learning has promise to positively impact patient care, improve adherence the local policies, and increase compliance to national regulations.

Background

Optimal communication of critical results is fundamental to clinical practice and is a National Patient Safety Goal proposed by the Joint Commission. In busy practices, a major source of delay in communicating a critical result relates to delays in recognizing the critical finding itself. This is especially true when a large number of competing high priority imaging studies are available. Short of having a radiologist screening every study, there has not been a practical solution; this is changing with the advent of Deep Learning. Deep Learning is a class of machine learning that has been successfully used in a variety of Artificial Intelligence applications including speech recognition, self-driving vehicles, and face recognition. We have evaluated the performance of a Deep Learning algorithm in recognizing critical imaging findings present in head CTs.

Evaluation

A total of 320 de-identified head CT images were utilized. The database was initially divided into 160 abnormal cases containing emergent intracranial findings (e.g. acute intracranial hemorrhage, cerebral contusions, tumors with mass effect, and occlusive venous sinus thrombosis), with the remaining 160 cases containing no emergent finding. Seventy five percent (75%) of the cases were randomly assigned to a training set and 25% to a validation set. The images were processed using a convolutional neural network using Caffe as the platform. The accuracy of the algorithm reached 87% after 30 iterations.

Discussion

This initial experience supports the deployment of the Deep Learning algorithm in clinical practice to screen head CT studies for potential critical findings. Once the algorithm detects a positive case, the study could be labeled as potentially critical and automatically receive a higher priority in the reading worklist (image); the application could then page the covering neuroradiologist for immediate review so the appropriate communication of the imaging findings could be accomplished more promptly.

SSG07-06 Radiology Report Terminology: Interpretive Differences between Patients and Radiologists

Tuesday, Nov. 29 11:20AM - 11:30AM Room: S402AB

Awards
Student Travel Stipend Award

Participants
Marina I. Mityul, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Adam Searleman, BS, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Jennifer L. Demertzis, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Andrew J. Gunn, MD, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Little is known about how patients interpret the terminology used by radiologists. Thus, we surveyed patients and radiologists to

Little is known about how patients interpret the terminology used by radiologists. Thus, we surveyed patients and radiologists to better understand how each group views commonly used phrases within the radiology report.

METHOD AND MATERIALS

138 patients and 113 radiologists were invited to participate in the anonymous survey. Respondents were asked to assign a statistical likelihood of the presence of cancer based upon the terminology used within a hypothetical radiology report. Common phrases such as "likely represents cancer," "compatible with cancer," "consistent with cancer," "concerning for cancer," "may represent cancer," "suspicious for cancer," "cannot exclude cancer," "diagnostic for cancer," "probably represents cancer," and "represents cancer" were evaluated. Potential responses for the statistical likelihoods included: 0-25%, 26-50%, 51-75%, 76-99%, and 100%. For statistical analysis, responses were given a numeric value by the authors on a 1-5 scale (1 = 0-25%; 2 = 26-50%; 3 = 51-75%; 4 = 76-99%; 5 = 100%).

RESULTS

115 patients (83.3% response rate) and 59 radiologists (52.2% response rate) participated. There was a significant difference in the assigned statistical likelihoods between the two groups for almost all phrases (Figure 1). The phrase "probably represents cancer" (mean: 4.16, 95%CI: 3.97-4.34) was selected by patients as conferring the highest statistical likelihood even though radiologists rated this phrase as conferring the sixth highest likelihood (mean: 3.64, 95%CI: 3.49-3.80) ($p<0.0001$). Radiologists selected the phrase "diagnostic for cancer" as conveying the highest statistical likelihood (mean: 4.79; 95%CI: 4.69-4.90) while patients ranked this phrase as having the third highest statistical likelihood (mean: 3.33; 95%CI: 3.10-3.57) ($p<0.0001$). The phrase "cannot exclude cancer" was assigned the lowest statistical likelihood by both groups; although patients assigned it a higher likelihood (mean: 2.23, 95%CI: 2.03-2.44) than radiologists (mean: 1.78, 95%CI: 1.56-2.00) ($p=0.036$).

CONCLUSION

Patients' perceptions of terminology within the radiology report are not synonymous with those of radiologists. These differences could lead to confusion and dissatisfaction.

CLINICAL RELEVANCE/APPLICATION

Radiologists should consider that patients read their reports, and work to use unambiguous terms that communicate the results of an examination more clearly and effectively.

SSG07-07 Natural Language Processing to Automatically Categorize Recommendation Statements in Radiology Reports: Starting to Close the Loop

Tuesday, Nov. 29 11:30AM - 11:40AM Room: S402AB

Participants
Thomas W. Loehfelm, MD, PhD, Palo Alto, CA (*Presenter*) Nothing to Disclose
Andrew B. Lemmon, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Daniel L. Rubin, MD, MS, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Radiologists often make recommendations ranging from clinical correlation to urgent action, but don't generally follow-up on them. An automated system that correctly classifies recommendations could be used to triage those statements that require closing the communication loop, without disrupting normal workflow.

METHOD AND MATERIALS

All CT, MRI, and US reports in a three month window (n = 25039) were analyzed for sentences in the impression containing the word "recommend" or "consider". Strings containing the identified sentence and the sentence preceding it were considered potential recommendation statement (n = 3548). Two radiologists reviewed 511 statements and categorized them as: Not a recommendation General preventative health recommendation Clinical correlation Routine follow-up Nonurgent action Urgent actionA Random Forest classifier was applied to bag of words models of consensus statements using Weka Machine Learning Software. The classifier was tested using 10-fold cross validation of the training set. The F measure, which takes into account precision and recall, is used as the primary performance metric.

RESULTS

Interobserver Variability: Two radiologists agreed on categories for 458/511 (89.6%) potential recommendation statements, yielding the consensus data set with the following category distribution: 18 18 133 155 134 0Only four statements in the original set of 511 were assigned to category 6 ("urgent action") by either of the reviewers, and in all four cases the reviewers disagreed, so none made it to the consensus data set.**Automatic Categorizer**: The Random Forest classifier correctly assigned 397/458 (86.6%, F measure = 0.862) of the consensus statements. Performance by category was (n, F measure): 6/18 (0.5) 18/18 (0.947) 119/133 (0.847) 147/155 (0.942) 107/134 (0.82)

CONCLUSION

Radiologists use imprecise and ambiguous language that impedes understanding. Two radiologists classifying recommendations from radiology reports only agreed 89.6% of the time. A Random Forest classifier correctly classified 86.7% of statements that the radiologists categorized. Such a classifier can be used to triage recommendations to facilitate closed-loop communication follow-up.

CLINICAL RELEVANCE/APPLICATION

Natural language processing tools can extract information from reports without disrupting the normal workflow of radiologists, facilitating the reporting and follow-up of findings and recommendations.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Daniel L. Rubin, MD, MS - 2012 Honored Educator
Daniel L. Rubin, MD, MS - 2013 Honored Educator

SSG07-08 Knowledge Representation of Prostatic Sector Anatomy from PI-RADS in Standard Lexicons

Tuesday, Nov. 29 11:40AM - 11:50AM Room: S402AB

Participants
David A. Clunie, MBBS, Bangor, PA (*Presenter*) Owner, PixelMed Publishing LLC; Consultant, Carestream Health, Inc; Consultant, CureMetrix, Inc; Consultant, MDDX Research & Informatics; Consultant, General Electric Company; ;
Andriy Fedorov, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Proactive incorporation of the PIRADS anatomical concepts in common lexicons assures interoperability, facilitates knowledge sharing, and enables communication of PIRADS results in DICOM SR.Supported by NCI U01 CA190819 - ITCR QIICR project.

Background

The PI-RADS Prostate Imaging - Reporting and Data System (PI-RADS v2) standardizes reporting of Multiparametric Magnetic Resonance Imaging (mpMRI).Communication of the precise localization of lesions is important clinically and for research. PI-RADS defines a sector map of the prostate anatomy but not a formal encoding or representation. Manual, semi-automated or automated annotations of lesion locations need to be labeled with pre-coordinated coded anatomical concepts for each sector. It is desirable to define the spatial relationships between these anatomic concepts to facilitate automated knowledge extraction.This abstract describes the definition of concepts corresponding to each of the 36 prostatic sectors defined in the PI-RADS Appendix II Sector Map in the form of an extension to existing medical anatomical ontologies, including the Foundational Model of Anatomy (FMA), SNOMED CT, the NCI Thesaurus and RadLex.

Evaluation

A survey of terminology sources evaluated the comprehensiveness of coverage of prostatic anatomy. None contained PIRADS v2 sector concepts. FMA contained the most detail, with concepts for peripheral, central and transition zones, and apical, middle and basal parts, but lacked subdivision into sectors, and concepts were not permuted with laterality.

Discussion

Using Protégé, FMA was extended with PIRADS sector classes, and OWL files and tabulated concepts submitted to FMA, SNOMED, NCIt and RadLex for future inclusion. Added concepts were subdivisions of zones of the prostate; "regional part of" relationships were used for laterality and combined regions with more granular sectors. Concept were related to neighbors by “spatially related to” relationships, such as “anterior to”.Practical use of the coded PIRADS v2 concepts was tested in DICOM Structured Reports using the Measurement Template (TID 1500) Finding Site, for single unifocal, multifocal and multiple lesions.

SSG07-09 Development and Evaluation of Natural Language Processing Software to Produce a Summary of Inpatient Radiographic Findings Identified for Follow-Up

Tuesday, Nov. 29 11:50AM - 12:00PM Room: S402AB

Awards
Student Travel Stipend Award

Participants
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Matthew A. Barish, MD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Manual and NLP searches for inpatient recommendations agree at a frequency sufficient to justify generation of an automated radiology discharge summary to avoid delayed or failed follow-up. NLP software accurately detects follow-up keywords in our test population of “long stay” inpatients. We are continuing to train, test and enhance the software to produce summaries containing pathologic findings, relevant anatomy, and recommendations.

Background

Hospital inpatients are subjected to multiple radiographic examinations during single admissions with frequent recommendations for follow-up of incidental findings. Urgent requirements of the patients’ care may postpone follow-up during an inpatient stay and result in failure of follow-up. Inclusion of follow-up recommendations in the discharge summary may mitigate this risk. We are evaluating a natural language processing (NLP) software tool to produce a “radiology discharge summary” to facilitate follow-up of incidental findings.

Evaluation

We obtained 503 radiographic reports from our radiology report repository by randomly selecting 43 patients with at least 7 inpatient days. A physician manually annotated the reports by searching for expressions indicating the necessity for follow-up along with pertinent anatomy, details of pathologic findings and recommendations for follow-up. A list of keywords was extracted: recommend, correlate, follow-up, consider, advise, suggest, beneficial, could perform, further evaluation, can be obtained. We trained the NLP software using the annotated reports, keywords and keyword permutations.

Discussion

There were 32 multi-study reports, resulting in 471 unique reports. 106 instances of the keywords were found in 61(13%) reports resulting in 79(17%) unique recommendations. 71(90%) recommendations were addressed during the inpatient stay or in the discharge summary. At this stage the NLP software identified 103(97%) keywords in the impression of the report. 3 keywords were not found as they were not included in the impression. NLP pattern recognition found relevant anatomy 28(53%) times in the keyword sentence, 12(23%) times in the sentence prior, and 9(17%) times prior to that. 4(8%) of relationships were misclassified.

INS-TUA

Informatics Tuesday Poster Discussions

Tuesday, Nov. 29 12:15PM - 12:45PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Christopher R. Deible, MD, PhD, Allison Park, PA (*Moderator*) Nothing to Disclose

Sub-Events

IN224-SD-TUA1 Clinical Validation of Direct Volume Estimation for Left Atrial Aneurysm

Station #1

Participants
Liansheng Wang, Xiamen, China (*Presenter*) Nothing to Disclose
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Xiantong Zhen, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose
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Mousumi Bhaduri, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Ashley J. Mercado, MD, London, ON (*Abstract Co-Author*) Nothing to Disclose
Shuo Li, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Our proposed method for the first time enables automatic volume estimation of left atrial aneurysm without segmentation and experimental results demonstrate our method achieves high estimation accuracy with a CC of 0.91 with those obtained manually by experienced doctors, which is clinically significant, indicating its potential use in the clinical diagnosis.

Background

The left atrial aneurysm is a severe heart disease, which can produce compression symptoms with diverticulum oppressing neighboring atrium and ventricle leading to arrhythmias, embolic manifestations and heart failure. Accurate volume estimation of left atrial aneurysm plays an essential role in the early diagnosis and therapy planning.

Evaluation

To handle the high variabilities and variations, we propose a new multi-view semi-supervised manifold learning (MSML) algorithm, which fuses multiple complementary features to generate compact, informative and discriminative aneurysm image representation by leveraging both labeled and unlabeled data. Based on the obtained image representation by the MSML, we adopt random regression forests to conduct direct and efficient volume estimation without segmentation. Experiments are conducted on a clinical dataset of 67 subjects with a total of 1220 images. Three evaluation metrics, correlation coefficient (CC), mean deviation (MD), and standard deviation (SD), were computed based on our direct volume estimation and ground truth manually labelled by clinical experts.

Discussion

The proposed direct estimation method achieves MD of 158.172, SD of 24.448, and a high CC of 0.91 with ground truth and largely outperforms other methods. It demonstrates the effectiveness for aneurysm volume estimation and reveals its clinical application of the proposed method. This study opens a new direction on automatic analysis of the left atrial aneurysm by providing a large annotated clinical dataset.

IN225-SD-TUA2 Experimental Reproduction of Skeletal Erosion Pattern Caused By Chronic Lymphocytic Leukemia

Station #2

Participants
Carlo Emanuele Neumaier, Genoa, Italy (*Presenter*) Nothing to Disclose
Alberto Nieri, Genoa, Italy (*Abstract Co-Author*) Nothing to Disclose
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Cecilia Marini, Genoa, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Chronic Lymphocytic Leukemia (CLL) is a heterogeneous disease characterized by low-grade proliferation of immature B-cell clone. Recently, we reported that estimation of compact bone volume (CBV) by a computational analysis of CT images can predict death rate in these patients suggesting a possible role for intraosseous microenvironment in disease progression. This study aimed to verify whether neoplastic clone is able to alter bone structure in healthy mice.

METHOD AND MATERIALS

CT slices of 40 prospectively enrolled CLL patients were submitted to our validated computational analysis to define the degree of bone alterations. Twenty NOD-SCID IL-2R γ chain null (NSG) mice were intravenously inoculated with 8x107 CLL cells sampled from the patient with the highest (10 mice, group A) or the lowest (10 mice, group B) bone erosion, respectively. Two serial high-resolution CT scan (GE Lightspeed pro32) were performed at week #3 and #6 post-xenograft according to the following parameters: 40 mA, 140 kV, DFOV 9. 6 cm, SFOV 32 cm, thickness of slices 0.625 mm. Reoriented slices of both femurs were analyzed with a computational algorithm to define their whole bone (WBV) and intraosseous (IBV volumes) as well as CBV. Ten sham NSG mice served as controls.

RESULTS

WBV was similar in all three groups at both time points. At week #3, IBV/WBV ratio was highest in group A (7.2%±1.1%) with respect to both group B (5.7%±1.1%, p<0.01 vs both) B and controls (4.2±1.3%, p<0.001 vs both), indicating skeletal erosion with cortical bone loss. Blood sampling documented an accelerated CLL progression only in group B. In agreement with this finding, IBV/WBV ratio increased only in these animals up to 8%±1% at week #6 (p<0.01 vs week#3). By contrast, femur structure remained unchanged both in group A and in control mice.

CONCLUSION

CLL induces skeletal alterations that parallel disease progression. Computational analysis of CT images is able to tell apart different B-Cell CLL grades.

CLINICAL RELEVANCE/APPLICATION

CT-based computational analysis of skeletal structure is a potential new tool to study disease progression and to test response to experimental treatments in the preclinical setting.

IN226-SD-TUA3 Conjugate Gaze Adjusted Length (CGAL):Can Evaluation of Eye Deviation in Three Dimensions Convey Critical Clinical Information in the Setting of Acute Stroke?

Station #3

Awards
Student Travel Stipend Award

Participants
Hillel S. Maresky Jr, MD, Zeriffin, Israel (*Presenter*) Nothing to Disclose
Paul Gottlieb, MD, Zerifin, Israel (*Abstract Co-Author*) Nothing to Disclose
Max Levitt, Ramat Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose
Sigal Tal, MD, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Conjugate eye deviation (CED) has been accepted for over a century as a clinical sign of acute stroke; however, two-dimensional limitations of cross-sectional imaging have kept this tool in the real of the clinician. Our purpose is to evaluate the use of three-dimensional imaging as an adjunct to diagnose acute stroke in the emergency setting, using MDCT post-processing software.

METHOD AND MATERIALS

All non-contrast CT scans of patients who presented to the emergency department with single-vessel acute ischemic stroke during the year 2013 were analyzed. Volumetric reconstruction was performed of the patient's eyes, and analyzed for CED. CGAL was calculated by dividing the vector of deviation from the centre of the globe by the diameter of the globe, and was compared to the clinical vascular territory. Kappa agreements were ascertained for right-right and left-left CED and MCA territory. CGAL was compared with NIH stroke scale on presentation. Short interval ollow-up scans (CT/ MRI) were compared with original scans for sensitivity and specificity.

RESULTS

One hundred and three patients' eyes were reconstructed. Horizontal deviation was noted in 86% of the patients (48% right, 42% left). CGAL > 0.35 was noted in 89% of the patients;48% right, 45% left. Substantial Kappa agreements were observed, with right-sided gaze and clinical right MCA territory K=0.85; left-sided gaze and clinical left MCA territory K=0.72 Follow-up CT scans for 39 patients were obtained and reconstructed, with an occurence of horizontal gaze of 56%, and right-left kappa agreements of 0.39 and 0.45, respectively. MRI performed on 31 patients showed a high DWI signal in 22 patients, with 20/22 positive showed CGAL > 0.35 ☐(Sensitivity = 90%). Eight of nine Negative DWI correlated with CGAL < 0.35 on initial CT ☐ (Specificity = 89%). CGAL correlated with stroke score with r=0.72, p=0.01.

CONCLUSION

Three-dimensional CED evaluation displays a high sensitivity and specificity for acute stroke, correlating with both vascular territory and stroke severity.

CLINICAL RELEVANCE/APPLICATION

Three-dimensional reconstruction of eye deviation reveals the powerful potential of the Prevost sign, which is may be an ancillary tool in the hands of the radiologist to appreciate cerebrovascular accident vascular territory and severity.

IN227-SD- Convolutional Neural Networks Trained on Noisy Annotations Achieve Accurate Detection and

TUA4 **Labeling of Vertebrae in Lumbar MR Images**

Station #4

Participants
Daniel Forsberg, PhD, Linkoping, Sweden (*Presenter*) Employee, Sectra AB
Erik Sjoblom, Linkoping, Sweden (*Abstract Co-Author*) Employee, Sectra AB
Jeffrey L. Sunshine, MD, PhD, Pepper Pike, OH (*Abstract Co-Author*) Research support, Siemens AG; Travel support, Siemens AG; Travel support, Koninklijke Philips NV; Travel support, Sectra AB; Travel support, Allscripts Healthcare Solutions, Inc

CONCLUSION

Accurate detection and labeling of MR images depicting the lumbar spine is possible using DL, even with readily available limited training data. These results demonstrate that allowing DL trained models to provide assistance to radiologists for their review could increase efficiency of anatomic labeling.

Background

Deep learning (DL) lately has received attention within a large number of disparate application domains, including medical imaging and radiology, and has been shown repeatedly to outperform other approaches for a variety of tasks. However, a challenge for DL is that large amounts of well curated data is typically needed for training. In this work, we investigate whether a small set of clinically annotated spine labels can be used to train convolutional neural networks (CNNs) capable of detection and labeling of vertebrae in lumbar MR images.

Evaluation

Lumbar MR cases with annotated spine labels were identified and corresponding mid sagittal T1 and T2 images along with labels and locations were extracted from the PACS. The annotations were visually reviewed to ensure a reasonable quality (labels located within the vertebral bodies). The retained data (479 cases) was randomly split into training (60%), validation (20%) and test (20%) data. Two CNNs (one general thoracolumbar vertebra detector and one specific S1 vertebra detector) were set up and trained on image patches from the training data. The validation data was used for network configuration along with optimal selection of hyper parameters. The combined detection output from the two CNNs provided the final detection and labeling output, which was evaluated on the test data.

Discussion

For the T1 images the detection sensitivity, precision and accuracy was 0.98, 0.99 and 0.97 respectively, with a labelling accuracy of 0.93 (0.98 with +/- 1 label shift). Corresponding results for the T2 images were 0.99, 0.98 and 0.97 for detection and 0.94 (0.99 with +/- 1 label shift) for labeling. Failed detections typically involved missed S1 detections, L5 misclassified as S1 or missed vertebrae that were not fully visible. Interestingly, many pathological cases were successfully detected and labeled.

IN228-SD-TUA5 **Workflow Analysis of Custom-made, Semiautomatic Software Option for MRI Quantification of Abdominal Adipose Tissue**

Station #5

Participants
Nikita Garnov, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Alexander Schaudinn, MD, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Nicolas Linder, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
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Thomas Rakete, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Nora Dipper, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Sophia Michel, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Karlas, MD, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Matthias Bluher, MD, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Arne Dietrich, 04103, Germany (*Abstract Co-Author*) Nothing to Disclose
Stefanie Lehmann, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Andreas Oberbach, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Rima Chakaroun, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas K. Kahn, MD, Leipzig, Germany (*Abstract Co-Author*) Nothing to Disclose
Harald F. Busse, PhD, Leipzig, Germany (*Presenter*) Nothing to Disclose

CONCLUSION

The custom-made software provides a viable option for fast and reliable supervised segmentation of whole-abdominal MRI data within minutes. Only minimal adjustments – suggesting best automatic preprocessing – were required for SEV patients (35–40 kg/m^2). Pre-segmented data of SUP patients (>45 kg/m^2) took longest to interactively correct for with t_{TI} still considered to be tolerable (<10 min).

Background

Quantification of visceral and subcutaneous adipose tissue (VAT, SAT) amounts has gained considerable interest in obesity research. Total AT volumes can be quantified by segmenting AT areas in tens of CT or MR images which is typically very time-consuming. Various automatic approaches have therefore been described and tested. This work presents a detailed workflow analysis of a custom-made semiautomatic MRI quantification software for users with different experience and over a wide range of BMI groups.

Evaluation

A custom-made software (under Matlab) enables the user to graphically adjust the automatically generated SAT and VAT boundaries and histogram thresholds for water-fat separation. A total of 80 patients were divided into six BMI groups: 10 normal (<26 kg/m^2), 10 overweight (26–30), 20 obese (>30, OBS), 20 severely obese (>35, SEV), 10 morbidly obese (>40) and 10 "super obese" (>45, SUP). All subjects underwent MRI at 1.5T (35 slices, 10 mm thick, diaphragm to pelvic floor). Data were analyzed by one experienced reader (R_E, all groups, n=80) and two less experienced ones (R_1 and R_2, OBS+SEV only, n=40). Automatic segmentation time (t_{AS}), manual correction time (t_{MC}, adjustment of boundaries and thresholds) and total interaction time (t_{TI}, from reading of pre-segmented images to saving of final data) were recorded.

Discussion

Mean t_{AS} was 00:28 min per dataset (0.8 s per slice). For 40 OBS+SEV patients, median t_{MC} per patient were 02:33 (R_E), 03:52 (R_1) and 03:06 min (R_2). Minimum and maximum group-specific t_{MC} by R_E were observed for SEV (00:35 min) and SUP (04:09 min); average time exposure was 02:59 min per patient. Median t_{TI} was 00:56 for SEV and 09:57 min for SUP. Threshold adjustment and modification of the VAT mask were the least and most time-consuming work step, respectively.

IN229-SD-TUA6 An Investigational Patch-based Convolutional Neural Network Model for the Detection of Clinically Significant Prostate Cancer using Multiparametric MRI

Station #6

Awards
Trainee Research Prize - Medical Student

Participants
Karthik V. Sarma, BSc, Los Angeles, CA (*Presenter*) Nothing to Disclose
Xinran Zhong, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
King Chung Ho, MSc, los angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose
Fabien Scalzo, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Kyunghyun Sung, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Nelly Tan, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Corey W. Arnold, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Despite prostate cancer being the second leading cause of cancer death in American men, the USPSTF recommends against screening to avoid overdiagnosis and treatment of indolent disease. The use of multiparametric magnetic resonance imaging (mp-MRI) has shown potential to discriminate aggressive from indolent disease. We demonstrate a convolutional neural network (CNN) that can generate a voxel-wise cancer probability map for clinically significant (Gleason score >= 7) prostate cancer.

METHOD AND MATERIALS

mp-MRI data was collected retrospectively for a set of 22 patients who had undergone radical prostatectomy. Surface mesh annotations were manually created from imaging for prostate and lesion segmentation. The prostate and tumors within were segmented by a genitourinary pathologist on whole mount histopathologic slides and manually mapped to the meshes. Ground truth was generated with any voxel contained within a lesion mesh with an assigned score >= 7 assigned to the positive class and all other prostate voxels assigned to the negative class.A CNN was trained on the resulting dataset with manually registered input channels for T2-weighted MRI, ADC, Kep, and Ktrans maps. 21x21 training patches were created for every prostate voxel with ground truth assigned based on the middle voxel. A four-layer model with two convolutional layers with max-pooling and two linear layers with dropout was used.

RESULTS

Leave-one-patient-out (i.e. 22-fold) cross-validation was performed, with results averaged across each fold. A softmax classifier was used for assignment to the lesion or normal class using a threshold calculated to give 80% specificity. For evaluation, voxels with a positive probability above the threshold value were assigned to the positive class. Average results were as follows: Accuracy 80%, AUC 0.72, S90 40%.

CONCLUSION

The patch-based CNN system was able to generate results competitive with voxel-based predictive systems. Future work includes training models with larger datasets, which could allow the use of deeper networks that may improve performance. Future models could also attempt to predict Gleason score directly instead of a dichotomized indicator and correct for motion and distortion.

CLINICAL RELEVANCE/APPLICATION

This investigation into the use of CNNs for detecting clinically significant prostate cancer in mp-MRI demonstrates that deep learning may be useful for prostate CAD.

IN230-SD-TUA7 Evaluation of a Machine Learning Approach to Protocol MRI Examinations: Initial Experience Predicting Use of Contrast by Neuroradiologists in MRI Protocols

Station #7

Participants
Steven A. Rothenberg, MD, Baltimore, MD (*Presenter*) Co-founder, McCoy Medical Technologies
Jigar B. Patel, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose
Misha H. Herscu, BA, Cambridge, MA (*Abstract Co-Author*) Co-founder, McCoy Medical Technologies
Eliot L. Siegel, MD, Baltimore, MD (*Abstract Co-Author*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc;

Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;

PURPOSE

This study was designed to determine the effectiveness of a machine learning approach to predict the administration of gadolinium based on indications extracted from report text. The goal was to investigate the potential to provide decision support to help clinicians and mid level practitioners request the most appropriate diagnostic MRI (contrast enhanced versus unenhanced) for any given indication and to improve the efficiency of MRI protocoling by radiologists.

METHOD AND MATERIALS

One thousand radiology reports of consecutive brain MRI exams and associated CPT codes were collected from the electronic medical record. A Python script extracted the indication and/or patient history from each report. Additional pre-processing steps included: deleting words with presumed irrelevance (male, female, etc.), removing all numbers, removing all punctuation and case information.
The indication and history samples were converted into three different document-term matrices (DTMs) to generate tokens of unique 1-5 word n-grams. The cross-validation used 70% of the data for training and 30% for testing. The 300 indications used for model validation were blindly protocolled by a board certified neuroradiologist.

RESULTS

Of the five types of machine learning classifiers trained and tested, the best overall performing model was Support Vector Machine with a linear kernel and TF-IDF weighting for the feature space. The sensitivity and specificity of the machine learning model to predict contrast from extracted text strings was 80.7% and 82.5% (P=0.0001) respectively, while a board certified neuroradiologist was 86.0% and 85.4%. The trained algorithm's concordance rate for choosing the correct study was 5.0% worse than a neuroradiologist.

CONCLUSION

Trained supervised machine learning classification algorithms can predict administration of contrast from reported indications for our patient population fairly well. Further advances in preprocessing, the addition of bias filters, larger data sets, and addition of relevant data from the RIS/EMR (such as renal function) may improve performance.

CLINICAL RELEVANCE/APPLICATION

This approach may streamline order entry workflow and decrease error rates for both radiologists and referring clinicians through locally relevant clinical decision support. Similar classification schema has promising applications ranging from scanner utilization workflow to clinical decision management.

IN231-SD-TUA8 Evaluation of an Imaging-centric Context-driven Annotation Engine

Station #8

Participants
Lucas Oliveira, PhD, Cambridge, MA (*Presenter*) Employee, Koninklijke Philips NV
Pritesh Patel, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Gabriel Mankovich, BSC, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
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Amir Tahmasebi, PhD, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Thomas A. Forsberg, MSc, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
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Robbert C. Van Ommering, PhD, Eindhoven, Netherlands (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Aaldert J. Elevelt, MS, Best, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Paul J. Chang, MD, Chicago, IL (*Abstract Co-Author*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

CONCLUSION

We proposed a context-driven annotation engine for radiology reading. Our evaluation demonstrated that the suggestion engine could narrow down appropriate description selection.

Background

Structured Annotation Image Markup (AIM) is a promising approach to improve the quality of reporting of radiology findings. In order for AIM reporting tools to be adopted in the routine workflow, minimal user interaction is desirable. Previous attempts at facilitated codified reporting involved complex and cumbersome selection mechanisms that were disconnected from the image context. In this study, we evaluate the extent to which image finding annotation can be improved by a RadLex-based suggestion engine incorporating contextual information in the search process driven by a codified database.

Evaluation

We designed a framework to generate a database of codified image finding descriptors from a corpus of 200,000 narrative radiology reports from an academic hospital. The framework encompasses: 1) a RadLex-based concept extraction pipeline; 2) a database for storing and querying the structured results; and 3) a description suggestion engine which uses user-supplied anatomical location and/or finding context to reduce the search space of the query.To evaluate the system, we extracted 158 unique tumor descriptors from a prospective clinical study. These descriptors contained anatomy, finding, and a series of descriptions. 77% of the annotations were covered in the database.Providing no contextual information, the suggestion engine's accuracy was <0.1. When the anatomical context was provided, 12% of the suggestions were relevant; and when both anatomical and finding context, the relevance was 25%.

Discussion

Our evaluation demonstrated that by providing anatomical and finding context, the proposed suggestion engine could narrow down the appropriate description selection to 1 out of 4. This research can be complemented by anatomical segmentation and finding characterization software to automatically generate contextual cues. Despite large corpus used to build the database, 23% of the evaluation annotations were not represented in it (e.g., “chest wall mass” was included but “chest wall lesion” was not).

IN113-ED-TUA9 Pixar Meets CT: Cinematic Rendering-A Novel, Life-Like Three-dimensional Visualization Technique

Station #9

Participants
Marwen Eid, MD, Charleston, SC (*Presenter*) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Damiano Caruso, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Moritz H. Albrecht, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Consultant, Guerbet SA
Adam Spandorfer, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ; ;

TEACHING POINTS

Present an overview of the advanced Cinematic Rendering algorithm. Discuss the potential applications of Cinematic Rendering in clinical practice. Illustrate the realistic appearance and accuracy of 3D images with Cinematic Rendering compared with traditional Volume Rendering.

TABLE OF CONTENTS/OUTLINE

Volume-Rendering technique (VRT) reconstruction is increasingly used in routine clinical radiology, and allows for calculation of accurate 3D reconstructions from the original data set. Since the impact of imaging in modern medicine is constantly growing, these VRT images are widely used in radiological routine both by referring clinicians and radiologists.Cinematic Rendering is a new prototype 3D rendering algorithm. This algorithm simulates the propagation of light rays, each with different paths, through the volumetric data as well as the interaction of light with the data, thus modelling real life physical conditions of light propagation. The resulting images provide a photorealistic and more accurate 3D representation of the acquired images compared with standard VRT.The aim of this pictorial essay is to give an overview of the Cinematic Rendering technique illustrating its potential advantages and applications in the medical field of future 3D imaging.

Lunch & Learn: From Medical Imaging to Print Innovation and Clinical Practice: Supported by 3D Systems (invite-only)

Tuesday, Nov. 29 12:30PM - 1:30PM Room: S404AB

Participants

PARTICIPANTS

Anne Garcia, Founder of OpHeart organization Houston, TX Barry T. Katzen, MD, FACR, FACC, FSIR Miami, FL Kenneth Wang, M.D., Ph.D. Baltimore, MD

PROGRAM INFORMATION

If you are interested in attending, please visit: http://bit.ly/2ewiN4k. 3D printing has been used for medical applications since the early 2000s. The technology is now being applied in many medical fields and growing. Having a tangible model of a patient's anatomy available for a physician to study or use to simulate surgery is preferable to relying solely on MRI or CT scans. Speakers will discuss latest technology innovation and the future 3D printing by sharing their experience with 3D printing practice in different fields such as orthopedics, vascular and cardiac from both clinical and human aspects S404AB 1 Because mama said so: One mother's perspective on how you are critical in saving babies' lives Anne Garcia; S404AB 2 Current and future of 3D printing applications Barry T. Katzen, MD; S404AB 3 Image-based 3D printing for surgical planning prior to shoulder arthroplasty Kenneth Wang, MD This course does not offer CME credit.

RSVP

http://bit.ly/2ewiN4k

RCA33

Creating Vector-based Drawings for Presentations and Publications with Adobe Illustrator (Hands-on)

Tuesday, Nov. 29 12:30PM - 2:00PM Room: S401AB

ED IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sarah C. Abate, BS, Ann Arbor, MI, (sabate@med.umich.edu) (*Presenter*) Nothing to Disclose
Elise Van Holsbeeck, DO, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss why we use vector based programs. 2) Explain how to use the tools in Illustrator. 3) Demonstrate how to import and label an image. 4) Demonstrate how to make one's own line drawing. 5) Demonstrate how to color and shade drawing. 6) Demonstrate how to export an image for print, PowerPoint, and Internet

Active Handout:Sarah C. Abate

http://abstract.rsna.org/uploads/2016/16005085/ACTIVE RCA33 Illustrator_FINAL.pdf

RCC33

Computer-Aided Diagnosis: Effective Use of Computer-Aided Diagnose in Clinical Practice

Tuesday, Nov. 29 12:30PM - 2:00PM Room: S501ABC

BR **CH** **GI** **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants

Hiroyuki Yoshida, PhD, Boston, MA, (yoshida.hiro@mgh.harvard.edu) (*Moderator*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

LEARNING OBJECTIVES

Learn about 1) the best uses of CAD in clinical practice, 2) current and upcoming reading paradigms for clinical use, 3) strengths and weaknesses of CAD systems, 4) characteristics and pitfalls of CAD prompts, 5) how to best incorporate CAD results into the diagnostic decision-making process.

ABSTRACT

Computer-aided diagnosis (CAD) has become a standard tool in diagnostic radiology. This refresher course will explain and demonstrate how to use three widely available CAD systems--breast CAD, lung CAD, and colon CAD--effectively in clinical practice. The purpose of CAD is to improve radiologists' diagnostic accuracy. A number of CAD systems have been made commercially available in the United States and worldwide, including CAD for the detection of breast cancer on mammograms and breast tomosynthesis, detection of lung nodules on chest radiographs and on thoracic CT, as well as detection of polyps on CT colonography. However, the use of CAD in clinical practice has not been well standardized, and its most effective use is not understood well by radiologists. Each CAD system has its own unique strengths and weaknesses depending on how it was developed and on the data that were used for its development. A good understanding of the intended use of CAD and its limitations in different modalities is important, because using CAD beyond its limitations can lead to ineffective or even harmful results. This course will provide the best CAD practices in clinical use, current and upcoming reader paradigms for clinical use, strengths and weaknesses of different CAD systems, characteristics of CAD prompts including pitfalls, and how to best incorporate CAD results into the diagnostic-decision making process.

Sub-Events

RCC33A Effective Use of Breast Computer-Aided Diagnosis in Clinical Practice

Participants

Robert M. Nishikawa, PhD, Pittsburgh, PA, (nishikawarm@upmc.edu) (*Presenter*) Royalties, Hologic, Inc; Research Consultant, iCAD, Inc;

LEARNING OBJECTIVES

1) Learn current state of computer-aided detection in screening mammography. 2) Learn new possible ways to implement computer-aided detection clinically. 3) Learn how computer-aided detection is used clinically affects its effectiveness.

ABSTRACT

RCC33B Effective Use of Lung Computer-Aided Diagnosis in Clinical Practice

Participants

Matthew T. Freedman, MD, MBA, Baltimore, MD (*Presenter*) Institutional research contract, Riverain Technologies, LLC

LEARNING OBJECTIVES

1) Be aware that CADe and image processing approaches are available to help them (a) detect lung nodules and lung cancer on chest radiographs and lung CTs, (b) the detection of change, the detection of tubes, lines and catheters on chest radiographs, and (c) to measure the extent of COPD, 2) Computer image processing approaches can suppress the visibility of ribs on chest radiographs and pulmonary blood vessels on CTs. 3) They will be informed that some CADe devices, in clinical tests, decrease the time for the detection of lung nodules and the localization of tubes, lines and catheters. 4) They will better understand a basic approach to start to select CADe software for their own clinical practices.

Active Handout:Matthew T. Freedman

http://abstract.rsna.org/uploads/2016/16005049/ACTIVE RCC33B.pdf

RCC33C Effective Use of Colon Computer-Aided Diagnosis in Clinical Practice

Participants

Stuart A. Taylor, MBBS, London, United Kingdom, (stuart.taylor1@nhs.net) (*Presenter*) Research Consultant, Robarts Clinical Trials, Inc

LEARNING OBJECTIVES

1) To understand the rational for CAD in CT colonography. 2) To appreciate the diagnostic accuracy of CAD in detecting colonic neoplasia according to lesion morphology. 3) To learn about the various CAD reading paradigms used in CT colonography, and the pros and cons of each. 4) To understand how colon CAD can be integrated into clinical practice.

INS-TUB

Informatics Tuesday Poster Discussions

Tuesday, Nov. 29 12:45PM - 1:15PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Christopher R. Deible, MD, PhD, Allison Park, PA (*Moderator*) Nothing to Disclose

Sub-Events

IN233-SD-TUB1 Application of 3D Printed Models of Diverse Hip Pathologies to Augment Resident Training

Station #1

Participants
Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Taryn Hodgdon, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The use of 3D printed models in resident education for communication of anatomically complex disease greatly facilitates understanding of disease pathophysiology.

Background

Complex hip pathologies require excellent understanding for mastery of accurate diagnosis. Unfortunately, traditional teaching may be limited in addressing complex cases requiring urgent intervention. Specifically, acetabular fractures, pre-arthritic hip deformities (e.g. femoroacetabular impingement and dysplasia), and proximal femoral fractures may pose a challenge to trainees. 3D printing has enabled facile and relatively economic exploration of intricacies of complex anatomy, rapidly granting unanticipated understanding by incorporating multisensory feedback in learning. In this study, we evaluated the potential of 3D printing in resident teaching.

Evaluation

Following ethics approval, we enrolled 15 patients representing a wide spectrum of hip disease who underwent CT imaging as part of their clinical workup. The pathologies included 5 acetabular fractures, 3 pre-arthritic hip deformities, 4 proximal femoral fractures, and 3 postoperative complications. We processed CT images using Mimics software (Leuven, Belgium) to isolate bones and the involved neurovascular structures. We then fabricated these structures on an Objet260 printer (Stratasys, Eden Prairie MN) and incorporated these models into dedicated teaching workshops. We matched 46 consenting resident physicians into control and exposure groups. Residents were assigned to either receive lectures augmented with 3D model interaction or lectures without it. Resident understanding was then formally tested using practical imaging questions as well as theoretical questions.

Discussion

3D printed models of hip pathologies facilitate learning as evidenced by significantly higher test scores in the 3D model-augmented teaching group relative to the control group. 3D printed models provide immediate tactile and visual feedback and thus enable rapid, intuitive understanding of disease pathophysiology beyond verbose textual descriptions or traditional image collations. Interaction with 3D printed models may become an important teaching modality in radiology.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

IN234-SD-TUB2 The Key Points of Automated Generation of Radiological Description from Brain MR Images

Station #2

Participants
Kentaro Akazawa, Baltimore, MD (*Presenter*) Nothing to Disclose
Ryo Sakamoto, MD, PhD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Satoshi Nakajima, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Dan Wu, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Yue Li, PhD, Baltimore, MD (*Abstract Co-Author*) Employee, AnatomyWorks LLC
Susumu Mori, PhD, Baltimore, MD (*Abstract Co-Author*) Research Consultant, AnatomyWorks LLC CEO, AnatomyWorks LLC

CONCLUSION

The key points of automated generation of radiological description from brain MR image might be how to set the threshold after corrected the spatial information reduction, relational tables and the Boolean expression.

Background

Our technologies for quantitative brain MR image analyses advanced significantly, supporting numerous MR-based brain research. However, those have been rarely adopted to clinical practice.We describe a method of automated anatomical descriptions (AAD) that summarize clinically important anatomical features from raw MR images like radiologists and clarify the problems to develop tools that would be compatible with daily clinical practices.

Evaluation

Our approach is based on several technical components. First, recent advancement in the multi-atlas image segmentation methods. Second, the ontology-based multi-granular anatomical analysis can evaluate the brain anatomy at five different segmentation levels. This approach was applied to data from more than 500 normal subjects and the age-dependent normal values were defined for all segmented structures. We applied this approach to 93 patients that were concerned about dementia and AAD about brain atrophy were generated. Three neuroradiologists (3Rs) then independently evaluated the same data and the agreement was observed.332 pairs of sentences between AAD and 3Rs were generated and 189 pairs (56.9%) were same among them. The unmatched pairs were classified based on the causes into no matched structure in 3 subjects, non-necessity to report in 22, the defined formula in 28 and the threshold setting in 90.

Discussion

There were several challenges to improve the method. Regarding the spatial information reduction, medial temporal lobe was not in the atlas. The knowledge-based clinical significant filter did not work for limbic and parietal lobe and caudate nucleus. The Boolean expression did not have the definition for amygdala and each single lobe. Radiologists seemed to change the thresholds according to the structures and solitary threshold appeared to be an issue. In this research, the subjects were concerned about dementia and the elements noted above should be changed depending on the given clinical information.

IN235-SD-TUB3 Multi-label Deep Convolutional Neural Networks for Holistic Interstitial Lung Disease Detection

Station #3

Participants
Mingchen Gao, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Ziyue Xu, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Le Lu, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Adam P. Harrison, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Ronald M. Summers, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc; ;
Daniel J. Mollura, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Computer-aided detection (CAD) of interstitial lung diseases (ILDs) using single CT images is a difficult and important medical imaging problem. The challenges stem from the tremendous variation of disease appearance, location, and configuration. In this work, we describe a new "deep learning" method using convolutional neural networks (CNN) to detect multiple ILDs simultaneously on a CT slice.

METHOD AND MATERIALS

Beyond the basic approaches from most of the previous work, focusing on predicting a single ILD label to manually pre-defined region of interest, we propose a multi-label deep regression model for holistic CT slices. Our method is composed of two main stages. First, an end-to-end convolutional neural network (CNN) network is trained directly on CT slices for ILD detection. The deep CNN regression model learns the deep image features and the final multi-label predictions simultaneously. While CNNs can learn effective image features, their feature learning strategy is not invariant to the spatial locations. To accommodate the large spatial variations of the ILD locations, the second stage of our method aggregates the learned CNN features at different network depths and turns them into location-invariant representations using Fisher Vector (FV) Encoding.

RESULTS

The proposed algorithms are evaluated on a publicly available Lung Tissue Research Consortium (LTRC) dataset. The experiments are conducted on 533 CT scans, using five-fold cross-validation. Four most typical ILDs are investigated here, Ground Glass, Reticular, Honeycomb and Emphysema. In total there are 11677 healthy CT slices, 5675, 1410, 119, and 2 slices with one, two, three, or four ILD disease types, respectively. We achieved high area-under-curve (AUC) scores of 0.982, 0.972, 0.893 and 0.993 for each disease, respectively. This is performed without the manual ROI inputs needed by much of the state-of-the-art and is the first solution to detection multiple ILDs simultaneously.

CONCLUSION

We present a new ILD detection algorithm using deep-feature learning combined with location-invariant encoding. Our work represents an important step forward in providing clinically effective ILD detection.

CLINICAL RELEVANCE/APPLICATION

The method sheds light to holistically detecting multiple ILDs simultaneously. This method can be readily adapted to other CAD problems that face similarly large spatial and appearance variations.

IN236-SD-TUB4 Clinical Applications of 3D Portable Document Format (PDF) for Image Visualization

Station #4

Participants
Peter Metherall, PhD, Sheffield, United Kingdom (*Presenter*) Nothing to Disclose
Rebecca Denoronha, MBCHB, FRCR, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Keith Chapple, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Nicholas Kelland, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Justin Lee, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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Paul Sutton, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Nikhil Kotnis, FRCR, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

Jaydip Ray, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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Frank Johnson, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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Ferekh Salim, MBChB, MRCP, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
John M. Himsworth, PhD, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Judith Sugden, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

3D PDF offers a simple and interactive method of displaying complex anatomy. Using registration techniques it is possible to easily combine models from multiple modalities and derived information such as thickness analysis. We have shown that Adobe viewer offers a versatile platform for displaying complex medical images.

Background

CT and MR volume rendered (VR) images are usually produced in the Radiology Department and saved as an animimation for the referring clinician. Whilst sufficient for some applications, if the observer needs to gain a detailed understanding of the 3D anatomy it is important that they can fully interact with the 3D image. 3D Portable Document Format (PDF) is a relatively new surface rendering method for visualising medical data and is becoming more widely available in imaging software.

Evaluation

Commercial software (3-matic, Materialise) was used to generate 3D PDF for a wide variety of clinical applications and viewed with Adobe Acrobat reader Anaplastology – Cranioplasty Cardiology – Multimodality fusion for endo/epicardial catheter ablation procedures for ventricular tachycardia ENT – Bone conduction implant planning General Surgery – Perianal fistula, abdominal vasculature for hemicolectomy Oncology – CBCT/CT fusion for transarterial chemoembolization Orthopaedic Surgery – Trochlear dysplasia and complex surgical planning Renal – complex renal stones

Discussion

The Adobe viewer offers a familiar and user friendly interface with sophisticated 3D functionality which can be extended with the JavaScript for Acrobat API. This offers programmatic control of the 3D view enabling a powerful method to customise the PDF. Accurate segmentation is imperative to obtain an authentic representation of the anatomy. Although this can often be time consuming this may be offset by benefits such as improved safety, efficacy and reduced surgical time owing to the improved understanding and confidence of the surgeon. As the models are often easier to understand than cross sectional or VR images they can also be useful for obtaining patient consent. In addition to displaying anatomy, derived data such as thickness analysis can easily be incorporated into the model.

IN237-SD-TUB5 Automated Segmentation of Liver Metastases with Deep Convolutional Neural Networks

Station #5

Participants
Eugene Vorontsov, Montreal, QC (*Presenter*) Intern, Imagia Cybernetics Inc
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Olina Dagher, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
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Simon Turcotte, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
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Franck Vandenbroucke-Menu, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Bich Nguyen, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Christopher Pal, PhD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Samuel Kadoury, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
An Tang, MD, Montreal, QC (*Abstract Co-Author*) Advisory Board, Imagia Cybernetics Inc

PURPOSE

To evaluate the agreement and accuracy of fully automated segmentation of colorectal metastases with deep convolutional neural networks (DCNN), using expert segmentation as the reference standard.

METHOD AND MATERIALS

Patient consent was waived by the institutional review board for this retrospective study based on a biobank registered by a national tumour repository network. Thirty contrast-enhanced computed tomography (CT) studies from patients with colorectal liver metastases with a total of 60 liver lesions were included. We adopted a supervised feature learning model. A feed-forward DCNN with skip connections was trained using labeled data to perform liver lesion segmentation on contrast-enhanced CT images acquired in the portal venous phase. Segmentation was evaluated on all data using five-fold leave-six-out cross-validation (in each fold, retaining 24 cases for training the model). The segmentation reference standard was based on segmentations of pathology-proven liver metastases. Reference segmentations were prepared by trainees, supervised by trained image analysts and approved by a radiologist. Dice scores and Bland-Altman analysis on tumor volume were calculated for different size thresholds (<20 mm, 20-40 mm, and ≥40 mm). Estimates of diagnostic accuracy (area under the receiver operating characteristic [AUC] analysis, sensitivity and specificity) were also computed across the dataset.

RESULTS

For size thresholds of <20 mm, 20-40 mm, ≥40 mm, and all combined, the Dice scores were respectively 0.72 ± 0.08, 0.74 ± 0.13, 0.84 ± 0.08, and 0.76 ± 0.12 (mean, standard deviation). The Bland-Altman analysis revealed inter-method agreement of 1.8 ±

24.9 mL (95% confidence interval). For pixel-wise detection of liver lesions, the AUC was 0.97; for a threshold of 0.5, the pixel-wise sensitivity and specificity were respectively 0.89 and 0.98.

CONCLUSION

Deep learning showed high accuracy for automated segmentation of liver metastases. However, preliminary results with this technique provided moderate precision, especially for larger tumors.

CLINICAL RELEVANCE/APPLICATION

Deep learning shows promise for automated tumor segmentation, but larger datasets with a wider spectrum of liver lesions will be needed to refine performance.

IN238-SD-TUB6 PI-RADS Report Builder: Semi-automated Dictation Support for Structured Reporting

Station #6

Awards
Student Travel Stipend Award

Participants
Steven A. Rothenberg, MD, Baltimore, MD (*Presenter*) Co-founder, McCoy Medical Technologies
Paul B. Stoddard, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Jason M. Thomas, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Jade J. Wong-You-Cheong, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Melina Pectasides, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Prostate Imaging Reporting and Data System (PI-RADS) is an algorithmic tool used for multiparametric prostate MRI (mpMRI) that lends itself well to structured reporting. The goal of PI-RADS is to improve methodologic rigor of mpMRI interpretation. However, there is broad resistance to the use of structured reporting in the radiology community stemming from a perceived detriment to efficiency and lack of value added. Our goal was to create a semi-automated PI-RADS report builder (RB) with a user-friendly interface. We hypothesized that this would 1) decrease time to report creation 2) increase reliability of interpretation and 3) increase accuracy.

METHOD AND MATERIALS

Retrospective, IRB-approved, HIPAA compliant study. PI-RADS (v2) scoring algorithms were scripted into a web-based, user-friendly interface to allow entry of lesion descriptors and automatically provide a PI-RADS score and structured report in return (Figure 1). Readers were blinded to the medical record and original mpMRI interpretation. Time of interpretation with or without RB was evaluated with Wilcoxon signed rank tests on a per reader basis. Reliability was assessed with intraclass correlation coefficients. Accuracy was assessed with receiver operating characteristic curve analysis using a reference standard of MRI/Ultrasound fusion biopsy.

RESULTS

Time to report creation (in minutes) significantly decreased with the RB (Reader 1: without 11.6 ± 2.88, with 7.2 ± 1.48, p = 0.042; Reader 2: without 16.2 ± 1.30, with 7.2 ± 1.30, p = 0.039). Rater reliability also greatly improved with implementation of the RB (ICC without RB = 0.455; ICC with RB = 0.974). Per reader analysis of accuracy revealed no significant change in experienced reader performance (AUC with RB = 1.0; without RB = 1.0), but improved novice reader accuracy (AUC with RB = 1.0; without RB = 0.75).

CONCLUSION

PI-RADS RB can facilitate creation of a structured mpMRI report. Our semi-automated tool increases efficiency and reliability. In more novice readers, RB also improves accuracy. Standardization of interpretation and reporting of mpMRI greatly enhances methodological rigor of mpMRI, encouraging growth in the arena of MRI/Ultrasound fusion biopsy.

CLINICAL RELEVANCE/APPLICATION

PI-RADS report builder is a semi-automated, user-friendly tool that creates a structured mpMRI report, increasing radiologist efficiency, reliability and, potentially, accuracy.

IN239-SD-TUB7 Realizing benefits of an Enterprise Imaging Platform in 27 Months by Standardizing Processes and Tools to Share Images and Information for over 18,000 Daily Clinician Accesses within the Public Healthcare System, Serving more than 8,500,000 Inhabitants

Station #7

Participants
Juan Lucas Retamar Gentil, Sevilla, Spain (*Presenter*) Nothing to Disclose
Manuel Lepe Gonzalez, Huelva, Spain (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The Enterprise Imaging Platform consists of a single instance of diagnostic viewer, centralized VNA in DC storing 30,876,056 historic exams plus replicated secondary DC. Connecting 94 hospitals plus 162 sites producing 9,859,051 of exams per year, and 1,560 ambulatory sites that consumes images and other related patient information. The project was completed in short 15 month from kick off to go-live.. 100% of Radiology and Nuclear Medicine, some Retinography, Endoscopy and ECG exams are already managed within the platform. Other "ologies" are planned. Significant economic benefits by (1) consolidating 9 disparate systems (maintenance contracts), (2) Reducing the number of integrations and optimizing support resources by the utilization of a common platform, (3) Eliminating cost of printing film with an image exchange capability. The project has a calculated payback period of 12.25 months with the annual savings rate of average 65%. The organization has already realized a cost savings of 1.58M€ during the initial 15 months project timeframe.

Background

Main objective is to guarantee the same level of care to any patient of the Region no matter where they live. Enable every clinician to treat every case with the right information and tools, no matter where he or she is located. Additional goals are upgrade to state of the art enterprise imaging solution and reduce integrations, maintenance and operating costs.

Evaluation

The System counts with 9 disparate solutions not integrated at the enterprise level. The result is a workflow that doesn't allow real collaboration amongst the clinicians. Multiple information systems and data silo's causing increasing management costs and resource constraint. Imaging exams are repeated.

Discussion

Given the scale of the regional deployment, early understanding of workflow and various system integration, clear definition of the project scope and on-going monitoring of the platform performance are all elements to success. Benefits includes flexibility to assign workload to the radiologists regardless of where images were acquired, allowing transparent access to complete patient information and use of all tools needed.

IN010-EB-TUB Application of Computer Algorithm for Detection of Uncertainty in Unstructured Radiology Reports

Hardcopy Backboard

Participants
Adi Price, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
David McCoy, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Joseph Mesterhazy, BS, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Mark W. Wilson, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Bao H. Do, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Jared A. Narvid, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The (NLP) algorithm tested is an effective tool for automatic detection of uncertainty in large numbers of unstructured radiology reports.

FIGURE

Background

The radiology report necessarily communicates the certainty or doubtfulness of particular diagnoses. Yet interpretative performance varies significantly among radiologists, affecting clinician satisfaction and patient care. The purpose of this study is to validate a natural language processing (NLP) algorithm to automatically detect uncertainty in unstructured radiology reports. We hypothesize that our algorithm demonstrates test characteristics which would facilitate the accurate detection of uncertainty in large numbers of reports.

Evaluation

Twenty terms and their derivatives indicating uncertainty from prior work were collected to build an uncertainty signal database. Additionally, reports containing disease terms felt to be associated with uncertainty (for example appendicitis) were reviewed for new uncertainty signals. An NLP algorithm running on the Apache/PHP/MySql platform was designed to accept entire unstructured reports as input and detect contextually appropriate use of expressions of uncertainty in the "Impression" section. Three-hundred and forty-five randomly selected diagnostic radiology reports across sub-specialties were independently reviewed by three radiologists and the NLP algorithm for the presence of uncertainty. Performance of the algorithm was evaluated using sensitivity, specificity, accuracy and area under the curve.

Discussion

In the adjudicated list 109 (32%) reports contained expressions of uncertainty. Inter-observer agreement regarding uncertainty between the three human reviewers was 0.50, 0.59, and 0.50. For the NLP algorithm, sensitivity, specificity, accuracy and area under the curve was 93% (95% CI: 86%, 97%), 94% (95% CI: 91%, 97%), 94% (95% CI: 89%, 98%) and 0.94 (95% CI: 0.90, 0.97). Errors in detection revealed challenges for the algorithm, such as contextually appropriate recognition of diagnostic versus other types of uncertainty, and navigating typographical or dictation errors.

IN021-EC-TUB Deep-learning-based Electronic Cleansing for Single- and Dual-Energy CT Colonography

Custom Application Computer Demonstration

Awards
Identified for RadioGraphics

Participants
Rie Tachibana, Boston, MA (*Presenter*) Nothing to Disclose
Janne J. Nappi, PhD, Boston, MA (*Abstract Co-Author*) Royalties, Hologic, Inc.; Royalties, MEDIAN Technologies;
Toru Hironaka, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Se Hyung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Daniele Regge, MD, Torino, Italy (*Abstract Co-Author*) Speakers Bureau, General Electric Company
Hiroyuki Yoshida, PhD, Boston, MA (*Abstract Co-Author*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

TEACHING POINTS

Electronic cleansing (EC) is used for subtracting tagged materials in non-cathartic CT colonography (CTC) examinations to improve the detection sensitivity of virtual endoscopic fly-through reading. The teaching points of this exhibit are to (1) introduce how EC works, (2) understand the nuisance and causes of EC artifacts that distract and mislead readers with existing EC schemes, (3) learn about the emerging deep-learning EC (DL-EC) methods, and (4) demonstrate how DL-EC improves image quality in non-cathartic single- and dual-energy CTC.

TABLE OF CONTENTS/OUTLINE

1. Introduction and background: Review the role of EC in CTC and the principles of existing EC schemes.2. EC artifacts: Review the artifacts generated by existing EC schemes, and review the diagnostic pitfalls due to these artifacts.3. Deep-learning EC (DL-EC): Present overview of the emerging DL-based EC methods for single- and dual-energy CTC.4. Image quality improvement by DL-EC: Describe the effect of DL-EC in removing image artifacts, in comparison with existing EC schemes.5. DL-EC in action: Demonstrate DL-EC results in non-cathartic single- and dual-energy CTC cases.

RCA34

3D Printing Hands-on with Open Source Software Introduction (Hands-on)

Tuesday, Nov. 29 2:30PM - 4:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Michael W. Itagaki, MD, MBA, Seattle, WA (*Moderator*) Owner, Embodi3D, LLC
Beth A. Ripley, MD, PhD, Seattle, WA, (bar23@uw.edu) (*Presenter*) Nothing to Disclose
Tatiana Kelil, MD, Brookline, MA, (Tkelil@partners.org) (*Presenter*) Nothing to Disclose
Anish Ghodadra, MD, Pittsburgh, PA, (aghodadramd@gmail.com) (*Presenter*) Nothing to Disclose
Hansol Kim, MD, Boston, MA (*Presenter*) Nothing to Disclose
Steve D. Pieper, PhD, Cambridge, MA (*Presenter*) CEO, Isomics, Inc; Employee, Isomics, Inc; Owner, Isomics, Inc; Research collaboration, Siemens AG; Research collaboration, Novartis AG; Consultant, Wright Medical Technology, Inc; Consultant, New Frontier Medical; Consultant, Harmonus; Consultant, Stryker Corporation; Research collaboration, gigmade;
Dmitry Levin, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about basic 3D printing technologies and file formats used in 3D printing. 2) To learn how to segment a medical imaging scan with free and open-source software and export that anatomy of interest into a digital 3D printable model. 3) To perform basic customizations to the digital 3D printable model with smoothing, text, cuts, and sculpting prior to physical creation with a 3D printer.

ABSTRACT

“3D printing” refers to fabrication of a physical object from a digital file with layer-by-layer deposition instead of conventional machining, and allows for creation of complex geometries, including anatomical objects derived from medical scans. 3D printing is increasingly used in medicine for surgical planning, education, and device testing. The purpose of this hands-on course is to teach the learner to convert a standard Digital Imaging and Communications in Medicine (DICOM) data set from a medical scan into a physical 3D printed model through a series of simple steps using free and open-source software. Basic methods of 3D printing will be reviewed. Initial steps include viewing and segmenting the imaging scan with 3D Slicer, an open-source software package. The anatomy will then be exported into stereolithography (STL) file format, the standard engineering format that 3D printers use. Then, further editing and manipulation such as smoothing, cutting, and applying text will be demonstrated using MeshMixer and Blender, both free software programs. Methods described will work with Windows, Macintosh, and Linux computers. The learner will be given access to comprehensive resources for self-study before and after the meeting, including an extensive training manual and online video tutorials.

Active Handout:Michael Ward Itagaki

http://abstract.rsna.org/uploads/2016/14003456/active RCA24-34 Intro to Open Source 3D Printing.pdf

RCB34

Intro to Texture Analysis (Hands-on)

Tuesday, Nov. 29 2:30PM - 4:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Presenter*) Nothing to Disclose
Barbaros S. Erdal, PhD, Columbus, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn what image texture analysis is and recognize some of its applications in Radiology through practical examples.2) Understand how to extract imaging texture features from various imaging modalities. 3) Learn how to visualize and analyze results.

ABSTRACT

During this course, an introduction to image texture analysis will be provided through hands on examples. Participants will interact with open source as well as freely available commercial platforms in order to achieve tasks such as segmentation, registration and image feature extraction. Imaging samples will include both 2D and 3D datasets from a variety of anatomical regions and modalities (CT, MR). First, a brief generic introduction will be given and concepts related to algorithm development will be discussed. Participants will then be exposed to DICOM and various visible light based formats. After hands on exercises on texture extraction, visualization of results will be covered. Finally, various quantization methods for storage and analysis will be presented.

RCC34

3D Printing: Clinical Applications II

Tuesday, Nov. 29 2:30PM - 4:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants

Dimitris Mitsouras, PhD, Boston, MA, (dmitsouras@alum.mit.edu) (*Moderator*) Research Grant, Toshiba Corporation;
Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1. Review current clinical applications of 3D printing. 2. Review of 3D printing technologies 3. Review workflows for clinical 3D printing.:4. Quality assessment of medical 3D-printed models. 5. Future directions of 3D printing in medicine.

ABSTRACT

Sub-Events

RCC34A Introduction to 3D Printing

Participants
Dimitris Mitsouras, PhD, Boston, MA, (dmitsouras@alum.mit.edu) (*Presenter*) Research Grant, Toshiba Corporation;

LEARNING OBJECTIVES

1. Review current clinical applications of 3D printing. 2. Review of 3D printing technologies 3. Review workflows for clinical 3D printing. 4. Quality assessment of medical 3D-printed models. 5. Future directions of 3D printing in medicine.

ABSTRACT

Medical 3D printing is emerging as a clinically relevant imaging tool in directing preoperative and intraoperative planning in many surgical specialties. Data from standard imaging modalities such as CT, MRI, echocardiography and rotational angiography can be used to fabricate life-sized models of human anatomy and pathology, as well as patient-specific implants and surgical guides. 3D printed models can improve diagnosis and allow for advanced pre-operative planning. Printed models are suitable for planning both surgical and minimally invasive procedures. Added value has been reported toward improving outcomes, minimizing peri-operative risk, and helping develop new procedures such as transcatheter mitral valve replacements. Anatomic models enable surgeons and interventional radiologists to assimilate information more quickly than image review, choose the optimal surgical approach, and perform a procedure more safely and in a shorter time. Patient-specific 3D-printed implants are also beginning to appear and may have significant impact on cosmetic and life-saving procedures in the future. Finally, bioprinting of full replacement organs is a major research goal. In summary, medical 3D printing is rapidly evolving and may be a potential game-changer that radiologists are ideally-suited to deliver.

RCC34B 3D Printing Workflow

Participants
Carlos H. Torres, MD,FRCPC, Ottawa, ON, (catorres@toh.on.ca) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe a 3D printing service. 2) Become familiar with common 3D printing software terminology and software capabilities. 3) Appreciate the implementation of 3D printing software in everyday clinical practice. 4) Illustrate current trends and future directions in 3D printing.

ABSTRACT

RCC34C 3D Printing in Interventional Radiology and Vascular Surgery

Participants
Matthew D. Tam, FRCR, Westcliff on Sea, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the potential roles of 3D printing in vascular surgery and interventional radiology 2) Gain an overview of the production of solid and hollow luminal models 3) See examples of use of 3D models in real cases in a vascular interventional service 4) Understand what is being done and delivered through a brief review of recent publications.

ABSTRACT

3D printing in medicine and radiology continues to be an interesting and developing field.Vascular surgery and interventional radiology procedures can benefit from 3D printing. It can be incorporated into daily practice through procedure planning and procedure execution. It can potentially advance the field through aiding implant design and development.

RCC34D Clinical Science Applications that Leverage the Use of 3D Printing

Participants

Justin R. Ryan, PhD, Phoenix, AZ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List the necessary technologies for application-specific casting. 2) Describe the methods fundamental to lost-core casting. 3) Apply casting techniques to further leverage 3D printing for the purpose of low-cost simulation and clinical/research experimentation.

SSJ13

Informatics (Enterprise Integration and Business Analytics)

Tuesday, Nov. 29 3:00PM - 4:00PM Room: S402AB

IN

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 0

Participants

Rasu B. Shrestha, MD, MBA, Pittsburgh, PA (*Moderator*) Advisory Board, General Electric Company; Editorial Advisory Board, Anderson Publishing, Ltd; Advisory Board, KLAS Enterprises LLC; Advisory Board, Peer60; Board, Pittsburgh Dataworks; Board, Omnyx, LLC;
Jonelle M. Petscavage-Thomas, MD, MPH, Hummelstown, PA (*Moderator*) Consultant, Medical Metrics, Inc

Sub-Events

SSJ13-01 Report Turnaround Time after Mobile Dictation System Implementation - An Initial Assessment

Tuesday, Nov. 29 3:00PM - 3:10PM Room: S402AB

Participants
Raja Gali, MS, Philadelphia, PA (*Presenter*) Nothing to Disclose
Jaydev K. Dave, PhD, MS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Vijay M. Rao, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Paras Lakhani, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Adam E. Flanders, MD, Narberth, PA (*Abstract Co-Author*) Nothing to Disclose
Yeeting Young, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The introduction of mobile app that lets the attending radiologist finalize a report shows a marked improvement in the turnaround time.

Background

Report turnaround time is one of the critical quality metric used in radiology and is important for patient care. This study was performed to evaluate the impact of a mobile app, designed for attending radiologist to sign-off and finalize a report, on the report turnaround time in an academic radiology department of a tertiary care center.

Evaluation

Report turnaround time data was collected 60 days before and 30 days immediately after the implementation of the mobile app (PowerScribe 360 Mobile Radiologist, Nuance Communications, Inc.) from RIS (Centricity, GE Healthcare). Data from the attending radiologists with less than 30 cases either before or after the implementation was not included in the analysis. The outcome variable tested was the average time taken from initial dictation (D) to final sign-off (F) of the report (D – F). Pre and post mobile app implementation data were compared for the entire data set and then comparisons were repeated split by modality (MRI, CT, and US) and by patient type (Emergency, Outpatient and Inpatient) Paired t-test with Bonferroni corrections for multiple comparisons was used for analysis.

Discussion

Data from 102,084 reports read by 59 attending radiologist was obtained. Aggregate data analysis showed a significant mean reduction in D – F by 3.9 hours (95% CI: 2.9 to 5.0 hours; $p < 0.05$) post mobile app implementation. Analysis split by modality also showed a significant mean reduction in D – F for CT by 2.9 hours (95% CI: 1.9 to 3.9 hours; $p < 0.05$), for MRI by 5.4 hours (95% CI: 3.8 to 7.0 hours; $p < 0.05$), and for US by 6.2 hours (95% CI: 2.2 to 10.1 hours; $p < 0.05$). Analysis was repeated split by patient type; no significant difference was noted for emergency patients ($p = 1$), while outpatients and inpatients reports showed significant reductions in D – F by 58.6% and 52.5% ($p < 0.05$), respectively.

SSJ13-02 Effect of Medical Provider Sentiment on Intensive Care Unit Diagnostic Imaging Utilization

Tuesday, Nov. 29 3:10PM - 3:20PM Room: S402AB

Participants
Mohammad Ghassemi, MSc, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Tuka Al-Hanai, MSc, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Jesse Raffa, PhD, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Shamim Nemati, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Falgun H. Chokshi, MD, Marietta, GA (*Presenter*) Nothing to Disclose

PURPOSE

The contribution of medical provider judgment to diagnostic imaging utilization is unclear. Our purpose was to investigate the effects of intensive care unit (ICU) provider sentiment in medical notes as a proxy for such judgment.

METHOD AND MATERIALS

Using the Multiparameter Intelligent Monitoring In Critical Care database (MIMIC-III), we included all adult ICU patients admitted for up to 5 days (2001-2012). Provider note sentiment was converted to positive & negative sentiment scores using SentiWordNet. Using a Poisson Generalized Estimating Equation (GEE) regression model, we performed three analyses, each with primary outcome as number of imaging exams. We adjusted for age, gender, ethnicity, illness severity, multiple comorbidities, and ICU type. First analysis: we investigated the linear association between sentiment and imaging utilization. Second analysis was identical to the first, but included quadratic terms for the sentiment features in the model. Third analysis, we estimated the effect of time on the associations found in the first two parts of the analysis by including dummy encoded ICU stay day terms, and day x sentiment interaction terms in the models.

RESULTS

We analyzed 272,879 distinct medical provider notes, from 18,607 distinct ICU stays, with 45,699 distinct days of data. There was statistically significant association between provider sentiment and imaging utilization ($p < 0.01$); negative sentiment was associated with an increase in imaging utilization. Also, the nature of the provider sentiment-imaging utilization relationship is not strictly linear, and changed over time. Sentiment's effects are most pronounced at the beginning of the stay, and grow weaker over subsequent days. We found that the presence of any form of sentiment may increase imaging utilization up until a critical threshold, beyond which utilization is reduced.

CONCLUSION

Even with a simplistic sentiment analysis method, we have shown that ICU medical provider sentiment has a non-linear (quadratic) effect on diagnostic imaging utilization that evolves over time; this likely reflects complexities in provider decision-making and medical notes that were not captured by our simplistic method.

CLINICAL RELEVANCE/APPLICATION

Provider sentiment adds a dimension to clinical decisions that has not been evaluated. Sophisticated methods may lead to decision support that incorporate sentiment to guide resource utilization.

SSJ13-04 The Patient Engagement for Equity in Radiology (PEER) project: Big-Data Driven Predictive Analytics Model to Identify Social Determinants of Health Negatively Impacting Access to Radiology Care and Develop Culturally Sensitive Healthcare Solution

Tuesday, Nov. 29 3:30PM - 3:40PM Room: S402AB

Participants
Efren J. Flores, MD, Boston, MA (*Presenter*) Nothing to Disclose
Thomas J. Bollerman, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Christina Jaworsky, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Jing Ai, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Oleg S. Pianykh, Newton Highlands, MA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The **PEER** project embraces the opportunity to mitigate the negative impact of social determinants of health and develop patient-centered, socially sensitive solutions to improve patient engagement and healthcare access.

Background

Healthcare disparities negatively affect patients and occur across many medical conditions, socioeconomic and demographic factors. The term "non-compliance" places the responsibility of attending a medical appointment solely on the patient. "Missed Care Opportunities" (MCO) reflect the responsibility of the healthcare system to improve patient engagement. Big-data predictive analytics provide an opportunity to address these factors.

Evaluation

Data obtained from radiology scheduling system and electronic medical record included age, gender, religion, race, ethnicity, address, veteran status, education level, employment, type insurance, religion, address, physical limitations, absence at clinical appointments, medical conditions and homelessness, among others. External sources, including Census data, were utilized to obtain factors such as weather conditions, median household income, public transportation access, distance to appointment, among others. Multivariate logistic regression identified factors significantly associated with MCOs. Preliminary analysis of 1.1 million outpatient exams from February 2014- March 2016 that languages other than English (OR: 1.7), certain ethnic groups compared to Caucasian (OR= 1.8) and lower education level (OR:1.3) were significantly associated ($p<0.001$) with MCOs. Among the pediatric population, obesity (OR: 2.69), ICD codes including child abuse or neglect (OR= 1.8, $p<0.001$), failure to thrive (OR: 1.6), and missed clinical visit appointments (OR: 1.7) were significantly associated with MCOs ($p<0.001$). In breast imaging, medical conditions such as congestive heart failure (OR: 2.3) and COPD (OR: 2.0) were significantly associated with MCOs ($p<0.001$).

Discussion

The predictive analytics model leverages technology to identify socioeconomic, demographic and medical factors that are strongly associated with MCOs. Identifying these factors is paramount to understand our patient's needs beyond radiology in order to bridge the healthcare gap and provide equitable care.

SSJ13-05 Contextualized Prioritization of Problem Lists for Efficient Radiologist Consumption: Algorithm Development and Evaluation

Tuesday, Nov. 29 3:40PM - 3:50PM Room: S402AB

Participants
Pritesh Patel, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
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Ranjith Tellis, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Richard J. Gorniak, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Adam E. Flanders, MD, Narberth, PA (*Abstract Co-Author*) Nothing to Disclose
Igor Trilisky, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Melvy S. Mathew, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Paul J. Chang, MD, Chicago, IL (*Abstract Co-Author*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

PURPOSE

The electronic medical record (EMR) problem list (PL) contains the patient's historical and current information in the form of ICD10 code that may be valuable to radiological interpretation. However, PLs can be lengthy and cumbersome to review as most codes are irrelevant for image interpretation (e.g., nail fungus). We developed and evaluated a data-driven algorithm that prioritizes PLs based on contextual radiological relevance.

METHOD AND MATERIALS

Development: A code relevance metric was introduced that rank ordered ICD10 codes more frequent in history sections of radiology reports (thus assumed relevant normalized by frequency in a set of PLs). To determine frequency, MetaMap detected code occurrences in a de-identified corpus of 243,374 reports; PLs of 20,148 patients were used for frequency normalization. The relevance metric was contextualized for neuroimaging exams by filtering for neuro reports and relevant PLs of patients with neuro exams. A similar process was used for abdomen, MSK, cardiac and chest examinations.Evaluation: Via survey, radiologists from two academic hospitals indicated preferred order for 20 randomly selected PLs with > 9 codes displayed in: (1) chronological, (2) indifferent or (3) decreasing relevance. Neuro-radiologists were presented the neuro-contextualized rankings, and so on. A significance level of 0.05 was used.

RESULTS

39 radiologists completed the survey (response: 20%) yielding 780 votes. The relevance order was preferred by radiologists in 40% of all PLs and chronological order preferred in 22%. Abdomen (avg score 2.3), chest (2.3) and neuro respondents (2.2) significantly preferred the relevance order; MSK readers favored the chronological order (1.7). Cardiac readers had no significant preference (2.0). There were no significant differences in the preferences between institutions.

CONCLUSION

An algorithmically determined contextual prioritization of PLs is preferred over the EMR's chronological order. The technology can be integrated in a software solution that automatically synthesizes an "executive summary" of the patient's history, signs, symptoms and problems thereby assisting the radiologist in the efficient and accurate correlation of image findings and improving the value added by the exam interpretation.

CLINICAL RELEVANCE/APPLICATION

A prioritization option can be included in problem list viewers assisting the radiologists in propagating more relevant codes to the top of the list.

SSJ13-06 MRI Schedule Optimization through Discrete Event Simulation and Neural Networks as a means of Increasing Scanner Productivity

Tuesday, Nov. 29 3:50PM - 4:00PM Room: S402AB

Awards
Student Travel Stipend Award

Participants
Michael Muelly, MD, Stanford, CA (*Presenter*) Nothing to Disclose
Shreyas S. Vasanawala, MD, PhD, Stanford, CA (*Abstract Co-Author*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;

CONCLUSION

Scanner productivity can be increased by up to 60% with optimized exam slot length. Further, neural networks can be used to reliably estimate exam length on the basis of individual patient and study characteristics.

Background

Despite advantages of MRI, CT remains the preferred modality in many clinical settings due to the higher cost of MRI. Scanner productivity may be increased with shortened scan time or improved scheduling efficiency.Most MRI facilities use fixed block lengths for scheduling. However, exams are variable in length leading to significant dead time. Our aim was to devise the optimal slot length and estimate individual scan times based on a priori data.

Evaluation

We ran a discrete event simulation using Mathworks Matlab to test different scheduling strategies for a one-month period using historical data from MR scanners used in both the in- and outpatient setting. The average exam length in July 2015 was found to be 34.9 min with a standard deviation of 11.1 min. Studies were randomly inserted into slots in repeated fashion, 1000 times each for exam slot lengths ranging from 10 to 60 minutes. Using this method, the optimal slot length to maximize productive scan time was determined to be 28.8min (CI 27.5-30.1min) resulting in an increase in the studies performed compared to 60min slots (614/month vs 355/month, $p<0.01$).Next, we used a feed-forward type neural network, trained using the same data, to predict study length with a priori information: scan protocol, patient age, contrast usage, and protocol mean of unplanned sequence repeats. On testing, the correlation coefficient was $r=0.90$ with a mean squared error of 8.6.

Discussion

A barrier to the use of MRI is cost. One way to reduce cost per exam is through reducing inefficiencies in scheduling thus increasing the number of exams performed per scanner. For convenience, exams are usually scheduled using fixed time slots often resulting in dead time. Using discrete event simulation, we have determined the slot length to maximize scheduling efficiency.To further increase efficiency fixed slot times could be completely abandoned and slot length estimated using data available a priori.

RC424

How to Use the STARD (Standards for Reporting Diagnostic Accuracy Studies) and PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Reporting Guidelines to Optimize Your Manuscript for Publication in Radiology

Tuesday, Nov. 29 4:30PM - 6:00PM Room: S502AB

IN **RS**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Herbert Y. Kressel, MD, Boston, MA (*Moderator*) Stockholder, Pfizer Inc; Stockholder, GlaxoSmithKline plc

LEARNING OBJECTIVES

1) To familiarize attendees with reasons why quality improvement initiatives are important for the dissemination of published research. 2) To discuss the components of the STARD criteria and why these are important for studies of diagnostic accuracy. 3) To describe the PRISMA statement and why these make up key components of high quality systematic reviews. 4) To enable authors to improve completeness of reporting in their submitted manuscripts, to demonstrate study quality and thus enhance the liklihood that their manuscripts will be favorably reviewed when submitted to journals such as Radiology for publication.

ABSTRACT

The purpose of this session is to describe STARD and PRISMA, two documents that aim to improve scientific study quality by improving reporting. The Editor-in-Chief of Radiology, Dr. Herbert Kressel, Professor Radiology at Harvard Medical School,will introduce the importance of quality metrics in scientific research. Dr. Patrick Bossuyt, Professor of Clinical Epidemiology at University of Amsterdam, and one of the original authors of the STARD manuscript, who recently worked to revise STARD, will discuss the components of the STARD criteria and why these are important for studies of diagnostic accuracy. Dr. Matthew McInnes, Associate Professor of Radiology at University of Ottawa, and our 2014 Eyler Editorial fellow will describethe PRISMA statement and the important key components of high quality systematic reviews. Dr. Deborah Levine, Professor of Radology at Harvard Medical School and the Senior Deputy Editor of Radiology will describe how to put all of this information together into your final study plan and written manuscript. Our goal is to enable authors to improve completeness of reporting in their submitted manuscripts, to demonstrate study quality and thus enhance the liklihood that theirmanuscripts will befavorably reviewed when submitted for publication to Radiology as well as to other biomedical journals.Please see our publication information for authors at : http://pubs.rsna.org/page/radiology/pia as well as information about checklists at: http://pubs.rsna.org/page/radiology/pia/checklists

URL

http://pubs.rsna.org/page/radiology/pia

Sub-Events

RC424A Why Reporting Guidelines are Useful

Participants
Herbert Y. Kressel, MD, Boston, MA (*Presenter*) Stockholder, Pfizer Inc; Stockholder, GlaxoSmithKline plc

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC424B STARD (Standards for Reporting Diagnostic Accuracy)

Participants
Patrick M. Bossuyt, PhD, Amsterdam, Netherlands, (p.m.bossuyt@amc.nl) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

Active Handout:Patrick M. M. Bossuyt

http://abstract.rsna.org/uploads/2016/16001981/RC424B RSNA 2016 - Bossuyt - STARD - (Handout).pdf

RC424C PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

Participants
Matthew D. McInnes, MD, FRCPC, Ottawa, ON, (mmcinnes@toh.on.ca) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

To be completed by Dr. Levine (we are co-presenting).

ABSTRACT

To be completed by Dr. Levine (we are co-presenting).

RC424D Putting It All Together

Participants
Herbert Y. Kressel, MD, Boston, MA (*Presenter*) Stockholder, Pfizer Inc; Stockholder, GlaxoSmithKline plc

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC453

Clinical Decision Support: Impact and Lessons from Large Scale Implementations

Tuesday, Nov. 29 4:30PM - 6:00PM Room: S403A

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Emanuele Neri, MD, Pisa, Italy, (emanuele.neri@med.unipi.it) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the strategy of implementation of a Clinical Decision Support System. 2) To learn from the evidences how the Clinical Decision Support System impact in the clinical practice.

Sub-Events

RC453A Results and Lesson from the Medicare Imaging Demonstration

Participants
Keith D. Hentel, MD, MS, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the lessions learned in the Weill Cornell Implementation of CDS for the MID. 2) Apply lessons learned in the MID to guide future CDS implementations.

ABSTRACT

RC453B Massachusetts General Hospital

Participants
Jeffrey B. Weilburg, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC453C Virginia Mason

Participants
C. Craig Blackmore, MD,MPH, Seattle, WA, (craig.blackmore@virginiamason.org) (*Presenter*) Author with royalties, Springer Science+Business Media Deutschland GmbH

LEARNING OBJECTIVES

1) To understand the implementation of clinical decision support at Virginia Mason. 2) To apply lessons learned from successful implementation of clinical decision support. 3) To analyze factors contributing to the success or failure of clinical decision support in decreasing inappropriate imaging.

ABSTRACT

At Virginia Mason, we published one of the earliest clinical decision support programs for advanced imaging. That program differed in many important ways from other programs, including the Medical Imaging Demonstration project, by deploying a targeted intervention directed at a limited number of high cost/high utilization studies. Our clinical decision support system achieved 25% decreases in imaging across the included studies through use of a “hard stop” barrier whereby inappropriate imaging was not permitted to proceed.

RC453D Brigham and Women's Hospital

Participants
Ramin Khorasani, MD, Boston, MA (*Presenter*) Consultant, Medicalis Corp

LEARNING OBJECTIVES

1) Understand functional requirements and components for effective CDS for imaging. 2) Using a case example, review impact of large scale implementation of imaging CDS. 3) Summarize lessons learnt to inform impactful implementation of imaging CDS in the context of new federal regulations for imaging CDS (Protecting Access to Medicare Act, PAMA, of 2014).

ABSTRACT

Clinical Decision Support (CDS) has been recognized as an important tool in helping reduce inappropriate use of medical imaging to improve the quality of care and reduce waste by providing evidence-based recommendation to ordering providers at the time of order entry. Three federal regulations aimed to assess the impact of imaging CDS on use of high cost imaging, and promote and accelerate its use. 1. (Medicare Improvements for Patients and Providers Act or MIPPA) required CMS to perform a large scale demonstration project (Medicare Imaging Demonstration or MID; 2011-2014) to assess the impact of imaging CDS based on pre-determined professional society guidelines on utilization of ambulatory targeted high cost imaging procedures for medicare fee for service patients. 2. Stage two of Meaningful Use of health IT federal regulations provide modest financial incentives for adoption of

CDS, including for imaging, and 3. Promoting Evidence-Based care section of the Protecting Access to Medicare Act (PAMA) of 2014 mandates use of imaging CDS for specified ambulatory high cost imaging services as a requirement for payment for such services beginning January 2017. Despite these ongoing federal initiatives, adoption of imaging CDS has been limited in part because of ongoing debate on best practices for implementation and use of imaging CDS.In this session, speakers with experience in use of imaging CDS, including large scale implementation, will share their experience on impact of CDS, and lessons learnt from implementation of imaging CDS to help inform best practices for imaging CDS.

RC454

Health IT Policy Panel: The New Federal Requirement for Imaging Decision Support (H.R. 4302)

Tuesday, Nov. 29 4:30PM - 6:00PM Room: S504AB

HP IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
David B. Larson, MD, MBA, Los Altos, CA (*Moderator*) License agreement, Bayer AG; Potential royalties, Bayer AG

Sub-Events

RC454A Overview of the Imaging Decision Support Requirement

Participants
Curtis P. Langlotz, MD, PhD, Menlo Park, CA, (langlotz@stanford.edu) (*Presenter*) Shareholder, Montage Healthcare Solutions, Inc; Spouse, Consultant, Novartis AG;

LEARNING OBJECTIVES

1) Understand the requirements and scope of the U.S. Federal decision support requirement in the Protecting Access to Medicare Act of 2014. 2) Learn the legal definitions of appropriate use criteria and qualified provider-led entity. 3) Review the consequences of non-compliance. 4) Recognize the challenges CMS will face in implementing the law. 5) Recognize the challenges health care organizations will face in responding to the law. 6) Learn the latest information on implementation approach and timetable.

RC454B The Origins of the Imaging Decision Support Legislation

Participants
Keith J. Dreyer, DO, PhD, Boston, MA (*Presenter*) Medical Advisory Board, IBM Corporation

RC454C Experience and Recommendations of the High Value Health Care Collaborative

Participants
Keith S. White, MD, Murray, UT, (Keith.White@imail.org) (*Presenter*) Software support, Jidoka Systems

LEARNING OBJECTIVES

1) Understand the key differentiators of a Quality Improvement (QI) from a Quality Assurance (QA) program. 2) Understand how local teams should organize to establish QI programs focusing on Priority Clinical Areas (PCAs) to optimize local success in implementing PAMA regulations. 3) Identify pitfalls and strategies to mitigate risks of implementation of PAMA regulations. 4) Identify opportunities and strategies to optimize outcomes of local implementation of PAMA regulations.

ABSTRACT

Active Handout:Keith S. White

http://abstract.rsna.org/uploads/2016/15003162/ACTIVE RC454C PAMA_Deliverable_Final.pdf

RC454D CMS Approach to Implementing the Legislation: Current Status

Participants
Joseph Hutter, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the key provisions of Section 218(b) of PAMA 2014. 2) Understand the CMS Final Rule setting up a new nationwide program for appropriate use criteria for imaging. 3) Understand the timetable for future components of the CMS program.

RCA35

Data Collection, Organization and Analysis with Excel - A Hands-On Tutorial (Hands-on)

Tuesday, Nov. 29 4:30PM - 6:00PM Room: S401AB

IN RS

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Jaydev K. Dave, PhD, MS, Philadelphia, PA, (jaydev.dave@jefferson.edu) (*Presenter*) Nothing to Disclose
Raja Gali, MS, Philadelphia, PA, (raja.gali@jefferson.edu) (*Presenter*) Nothing to Disclose
Manish Dhyani, MBBS, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe techniques for creating a spreadsheet to allow trouble-free data analysis. 2) Demonstrate key data management skills. 3) Describe tools for performing basic descriptive statistics. 4) Identify how to perform simple statistical tests and perform these tests with a sample dataset. 5) Understand how bad data (or bad data acquisition techniques) may corrupt subsequent data analyses. 6) Practice data plotting/representation techniques. 7) Identify differences between a spreadsheet and a database. 8) Identify statistical tasks that require more sophisticated software.Pre-requisites:
Familiarity with Microsoft Windows and Microsoft Excel environment will be assumed

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 to a user, familiar with Microsoft Excel environment, how this spreadsheet program may be used for such purposes. The course will begin with describing efficient approach for data acquisition and highlight key data management skills; and with reviewing commons errors that may be avoided during data logging. Then we will provide a brief introduction on basic descriptive tests before proceeding with a hands-on tutorial using a sample dataset to calculate basic descriptive statistics, and to perform basic statistical tests like t-test, chi-square test, correlation analysis, etc. Effect of corrupted data on such analysis will also be demonstrated. The final hands-on component for this course will include data plotting and representation including the use of pivot tables. The course will conclude with a discussion on identifying differences between a spreadsheet and a database, limitations of a spreadsheet program and avenues where a dedicated statistical software program would be more beneficial. A list of some of these dedicated statistical software programs for analyses will also be provided.Pre-requisites:
Familiarity with Microsoft Windows and Microsoft Excel environment will be assumed

RCB35

Making the Most of Google Docs: Docs, Slides, Forms, and Sheets (Hands-on)

Tuesday, Nov. 29 4:30PM - 6:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Ross W. Filice, MD, Washington, DC (*Presenter*) Nothing to Disclose
Aaron P. Kamer, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose
Andrew B. Lemmon, MD, Atlanta, GA, (alemmon@emory.edu) (*Presenter*) Nothing to Disclose
Thomas W. Loehfelm, MD, PhD, Palo Alto, CA (*Presenter*) Nothing to Disclose
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the benefits and drawbacks of using Google tools for collaborative editing. 2) Explain issues related to storing protected health information in Google Drive. 3) Demonstrate the ability to use the Google productivity applications for collaboration on document, spreadsheet, online form and presentation creation.

ABSTRACT

Note: Attendees should have or create a Google account prior to coming to the session.In today's busy environment, we need tools to work smarter, not harder. Google's suite of productivity applications provides a platform for collaboration that can be used across and within institutions to produce documents and presentations and to obtain and work-up data with ease. However, with increased sharing, security concerns need to be addressed. At the end of the session, learners should be able to demonstrate creating, sharing, and editing a document as a group.

RCC35

Ergonomics

Tuesday, Nov. 29 4:30PM - 6:00PM Room: S501ABC

IN **OT**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
William J. Weadock, MD, Ann Arbor, MI (*Moderator*) Owner, Weadock Software, LLC

LEARNING OBJECTIVES

1) The attendee will learn how the radiology reading room environment can physically 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 optimized 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.

Sub-Events

RCC35A Introduction to Ergonomics

Participants
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC

LEARNING OBJECTIVES

View learning objectives under main course title.

RCC35B Lessons Learned From Our Reading Room of the Future Lab

Participants
Eliot L. Siegel, MD, Baltimore, MD (*Presenter*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;

RCC35C No Strain, No Pain: A Guide to Reducing Musculoskeletal Strain and Eye Fatigue Among Radiologists

Participants
Rebecca L. Seidel, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

SPSC40

Controversy Session: Elementary, My Dear Watson: Will Machines Replace Radiologists?

Wednesday, Nov. 30 7:15AM - 8:15AM Room: E450B

IN OT

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants

John Eng, MD, Cockeysville, MD, (jeng@jhmi.edu) (*Moderator*) Nothing to Disclose
Eliot L. Siegel, MD, Baltimore, MD (*Presenter*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;
Bradley J. Erickson, MD, PhD, Rochester, MN (*Presenter*) Stockholder, OneMedNet Corporation; Stockholder, VoiceIt Technologies, LLC; Stockholder, FlowSigma

LEARNING OBJECTIVES

1) Identify the advances in machine learning that may enable computing machines to perform tasks currently performed by a radiologist. 2) Classify the key challenges facing computing machines to perform these tasks. 3) Estimate the probability that computing machines will perform these tasks within the next 20 years.

ABSTRACT

This session will address the role of computer-aided diagnosis and machine learning in the practice of radiology. The debate format will address the question of whether computers will replace radiologists in 20 years. The session will include information on state-of-the-art machine learning methods, computer-aided diagnosis results, and prognostications on these tools. Impediments to computers replacing radiologists will also be described.

URL

SPSH40

Hot Topic Session: New Informatics Tools in the Era of Managed Care

Wednesday, Nov. 30 7:15AM - 8:15AM Room: E451A

IN

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants

Sub-Events

SPSH40A Image Exchange: Pearls and Pitfalls

Participants
Andy Strickland, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

The speaker will provide our institutions history with image exchange. Describe the types of solutions we have used. Discuss the benefits and problems experienced with exchange options. Provide thoughts and ruminations of what image exchange might look like in the near future.

ABSTRACT

Image Exchange has become an important aspect of PACS programs in most hospitals in the US. For the last few years, we have used CDs that we mail or deliver to one another. The CDs are manually copied to the receiving PACS system and normalized. CDs are still an important component of image exchange in most places. In recent years, cloud-based vended solutions have become widely available. Many larger systems have built virtual private networks (VPNs) between themselves and their most common exchange partners. UW Medicine has built over 100 of these to support our high volume of (mostly) inbound exams. There are a variety of drawbacks and complications with the current state of image exchange, no matter which techniques are used. In the near future, we hope to see new options which avoid most or all of these problems. One approach, which might work for an HIE, is for a dominant member to broker all image exchanges through the use of an XDS registry that contains the metadata of all the exams generated by all the member institutions, but does not contain the images. Members of the HIE would be able to request and/or view the exams from their partner institutions. Authentication, access and audit would be centrally administered. Normalization would still be an issue, but a PIX system should at least be able to match patient identifiers in many cases and make it possible to identify potentially relevant imaging from all participating locations. The use of smart hanging protocols on PACS viewers could potentially identify relevant priors without morphing metadata first. Optionally, DICOM brokers could assist in automatically normalizing data if and when it is ingested into the destination PACS. We plan to participate IHE-based in the near future and reduce the use of our current image exchange methods, however, slow adaption to IHE profiles and available software make this difficult.

URL

SPSH40B Using Data to Improve Operational Efficiency and Quality in Emergency Radiology

Participants
Jeffrey W. Dunkle, MD, Indianapolis, IN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify key performance metrics in Emergency Radiology. 2) Differentiate between the different components of turnaround time (TAT) and the parts of wokflow they correlate to. 3) Assess trends in TAT and volume data to identify service gaps and support staffing decisions. 4) Identify types of quality improvement projects that can add extra value in Emergency Radiology.

SPSH40C Clinical Decision Support Interventions in the ED Setting

Participants
Aaron D. Sodickson, MD, PhD, Boston, MA, (asodickson@bwh.harvard.edu) (*Presenter*) Research Grant, Siemens AG; Consultant, Bayer AG

LEARNING OBJECTIVES

1) Identify potential targets for decision support interventions during ordering of Emergency Imaging. 2) Understand common implementation challenges in an ED setting. 3) Highlight potential benefits of decision support interventions to improve appropriateness of imaging and capture of relevant clinical information.

ABSTRACT

URL

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Aaron D. Sodickson, MD, PhD - 2014 Honored Educator

RC553

Tools and Use Cases for Text Information Extraction in Radiology

Wednesday, Nov. 30 8:30AM - 10:00AM Room: S404AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Paras Lakhani, MD, Philadelphia, PA, (paras.lakhani@jefferson.edu) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Place natural language processing (NLP) in context of the history of radiology reporting. 2) Review how NLP is used in disciplines outside of radiology. 3) Understand basic NLP methods. 4) Assess the applicability of NLP to radiology reports.

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.

Sub-Events

RC553A Creation of Patient-Oriented Radiology Reports with Natural Language Processing

Participants

Paras Lakhani, MD, Philadelphia, PA, (paras.lakhani@jefferson.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Potential problems with current radiology reports from a patient's point of view. 2) NLP methods to create patient centric reports. 3) Examples of patient-oriented reports created by NLP approaches.

RC553B Navigating the Available Tools and Methods for Natural Language Processing

Participants

Scott Leroy Duvall, PhD, Salt Lake City, UT, (scott.duvall@utah.edu) (*Presenter*) Research Grant, Amgen Inc; Research Grant, AbbVie Inc.; Research Grant, Anolinx LLC; Research Grant, AstraZeneca Pharmaceuticals LP; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Genentech Inc.; Research Grant, Genomic Health, Inc.; Research Grant, Gilead Sciences Inc.; Research Grant, HITEKS Solutions Inc.; Research Grant, LexisNexis Risk Solutions; Research Grant, Merck & Co, Inc; Research Grant, Mylan Specialty LP; Research Grant, Novartis International AG; Research Grant, PAREXEL International Corporation; Research Grant, Shire plc

LEARNING OBJECTIVES

1) Present a survey of open-source tools for NLP and manual chart review and how these can be built upon. 2) Demonstrate the creation of manually created reference standards against which to measure NLP systems.

ABSTRACT

Natural language processing (NLP) shouldn't be a scary term. It's not magic, but there are some things these methods can do well that you can take advantage of today. This session will walk attendees through open source tools that can easily be built upon for customized needs. Partnering fully automated NLP with manual chart review will also be introduced as a way to get the best of both worlds.

RC553C NLP and Information Extraction from Multi-institutional Radiology Reports

Participants

Curtis P. Langlotz, MD, PhD, Menlo Park, CA, (langlotz@stanford.edu) (*Presenter*) Shareholder, Montage Healthcare Solutions, Inc; Spouse, Consultant, Novartis AG;

LEARNING OBJECTIVES

1) Understand machine-learning methods for natural language processing. 2) Learn a scalable method for extraction of information from radiology reports using a simple information model. 3) Review evaluation methods for multi-institutional natural language processing research.

RC553D Natural Language Processing for Extracting and Managing Oncological Measurements

Participants

Merlijn Sevenster, PhD, Cambridge, MA (*Presenter*) Employee, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Describe challenges in extracting measurements from free-text radiology reports. 2) Explain a use case of measurement extraction in oncology research. 3) Explain a use case of measurement extraction in workflow technology adoption.

ABSTRACT

Oncological treatment response is assessed by longitudinal comparison of radiological measurements. In the dominant speech-centric workflow model, oncological measurements are dictated in narrative radiology reports and then manually transcribed into dedicated Excel spreadsheets. This process is error prone and inefficient, and may benefit from machine assistance. We present natural language processing methods to extract measurements from radiology reports and correlate them automatically accross reports.

RC554

The Use of Business Analytics for Improving Radiology Operations, Quality, and Clinical Performance (In Association with the Society for Imaging Informatics in Medicine)

Wednesday, Nov. 30 8:30AM - 10:00AM Room: E353A

IN LM SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Katherine P. Andriole, PhD, Dedham, MA, (kandriole@bwh.harvard.edu) (*Moderator*) Advisory Board, McKinsey & Company, Inc;

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.

Sub-Events

RC554A Introduction to Business Analytics Demonstrating Application to Radiology

Participants

Katherine P. Andriole, PhD, Dedham, MA, (kandridole@bwh.harvard.edu) (*Presenter*) Advisory Board, McKinsey & Company, Inc;

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 data extraction, transformation, analysis, and presentation or visualization of key performance indicators (KPI). 3) Review several example radiology use cases.

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 analyzing data, followed by dynamically presenting key performance indicators (KPI) will be demonstrated. Example use cases involving multiple database sources taken from a radiology practice will be shown.

RC554B Operational and Predictive Analytics in Radiology

Participants

Luciano M. Prevedello, MD, MPH, Dublin, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain the big data science and radiology. 2) Identify the role of informatics in capturing, extracting, analyzing, and communication quality projects. 3) Illustrate graphical dashboarding examples to support quality efforts.

ABSTRACT

RC554C Capabilities of Current and Future Business Analytics Technologies

Participants

Tessa S. Cook, MD, PhD, Philadelphia, PA, (tessa.cook@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

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

RCB41

Hands-On Basic Dicom with Horos/Osirix (Hands-on)

Wednesday, Nov. 30 8:30AM - 10:00AM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Simon Rascovsky, MD, MSc, Bogota, Colombia (*Presenter*) Officer, eDx Tecnologia en Salud SAS
Ross W. Filice, MD, Washington, DC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe basic DICOM object metadata structure. 2) Demonstrate familiarity with Osirix/Horos DICOM viewer functions including image display, and measurements. 3) Use Osirix/Horos to send/receive DICOM objects. 4) Name several common dcm4che toolkit tools, and describe their purpose.

RCC41

Structured Reporting and the RSNA Reporting Initiative

Wednesday, Nov. 30 8:30AM - 10:00AM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how to implement structured reporting across your department to make radiology reports more consistent and improve quality. 2) Describe national and international efforts to share best-pracitce radiology report templates. 3) Explore how RSNA's reporting initiative adds value to the healthcare enterprise.

Sub-Events

RCC41A Herding the Cats: Successfully Implementing a Department-Wide Standardized Reporting Program

Participants

David B. Larson, MD, MBA, Los Altos, CA (*Presenter*) License agreement, Bayer AG; Potential royalties, Bayer AG

LEARNING OBJECTIVES

1) Understand critical interpersonal elements to consider in implementing and managing a department-wide standardized structured report program. 2) Understand the technical challenges associated with implementing and managing a department-wide standardized structured report program.

ABSTRACT

Modern voice recognition technology has made department-wide standardized structured reporting feasible. However, the most significant challenges often lie in the interpersonal and organizational aspects.The author will discuss his experience in implementing and maintaining department-wide standardized structured reporting programs at two academic institutions, highlighting critical steps, major pitfalls, and strategies for success. The session will focus on those who might wish to develop department-wide structured reporting programs at their own institutions.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

David B. Larson, MD, MBA - 2014 Honored Educator

RCC41B Radiology Reporting in the Age of Precision Medicine

Participants

Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the background and rationale for RSNA's reporting initiative. 2) Describe recent advances in the technologies for radiology reporting. 3) Explore how reporting can add augment radiology's value to the healthcare enterprise. 4) Envision the latest directions and opportunities for radiology reporting.

ABSTRACT

Since 2007, the RSNA has taken a leading role in developing tools and clinical content to help radiologists improve their reporting practices. RSNA's library of best-practice reporting templates (www.radreport.org) has seen more than 2 million views and downloads. The "Management of Radiology Report Templates" (MRRT) profile and a DICOM standard for transmitting template-based reports into the electronic health record (EHR) have been recently developed. These standards, and a set of tools that use them, provide new opportunities for information from radiology reports to be integrated into the clnical enterprise. The "Open Template Library" (open.radreport.org) allows any RSNA member to contribute report templates, and the open-source "T-Rex" template editor simplifies the editing process. Through partnerships with other organizations, RSNA is seeking to improve and extend these approaches. This presentation will highlight recent advances and new directions in radiology reporting.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Charles E. Kahn JR, MD, MS - 2012 Honored Educator

RCC41C radreport.org: Facing Challenges and Moving Forward

Participants
Marta E. Heilbrun, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how to share templates on open.radreport.org Know how templates from open.radreport.org are promoted to radreport.org 2) Describe the active collaborations with the European Society of Radiology (ESR) and other societies with the RSNA structured reporting effort.

ABSTRACT

As a component of the RSNA structured reporting initiative a select template library was created and is available at www.radreport.org. In order to facilitate the exchange of templates and to identify best practices, a resource for hosting templates created by RSNA members and affiliated societies has been created at the www.open.radreport.org site. This presentation will walk the audience through the process for sharing templates on open.radeport.org and using the T-Rex editor to create MRRT templates. Additionally, the activities of the Template Library Advisory Panel (TLAP), a joint collaboration between the RSNA and the ESR will be described. The TLAP is responsible for promoting the crowd-sourced templates to the the select template library will be described.

RCA42

3D Printing (Mimics) (Hands-on)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Moderator*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Presenter*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Presenter*) Nothing to Disclose
Dimitris Mitsouras, PhD, Boston, MA, (dmitsouras@alum.mit.edu) (*Presenter*) Research Grant, Toshiba Corporation;
Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Taryn Hodgdon, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Carlos H. Torres, MD,FRCPC, Ottawa, ON, (catorres@toh.ca) (*Presenter*) Nothing to Disclose
Ai-Li Wang, Ottawa, ON (*Presenter*) Nothing to Disclose
Ekin P. Akyuz, BSc, Ottawa, ON (*Presenter*) Nothing to Disclose
Nicole Wake, MS, New York, NY (*Presenter*) Nothing to Disclose
Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Gerald T. Grant, MD, MS, Louisville, KY (*Presenter*) Nothing to Disclose
Satheesh Krishna, MD, Ottawa, ON, (dr.satheeshkrishna@gmail.com) (*Presenter*) Nothing to Disclose
John P. Lichtenberger III, MD, Bethesda, MD, (john.lichtenberger@usuhs.edu) (*Presenter*) Author, Reed Elsevier
Ashish Gupta, MD, Ottawa, ON (*Presenter*) Grant, Medtronic plc
Elizabeth George, MD, Boston, MA (*Presenter*) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Amy E. Alexander, BEng, Rochester, MN (*Presenter*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To become familiar with the computational processing of cross-sectional images required to enable 3D printing using practical examples. 2) To learn to use software to identify and extract anatomical parts from cross-sectional images using manual and semi-automated segmentation tools, including thresholding, region growing, and manual sculpting. 3) To gain exposure to techniques involving model manipulation, refinement, and addition of new elements to facilitate creation of customized models. 4) To learn the application of tools and techniques, including "wrapping" and "smoothing" to enable the accurate printing of the desired anatomy, pathology, and model customizations using Computer Aided Design (CAD) software. 5) To become exposed to Standard Tessellation Language (STL) file format and interfacing with a 3D printer.

ABSTRACT

"3D printing" refers to fabrication of a tangible object from a digital file by a 3D printer. Materials are deposited layer-by-layer and then fused to form the final object. There are several 3D printing technologies that share similarities but differ in speed, cost, and resolution of the product. Digital Imaging and Communications in Medicine (DICOM) image files cannot be used directly for 3D printing; further steps are necessary to make them readable by 3D printers. The purpose of this hands-on course is to convert a set of DICOM files into a 3D printed model through a series of simple steps. Some of the initial post-processing steps may be familiar to the radiologist, as they share common features with 3D visualization tools that are used for image post-processing tasks such as 3D volume rendering. However, some are relatively or completely new to radiologists, including the manipulation of files in Standard Tessellation Language (STL). It is the STL format that is read by the 3D printer and used to reproduce a part of the patient's anatomy. This 90 minute session will begin with a DICOM file and review the commonest tools and techniques required to create a customized printable STL model. An extensive training manual will be provided before the meeting. It is highly recommended that participants review the training manual to optimize the experience at the workstation.

Honored Educators

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Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RCB42

Intro to Statistics with R (Hands-on)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: S401CD

IN RS

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Joe C. Wildenberg, MD,PhD, Philadelphia, PA, (joe.wildenberg@gmail.com) (*Presenter*) Nothing to Disclose
James E. Schmitt, MD, PhD, Philadelphia, PA, (james.schmitt@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Install and launch the R software package. Understand how to search for and download external packages to extend R's functionality. 2) Load data from external files such as txt, csv, and xlsx. 3) Perform basic mathematical operations and utilize data structures to manipulate data. 4) Use loops to perform more complex operations over the data, including true/false logic. 5) Understand the basics of creating plots and histograms. 6) Perform common statistical tests including correlation, Chi-square, and ANOVA.

ABSTRACT

RCC42

Will MACRA and MIPS Kill Your Practice?

Wednesday, Nov. 30 10:30AM - 12:00PM Room: S501ABC

HP IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants

David C. Levin, MD, Philadelphia, PA, (david.levin@jefferson.edu) (*Moderator*) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC
Ezequiel Silva III, MD, San Antonio, TX (*Presenter*) Nothing to Disclose
J. Raymond Geis, MD, Fort Collins, CO (*Presenter*) Shareholder, Montage Healthcare Solutions, Inc; Advisor, Nuance Communications, Inc;

LEARNING OBJECTIVES

1) Understand what ramifications the Medicare Access and CHIP Reauthorization Act (MACRA) have for a radiology practice. 2) Understand what we know so far about how the Merit-Based Incentive Payment System (MIPS) will affect a radiology practice. 3) Be aware of the aspects of MIPS that are still being formulated.

ABSTRACT

SSK17

Physics (CAD)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: S404AB

CT IN PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Bram Van Ginneken, PhD, Nijmegen, Netherlands (*Moderator*) Stockholder, Thirona BV; Co-founder, Thirona BV; Research Grant, MeVis Medical Solutions AG; Research Grant, Delft Imaging Systems; Research Grant, Toshiba Corporation;
Heang-Ping Chan, PhD, Ann Arbor, MI (*Moderator*) Institutional research collaboration, General Electric Company

Sub-Events

SSK17-01 Automatic Lymph Node Cluster Segmentation Using Holistically-Nested Deep Convolutional Neural Networks and Structured Optimization in CT Images

Participants
Isabella Nogues, BA, Bethesda, MD (*Presenter*) Nothing to Disclose
Le Lu, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Xiaosong Wang, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Holger R. Roth, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Gedas Bertasius, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Nathan S. Lay, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Yohannes Tsehay, BA, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Ronald M. Summers, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc; ;

PURPOSE

To perform lymph node cluster (LNC) segmentation and volume measurement in thoracoabdominal (TA) CT images. To overcome complexity of TA LNC segmentation caused by poor intensity and texture contrast between agglomerated lymph nodes and surrounding tissues.

METHOD AND MATERIALS

This study presents a novel approach to TA LNC segmentation that combines holistically-nested neural networks (HNNs) and structured optimization (SO). Two HNNs, built upon fully convolutional neural networks and deeply supervised networks, are trained to learn LNC appearance (HNN-A) or contour (HNN-C) probabilistic output maps from TA CT images. HNN first produces class label maps with the same resolution as the given input image. Next, HNN-A and HNN-C predictions are formulated into the unary and pairwise terms of conditional random fields (CRFs), which are subsequently solved using three SO methods: dense CRF (dCRF), graph cuts (GC), and the recently developed boundary neural fields (BNF). LNC volumes are then computed from the segmentation predictions.The method was evaluated on a (publicly available) dataset containing 84 abdominal (with 395 LNs) and 87 mediastinal (with 295 LNs) CT scans. 16,268 axial slices were extracted in the portal venous phase with slice thickness 1-1.25 mm. All enlarged LNs (those with short axis diameter >=10 mm, volume range 0.24–31.74 cc, with mean 11.75 +/- 25.05 cc) were segmented by an expert radiologist.

RESULTS

BNF yields the highest quantitative results. Its mean Dice coefficient (DC) between segmented and ground truth LN volumes is 82.1+/-9.6%, compared to 73.0+/-17.6% for HNN-A alone, 69.0+/-22.0% for dCRF, and 67.3+/-16.8% for GC.BNF's LNC relative volume difference (RVD) is 13.7+/-13.1%, compared to 32.2+/-46.3% for HNN-A, 29.6+/-45.4% for dCRF, and 86.5+/-107.6% for GC.The p-values from a paired t-test comparing ground truth to segmented lymph node volumes are p=0.87 for BNF, p=0.37 for HNN-A alone, p=0.10 for dCRF, and p<<0.01 for GC.

CONCLUSION

BNF yields a state-of-the-art RVD result, which thus is promising for the development of LN imaging biomarkers based on volumetric measurements.

CLINICAL RELEVANCE/APPLICATION

Improved TA LNC segmentation and a more robust LN volume measurement will yield more accurate assessment of lymphadenopathy in oncology patients, and may lay the groundwork for improved RECIST measurements of LNs.

SSK17-02 Ensemble Deep Learning for the Improvement of the Performance of Computer-aided Detection of Polyps in CT Colonography

Wednesday, Nov. 30 10:40AM - 10:50AM Room: S404AB

Participants
Kensuke Umehara, Boston, MA (*Presenter*) Nothing to Disclose
Janne J. Nappi, PhD, Boston, MA (*Abstract Co-Author*) Royalties, Hologic, Inc.; Royalties, MEDIAN Technologies;
Toru Hironaka, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Daniele Regge, MD, Torino, Italy (*Abstract Co-Author*) Speakers Bureau, General Electric Company
Takayuki Ishida, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroyuki Yoshida, PhD, Boston, MA (*Abstract Co-Author*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

PURPOSE

To develop and evaluate an ensemble deep learning (EDL) in the improvement of the detection performance of computer-aided detection (CADe) of polyps in CT colonography.

METHOD AND MATERIALS

A total of 154 CT colonography (CTC) cases were sampled from a large multi-center CTC screening trial. A deep convolutional neural network (DCNN) that had been pre-trained with millions of natural non-medical images was re-trained to identify polyps by use of virtual endoluminal (VE) images of the polyp candidates that were obtained by application of our existing CADe system to these CTC cases. Seven different types of rendering were generated for each of the VE images. An EDL was developed by first re-training seven DCNNs on the seven types of rendered VE images, and then combine them by a super-learner algorithm using a random forest classifier as the meta-classifier. The resulting EDL was reviewed the VE images of the polyp candidates to determine the final detected polyps. For evaluation, the 154 CTC cases were divided randomly into a training and a test dataset. The test set contained 107 biopsy-confirmed adenomas and carcinomas ≥6mm in size: 69 were ≥10 mm and 38 were 6–9 mm in size. The performance of the EDL on the test dataset was evaluated by sensitivity analysis compared with that of the baseline CADe and a single DCNN with McNemar test.

RESULTS

At 4.3 FPs per patient, the per-polyp sensitives of CADe, DL, and EDL were 84.1%, 91.6%, and 93.5%, respectively, for polyps ≥6 mm; and 84.1%, 97.1%, and 97.1%, respectively, for polyps ≥10 mm. The sensitivity difference between CADe and EDL was statistically significant (for polyps ≥6 mm, p=0.002; for polyps ≥10 mm, p=0.03). The CADe scheme yielded 93.5% of the polyps at 12.7 FP detections per patient on average. With the application of EDL, the number of FP detections was reduced to 4.3 per patient (66% reduction) at the same sensitivity.

CONCLUSION

EDL can significantly improve the performance of CADe of polyps in CTC.

CLINICAL RELEVANCE/APPLICATION

The EDL-based CAD could be used to provide a high detection accuracy of polyps in screening population.

SSK17-03 Detectability of Simulated Low-Contrast, Low-Attenuation (LCLA) Liver Lesions on CT: A Comparison of Two Alternate Forced Choice (2AFC) Human Observer Results with Channelized Hotelling Observer and Contrast-to-Noise Ratio for both FBP and ADMIRE

Wednesday, Nov. 30 10:50AM - 11:00AM Room: S404AB

Participants
Arjun Maniyedath, MS, Shaker Heights, OH (*Abstract Co-Author*) Employee, Plexar Associates, Inc
Frank Dong, PhD, Solon, OH (*Presenter*) Equipment support, Siemens AG Software support, Siemens AG
Jordyn Bauer, Solon, OH (*Abstract Co-Author*) Nothing to Disclose
Andrew Primak, PhD, Malvern, PA (*Abstract Co-Author*) Employee, Siemens AG
Wadih Karim, RT, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Lucy D'Agostino McGowan, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose
Nancy A. Obuchowski, PhD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Siemens AG; Research Consultant, QT Ultrasound Labs; Research Consultant, Elucid Bioimaging Inc
Mark E. Baker, MD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Bracco Group; Researcher, Siemens AG; Research support, Siemens AG
David Rohler, PhD, Shaker Heights, OH (*Abstract Co-Author*) Employee, Plexar Associates, Inc
Brian R. Herts, MD, Cleveland, OH (*Abstract Co-Author*) Research Grant, Siemens AG

PURPOSE

To compare the LCLA lesion detectability accuracy of Channelized Hotelling Model Observer (CHO), Contrast-to-Noise Ratio (CNR) and area-weighted CNR (CNRa) against Human Observer detection accuracy (2AFC), for both filtered back-projection (FBP) and Advanced Modeled Iterative Reconstruction (ADMIRE).

METHOD AND MATERIALS

A custom designed abdominal phantom with liver insert (90 HU density) containing 3 copies each of 4 unique low-attenuation spherical lesions (15 mm x 6 HU, 10 mm x 12 HU, 10 mm x 18 HU, and 5 mm x 24 HU lesion contrasts) was scanned on a Siemens Somatom Force CT scanner at 6 exposure settings: 200, 160, 120, 80, 40 and 20 effective mAs without automated exposure control. A total of 100 repeat scans were done at each exposure level and images were reconstructed with both FBP and ADMIRE (strength A3). A 19 reader Naïve Human Observer (NHO) study in the form of a 2AFC experiment was performed on 577 pairs of lesion-present and lesion-absent images that were selected from one set of the four unique lesions, and the accuracy (AUC) values were computed for both reconstruction modes. A CHO (with internal noise) with 40 Gabor channels was used to evaluate pairs of 100 images, and the accuracy values (Area Under the Curve (AUC)) were computed. The internal noise for CHO was calibrated using the AUC result from data corresponding to FBP at 160 mAs from the NHO analysis. CNR and CNRa and the corresponding scaled accuracy values were also computed for the select lesions. The NHO 2AFC results were compared with the accuracy from CHO, CNR and CNRa and linear regression coefficients (R^2) were calculated.

RESULTS

CNR showed poor correlation with human observer results, with R^2 values of 0.28 and 0.39 for FBP and ADMIRE respectively, and 0.48 and 0.44 respectively for CNRa. CHO showed strong correlation with humans with a R^2 value of 0.88 and 0.92 for FBP and ADMIRE respectively.

CONCLUSION

Our analysis showed good overall detectability correlation of CHO with human results for both ADMIRE and FBP at all exposure levels and for all lesions.

CLINICAL RELEVANCE/APPLICATION

Objective assessment of detectability performance in a controlled environment is important in order to determine the dose reduction

Objective assessment of detectability performance in a controlled environment is important in order to determine the dose reduction potential of novel iterative reconstruction methods. Validation of good correlation between CHO and human observers demonstrate that rigorous human observer studies can be replaced with simpler CHO studies.

SSK17-04 3D Computer-Aided Detection System for Lung Nodule: Comparison of Detection Performance between Filtered-Back Projection and Iterative Reconstruction Methods at Standard-, Reduced and Ultra-Low-Dose CT Levels

Wednesday, Nov. 30 11:00AM - 11:10AM Room: S404AB

Participants
Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Presenter*) Research Grant, Toshiba Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Fuji Pharma Co, Ltd; Research Grant, FUJIFILM RI Pharma Co, Ltd; Research Grant, Guerbet SA;
Kota Aoyagi, Otawara, Japan (*Abstract Co-Author*) Employee, Toshiba Corporation
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Hisanobu Koyama, MD, PhD, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuro Sugimura, MD, PhD, Kobe, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

PURPOSE

To determine the utility of iterative reconstruction (IR) method on a 3D computer-aided detection (CAD) system for pulmonary nodule at standard-, reduced- and ultra-low-dose CTs (SDCT, RDCT and ULDCT) as compared with filtered-back projection method.

METHOD AND MATERIALS

Forty patients prospectively underwent chest CT examinations at MDCT scanners with SDCT (250mA), RDCT (50mA) and ULDCT (10mA) protocols, and CT data were reconstructed into 1-mm-thick images with and without commercially available IR method (i.e. adaptive iterative dose reduction using 3D processing: AIDR 3D). Therefore, the following CT data set in each patient was reconstructed: SDCT with and without AIDR 3D, RDCT with and without AIDR 3D, and ULDCT with and without AIDR 3D. Then, nodule detections were automatically performed by our proprietary CAD software. To determine the utility of IR method for improving nodule detection capability, sensitivity and false positive rate (/case) of the CAD system were also compared among all protocols by means of McNemar's test or signed rank test.

RESULTS

The gold standard consisted of 101 (48 solid and 53 sub-solid) nodules. Although there were no significant difference of false-positive rate among all protocols, sensitivities of RDCT and ULDCT with AIDR 3D (RDCT: 72.3% , ULDCT: 66.3% <2.9/case>) were significantly higher than that without AIDR 3D (RDCT: 56.4% <2.9/case>, p<0.0001; ULDCT: 35.6% <2.9/case>, p<0.0001). Sensitivity of SDCT with and without AIDR 3D (with AIDR 3D: 73.3% <2.8/case>, without AIDR: 76.2% <2.6/case>) were significantly higher than that of RDCT without AIDR 3D (p<0.0001) and ULDCT with and without AIDR 3D (p<0.0001), although there were no significant differences of sensitivity between SDCT with and without AIDR 3D and RDCT with AIDR 3D (p>0.05).

CONCLUSION

Iterative reconstruction method is useful for improving nodule detection performance on a 3D CAD system at reduced- and ultra-low-dose CTs as compared with filtered-back projection method. When applied AIDR 3D, 75% radiation dose can be reduced without decreasing detection performance on 3D CAD system.

CLINICAL RELEVANCE/APPLICATION

Iterative reconstruction method (i.e. AIDR 3D) is useful for improving nodule detection performance on a 3D CAD system at reduced- and ultra-low-dose CTs as compared with filtered-back projection method. In addition, when applied AIDR 3D, tube current would be better to be set equal to or more than 50mA in this setting.

SSK17-05 CAD Performance on a Large Cohort of National Lung Screening Trial Patients at Screening and Sub-screening Doses

Wednesday, Nov. 30 11:10AM - 11:20AM Room: S404AB

Participants
Stefano Young, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
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Grace Lee, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Matthew S. Brown, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Abstract Co-Author*) Institutional research agreement, Siemens AG Research support, Siemens AG

PURPOSE

Lung cancer screening is designed to be low-dose and high-throughput. CAD tools promise to assist radiologists in analyzing the influx of screening exams. However, the effects of dose on CAD performance are not fully understood. In this work, we investigated the impact of reducing the dose further than the National Lung Screening Trial (NLST) dose protocols.

METHOD AND MATERIALS

The raw CT data files from 481 NLST patients were collected and input to a reduced-dose simulation software. The original NLST protocols called for 25 mAs for standard-size patients and 40 mAs for larger patients. We simulated reduced-dose scans corresponding to 50% and 25% of the original protocols. All cases were reconstructed at the scanner (Sensation 64, Siemens Healthcare) with 1 mm slice thickness and B50 kernel. The lungs were segmented in MeVisLab software, and then all images and segmentations were input to an in-house CAD algorithm. CAD results were compared to a reference standard generated by an experienced reader as part of the NLST. We computed subject-level sensitivities, false-positive rates, and analyzed the relative change in those metrics with dose. LungRADS categories were also assigned to each nodule based on nodule size and solidity, and a sub-analysis was peformed by LungRADS category.

RESULTS

For larger category 4 nodules, median sensitivities were 100% at all three dose levels, and mean sensitivities were 72%, 63%, and 63% at original, 50%, and 25% dose respectively. Overall mean subject-level sensitivities were 38%, 37%, and 38% at original, 50%, and 25% dose due to the prevalence of smaller category 2 nodules. The mean false-positive rates were 3, 5, and 13 per case.

CONCLUSION

The results suggest some loss of CAD sensitivity with dose for larger nodules, although overall sensitivity appeared unaffected by dose. The false-positive rate increased substantially at 25% dose, illustrating the difficulty of adapting CAD to very challenging, high-noise screening exams.

CLINICAL RELEVANCE/APPLICATION

Care should be taken to adapt CAD algorithms for very challenging, high-noise lung screening exams.

SSK17-06 Computational Detection, Analysis, and Classification of Lytic, Sclerotic, and Mixed Spinal Metastases on PET/CT Imaging

Wednesday, Nov. 30 11:20AM - 11:30AM Room: S404AB

Participants
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Ronald M. Summers, MD, PhD, Bethesda, MD (*Presenter*) Royalties, iCAD, Inc; ;

PURPOSE

To develop a fully-automated system to detect, analyze, and classify spinal metastases on 18F-FDG PET/CT, integrating CT and PET features into lesion segmentation algorithms and classifiers

METHOD AND MATERIALS

The most common locale for spinal metastases, thoracic and lumbar vertebral bodies, is targeted. Modeling clinical evaluation, fused images are created. To utilize the higher dimensional operation capability of computers, two image sets are produced for each study by weighted integration of PET with CT data, with one set for lytic and one for sclerotic loci, for density amplification by PET activity. Spine segmentation/partitioning is performed, and watershed, graph cut, and level set algorithms are used to obtain initial detections. If a preliminary lytic and a sclerotic detection are spatially overlapping, they are merged and sent to a mixed lesion SVM classifier; otherwise, they are routed to lytic and sclerotic lesion classifiers, respectively. 10-fold cross validation was employed to evaluate classifier performance The system was tested on PET/CTs of 53 patients (average age 53 (range 21-68), 28 F, 25 M). 35 patients had reported spinal metastases. 266 of 901 vertebrae demonstrated metastases. The numbers of lytic, sclerotic and mixed lesions were 205, 286, and 120, respectively

RESULTS

The sensitivities for detecting lytic, sclerotic and mixed lesions were 79.4% (95% CI [75.6%, 82.3%]), 80.8% (95% CI [76.7, 84.4]), and 80.2% (95% CI [74.2, 84.3]), respectively, with a false-positive (FP) rate of 2.1, 1.7 and 0.9 per patient. With only CT data used, performance sensitivity was 64.3%, 70.5%, and 48.6%, for lytic, sclerotic and mixed lesions respectively at a FP rate of 1.9, 1.9 and 1.0 per patient. Performance improvement with PET/CT fusion is statistically significant ($p<0.01$). There were 32 FP in 18 control cases. Lesions ranged from 4 to 37 mm size, and were most common from T9 to T12. FP detections were most often due to bone islands. False negatives occurred with small lesions/insufficient activity on PET

CONCLUSION

A multi-classifier quantitative analysis system was created to detect, classify, and generate metrics for metastatic lesions of the vertebral bodies in the thoracic and lumbar spine on 18F-FDG PET/CT

CLINICAL RELEVANCE/APPLICATION

Quantitative characterization of metastatic lesions to the spine can assist ongoing efforts to develop new clinically relevant response criteria to guide patient therapy.

SSK17-07 Dynamic Texture Feature Analysis Using Dynamic Contrast-Enhanced CT Applied to Malignant Pleural Mesothelioma

Wednesday, Nov. 30 11:30AM - 11:40AM Room: S404AB

Participants
Eyjolfur Gudmundsson, Chicago, IL (*Presenter*) Nothing to Disclose
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Buerkley Rose, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this work was to investigate the utility of texture analysis of dynamic contrast-enhanced computed tomography (DCE-CT) scans in the assessment of tumor response for malignant pleural mesothelioma (MPM).

METHOD AND MATERIALS

Two DCE-CT scans were acquired at approximately 3-month intervals from a total of 16 MPM patients, of whom eight were on treatment and eight were on observation. The dynamic component of the scans involved the imaging of a 55-mm thick slice of thoracic anatomy at 25 time points immediately following the start of contrast injection. Visible tumor within the dynamically imaged anatomy of each patient was manually contoured. These contours were projected to other time points of the scan using deformable image registration and eroded by one voxel to limit the effect of misregistration and inadvertent inclusion of non-tumorous tissue. Twelve first-order texture features were calculated from the tumor voxels at each time point. The relative change in texture feature values from the start of contrast injection was calculated for all time points of each scan, as was the difference in these relative changes between the first and second scans. A Wilcoxon rank-sum test was used to test whether the median relative change in texture feature value and the median difference in relative change between the two scans were significantly different between the two patient cohorts.

RESULTS

The texture features interquartile range, mean HU value, median HU value, energy, and entropy each showed significant differences ($p < 0.05$) between the two patient cohorts at ten or more time points for the second DCE-CT scan. Differences in relative change between the two scans were statistically significant between patients on treatment and patients on observation at seven time points across all texture features.

CONCLUSION

Observed differences in median texture feature values between patients on treatment and patients on observation for the second scan of this study suggest that dynamic texture analysis is sensitive to MPM tumor response. This finding should be validated in future studies using a larger patient cohort and a more unified treatment regimen.

CLINICAL RELEVANCE/APPLICATION

Ultimately, this work could lead to more sophisticated methods to assess tumor response in MPM patients.

SSK17-08 Performance Evaluation of Machine-Learning-based Electronic Cleansing Schemes for Ultra-Low-Dose Dual-energy CT Colonography

Wednesday, Nov. 30 11:40AM - 11:50AM Room: S404AB

Participants
Junko Ota, Boston, MA (*Presenter*) Nothing to Disclose
Rie Tachibana, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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Toru Hironaka, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Daniele Regge, MD, Torino, Italy (*Abstract Co-Author*) Speakers Bureau, General Electric Company
Hiroyuki Yoshida, PhD, Boston, MA (*Abstract Co-Author*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

PURPOSE

To develop and evaluate accuracy of machine-learning electronic cleansing (ML-EC) schemes for non-cathartic ultra-low-dose dual-energy CT colonography (DE-CTC).

METHOD AND MATERIALS

Thirty-two patients were prepared for non-cathartic colorectal examinations by oral ingestion of 50 ml of iodinated contrast on the day before and two hours prior to DE-CT (SOMATOM Definition Flash) scans. The DE-CTC images were acquired at a current/voltage of 15 mAs/140 kVp and 40 mAs/80 kVp and reconstructed with sinogram-affirmed iterative image reconstruction. Our ML-EC performed a water-iodine material decomposition of the DE-CTC images and calculated virtual-monochromatic (VM) images at multiple energies for preparing radiomic image set, after which a machine-learning method [k-nearest neighbors (kNN), random forest (RF) and deep learning (DL)] was used to label the images into regions of lumen air, soft tissue, fecal tagging, and two types of partial-volume boundaries based on the features of these images. The EC was performed by removing materials other than soft tissues from the original CTC images. For pilot evaluation, 384 volumes of interest (VOIs) where current EC schemes generate typical EC artifacts (Type I: air-tagging boundary; Type II: three-material layer; Type III: three-material mixture) were extracted and labeled into a reference standard. The EC accuracy was evaluated by means of the mean overlap ratio (OR) between the reference standard labels and the labels generated by the ML-EC schemes.

RESULTS

In the DL-based ML-EC scheme, the mean±std of ORs for Types I, II, and III artifacts were 0.984±0.029, 0.932±0.046, and 0.958±0.021, respectively, which were higher than those of kNN-based ML-EC (0.975±0.035 [p<.001], 0.895±0.058 [p<.001], and 0.938±0.027 [p<.001], respectively), and RF-based ML-EC (0.982±0.032 [p=.11], 0.913±0.064 [p<.001], and 0.953±0.025 [p<.001], respectively). Visual assessment confirmed that the DL-based ML-EC generates less EC artifacts than do kNN- and RF-based ML-EC.

CONCLUSION

Our DL-based ML-EC scheme yields superior performance over kNN- and RF-based ML-EC schemes in identifying and minimizing subtraction artifacts on non-cathartic ultra-low-dose DE-CTC images.

CLINICAL RELEVANCE/APPLICATION

Current electronic cleansing methods for visualization of the colonic surface in CTC produce subtraction artifacts. The proposed method shows potential to minimize these artifacts and to facilitate non-cathartic examinations.

SSK17-09 Multivariate Modeling of Nodule Recognition in 3-D Chest CT using Gaze Tracking

Wednesday, Nov. 30 11:50AM - 12:00PM Room: S404AB

Participants
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Geoffrey D. Rubin, MD, Durham, NC (*Abstract Co-Author*) Consultant, Fovia, Inc; Consultant, Informatics in Context, Inc; Research Consultant, General Electric Company;

PURPOSE

Nodule detection in CT scans requires a large volume to be visually scanned for small objects. Recognition of potential nodules is a critical step towards detection. However the process of recognition is unknown, involving potential factors such as search strategy, size of the nodule and visible cross sectional area of the lung. Using gaze tracking data from chest CT reads, we developed a multivariate probabilistic model to elucidate the importance of these factors in the recognition process and the variation across readers with various levels of training.

METHOD AND MATERIALS

Gaze data was collected from 13 readers, ranging from 1st year residents to attending radiologists. Each reader examined 40 chest CTs, each embedded with 3-6 simulated nodules. Nodule recognition is modelled as a spatio-temporal Poisson process. The instantaneous probability of nodule recognition (IPR) was modelled as a linear combination of i) gaze distance from the nodule center at the moment of recognition (DG); ii) the visible cross-sectional (CS) size of the embedded nodules (nodule CS); iii) visible CS area of the lung (lung CS) using generalized Poisson regression. The linearity assumption was validated by considering a smooth (potentially non-linear) additive function of the variables.

RESULTS

The mean (SD) of 25th and 75th percentiles of DG were 1.71 (0.49) and 5.35 (1.30) cm respectively across readers. The IPR decreased approximately exponentially with increasing DG for all 13 readers ($P<0.00001$), with a mean (SD) rate of decrease of 27.6% (8.8%) /cm across readers. The nodule CS effect was significant in 11/13 readers ($P<0.005$) with a mean (SD) rate of increase in IPR of 8.6% (4.2%) /mm2. The IPR decreased at a mean rate of 0.6% (0.2%)/cm2 with increasing lung CS, with significant effects for 12/13 readers ($P<0.001$).

CONCLUSION

Nodule recognition often occurs when the gaze is far from the target; the probability of recognition increases approximately exponentially with proximity. Factors like nodule size and lung cross section size also significantly impact recognition. Despite the variation in experience, the recognition process appears to be similar across readers.

CLINICAL RELEVANCE/APPLICATION

We have quantitatively characterized the process of nodule recognition during free search of 3-d chest CT scans. The insights from this characterization may lead to the development of CAD algorithms which work complementarily to the human recognition process.

INS-WEA

Informatics Wednesday Poster Discussions

Wednesday, Nov. 30 12:15PM - 12:45PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants

Arnon Makori, MD, Chicago, IL (*Moderator*) Medical Advisory Board, Carestream Health, Inc

Sub-Events

IN240-SD-WEA1 Validation of Natural Language Processing Tools for Identification of Pulmonary Embolism in Clinica Alemana Between 2013-2014

Station #1

Awards

Student Travel Stipend Award

Participants

Esteban E. Hebel, MD, Santiago, Chile (*Presenter*) Nothing to Disclose
Guillermo J. Ortiz, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Claudio Silva Fuente-Alba, MD , Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Our study proves that the use of NLP has a very high performance for identification of patients with PE.

Background

The extensive adoption of picture archiving and communication systems (PACS) has enabled access to a great volume of valuable information for institutional work. Natural language processing (NLP) has proven to be effective in analyzing the content of reports to identify diagnosis and patient characteristics. Unfortunately, very little has been done in Spanish. Such a tool would allow identifying cases of interest among a large volume of non-structured reports. The objective of this study was to develop and evaluate multipurpose NLP software for detection of pulmonary embolism (PE) cases among computed tomography pulmonary angiography (CTPA) reports in our center between 2013-2014.

Evaluation

In this IRB approved study, all diagnosis were tagged (using SNOMED-CT terminology) in a significant random sample of the 1973 CTPAs performed (n=219), in search of concepts and relevant relationships, such as negations and timing of the diagnosis on each report's conclusion. A classifier was developed that would identify relevant studies for PE and its negations. The classification models were assessed using measures of precision, recall and F-measure. Statistical significance was calculated using a x2 test for dichotomical variables, considering a p-value of 0.05, and estimating 95% confidence intervals when feasible.
Out of all the CTPAs, a total of 51.4 percent were performed to women, with a median age of 57.9 years (IQR: 44-72). The tool correctly identified 26 (11.9%) positive studies and 190 negative studies for current PE. It failed to identify one case and miscategorized two cases as positive. The software obtained a F-measure of 0.946, with precision and recall of 92.9% and 96.3% respectively ($p<0.001$).

Discussion

Much of the report information in PACS persists in free-text format, which is a challenge to be used for research, teaching or quality improvement. Although our software was designed to study one condition in particular, it was developed with multipurpose in mind by using SNOMED-CT, in order to use non-structured information from radiology reports in any clinical context.

IN241-SD-WEA2 Addressing the Challenges of Patient Problem Lists with Radiology Structured Reporting

Station #2

Participants

David J. Vining, MD, Houston, TX (*Presenter*) Royalties, Bracco Group; CEO, VisionSR; Stockholder, VisionSR
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Adrian Prisacariu, Houston, TX (*Abstract Co-Author*) Employee, COMPUTER PATRISOFT SAC
Mark Kontak, Houston, TX (*Abstract Co-Author*) Consultant, VisionSR, Inc

CONCLUSION

Many critical deficiencies exist today with patient problem lists. Radiology structured reporting employing SNOMED-CT coding and filtering by medial priorities and disease timeline analysis can be used to create meaningful and relevant PPLs.

Background

The creation of patient problem lists (PPLs) containing current and active diagnoses for each patient in an electronic health record (EHR) was mandated in Meaningful Use Stage 1, and this was followed by Stage 2 which required diagnoses to be coded with SNOMED-CT terminology. Many problems confront the creation of meaningful PPLs including the lack of EHR tools to achieve efficient coding, under-coding (e.g., selecting pneumonia vs. viral pneumonia), incorrect coding, failure to code, over-coding with exceedingly long lists, and not updating lists to include only active diagnoses. A solution to these problems is found in a radiology structured reporting system since image findings form the basis of many PPL diagnoses.

Evaluation

We develop a structured reporting system that captures key images and voice descriptions of each image finding, tags the images with SNOMED-CT terms, and assembles a multimedia structured report that is organized by anatomical categories or medical priorities. Each diagnosis is prioritized on a 5-point scale to indicate a level of action required by a clinician: 1 Incidental, 2 Important (needs serial monitoring), 3 Indeterminate (needs further evaluation), 4 Urgent, 5 Life-threatening. The system links related serial findings in disease timelines to calculate temporal data for each finding. The list of radiological findings can be filtered to exclude incidental findings and those that have been inactive for a period of time. As a result, dynamic PPLs can be generated to supplement EHR PPLs.

Discussion

Multimedia structured reporting provides a means to not only create standardized radiology reports but also create lists of radiological diagnoses that can supplement an EHR PPL. The implementation of filtering to exclude incidental findings and inactive problems can help to guide PPLs to support meaningful use and clinical quality measures.

IN242-SD-WEA3 Segmentation Label Propagation using Deep Convolutional Neural Networks and Dense Conditional Random Field

Station #3

Participants
Mingchen Gao, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
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Daniel J. Mollura, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Incomplete labeling is a common issue within medical image datasets due to the labor-intensive and expert-driven nature of annotations. In this work, we describe a segmentation-based propagation method that fully annotated datasets based on partial labeling.

METHOD AND MATERIALS

Robust supervised learning within medical image analysis relies upon the availability and accessibility of large-scale annotated datasets. However, many datasets are only partially labeled. For instance, on the publicly available University Hospitals of Geneva (UHG) interstitial lung disease (ILD) dataset, less than 15% of the lung region is labeled, significantly restricting the amount of training data. To address this problem, our method uses the features from the incomplete manual annotations to propagate labels to unlabeled regions. We first employ a deep convolutional neural network (CNN) to predict the label of each unannotated pixel independently. While CNNs are state-of-the-art, they do not consider the correlation between pixels. For this reason, we refine the CNN output using a dense fully-connected conditional random field, incorporating locality and intensity similarity into the label propagation. This produces more coherent and finer annotations.

RESULTS

The proposed algorithm was evaluated on the UHG dataset, which contains 120 CT scans with partial ILD annotations. After label propagation, the resulting accuracy reaches 92.8% compared to expert manual annotations. Importantly, our method increases the amount of labeled pixels by 7.8 times. As well, differing from the partial annotations, which only labeled one ILD disease per CT slice, our method is able to label all diseases that occur on the same slice, which is crucial for future slice-wise disease detection. This demonstrates another important facet in how our method can augment partial annotations.

CONCLUSION

We present a segmentation label propagation method that accurately populates labels from annotated regions to entire datasets. When tested on an IDL dataset, the amount of labeled training data is substantially and accurately expanded. We plan to publicly share this and other expanded datasets, upon publication.

CLINICAL RELEVANCE/APPLICATION

Our method is applicable to any multi-class segmentation problem. Combined with expert annotations, the proposed system could be used to iteratively produce fully-labeled large-scale datasets.

IN243-SD-WEA4 Evaluating Vertebral Bone Strength Prediction by Advanced Characterization of Trabecular Microarchitecture using Scaling Index Computation on Volumetric Quantitative Computed Tomography

Station #4

Participants
Anas Z. Abidin, MS, Rochester, NY (*Presenter*) Nothing to Disclose
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Thomas Baum, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Axel Wismueller, MD, PhD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To use advanced geometric characterization of the trabecular bone microarchitecture in spinal vertebrae for improved fracture risk assessment.

METHOD AND MATERIALS

Volumetric CT data (0.14 x 0.14 x 0.3 mm^3 resolution) was acquired from 10 spinal vertebrae specimens using a whole-body 256

Volumetric CT data (0.14 x 0.14 x 0.3 mm^3 resolution) was acquired from 19 spinal vertebrae specimens using a whole-body 256-row CT scanner with a dedicated calibration phantom. Each sample consisted of three vertebral segments; the images of the central vertebra were used for analysis. After imaging, the true failure load was measured through a biomechanical test involving uni-axial compression on the middle vertebra of the specimen. A semi-automated method was used to annotate the trabecular compartment within a cylindrical volume of interest (VOI) to exclude cortical bone in each sample, and voxel intensities within the VOI were converted to bone mineral density (BMD). A 3D geometric analysis technique based on local scaling properties (Scaling Index Method, SIM) was used to characterize the microarchitecture of the trabecular bone. The high-dimensional SIM features and the mean BMD of the VOI (which served as a surrogate for the current clinical standard) were used with support vector regression to predict the specimen failure load. The performance was measured by computing the root-mean-square error (RMSE) between the actual and the predicted failure load. A Wilcoxon signed-rank test was used to identify significant differences between RMSE distributions.

RESULTS

Geometric SIM features outperformed CT-measured mean BMD (RMSE = 1.11 ± 0.33) ($p < 0.01$). The best failure load prediction performance was obtained when SIM-derived features were combined with mean BMD (RMSE = 0.79 ± 0.11).

CONCLUSION

Our results suggest that advanced methods for characterization of the trabecular microarchitecture can significantly improve biomechanical bone strength prediction in spinal vertebrae. We conclude that our method has the potential to improve spinal fracture risk estimation over traditional BMD measurement.

CLINICAL RELEVANCE/APPLICATION

Geometric characterization of trabecular microarchitecture in osteoporotic spinal vertebrae can improve image-based vertebral fracture risk estimation and thus contribute to better therapy management.

IN245-SD-WEA6 A Novel Tool to Convert MIRC Teaching Files into Interactive Mobile eBooks for Precision Medical Imaging Education

Station #6

Participants
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Wei-Juhn Chen, Kaosiung, Taiwan (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

With this new application, we enhance the merits of MIRC TFS into a precision interaction for medical imaging education and we believe that this innovation could be used to ease the steep learning curve of modern radiology.

Background

In order to complement the apprenticeship of medical imaging education from on-the-scene finger-pointing or cursor-pointing to off-sight interactive engagement, we invent a novel tool to marry the beauty of MIRC TFS, giving birth to interactive eBooks compatible with current available platforms.

Evaluation

A new plug-in application was developed on the existing eBook teaching and knowledge platform for medical education. This plug-in was endowed with the functions to parse the XML files embedded in the MIRC TFS zip files as well as the scalable vector graphics (SVGs) created by authors to annotate the regions of interests of the images. Then this novel application could automatically transcript the annotated information of the SVGs into the events of interaction of lesion identification on mobile apps or HTML5 web pages for readers by using reader's finger tips. And all the associated transaction data from the learning interaction could be collected for teaching analytical purposes.

Discussion

The associated data collected during learning or reading include the number of clicks and the time needed to hit the right targets as well as the inter-reader differences for paticular quizzes. For example, a finding of architecture distortion on a right MLO view of tomosynthesis could be rendered as a hot spot of stacked images using our plug-in application then the residents in training could be able to swipe the images to find and depict the lesions using his or her finger tip. While the regions of interest on the right image was hit by the resident, a hurrah sign will popup to show approval, otherwise a disapproval sign will show up.

IN124-ED-WEA7 Multi-reader Studies: Encountered Problems and Solutions in Prostate mpMRI

Station #7

Participants
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Peter L. Choyke, MD, Rockville, MD (*Abstract Co-Author*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc
Baris Turkbey, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Multi-reader studies are a powerful clinical research tool to assess accuracy and agreement of readers of varying experience across institutions. However, these can be complicated by logistical issues of delivering DICOM images between institutions, collecting reliable data, correlating subjective reads between readers, and analyzing complex data. We have developed a methodology to anonymize DICOMs, collect large amounts of data using readily available Microsoft Access applications, and assess inter-observer agreement for prospectively detected and scored lesions. We will use prostate mpMRI studies as an example of how these principles can be applied to multiple radiological setting.

TABLE OF CONTENTS/OUTLINE

DICOM Cleaning Tools User-friendly freeware can anonymize patient information (**Figure 1**) Facilitated data accrual to ensure data integrity Paper based reporting tools result in unreported variables (**Figure 2**) Microsoft Access tools can offer solutions to enforce data integrity (**Figure 3** and **Figure 4**) In prospective oncological lesion detection, agreement between readers is best assessed with the index of specific agreement (ISA). Kappa statistics do not adequately assess scoring agreement in prospective lesion detection. ISA provides an appropriate measure for prospective lesion detection (**Figure 5**)

IN026-EC-WEA A Web-based System for Patient-Oriented Reports in Musculoskeletal Imaging

Custom Application Computer Demonstration

Participants
Sri Ram T. Sathi, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Charles E. Kahn JR, MD, MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

CONCLUSION

PORTER can be incorporated into patient portals to annotate and help explain radiology reports without storing or exchanging protected health information. The system has been applied to a wide range of musculoskeletal imaging procedures, and is presented for demonstration.

Background

Patients frequently have access to their radiology reports through online patient portals. Although the reports can help patients become better informed and participate more actively in their care, the language of radiology reports remains challenging to understand. The PORTER (Patient-Oriented Radiology Reporter) system applies a lay-language glossary of words and phrases from radiology reports to improve patients' understanding.

Evaluation

From an original prototype system of 314 terms for knee MRI reports, PORTER's vocabulary has been expanded to more than 800 terms to address the most common imaging procedures of the musculoskeletal system. Its glossary includes synonyms, abbreviations, plurals, and adjectival forms. A web service uses a secure HTTP POST transaction; it takes as input the text of the radiology report and the imaging procedure's RadLex Playbook code. The web service generates an HTML document that highlights terms in the report that are defined in PORTER's glossary of musculoskeletal imaging terms. No personally-identifiable information is exchanged. Glossary terms are highlighted; when the reader's mouse hovers over a glossary term, a pop-up balloon provides the lay-language definition, which may be supplemented by a link to a relevant public reference such as Wikipedia. Relevant illustrations, if available, can be displayed in a sidebar. Mechanisms have been incorporated to track user interactions, such as the terms over which the reader hovers or clicks.

Discussion

PORTER annotates radiology reports with lay-language definitions and illustrations to help improve patients' understanding. The expanded vocabulary allows the system to address a wide range of frequently performed imaging procedures. This interactive exhibit provides a live demonstration of the system.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Charles E. Kahn JR, MD, MS - 2012 Honored Educator

RCA43

Using the RSNA CTP Software for Clinical Trials and Research (Hands-on)

Wednesday, Nov. 30 12:30PM - 2:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Bradley J. Erickson, MD, PhD, Rochester, MN, (bje@Mayo.edu) (*Presenter*) Stockholder, OneMedNet Corporation; Stockholder, VoiceIt Technologies, LLC; Stockholder, FlowSigma
Kirk E. Smith, BS, Little Rock, AR, (ksmith@uams.edu) (*Presenter*) Nothing to Disclose
Tracy S. Nolan, BEng, Little Rock, AR, (tnolan@uams.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand what CTP software can do. 2) Understand how to install and configure CTP to do basic tasks. 3) Meet others in the CTP user community.

ABSTRACT

Over the past year, CTP has undergone a change in its support model. In the past, RSNA directly supported a person to maintain and enhance CTP. The feeling now is that CTP is mature and so RSNA has decided to release it as open source and to let the community take it over. We hope that this will be a positive step forward for CTP and the community that requires this functionality. This meeting will include time for community members to meet each other and discuss initiatives going forward.

RCB43

Getting Stuff Done: A Hands-on Technology Workshop to Enhance Personal Productivity (Hands-on)

Wednesday, Nov. 30 12:30PM - 2:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Matthew B. Morgan, MD, Sandy, UT (*Presenter*) Consultant, Reed Elsevier
Puneet Bhargava, MD, Shoreline, WA, (bhargp@uw.edu) (*Presenter*) Editor, Reed Elsevier
Amanda Lackey, MD, Columbus, OH (*Presenter*) Editor, Reed Elsevier
Dushyant V. Sahani, MD, Boston, MA (*Presenter*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

LEARNING OBJECTIVES

1) Introduce the concept of “Getting Things Done” . 2) Learn the concepts of Inbox Zero and other email management techniques. 3) Using tools such as note-taking applications, citation and password managers.

ABSTRACT

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Puneet Bhargava, MD - 2015 Honored Educator
Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator
Dushyant V. Sahani, MD - 2016 Honored Educator

RCC43

Want to Learn More About Imaging Informatics? Education, Resources and Certifications

Wednesday, Nov. 30 12:30PM - 2:00PM Room: S501ABC

ED IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Christopher J. Roth, MD, Raleigh, NC, (Christopher.roth@duke.edu) (*Moderator*) Nothing to Disclose

Active Handout:Christopher John Roth

http://abstract.rsna.org/uploads/2016/16005066/RCC43 2016 RSNA Learning and Society Certifications for Handout.pdf

Sub-Events

RCC43A Landscape of Online Resources for Informatics Self-Study

Participants
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify online sources of content for didactic informatics self-study. 2) Identify online resources for hands-on study of database and programming concepts.

ABSTRACT

RCC43B Formal Opportunities and Resources for Imaging Informatics Training

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

RCC43C Imaging and Nonimaging Informatics Society Certifications: What is Out There and Is It Valuable?

Participants
Christopher J. Roth, MD, Raleigh, NC, (Christopher.roth@duke.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Summarize the forces driving physician adoption and leadership in local and national informatics initiatives. 2) Compare the opportunities toward pursuing: American Board of Imaging Informatics Certified Imaging Informatics Professional (ABII CIIP) certification, and, American Board of Preventative Medicine Clinical Informatics (ABPM CI) ABMS board certification, Healthcare Information and Management Systems Society Certified Professional in Health Information & Management System (HIMSS CPHIMS).

RCC43D Overview of Imaging Informatics with Technologists and Administrators

Participants
Scott R. Steingall, BS,ARRT, Malvern, PA, (scott.steingall@siemens.com) (*Presenter*) Employee, Siemens AG

LEARNING OBJECTIVES

1) Identify the informatics education requirements within the current educational process for imaging technologists and administrators. 2) Describe the need to include more informatics based education for the imaging technologists and administrators. 3) Compare the current informatics offerings from the American Society of Radiologic Technologists (ASRT), The Association for Medical Imaging Management (AHRA), and the Radiology Business Management Association (RBMA).

ABSTRACT

INS-WEB

Informatics Wednesday Poster Discussions

Wednesday, Nov. 30 12:45PM - 1:15PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants

Arnon Makori, MD, Chicago, IL (*Moderator*) Medical Advisory Board, Carestream Health, Inc

Sub-Events

IN246-SD-WEB1 You've Got Mail: A Pilot Study on Notifying Referring Physicians About Missed Patient Follow-Up Directly in the Electronic Medical Record

Station #1

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Darco Lalevic, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Charles E. Kahn JR, MD, MS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Christopher Pizzurro, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Hanna M. Zafar, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Referring physicians are willing to provide feedback about their patients who have no documented follow-up in the EMR after an abdominal imaging exam. In this small pilot, there was a preference for notifications to be sent both by e-mail as well as electronically within the EMR. Future development of the system will take this preference into account in order to better care for our patients and serve our referring colleagues.

Background

When patients miss follow-up issued based on imaging examinations, the reasons are multifactorial. In addition, it can be difficult to ascertain whether a study is clinically indicated by reviewing the patient's chart. To begin to close the loop for patients awaiting follow-up in our health system, we piloted a system to send interactive notifications to referring physicians directly within the electronic medical record (EMR), to determine if follow-up is clinically indicated.

Evaluation

In collaboration with our corporate information technology team, we developed a method to send messages to providers' inboxes within our health system's EMR. We sent messages to 9 providers caring for 11 patients with imaging finding of possible cancer detected on abdominal CT, MR or US exam performed between 8/1/2013 and 9/30/2013, with no completed follow-up and no chart documentation as to why follow-up was not clinically indicated. Messages redirected providers to a radiology recommendation-tracking engine that allowed them to review the original report and offer structured feedback as to whether follow-up was clinically indicated.

Discussion

Of the 9 physicians, 3 accessed the engine via the messages sent into the EMR; 1 viewed the message but did not access the engine; 1 was unable to view the EMR message; and 4 did not access the EMR messages. Of the latter 6 physicians, 3 were successfully contacted by phone. 5/9 physicians indicated that they were not the correct providers to contact, but 2/9 were able to identify the physicians presently caring for the patient. Follow-up was no longer clinically indicated for 2 patients (one had already completed follow-up elsewhere; the other was deceased). Imaging follow-up remained clinically indicated and will be ordered for 3 patients.

Honored Educators

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Charles E. Kahn JR, MD, MS - 2012 Honored Educator
Mitchell D. Schnall, MD, PhD - 2013 Honored Educator

IN247-SD-WEB2 Improving Reading of T2 MRIs through Deep Learning

Station #2

Participants
Kevin Mader, DPhil,MSc, Zuerich, Switzerland (*Presenter*) Employee, 4Quant Ltd; Shareholder, 4Quant Ltd
Bram Stieltjes, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Elmar M. Merkle, MD, Basel, Switzerland (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Research Grant, Bayer AG; Research Grant, Guerbet SA; Research Grant, Bracco Group
Kangqiang Peng, BSC, Guangzhou, China (*Abstract Co-Author*) Officer, 4Quant Ltd; Shareholder, 4Quant Ltd

CONCLUSION

We show a possible direction for automating the process of finding new relevant imaging biomarkers for disease using a relatively uncommon disease in a heterogeneous patient group.

Background

Radiological guidelines are currently painstakingly developed by manually aggregating the experience of many prominent physicians from ideally multiple medical centers. For rare diseases the challenge of not only identifying but properly interpreting the stage and progression in standard biologically nonspecific measurements like MRI, Ultrasound, and CT is formidable. Nasopharyngeal Cancer while rare in most of the world is unusually common in Southern China. It is a serious form of head and neck cancer which can be difficult to find and even more difficult to make meaningful prognosis. Determining the aggressiveness of a specific tumor is essential for selecting the proper treatment and ultimately improving the patient's chances at survival.

Evaluation

Using a clinical study with over 200 patient datasets, we trained a neural network to identify both the standard TNM staging as well as the 12 month outcome variable. We used a deep network with over 20 layers and thousands of free parameters to perform the training. To compensate for so many degrees of freedom we augmented the dataset with transformed versions of the original images simulating differently sized as well as poorly positioned patients. We optimized the classifications by using a cross-entropy error. The loss ultimately was below 0.5 for the entire feature vector on both training and validation datasets after 500 epochs of training and 12 hours of computational time. Rather than taking the output diagnosis, we focused on determining to which regions and structures the network paid attention using several outcome-based approaches.

Discussion

Once the network was trained, computing the regions of interest for a new patient can be done in fractions of a second. From a large 3D volume the relevant features can then be more closely examined. Additionally another byproduct of the network are a collection of patterns and structures validated across hundreds of patients.

IN248-SD-WEB3 Coregistration of Liver Cone-Beam CT and CT Datasets

Station #3

Participants
Marco Solbiati, Busto Arsizio, Italy (*Presenter*) Nothing to Disclose
Luigi Solbiati, MD, Rozzano, Italy (*Abstract Co-Author*) Nothing to Disclose
Tiziana Ierace, MD, Busto Arsizio, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Rotilio, Milano, Italy (*Abstract Co-Author*) Shareholder, RAW Srl
Katia Passera, MEng, BUSTO ARSIZIO, Italy (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

This method is very promising and could change current workflow of mini-invasive cancer treatments leading to lower risks for patients and operators

Background

Interventional rooms for minimally invasive treatments of neoplastic lesions are increasingly equipped with cone-beam CT scanners (CBCT) for the guidance of procedures and the immediate assessment of the results achieved.Accordingly, the need for precise and fast registration of pre-treatment contrast-enhanced CT (CE-CT) and post-treatment contrast-enhanced CBCT (CE-CBCT) datasets is increasingly felt. For thermal ablations incomplete treatments occur in 5-15% of cases and are visualized on follow-up CE-CT studies.In the figure below, a case in which post-treatment CE-CT shows incomplete ablation requiring subsequent re-treatment.

Evaluation

CT and CBCT datasets differ with respect to many parameters, such as FOV, voxel spacing, image quality and liver parenchyma deformations due to respiratory movements. These issues make registration very challenging.Our method consists of different steps: (i) liver and lesion segmentation on pre-treatment CE-CT (ii) registration of CE-CBCT with CECT, performed starting with initial rigid registration, to coarsely realign the two volumes, followed by non-linear registration to correct local deformations (iii) overlap of lesion contours on registered CBCT.In 10 patients with 15 hepatic neoplastic lesions undergone thermal ablation with microwaves (MWA) under ultrasound guidance, datasets of pre-treatment CE-CT and post-treatment CE-CBCT and 24-hr follow-up CE-CT were studied using this method.In 3/10 patients, registration of post-treatment CE-CBCT with pre-treatment CE-CT allowed to identify untreated, still viable portions in 5/15 neoplasms that were immediately targeted and re-treated with MWA under US guidance. On post-retreatment follow-up CE-CT all lesions were completely ablated

Discussion

Our results show that registration permits to identify untreated areas during the same interventional session, thus decreasing for patients risks and discomfort of retreatments and for operators the difficulties created by new treatments of the same lesions.In addition,management costs significantly decrease

IN249-SD-WEB4 Comparing Wearable Display Technologies: What Are Their Relative Advantages and Disadvantages to the Diagnostic and Interventional Radiologist?

Station #4

Awards
Student Travel Stipend Award

Participants
Vikash Gupta, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Alaa Beydoun, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Tammam Beydoun, DO, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose
Eliot L. Siegel, MD, Baltimore, MD (*Abstract Co-Author*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory

Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;

CONCLUSION

The emergence of visual overlay devices creates an exciting era for medicine and allows for significant advancement in radiology. Google Glass and Microsoft HoloLens each have a unique set of advantages and disadvantages. Understanding these technical capabilities and how they relate to applications in radiology will be paramount for future research and clinical implementations.

Background

Wearable visual overlay devices are a new and emerging technology with tremendous potential in many disciplines, including radiology. Currently, there is little information about how these devices compare, particularly in the medical setting. This project aims to:1.   Compare the technical features and limitations of two wearable devices (Google Glass and Microsoft HoloLens) and how they can be utilized in diagnostic and interventional radiology.2.   Demonstrate the benefits and drawbacks of these devices in contrast to traditional display methods.

Evaluation

Each device is evaluated for how well it can:-Capture and playback procedures-Display imaging or clinical data in a clear, non-obtrusive manner-Co-register imaging during interventional procedures-Facilitate collaboration with other physiciansUsing phantom devices for the abovementioned use cases, the following metrics are assessed:-Operator efficiency-Operator opinion-Rate of technical errorEach device is reviewed regarding ease of implementation including:-Cost and expected lifecycle-Integration with existing imaging hardware-Ease of use/onboarding

Discussion

Microsoft HoloLens and Google Glass provide similar but unique capabilities. Google Glass offers a reliable solution for recording procedures from a 1st person perspective and displaying ancillary data during cases in a non-obstructive format. Google Glass has a lower barrier to implementation as a recording and teaching device. Microsoft HoloLens provides these capabilities but can also overlay co-registered data on the real world with appropriate depth perception. From a display standpoint, the HoloLens provides superior hardware. The effect of these devices on efficiency and error rate will be better elucidated as operators gain more experience.

IN027-EC-WEB Sunburst: Open Source Radiologist Timeline Dashboard for Summarizing Prior Imaging Reports Using NLP and UMLS

Custom Application Computer Demonstration

Participants
Shubham Shukla, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Liana Greer, New York, NY (*Presenter*) Nothing to Disclose
Evan Lustbader, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Jai Chaudhary, MENG, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Praveen Gupta, New York, NY (*Abstract Co-Author*) Nothing to Disclose
George L. Shih, MD, MS, New York, NY (*Abstract Co-Author*) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, MD.ai, Inc; Stockholder, MD.ai, Inc;

CONCLUSION

Sunburst has the potential to be a key tool radiologist workflow for imaging interpretation. The textual analysis and visual findings display powered by Sunburst provide a complementary application to the PACS image based system in the interpretation and contextualization of new radiographic findings. We hope to continue developing Sunburst to include machine learning algorithms to start to predict disease progression and other imaging findings to further enhance workflow and provide additional triage.

FIGURE

http://abstract.rsna.org/uploads/2016/16013601/16013601_nh3p.jpg

Background

Imaging interpretation for disease progression requires appropriate understanding of prior imaging context, which is typically done by manually examining prior exam reports and images which can be time-consuming and tedious. Patient timeline tools already exist to provide some of this context, but still require radiologists to review the same data. We present Sunburst (http://sunburst.trove.nyc) , an open source radiologist assistant dashboard summary, that allows direct visualization of relevant finding trends over time (http://src.sunburst.trove.nyc).

Evaluation

Sunburst leverages natural language processing (NLP) techniques, the Unified Medical Language System (UMLS) ontology, and Metamap, to analyze the important findings in the relevant radiology reports (eg, 3 prior exams of the same modality). The app contextually analyzes the report impression text and extracts key phrases into either 'presence' or 'absence' categories (eg, presence of adrenal nodules, or absence of hepatic lesions). Sunburst then provides a summary dashboard where clinicians can easily see all key findings, their trends by date, and the actual sentence in the report from which the key finding was extracted.

Discussion

Our radiologist assistant app allows radiologists to quickly assimilate the most relevant information from prior imaging exams, to orient them for the new uninterpreted exam. While direct review of the prior images may still be necessary, our initial impression is that this tool will significantly enhance our radiologist workflow, especially as we’re able to provide the UMLS relationships between the diseases and their related imaging manifestations.

IN028-EC-WEB GlioView: An Application that Visualizes Variability in Brain Tumor Segmentation to Inform the Clinical Assessment of Change

Custom Application Computer Demonstration

Participants
Edgar A. Rios Piedra, MSc , Los Angeles, CA (*Presenter*) Nothing to Disclose
Rick K. Taira, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Suzie M. El-Saden, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Benjamin M. Ellingson, MS, PhD, Los Angeles, CA (*Abstract Co-Author*) Research Consultant, MedQIA Imaging Core Laboratory Research Consultant, F. Hoffmann-La Roche Ltd Research Consultant, Tocagen Inc Research Consultant, Boston Scientific Corporation Research Consultant, Amgen Inc Research Grant, Siemens AG Research Grant, F. Hoffmann-La Roche Ltd
Alex A. Bui, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
William Hsu, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

GlioView automates tumor segmentation and assessment of tumor volumetric change, while providing an estimate of uncertainty in these measurements. In this way, GlioView provides clinicians with an increased level of confidence for interpreting imaging data and improve clinical decision-making.

FIGURE

http://abstract.rsna.org/uploads/2016/16006734/16006734_1dnb.jpg

Background

Radiological characterization of high-grade primary brain tumors plays a vital role in diagnosing, treating, and evaluating treatment response. Accurate measurement of tumor burden can be a challenging, labor intensive, and time consuming task for neuroradiologists. Additionally, measurements may have high variability due to rater interpretation and the heterogeneous nature of high-grade gliomas. Currently, there is a significant need for a radiology workstation that can quickly segment brain tumors, including measures of segmentation uncertainty, and provide the radiologist with clear visualization of changes that occur during clinical follow-up.

Evaluation

To address this need, we created an application that: 1) performs automated volumetric segmentation and analysis of brain tumor MR images for each tumor component; 2) visualizes the results and error bounds in tumor segmentation; and 3) captures change and variability over time that arises on subsequent examinations.Segmentation error was estimated by iterative measurements of the tumor boundary using a novel and accurate knowledge-based approach that was incorporated into an automated pipeline that includes image preprocessing and tumor segmentation for all time points for a patient.This process was built into a graphical user interface (GlioView) that lets the user run the automated pipeline and select different visualization options. Results are visualized as color-coded overlays on top of the original images alongside the volume variability estimates.

Discussion

Measurement of segmentation uncertainty is important for the evaluation of tumor changes over time. GlioView provides an intuitive interface for image analysis and provides an estimate of tumor extent, which can be used for RANO evaluation. The addition of error bounds alongside volumetric measurements provides a more objective approach for interpreting over time change.

IN011-EB-WEB Effect of Standardized Template Dictation on Assignment of ACR BI-RADS Categories 1 and 2 for Screening Mammography

Hardcopy Backboard

Participants
Aaron Dunn, DO, Philadelphia, PA (*Presenter*) Nothing to Disclose
Brian S. Englander, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

With the introduction of standardized templates for breast imaging, there was a change in the use of ACR BI-RADS Categories. Use of template based electronic health records resulted in a decrease in inclusion of benign, inconsequential findings. Screening mammography was determined to be normal, rather than benign, with less extraneous data. Future opportunities exist to consider whether there is any change in the use of other Categories, assessments, or density assignments.

Background

Normal and benign findings are not always clearly distinguished during interpretation and dictation of screening mammography and assignment of ACR BI-RADS Categories. Multiple variables contribute to the use of 1 or 2 Categories.

Evaluation

Use of ACR BI-RADS Categories was evaluated during a 1-year period preceding implementation of an electronic health record and a 1-year period following implementation. Prior to implementations, reports were dictated with Nuance PowerScribe 360 with no required report structure or language. With the introduction of EPIC for direct reporting of mammography, interpreting radiologists were required to assign an ACR BI-RADS Category with a template report; there was no default Category. Between 1 April 2014 and 31 March 2015, 12,920 screening mammograms were interpreted by 4 experienced radiologists. 11,773 BI-RADS Categories 1 and 2 were assigned; 2,408 studies were assigned Category 1, and 9,365 were assigned Category 2.Between 1 April 2015 through 31 March 2016, 12,665 screening mammograms were interpreted by 4 experienced radiologists. 11,379 BI-RADS Categories 1 and 2 were assigned; 4,783 studies were assigned Category 1, and 6,596 were assigned Category 2. During the 2-year period, there was no change in staffing, equipment, or any other variable.

Discussion

There is a statistically significant decrease in the number of patients who were assigned BI-RADS Category 2 (6,598 compared with 9,365), with a statistically significant increase in the number of patients who were assigned BI-RADS Category 1 (4,783 compared with 2,408). Statistical significance was measured with a p-value <0.0001. The increased use of Category 1 was seen for all four radiologists.

MSRT45

ASRT@RSNA 2016: Dissecting the Digital Image: From Formation to Interpretation and Beyond

Wednesday, Nov. 30 2:20PM - 3:20PM Room: N230B

IN

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants

Timothy J. Blackburn, PhD, Dallas, TX, (Timothy.Blackburn@UTSouthwestern.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify key differences between analogue and digital imaging acquisitions. 2) Describe patient dose considerations with digital imaging. 3) List key features of information contained in a digital image beyond the visual image itself. 4) Compare the roles of DICOM, PACS, IHE, and HL7 in the electronic radiology department.

ABSTRACT

While the field of radiology was founded on analogue imaging modalities the current practice is now nearly completely digital. This requires changes in image acquisition systems, workflow, display/interpretation and storage. Digital imaging provides the potential of not only reducing patient dose but being able to maintain an electronic record of exposures. In an ever changing electronic radiology department the role of the radiographer must also change. This lecture will explore digital radiographic image acquisition, transmission, display and storage. Workflow, image analysis, and dose tracking will also be covered. Digital Imaging and Communications in Medicine (DICOM), Picture Archive and Communications Systems (PACS), and Health Level Seven (HL7) standards along with Integrated Healthcare Enterprise (IHE) initiatives will be reviewed.

Active Handout:Timothy J. Blackburn

http://abstract.rsna.org/uploads/2016/16000830/Active RSNA2016_MSRT45.pdf

RCA44

3D Printing Hands-on with Open Source Software: Advanced Techniques (Hands-on)

Wednesday, Nov. 30 2:30PM - 4:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Michael W. Itagaki, MD, MBA, Seattle, WA (*Moderator*) Owner, Embodi3D, LLC
Beth A. Ripley, MD, PhD, Seattle, WA, (bar23@uw.edu) (*Presenter*) Nothing to Disclose
Tatiana Kelil, MD, Brookline, MA (*Presenter*) Nothing to Disclose
Anish Ghodadra, MD, Pittsburgh, PA, (aghodadramd@gmail.com) (*Presenter*) Nothing to Disclose
Hansol Kim, MD, Boston, MA (*Presenter*) Nothing to Disclose
Steve D. Pieper, PhD, Cambridge, MA (*Presenter*) CEO, Isomics, Inc; Employee, Isomics, Inc; Owner, Isomics, Inc; Research collaboration, Siemens AG; Research collaboration, Novartis AG; Consultant, Wright Medical Technology, Inc; Consultant, New Frontier Medical; Consultant, Harmonus; Consultant, Stryker Corporation; Research collaboration, gigmade;
Dmitry Levin, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn advanced techniques for converting a medical imaging scan into a digital 3D printable model with free and open-source software. 2) To perform advanced customizations to the digital 3D printable model with free software prior to physical creation with a 3D printer.

ABSTRACT

"3D printing" refers to fabrication of a physical object from a digital file with layer-by-layer deposition instead of conventional machining, and allows for creation of complex geometries, including anatomical objects derived from medical scans. 3D printing is increasingly used in medicine for surgical planning, education, and device testing. This advanced hands-on course builds upon the introductory course given by the same faculty. It will teach the learner advanced segmentation techniques used to convert a standard Digital Imaging and Communications in Medicine (DICOM) data set from a medical scan into a 3D printable model. Advanced manipulation of the digital model in preparation for 3D printing will then be discussed. All software used will be free. Methods described will work with Windows, Macintosh, and Linux computers. The learner will be given access to comprehensive resources for self-study before and after the meeting, including an extensive training manual and online video tutorials.

RCB44

Teaching Congenital Heart Disease with 3D Printed Models II: Criss-cross or Twisted Heart and Related Conditions (Hands-on)

Wednesday, Nov. 30 2:30PM - 4:00PM Room: S401CD

CA IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Shi-Joon Yoo, MD, Toronto, ON (*Presenter*) Owner, 3D HOPE Medical; CEO, IMIB-CHD;
Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Presenter*) Nothing to Disclose
William J. Weadock, MD, Ann Arbor, MI (*Presenter*) Owner, Weadock Software, LLC
Cynthia K. Rigsby, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Hyun Woo Goo, MD, Seoul, Korea, Republic Of, (hwgoo@amc.seoul.kr) (*Presenter*) Nothing to Disclose
Andreas Giannopoulos, MD, Boston, MA, (andgiannop@hotmail.com) (*Presenter*) Nothing to Disclose
Taylor Chung, MD, Oakland, CA (*Presenter*) Travel support, Koninklijke Philips NV;
Rajesh Krishnamurthy, MD, Houston, TX (*Presenter*) Nothing to Disclose
Whal Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the terms used in describing the pathology of criss-cross heart and related conditions. 2) Understand the pathologic and surgical anatomy of various forms of criss-cross heart and related conditions. 3) Develop ideas how to image the patients with criss-cross heart and related conditions for surgical management.

ABSTRACT

Congenital heart diseases are the most common significant birth defects requiring surgical treatment in the majority of cases. Understanding of pathologic anatomy is crucial in surgical decision and performing optimal surgical procedures. Learning cardiac morphology has relied on the pathologic specimens removed from dead patients or at the time of transplantation. However, the pathologic specimens are rare and hardly represent the whole spectrum of diseases. 3D print models from the CT and MR angiograms of the patients with congenital heart disease are great resources for teaching and can revolutionize education. In this hands-on session, 3D print models of hearts will be used for comprehensive understanding of comlex morphology of criss-cross or twisted hearts, superofinferior ventricles and topsy-turvy hearts. The session will consist of 15-minute introductory lecture, 60-minute hands-on observation and 15-minute discussion and evaluation. Experts on congenital heart disease pathology will be available for guidance and answering questions throughout the session.

Honored Educators

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Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RCC44

3D Printing: Clinical Applications III

Wednesday, Nov. 30 2:30PM - 4:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Jane S. Matsumoto, MD, Rochester, MN (*Moderator*) Nothing to Disclose
Justin W. Adams, Clayton, Australia (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

ABSTRACT

Sub-Events

RCC44A 3D Printing Applications in Pediatrics

Participants
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose

RCC44B 3D Printing in Clinical Sciences

Participants
Ciprian Ionita, PhD, Buffalo, NY, (cnionita@buffalo.edu) (*Presenter*) Grant, Toshiba Corporation; Grant, Stratasys, Inc; Grant, Vader Systems; Grant, Medtronic plc;

LEARNING OBJECTIVES

1) Describe the methods to create 3D printed patient specific vascular phantoms based on 3D angiography. 2) To demonstrate how patient specific 3D printed vascular phantoms can be used for bench top testing of endovascular devices and software. 3) To demonstrate the use of 3D printing in a clinical setting for endovascular treatment planning.

ABSTRACT

In the last decade Minimally Invasive Vascular Interventions became the preferred procedures for vascular disorders treatment, such as: cerebral aneurysms, stenoses, calcified valves, arteriovenous malformations, etc. During these procedures, the interventionalists insert a catheter using a peripheral artery access and thread it under fluoroscopy guidance, through the arterial network to the lesion site. Bench-top testing is essential in preclinical studies to determine the safety and limitations of the minimally invasive vascular procedures using endovascular devices. Similarly, software validation for blood flow estimation in humans, relies on bench top validation in vascular phantoms prior to in-vivo or clinical use. 3D printing of patient specific phantoms with realistic geometries can become a widely used tool for research and development of both software and devices. We recently have developed a method to create complex patient specific vascular and cardiac models which allow simulation of endovascular procedures and physiological simulations. We also translated the 3D printing into the clinical setting and performed a pilot study for endovascular treatment planning for patients with intracranial aneurysms, calcified mitral valves and AAA. In this coursewe will demonstrate one of the first realistic in-vitro 3D printed phantom for endovascular devices testing, treatment planning and blood flow simulations. These models have the potential to create a paradigm shift in the way the device safety and software validation is performed, as well as a new surgical planning tool.

RCC44C 3D Printing in Education

Participants
Justin W. Adams, Clayton, Australia (*Presenter*) Nothing to Disclose

RCC44D Quality and Safety in 3D Printing

Participants
Shuai Leng, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand quality control in each step of 3D printing, from the beginning to the end. 2) Establish a quality control program for the 3D printing. 3) Assess accuracy and precision of 3D printing for medical applications. 4) Optimize imaging and printing techniques to improve accuracy and efficiency of 3D printing.

SSM12

Informatics (Clinical Workflow, Displays and Mobile Devices)

Wednesday, Nov. 30 3:00PM - 4:00PM Room: S403A

IN

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: .50

FDA Discussions may include off-label uses.

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose
William W. Boonn, MD, Penn Valley, PA (*Moderator*) Officer, Nuance Communications, Inc; Shareholder, Nuance Communications, Inc
Vamsi R. Narra, MD, FRCR, Saint Louis, MO (*Moderator*) Consultant, Biomedical Systems;

Sub-Events

SSM12-01 Workflow Dynamics and the Imaging Value Chain: The Effect of Designating a Non-image Interpretive Task Workflow

Wednesday, Nov. 30 3:00PM - 3:10PM Room: S403A

Participants
John-Paul J. Yu, MD, PhD, Madison, WI (*Presenter*) Nothing to Disclose
Matthew H. Lee, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Andrew J. Schemmel, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
B. Dustin Pooler, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Taylor Hanley, BS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Douglas Wiegmann, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Tabassum A. Kennedy, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Aaron S. Field, MD, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Separating responsibilities into NIT and IIT workflows substantially increased image interpretation time and decreased TSEs for the primary fellow. Consolidation of NITs into a separate workflow allows for more efficient task completion.

Background

Workflow disruptions are a pervasive element of complex, cognitively demanding work environments that are associated with errors, task prolongation, and "re-work" – the phenomenon of re-orienting following an interruption that can lead to workflow inefficiency. These phenomena have garnered significant interest throughout clinical medicine where the implications of workplace interruptions can lead to harm or loss of life. The relationship between interruptions and patient safety has been observed in a variety of medical settings, suggesting that significant opportunities exist to improve healthcare delivery and patient outcomes through thoughtful workflow analysis and design.

Evaluation

To assess the impact of separating non-image interpretive task (NIT) from image-interpretive task (IIT) workflows in an academic neuroradiology practice, a prospective, randomized, observational investigation of a centralized academic neuroradiology reading room was performed. The primary reading room fellow was observed over a one-month period using time-and-motion methodology, recording frequency and duration of tasks performed. Tasks were categorized into separate IIT and NIT workflows. Post-intervention observation of the primary fellow was repeated following the implementation of a consult assistant (CA) responsible for NITs. Pre- and post-intervention data were compared.

Discussion

Following separation of IIT and NIT workflows, time spent on IITs by the primary fellow increased from 53.8% to 73.2% while NITs decreased from 20.4% to 4.4%. Mean duration of image interpretation nearly doubled, from 05:44 to 11:01 ($p<0.001$). Mean task switching events (TSE) per hour decreased 42%, from 11.2/hr to 6.5/hr ($p=0.002$). Decreases in specific NITs were also observed. The CA experienced 29.4 TSEs/hr. Rates of specific NITs for the CA were 6.41/hr for phone calls/paging, 3.60/hr for in-room consultations, and 3.83/hr for protocoling. Only 46.6% of the CA's time was needed for NIT workflow.

SSM12-02 Taking Back the PACS: How Making Sense of PACS Clutter Led to the Development of the PACS Crawler Open-Source Tool

Wednesday, Nov. 30 3:10PM - 3:20PM Room: S403A

Participants
Thomas J. Re, MD,MS, Basel, Switzerland (*Presenter*) Nothing to Disclose
Daniel Boll, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Bram Stieltjes, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Elmar M. Merkle, MD, Basel, Switzerland (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Research Grant, Bayer AG; Research Grant, Guerbet SA; Research Grant, Bracco Group
Tobias Heye, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

It is time for radiology departments to take control of their PACS! Regional PACS solutions shared with other local providers can be stimulated by the data discovery enabled by tools such as PACSCrawler.

Background

Just what is the composition of imaging data sitting in your PACS? How much of a burden are those “external studies” your patients have been bringing as prior exams? What alternatives are there to storing “some-body-else’s” data in your PACS? We set out to answer these questions for our institution.

Evaluation

We developed, in house, an open-source software tool, named, “PACSCrawler “ based on open-source library DCM4CHE (dcm4che.org), to extract the contents of our PACS to a local SQLite database (sqlite.org) for analysis using database tools. The PACSCrawler retrieved key DICOM header information for each study stored in our PACS for the last 6 years. The DICOM tag “Institution Name” (0008,0080) was used to stratify data into internal versus external studies. The category internal studies was further subdivided into three different sites: main, geriatrics and pediatric hospitals.About 1,000,000 studies were identified from 2010-15, which required <1GB SQLite local storage; processing time was <1hr. The average percentage of external studies in PACS storage was 12% ranging from 9-15% depending on the year (12,781-22,747 studies). The number of external studies was comparable to that of our pediatric radiology division. In other words, external institution’s data was as much of a burden on our system as one of our own divisions. While these external exams were arriving from over 300 different entities, 90% came from 12 local private practices and hospitals.

Discussion

While digital storage space is relatively cheap, avoiding unintended data redundancies can be one approach to cope with the ever exploding quantity of imaging studies being performed in medicine. The presented open source software allows for fast storage analysis independent of the PACS vendor. The software may help to form a regional PACS initiative by identifying potential partners, among those who contribute the majority of outside studies.

SSM12-03 Diagnostic Performance in Detecting Cerebral Infarction on Brain CT: Comparison of Liquid Crystal Displays with Different Resolutions and Luminance

Wednesday, Nov. 30 3:20PM - 3:30PM Room: S403A

Participants
Calogero Cicero, Bassano del Grappa, Italy (*Presenter*) Nothing to Disclose
Stefano Canestrini, Vicenza, Italy (*Abstract Co-Author*) Nothing to Disclose
Claudia Cavatorta, PhD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Manuela Lualdi, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesca Neri, Trieste, Italy (*Abstract Co-Author*) Nothing to Disclose
Emanuele Pignoli, PhD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Claudio Siciliano, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Guarise, Bassano del Grappa, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

It is well known that high quality image display is associated with a more efficient and accurate diagnostic performance. Among the several factors that influence image quality, spatial resolution and luminance play a critical role. In the present study we evaluated the impact of these parameters in identifying cerebral infarction on brain CT.

METHOD AND MATERIALS

Four color Nec medical displays with different spatial resolution, 2 and 3-megapixel (MP) and maximum luminance, 200 and 400 cd/m2, were investigated with proper ambient lighting conditions. Thirty-two studies varying in difficulty of interpretation were selected by a senior radiologist: 16 with and 16 without brain infarction. All the images were blindly and independently evaluated, during two different sessions, by the senior radiologist and by two junior radiologists. Observers had to rate presence or absence of cerebral infarction on a five point confidence scale. The Cohen Kappa statistic (Kc) was computed in order to evaluate the reproducibility in identifying the presence of the lesions between monitors and within/between radiologists; receiver operation characteristic (ROC) analysis was used to interpret the data and the area under ROC curves (AUC) was considered as the index of diagnostic accuracy.

RESULTS

Preliminary results showed that the senior radiologist evaluations produced a satisfactory level of reproducibility between differently set displays. The observed level of reproducibility decreased for the junior radiologist with the 2 MP display when lowest luminance was set. The AUCs increased with the rise of display’s spatial resolution and luminance for both the observers; the differences of observer performance between 3MP display with the highest luminance and 2MP display with the lowest luminance were statistically significant ($p < 0.05$) for the junior radiologists in both reading sessions.

CONCLUSION

Our study suggests that both high luminance and spatial resolution play a very important role in identifying cerebral infarction on brain CT.

CLINICAL RELEVANCE/APPLICATION

3MP liquid crystal displays with maximum luminance 400 cd/m2 show the best accuracy in the diagnosis of cerebral infarction on brain CT.

SSM12-04 Collaborative Robotic Ultrasound: Towards Clinical Application

Wednesday, Nov. 30 3:30PM - 3:40PM Room: S403A

Participants
Benjamin Frisch, PhD, Munich, Germany (*Presenter*) Nothing to Disclose
Oliver Zettinig, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Bernhard Furst, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Salvatore Virga, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose
Christoph Hennersperger, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

Nassir Navab, PhD, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Collaborative medical robotics pave the way for advanced and complex diagnostic US and US-guided interventions whose value will be proven by patient trials.

Background

Ultrasound (US) is a compact, widely available and customizable non-radiative imaging modality. However, the image quality and its interpretation depend on the user's abilities, leading to high interobserver variation. The acquisition of 3D datasets is limited to a comparatively narrow field of view. We introduce an US transducer mounted on a light-weight robotic arm that collaborates with the operator for 3D high-quality image acquisition and interventional support. The arm is equipped with torque sensors in all joints to ensure constant contact force of the transducer onto the skin and to detect collisions with the environment. External structured light cameras (SLCs) monitor the position of the patient, operators and tools to plan or dynamically replan the arm's trajectory. The inclusion of confidence maps allows for a real-time automatic optimization of the US image quality.

Evaluation

The first demonstrator, for vascular imaging, recognizes the patient's position with the SLCs to register an anatomical atlas, and automatically guides the US transducer to the aorta. Confidence maps optimize the acquisition of 3D US images, which allowed successful aortic diameter measurements on healthy volunteers. A second demonstrator evaluates a neurosurgical application, where the spine is monitored for targeted needle insertion. We acquire 3D images of the region of interest on a spine model embedded in a dedicated gelatin-agar phantom. A needle guide is rigidly mounted to the US transducer to allow automatic alignment of the needle to a preinterventional target trajectory defined in a registered CT volume. After insertion, correct placement in the facet joint could be validated using cone-beam CT in four phantom experiments.

Discussion

Both demonstrators confirm the feasibility of robotic US. The combination of situational awareness through sensors and external cameras, and real-time image optimization creates a system that supports an operator for imaging and intervention.

SSM12-05 Semi-Automated Analysis of Urinary Stones Using Dual-Energy CT in a Preoperative Setting: Improved Workflow and Reporting

Wednesday, Nov. 30 3:40PM - 3:50PM Room: S403A

Participants
Juan Montoya, Rochester, MN (*Presenter*) Nothing to Disclose
Andrea Ferrero, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Alice Huang, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Shuai Leng, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Terri J. Vrtiska, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG

CONCLUSION

Results suggest that the information provided by the software could have a significant impact in the evaluation of kidney stones in a preoperative setting.

Background

The purpose of this work was to demonstrate and test an in-house developed tool for semi-automated analysis of urinary stones in dual-energy CT (DECT).

Evaluation

Fifty-eight patients that underwent unenhanced DECT prior to surgical stone removal between October 2009 and November 2015 were subject to stone analysis. Patients were scanned according to our clinical protocol for urinary stone characterization using a dual-source CT system (Somatom Flash and Somatom Force, Siemens Healthcare). In the first step of the imaging analysis, 5-mm thick combined (low/high kV) images were loaded in to the workstation and a research technologist segmented the operated kidney using a set of ROI drawing tools. Subsequently, a radiologist expert in genitourinary imaging loaded 1-mm thick, low and high energy images with the interpolated 5-mm kidney ROI. Using a ROI analysis tool, the reader specified the kidney of interest and stones were automatically segmented and analyzed using an adaptive threshold method. After the completion of the analysis, reports were loaded in a stone browser and the reader specified the stone location using an 11-segment model. For qualitative analysis, reader compared diagnostic images (1 mm axial and 2mm coronal) and clinical reports with the information provided by the software and recorded per-patient and per-stone positive or adverse findings that would modified the clinical report.

Discussion

There were 349 stones detected and analyzed by the software. Qualitative per-patient analysis indicated positive findings for two patients where two stones were detected by the software and not noted by the reader in the clinical images. There was an adverse impact in the report of 8 patients where 12 small stones (~ 1-2 mm) were not detected. Per-stone analysis indicated positive impact for the clinical report in 17 stones with common reasons being improved separation of adjacent stones and size characterization of complex large stones. Three calcifications external to the kidney were misclassified as urinary stones.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Terri J. Vrtiska, MD - 2016 Honored Educator

SSM12-06 Influence of Medical Displays with Different Spatial Resolution and Luminance on the Evaluation of

Digital Radiography Images

Wednesday, Nov. 30 3:50PM - 4:00PM Room: S403A

Participants
Giuseppina Calareso, MD, Milano, Italy (*Presenter*) Nothing to Disclose
Francesca G. Greco, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Calogero Cicero, Bassano del Grappa, Italy (*Abstract Co-Author*) Nothing to Disclose
Stefano Canestrini, Vicenza, Italy (*Abstract Co-Author*) Nothing to Disclose
Manuela Lualdi, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Alberto Laffranchi, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Daniele Vergnaghi, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Claudia Cavatorta, PhD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Paolo Verderio, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Chiara M. Ciniselli, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Maddalena Plebani, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Enrico Alberioli, MD, Padova, Italy (*Abstract Co-Author*) Nothing to Disclose
Davide Scaramuzza, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Guarise, Bassano del Grappa, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the influence of monochrome displays with different spatial resolution and luminance on detection performances in two different clinical settings: bone fractures and chest lesions.

METHOD AND MATERIALS

Overall, 82 digital radiography images varying in difficulty of interpretation were selected by senior radiologists (reference evaluation), including 32 cases for the bone setting (16 with and 16 without bone fractures) and 50 for chest setting (17 normal cases, 16 pneumothorax and 17 pulmonary nodules). These images were blindly and independently evaluated with 4 monochrome NEC medical displays with different performances in terms of spatial resolution, 3 and 5-megapixel (MP), and maximum luminance, 250 and 500 cd/m2 by the senior radiologists and in 2 different occasions by junior radiologists. All the observers had to rate presence or absence of the lesions on a five point confidence scale. The Cohen Kappa statistic (Kc) was computed in order to evaluate the reproducibility in identifying the lesions between monitors and within/between radiologists; the accuracy in the interpretation of the images was evaluated with respect to the reference evaluation.

RESULTS

The between-monitor reproducibility showed Kc ≥ 0.80 for the senior radiologists, whereas lower values were found for juniors (range: 0.66-0.89 and 0.61-0.87 for the bone and chest setting, respectively). Preliminary results for 5MP display at 500 cd/m2 showed the lowest values of misclassified cases for junior radiologists with respect to the reference evaluation (range: 13%-16% and 20-26% for the bone and chest setting, respectively), and no errors were committed by senior radiologists in both settings. The number of misclassified cases with respect to the reference evaluation increased when using the 3MP display with the lowest luminance, with a percentage of misclassified cases of 6% and 10% for senior radiologists, and of 25%-28% and 30-48% for junior radiologists, for the bone and chest setting respectively.

CONCLUSION

Our preliminary evaluations suggest that an increased spatial resolution and luminance level might improve the evaluation performances of digital radiography images.

CLINICAL RELEVANCE/APPLICATION

Both high luminance and spatial resolution play an important role in the interpretation of digital radiography images especially for less experienced radiologists.

RCA45

Introduction to Computational Fluid Dynamics from Medical Images: A Step by Step Demonstration (Hands on)

Wednesday, Nov. 30 4:30PM - 6:00PM Room: S401AB

IN PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants

Dimitris Mitsouras, PhD, Boston, MA, (dmitsouras@alum.mit.edu) (*Presenter*) Research Grant, Toshiba Corporation;

LEARNING OBJECTIVES

At the end of this course the attendee will be able to: 1) Describe each of the steps involved in performing a computational fluid dynamic (CDF) simulation of blood: a) Segment the blood lumen in a 3D volumetric angiography image dataset (e.g., CT or MRI) starting from DICOM images. b) Produce a finite volume mesh on which to perform the CFD computation starting from the segmented lumen. c) Determine appropriate CFD boundary conditions to set up the problem physics on this mesh. d) Perform the blood flow simulation e) Finally, interrogate the resulting solution for quantities of interest such as pressure, fractional flow reserve (FFR) or endothelial shear stress. 2) Identify the different software components required to perform each of the steps. 3) Use these software components to perform their own computational fluid dynamic analyses in their own field of interest.

ABSTRACT

In this exercise, we will be working with the contrast-enhanced coronary CT angiogram (CTA) of a 48-year-old male patient with hypertension and dyslipidemia who presented with atypical chest pain and that had no personal or family history of CAD. Coronary CTA demonstrated a 59% stenosis of the proximal RCA (AHA segment 1). The patient then underwent elective catheter angiography, which demonstrated a 61% stenosis of the corresponding segment and an FFR measurement of 0.85, indicating no hemodynamic significance of this obstructive (>=50 %) lesion.We will first use a semi-automated coronary segmentation tool in Mimics (Materialise NV) to segment the right coronary artery and its two terminal branches, the posterior descending artery (PDA) and posterior left ventricular branch (PLV) from the CTA and create a 3D model. We will then export the 3D model in the Standard Tessellation Language, or STereo Lithography (STL) file format. The STL file will then be imported into the CFD software (Fluent, ANSYS Inc) and we will generate a finite volume mesh to fill the lumen defined by this STL. We will finally solve the Navier-Stokes equations in this mesh simulating blood flow at hyperemic conditions in the steady state, and we will interrogate the solution for pressure and CT-FFR after setting the coronary pressure at the ostium to that measured in the patient using a sphygmomanometer at the time of CTA.The training guide for this course can be downloaded from here: Click to Download PDF automaticallyor if link doesn't work, copy paste this URL to your web browser:http://www.brighamandwomens.org/Departments_and_Services/radiology/Research/documents/RSNASyllabus-final-online.pdf

Handout:Dimitris Mitsouras

http://abstract.rsna.org/uploads/2016/16005103/RSNASyllabus_final.pdf

RCB45

Tackling Lung Cancer Screening Informatics (Hands-on)

Wednesday, Nov. 30 4:30PM - 6:00PM Room: S401CD

CH IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Robert J. French Jr, MD, Burlington, MA, (robert.french@lahey.org) (*Presenter*) Nothing to Disclose
Peter B. Sachs, MD, Aurora, CO, (Peter.Sachs@ucdenver.edu) (*Presenter*) Nothing to Disclose
Shawn M. Regis, PhD, Burlington, MA, (shawn.m.regis@lahey.org) (*Presenter*) Consultant, Medtronic plc

LEARNING OBJECTIVES

1) Understand the clinical and regulatory requirements for an accredited lung cancer screening program. 2) Understand several options for cliinical program organization. 3) Understand multiple options for tools available or buildable in the EMR, PACS, work list and Voice Recognition components of radiology workflow to support lung cancer screening. 4) Understand how informatics tools can support data collection and reserach in this rapidly evolving realm.

ABSTRACT

Active Handout:Shawn M. Regis

http://abstract.rsna.org/uploads/2016/16005104/Active RCB45 Lahey presentation v3.pdf

RCC45

Deep Learning & Machine Intelligence in Radiology

Wednesday, Nov. 30 4:30PM - 6:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Paul J. Chang, MD, Chicago, IL (*Moderator*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

Sub-Events

RCC45A An Introduction to Deep Learning & Machine Intelligence: What the Radiologist Needs to Know

Participants
Vlado Menkovski, PhD, Eindhoven, Netherlands, (vlado.menkovski@philips.com) (*Presenter*) Research, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Explain the principles behind learning computer programs from data (Machine Learning). 2) Explaing the use of deep machine learning models (Deep Learning). 3) Describe the application of Deep Learning to medical image analysis and its challenges.

RCC45B Applying Deep Learning to Image Diagnosis

Participants
Igor J. Barani, MD, San Francisco, CA (*Presenter*) Stockholder, Enlitic, Inc; Employee, Enlitic, Inc

SPSH50

Hot Topic Session: The Promise of Machine Learning (and Pattern Recognition) in Radiology

Thursday, Dec. 1 7:15AM - 8:15AM Room: E350

IN

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 0

Participants

Eldad Elnekave, MD, Shefayim, Israel (*Presenter*) Nothing to Disclose
Eliot L. Siegel, MD, Baltimore, MD, (esiegel@umaryland.edu) (*Presenter*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;
Ronald M. Summers, MD, PhD, Bethesda, MD, (rms@nih.gov) (*Presenter*) Royalties, iCAD, Inc; ;

LEARNING OBJECTIVES

ABSTRACT

URL

http://www.cc.nih.gov/about/SeniorStaff/ronald_summers.htmlhttp://www.cc.nih.gov/drd/summers.html

RC653

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

Thursday, Dec. 1 8:30AM - 10:00AM Room: S403B

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Adam E. Flanders, MD, Narberth, PA, (adam.flanders@jefferson.edu) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

ABSTRACT

Sub-Events

RC653A Saving Body and Mind in the Reading Room

Participants
Eliot L. Siegel, MD, Baltimore, MD (*Presenter*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;

LEARNING OBJECTIVES

1) Describe three issues with human factors related to the modern reading room. 2) Indicate potential solutions for lighting, ambient noise, and ergonomic challenges.

RC653B Changing Information Systems: A Survival Guide

Participants
Steven C. Horii, MD, Philadelphia, PA (*Presenter*) Spouse, Employee, Cerner Corporation

LEARNING OBJECTIVES

1) Describe common issues facing departments changing vendors. 2) Explain the techniques that can be used at time of contracting to ensure future access to data. 3) List techniques used for image migration.

RC653C So Many Images, So Little Time: Advanced Imaging Techniques

Participants
Adam E. Flanders, MD, Narberth, PA, (adam.flanders@jefferson.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To appreciate the diversity of advanced visualization techniques.2) To understand how advanced visualization extends the value of medical imaging.3) To learn how advanced visualization has changed traditional workflow strategies.4) To appreciate some of the pitfalls of automation and the need for expert supervised assessment of advanced visualization output.

ABSTRACT

RC654

Using IHE Profiles to Plan for Medical Imaging

Thursday, Dec. 1 8:30AM - 10:00AM Room: S504AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
David S. Mendelson, MD, Larchmont, NY, (david.mendelson@mountsinai.org) (*Moderator*) Spouse, Employee, Novartis AG; Advisory Board, Nuance Communications, Inc; Advisory Board, General Electric Company; Advisory Board, Toshiba Medical Systems Corporation; Advisory Board, Bayer AG
Kinson Ho, Richmond, BC, (kinson.ho@mckesson.com) (*Presenter*) Employee, McKesson Corporation
David A. Clunie, MBBS, Bangor, PA (*Presenter*) Owner, PixelMed Publishing LLC; Consultant, Carestream Health, Inc; Consultant, CureMetrix, Inc; Consultant, MDDX Research & Informatics; Consultant, General Electric Company; ;
Christopher Lindop, Waukesha, WI, (lindop.chris@gmail.com) (*Presenter*) Employee, General Electric Company
Donald Dennison, Waterloo, ON (*Presenter*) Nothing to Disclose

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).

RCB51

Hands-on Introduction to Social Media (Hands-on)

Thursday, Dec. 1 8:30AM - 10:00AM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Amy L. Kotsenas, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Neil U Lall, MD, Cincinnati, OH, (NULall@gmail.com) (*Presenter*) Nothing to Disclose
Tirath Y. Patel, MD, Houston, TX (*Presenter*) Nothing to Disclose
Tessa S. Cook, MD, PhD, Philadelphia, PA, (tessa.cook@uphs.upenn.edu) (*Presenter*) Nothing to Disclose
Saad Ranginwala, MD, Cincinnati, OH, (sranginwala@gmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Appreciate the professional relevance of social media for radiologists. 2) Understand the differences between social media in personal and professional roles. 3) Understand the differences between and advantages/disadvantages of multiple social media networks. 4) Set up and use a Twitter account. 5) Understand the purpose of hashtags, lists, and DMs. 6) Get acquainted with other radiologists and radiology organizations on Twitter. 7) Use a variety of social media venues to share images for educational purposes. 8) Understand the difference between and utility of professionally oriented social networking sites such as Doximity and LinkedIn. 9) Understand how to safely /securely communicate via social media while maintaining HIPAA requirements.

ABSTRACT

URL

http://bit.ly/RSNASocialMediaIntro

Active Handout:Amy Louise Kotsenas

http://abstract.rsna.org/uploads/2016/11035017/ACTIVE RCB51 RSNA16 Hands On Social Media - Twitter Kotsenas (1).pdf

RCC51

Imaging Integration with Cancer Genomics/Proteomics: Methodologies Leveraging the Cancer Imaging Archive

Thursday, Dec. 1 8:30AM - 10:00AM Room: S501ABC

BQ **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

John B. Freymann, BS, Rockville, MD, (freymannj@mail.nih.gov) (*Presenter*) Nothing to Disclose
Justin Kirby, Bethesda, MD (*Presenter*) Stockholder, Myriad Genetics, Inc
C. Carl Jaffe, MD, Boston, MA (*Presenter*) Nothing to Disclose
Brenda Fevrier-Sullivan, BA, Bethesda, MD (*Presenter*) Nothing to Disclose
Evis Sala, MD, PhD, New York, NY, (salae@mskcc.org) (*Presenter*) Nothing to Disclose
Sandy Napel, PhD, Stanford, CA (*Presenter*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc; Scientific Advisor, RADLogics, Inc
Erich Huang, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Juan J. Ibarra-Rovira, MD, Houston, TX (*Presenter*) Nothing to Disclose
Maryellen L. Giger, PhD, Chicago, IL (*Presenter*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Corporation;

LEARNING OBJECTIVES

1) Learn the processes needed to develop reproducible image-genetic features from local or publicly available archives through presentations made by tumor specific clinical image-genetic clinician teams. 2) Learn from successful teams how clinical radiologists can use public archives to jump start integrative investigative efforts. 3) Learn from other radiology teams how to avoid missteps during development of image-genetic and radiomic research.

ABSTRACT

Diagnostic images analyzed by expert radiologists can offer reproducible data that connect them to tumor tissue genetics, proteomics and pathology images. But the methodology developed by clinician-based teams, and its potential pitfalls, are best demonstrated by presentations made by successful clinical image research teams. This didactic session will teach attendees a formal approach to the basic skills needed to navigate and utilize public image-genetic paired archives - for example NCI's The Cancer Imaging Archive of diagnostic radiology that also links genetic and pathology images on same patients. After a formal methodology overview, panelists will present lessons learned and best practices developed by volunteer clinician researcher teams who've already contributed much to the genetic-clinical imaging literature on breast, brain tumor, lung, renal, head-neck and bladder, illustrated with examples of completed analysis, findings and planned activities.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Evis Sala, MD, PhD - 2013 Honored Educator

MSES52

Essentials of Non-interpretative Skills

Thursday, Dec. 1 10:30AM - 12:00PM Room: S406B

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

MSES52A Informatics: What is it and Why You Should Care

Participants
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Define the study of informatics. 2) Describe how informatics relates to radiology practice and management. 3) Identify opportunities to apply informatics to your radiology practice.

ABSTRACT

When radiologists hear the word informatics, PACS and voice recognition both quickly come to mind. These two tools have transformed the practice of radiology, and are now largely commotized, so what is left for Informatics? This session will discuss the future of informatics in radiology including: analytics, radiology reporting, radiologist decision support, and machine learning.

MSES52B Business Intelligence and Analytics

Participants
Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) The technical steps required to develop and implement dashboards and scorecards (including data/state aggregation, semantic normalization, modeling, data mining, and presentation) will be discussed. 2) Specific strategies and technologies that can be used to create dashboards and scorecards (including HL7, DICOM, ETL, web services, and SOA) will be illustrated. 3) Strategies to create a sustainable and agile architecture to support advanced business intelligence and analytics (BIA) tools will be explored. (This course is part of the Leadership Track)

ABSTRACT

Current and near future requirements and constraints will require radiology practices to continuously improve and demonstrate the value they add to the enterprise. Merely "managing the practice" will not be sufficient; groups will be required to compete in an environment where the goal will be measurable improvements in efficiency, productivity, quality, and safety. Although the phrase "one cannot improve a process unless one can measure it" is a familiar platitude, it is an increasingly important and relevant concept. The proper leveraging of formal Business Intelligence and Analytics (BIA) is a critical, absolutely essential strategy for any radiology group. Although currently underutilized, concepts such as Key Performance Indicators (KPIs), tactical dashboards, and strategic scorecards, should be familiar tools for radiology groups attempting to "navigate disruption."

MSES52C Optimal Radiology Workflow

Participants
Benjamin W. Strong, MD, Eden Prairie, MN (*Presenter*) Nothing to Disclose

MSES52D Social Media for Health Care Leaders

Participants
C. Matthew Hawkins, MD, Decatur, GA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn basic fundamentals of the most common social media platforms. 2) Gain an understanding of how social media is changing consumer behavior. 3) Introduce the concept of social media authority and online brand.

ABSTRACT

The purpose of this course is to introduce radiologists to how social media has changed the way people communicate and make consumer choices. Thus, social media has fundamentally altered the way patients, patient-advocacy groups, and other physicians search for health-related information.This course will provide an overview as to how social media 1) influences the way people communicate, 2) shapes the brand of our profession, and 3) can potentially impact consumer/patient behavior. Furthermore, the fundamentals for building an online presence and social media authority will be presented, as well as tips for programmatically engaging others and sharing/creating content.

RCA52

3D Printing (Mimics) (Hands-on)

Thursday, Dec. 1 10:30AM - 12:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Moderator*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON, (asheikh@toh.on.ca) (*Presenter*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON, (frybicki@toh.ca) (*Presenter*) Nothing to Disclose
Dimitris Mitsouras, PhD, Boston, MA, (dmitsouras@alum.mit.edu) (*Presenter*) Research Grant, Toshiba Corporation;
Leonid Chepelev, MD, PhD, Ottawa, ON (*Presenter*) Nothing to Disclose
Taryn Hodgdon, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Carlos H. Torres, MD,FRCPC, Ottawa, ON (*Presenter*) Nothing to Disclose
Ai-Li Wang, Ottawa, ON (*Presenter*) Nothing to Disclose
Ekin P. Akyuz, BSc, Ottawa, ON (*Presenter*) Nothing to Disclose
Nicole Wake, MS, New York, NY (*Presenter*) Nothing to Disclose
Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Gerald T. Grant, MD, MS, Louisville, KY (*Presenter*) Nothing to Disclose
Satheesh Krishna, MD, Ottawa, ON, (dr.satheeshkrishna@gmail.com) (*Presenter*) Nothing to Disclose
John P. Lichtenberger III, MD, Bethesda, MD, (john.lichtenberger@usuhs.edu) (*Presenter*) Author, Reed Elsevier
Ashish Gupta, MD, Ottawa, ON (*Presenter*) Grant, Medtronic plc
Elizabeth George, MD, Boston, MA (*Presenter*) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Amy E. Alexander, BEng, Rochester, MN (*Presenter*) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To become familiar with the computational processing of cross-sectional images required to enable 3D printing using practical examples. 2) To learn to use software to identify and extract anatomical parts from cross-sectional images using manual and semi-automated segmentation tools, including thresholding, region growing, and manual sculpting. 3) To gain exposure to techniques involving model manipulation, refinement, and addition of new elements to facilitate creation of customized models. 4) To learn the application of tools and techniques, including "wrapping" and "smoothing" to enable the accurate printing of the desired anatomy, pathology, and model customizations using Computer Aided Design (CAD) software. 5) To become exposed to Standard Tessellation Language (STL) file format and interfacing with a 3D printer.

ABSTRACT

"3D printing" refers to fabrication of a tangible object from a digital file by a 3D printer. Materials are deposited layer-by-layer and then fused to form the final object. There are several 3D printing technologies that share similarities but differ in speed, cost, and resolution of the product. Digital Imaging and Communications in Medicine (DICOM) image files cannot be used directly for 3D printing; further steps are necessary to make them readable by 3D printers. The purpose of this hands-on course is to convert a set of DICOM files into a 3D printed model through a series of simple steps. Some of the initial post-processing steps may be familiar to the radiologist, as they share common features with 3D visualization tools that are used for image post-processing tasks such as 3D volume rendering. However, some are relatively or completely new to radiologists, including the manipulation of files in Standard Tessellation Language (STL). It is the STL format that is read by the 3D printer and used to reproduce a part of the patient's anatomy. This 90 minute session will begin with a DICOM file and review the commonest tools and techniques required to create a customized printable STL model. An extensive training manual will be provided before the meeting. It is highly recommended that participants review the training manual to optimize the experience at the workstation.

Honored Educators

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Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RCC52

Technologies for Creating Educational Content and Teaching Files

Thursday, Dec. 1 10:30AM - 12:00PM Room: S501ABC

ED **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

LEARNING OBJECTIVES

Sub-Events

RCC52A Podcasting and Screencasting for Teaching

Participants
Mahesh M. Thapa, MD, Seattle, WA (*Presenter*) Nothing to Disclose

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.

RCC52B e-Publishing

Participants
Michael L. Richardson, MD, Seattle, WA (*Presenter*) Nothing to Disclose

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.

Honored Educators

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Michael L. Richardson, MD - 2013 Honored Educator
Michael L. Richardson, MD - 2015 Honored Educator

RCC52C Incorporating the iPad in Resident Education: Using Mobile Technology to Improve the Way We Teach

Participants
Harprit S. Bedi, MD, Boston, MA, (hbedi@tuftsmedicalcenter.org) (*Presenter*) Nothing to Disclose

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.

ABSTRACT

SSQ10

Science Session with Keynote: Informatics (Quality and Safety)

Thursday, Dec. 1 10:30AM - 12:00PM Room: S403A

IN SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Woojin Kim, MD, Philadelphia, PA (*Moderator*) Officer, Nuance Communications, Inc
Kevin W. McEnery, MD, Houston, TX (*Moderator*) Advisor, Koninklijke Philips NV; Research Agreement, Koninklijke Philips NV
Kevin L. Junck, PhD, Birmingham, AL (*Moderator*) Nothing to Disclose

Sub-Events

SSQ10-01 Informatics Keynote Speaker: Using Imaging Informatics to Improve Quality and Safety in the Era of Value-Based Care

Thursday, Dec. 1 10:30AM - 10:40AM Room: S403A

Participants
Woojin Kim, MD, Philadelphia, PA (*Presenter*) Officer, Nuance Communications, Inc

Honored Educators

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Woojin Kim, MD - 2012 Honored Educator

SSQ10-02 Errors in Interpretation of Risk Estimates when Cumulative Dose is Considered

Thursday, Dec. 1 10:40AM - 10:50AM Room: S403A

Participants
Colin Walsh, MSc,BA, Dublin, Ireland (*Presenter*) Nothing to Disclose
Dara Murphy, Dublin, Ireland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

There has been considerable discussion in the literature about cumulative dose and whether it should play a role in the justification of future radiation exposures. We argue that with the increasing availability of dose histories we need to be aware of the types of errors that arise when considering cumulative dose.

METHOD AND MATERIALS

Errors relating to interpretation of risk where cumulative dose is a factor may be broken down into two categories: the first relates to how risk is modelled for low dose exposures; the second to the biological mechanisms by which harm may occur or develop.

RESULTS

Risk is modelled stochastically for low dose exposures and there is potential for confusion when we apply probability models in situations where the risk is repeated. The 'gambler's fallacy' can exert a powerful influence on our thinking leading to an overestimation of risk for subsequent exposures. Cumulative doses in excess of 100mSv - where there is clearer evidence of a link between radiation exposure and cancer induction – can cause additional concern. The second type of error relates to concerns that biological damage may accumulate with accumulating dose, leaving a patient at increased risk to a subsequent exposure. This is a factor for tissue effects at high doses, but we argue that there is no proper basis for applying this to low dose exposures. It is possible that a low dose exposure may cause vulnerabilities which place a patient at higher risk; it is possible it might promote resistance to a future exposure; it's possible that an exposure might produce vulnerability in one patient, and promote resistance in another. These effects, if they occur, are not sufficiently large to be detectable in the patient population. Adapting risk estimates based on the linear no threshold model to take account of such potential effects would be premature.

CONCLUSION

Confusion over interpretation of risks may lead to overestimation of risks for patients who have had previous scans, and deemphasise risks for patients who only need one scan.

CLINICAL RELEVANCE/APPLICATION

Modern information technology provides ready access to cumulative dose information. There are considerable benefits to providing this data. However, there is also a strong potential for confusion over radiation risks when dose history is considered. Overestimating or underestimating radiation risk can negatively impact clinical decision-making and patient care.

SSQ10-03 Current FDG PET Dosing in the US - An Overview from NCTN Clinical Trials

Thursday, Dec. 1 10:50AM - 11:00AM Room: S403A

Participants
Katherine Binzel, PhD, Columbus, OH (*Presenter*) Nothing to Disclose
David Poon, BS, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

Preethi Subramanian, MS, BEng, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Prayna Bhatia, BS, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Chadwick L. Wright, MD, PhD, Lewis Center, OH (*Abstract Co-Author*) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Nathan C. Hall, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

With increasing attention to radiation dose exposure overall, refined approaches to reduce dose burden from PET tracers are needed. In order to establish more insight into current national practices, we analyzed PET acquisition data from national cooperative trials performed within the NCI National Clinical Trial Network.

METHOD AND MATERIALS

FDG dosing recommendations have been established more than a decade ago (2006 for NCI) at 10 – 20 mCi, while FDA labeling envisions 5 -10 mCi. International clinical practice is trending to consistently lower tracer doses, however short of meta-analysis of published research papers, no data on current trends within national trials have been analyzed. We performed a multiple database query and analysis of NCTN clinical trials that include FDG PET/CT imaging.

RESULTS

More than 2000 PET examinations were included in this evaluation, from 177 different sites across the country. 92% of PET exams had injected doses greater than 10 mCi, with the current average dose trending around 13 mCi. Based on anecdotal data, US FDG dosing remains substantially higher than international practices. Protocol compliance was found to be high e.g. one trial of 474 FDG PET exams and a protocol dose guidance of 7-20 mCi, 2% used doses were below that range, however 10% were above. From an ALARA perspective, PET FDG dosing ranges should be lowered and should reach convergence with the FDA guidelines.

CONCLUSION

The evaluation of FDG PET dosing over several multi-institutional clinical trials showed that in general compliance with protocol dosing guidelines is excellent. There were a minimal number of studies which were completed outside of protocol dosing limits. However, the trend for dosing at sites across the country is well above FDA recommendations of 5-10 mCi of FDG, but within the decade old NCI recommendations. FDG dosing protocol guidance should reflect current opportunities to lower tracer radiation dose and long standing recommendations revisited on behalf of ALARA.

CLINICAL RELEVANCE/APPLICATION

FDG dosing compliance is high in national clinical trials that use PET, however protocol guidelines and practice recommendations remain above FDA guidelines and should be lowered.

SSQ10-04 Quantitative and Qualitative Optimization of Dosimetry in Computed Tomography Explorations of the Temporal Bone using Two Iterative Reconstruction Algorithms

Thursday, Dec. 1 11:00AM - 11:10AM Room: S403A

Participants
Olivier Legeas, MD, Brest, France (*Presenter*) Nothing to Disclose
David Bourhis, Brest, France (*Abstract Co-Author*) Nothing to Disclose
Julien Ognard, MD, MSc, Brest, France (*Abstract Co-Author*) Nothing to Disclose
Marc Garetier, MD, Brest, France (*Abstract Co-Author*) Nothing to Disclose
Adele Pennaneach, Quimper, France (*Abstract Co-Author*) Nothing to Disclose
Philippe F. Meriot, MD, Brest, France (*Abstract Co-Author*) Nothing to Disclose
Douraied Ben Salem, MD, PhD, Brest, France (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The two analysed iterative reconstruction algorithms responded well to the objectives of dose reduction in the exploration of the temporal bone.

Background

Iterative reconstruction (IR) has recently demonstrated its ability to reduce the dose of X-rays used in the exploration of several anatomical regions. However, there is no study involving a qualitative and quantitative comparison of the various IRs available for exploring the temporal bone. The aim of this study is to analyse Two IR algorithms (ASIR, GE Healthcare and SAFIRE, Siemens) in order to optimise dosimetry in scans of the temporal bone.

Evaluation

Using a Catphan® phantom, we studied the quantitative relationship between the contrast to noise ratio (CNR), the dose expressed as the volume computed tomography dose index (CTDIvol) and the strength of IR. The reference reconstruction technique was Filtered Back-projection (FBP) and the reference CTDIvol was 113mGy. We verified the absence of a reduction in spatial resolution and we defined an optimized dose to maintain reference CNR for each scale of IR. Based on these data we acquired series of images on an anthropomorphic phantom with an authentic human temporal bone for each level of iteration at the optimized dose; the purpose of this was to evaluate them qualitatively. Four radiologists used a three points image quality score to evaluate 16 anatomical structures, and an analysis of variance (ANOVA) was performed.

Discussion

The resulting measurements demonstrated a constant CNR with reduced dose without a loss of spatial resolution in the two manufacturers' systems. For each of the 5 scales of IR, the optimized dose was respectively 83, 59, 40, 22 and 11mGy for SAFIRE, and 89, 75, 64, 53 and 44 mGy for ASIR, and the mean image quality score were respectively 1,9(FBP); 1,7 (IR1); 1,6 (IR2); 1,7 (IR3);1,3(IR4);1,1(IR5) for SAFIRE and 1,9(FBP); 1,9 (IR1); 1,5 (IR2); 1,5 (IR3);1,3(IR4);0,9(IR5) for ASIR. The ANOVA analysis showed no significant difference between FBP and IR3 for SAFIRE and between FBP ans IR1 for ASIR, that leads to 65% dose reduction for SAFIRE and 20% for ASIR.

SSQ10-05 Radiological Arousal? Physiological Indices of Unconscious Detection of "Missed" Lung Lesions

Thursday, Dec. 1 11:10AM - 11:20AM Room: S403A

Participants
Gregory DiGirolamo, PhD, Worcester, MA (*Presenter*) Nothing to Disclose
Zachary R. Zaniewski, BA, Worcester, MA (*Abstract Co-Author*) Nothing to Disclose
Max P. Rosen, MD, MPH, Worcester, MA (*Abstract Co-Author*) Stockholder, Everest Scientific Inc; Consultant, PAREXEL International Corporation; Stockholder, Cynvenio Biosystems, Inc; Medical Advisory Board, Cynvenio Biosystems, Inc

PURPOSE

We have previously shown, that radiologists (RADS) look significantly longer at the location in which a lesion is present, even when they don't consciously recognize and report the lesion. Here we ask if the unconscious detection produces a change in physiological arousal, independent of conscious report, when an abnormality is present in the image. We used eye-tracking and pupil diameter to measure changes in arousal, as pupil diameter is a reliable and accurate measurement of physiological arousal.

METHOD AND MATERIALS

6 experienced RADS interpreted 18 axial chest CT scans (9 normal and 9 abnormal (containing 16 nodules). Pupil size was measured to determine if the presented lung lesion produced an unconscious detection and associated change in arousal. Pupil diameter was measured under 4 conditions: 1) A lung lesion was present, and the RAD was looking directly at it and successfully consciously detected it; 2) A lung lesion was present, and the RAD was looking directly at it and didn't consciously detect or consider it; 3) A lung lesion was present, and the RAD was neither looking directly at it nor consciously detected or considered it; and 4) No lesion was present.

RESULTS

On average 8/16 (50%, +/- 9%) lung nodules were consciously identified. Arousal, as indexed by pupil diameter, significantly differed between our 4 conditions, with $F(3, 15) = 3.44$, $p< 0.05$. Compared to arousal when looking at healthy tissue, arousal significantly increased ($p < 0.05$) when a lung lesion was present, and the RAD was looking directly at it and consciously detected it; or when RADS were looking at the lesion and were unconscious of it ($p<0.005$). Arousal was also significantly greater ($p< 0.05$) when a lesion was present, but RADS were neither looking at it or consciously detected it. Arousal was equivalent in all conditions in which a lesion was present regardless of the conscious detection.

CONCLUSION

Our data show that unconscious processes successfully detect the presence of a lesion and increase physiological arousal, as indexed by changes in pupil size, even without conscious awareness of the abnormality. Moreover, this increased arousal occurs with the presence of an abnormality even if not looking directly at the lesion.

CLINICAL RELEVANCE/APPLICATION

Many findings missed in clinical practice, may actually be detected unconsciously. The use of measures of physiological arousal may be used to improve radiologists' performance.

SSQ10-06 Preempting Unsafe and Near-Miss Events in MRI: Impact of Interventions and an Enterprise Reporting and Tracking System

Thursday, Dec. 1 11:20AM - 11:30AM Room: S403A

Participants
Judah Burns, MD, Bronx, NY (*Presenter*) Nothing to Disclose
William Walter, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Michael L. Lipton, MD, PhD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

An online portal for anonymous reporting and tracking actual and near miss MRI safety events was instituted to enhance the overall culture of safety surrounding MRI at a multi-site (n=8) tertiary health system. We present the results of 13 consecutive years of monitoring, including the initiation of incremental MRI safety measures, in relation to growing MRI volumes across the enterprise.

METHOD AND MATERIALS

Prospective collection of MRI safety and near-miss event reports was initiated in 2002. Ongoing monitoring of reports motivated numerous MRI safety initiatives, including: electronic door locks with auto-locking and monitoring capabilities, educational initiatives for referring clinicians, two-level written screening forms, and ferromagnetic detectors. Near-miss events were tabulated for hospital and outpatient sites, and categorized as: burn, nerve stimulation, Zone 4 door left open, unauthorized personnel, unsafe equipment, unsafe implant, incomplete screening form, and pacemaker referral. Categorized results were tabulated and compared to annual MRI exam volume.

RESULTS

Following a 6 month run-in period, 374 total events were reported (mean = 28.8/year). During the assessment period (2003-2015), departmental MRI volumes increased from 18,223 to 41,465 annual exams. The normalized rate of reported events decreased progressively from 0.27% to 0.05%. Pacemaker referral was the most commonly reported potential safety event (56%), followed by "incomplete screening form" and "unsafe implant". During the first 4 years of the monitoring program, the average annual rate of reported events was 0.18% and declined significantly to 0.07% over the final 9 years ($p<0.0001$). During this period, MRI exam volume shifted from predominantly hospital-based (80%) to a mix of hospital (56%) and outpatient imaging.

CONCLUSION

The initiation of an enterprise-wide MRI safety monitoring tool, which motivated a series of targeted mitigation strategies, enhanced the overall institutional culture of safety. A progressive reduction in MRI unsafe and near-miss events, both in absolute and relative terms, was achieved over 4 years and sustained over a subsequent 9-year period. Impact was greatest at hospital-based imaging sites, particularly during the first few years of the program.

CLINICAL RELEVANCE/APPLICATION

Tracking of MRI safety and near-miss events contributes to a reduction of relative and absolute annual reported events.

SSQ10-07 An Addition to the Radlex Playbook Naming Convention that Allows for Series Level Dose Comparisons

Thursday, Dec. 1 11:30AM - 11:40AM Room: S403A

Participants
Timothy P. Szczykutowicz, PhD, Madison, WI (*Presenter*) Equipment support, General Electric Company; License agreement, General Electric Company
Robert K. Bour, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Amanda Ciano, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Annelise Malkus, PhD, Madison, WI (*Abstract Co-Author*) Licensing agreement, General Electric Company
Frank N. Ranallo, PhD, Madison, WI (*Abstract Co-Author*) Grant, General Electric Company
Myron A. Pozniak, MD, Madison, WI (*Abstract Co-Author*) Stockholder, Cellectar Biosciences, Inc; Support, General Electric Company

CONCLUSION

Our proposed extension to the Radlex naming convention would not require the same degree of stewardship as the existing standard since there are only a relatively small number of contrast phases using in diagnostic radiology (early arterial, late arterial, etc.).

Background

CT can contain multiple acquisitions associated with different contrast phases. The naming associated with each of these images impacts many downstream workflows, for example hanging protocols and dose mapping. This work focuses on a proposed addition to the widely accepted Radlex playbook system that will enable series level dose comparison both intra and inter institutionally.

Evaluation

We exported all irradiation events for CT from our commercial dose monitoring software which included all dose information and the protocol and series names. By combining the protocol name and series name, we were able to create a unique identifier for each irradiation event. This identifier is indication specific (since the protocol name can be linked to a Radlex indication specific RPID) and contrast phase specific (since our series names contain series specific verbiage). Using this system, we can map irradiation events together even when multiple protocols are used for one exam or only part of a protocol was used. Our proposed addition to the Radlex system is a new standardized series level naming convention that relates to the contrast usage for the series. For example, the series name denotes the presence of contrast and what phase. For routine exams like our head protocol, this results in series names like “HEAD W/O” and “HEAD W IVC”. However, the utility of our system is shown when we scan a stroke patient which involves a non-contrast head, a CTA head, a perfusion scan and a with contrast head. Our naming convention allows for the routine head portions of this stroke workflow to be correctly mapped to a routine head Radlex RPID for dose reasons, and the total stroke dose to be computed.

Discussion

The type of series level naming in use at our institution allows one to compare doses both on an indication and series level. It also allows for analysis of the frequency optional portions of a protocol are used.

SSQ10-08 Experiences Operationalizing an Annotation Image Markup-compliant (AIM) PACS Tool Within Interpretation Workflow for Tracking Oncological Measurements

Thursday, Dec. 1 11:40AM - 11:50AM Room: S403A

Participants
Pritesh Patel, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Merlijn Sevenster, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Thomas A. Forsberg, MSc, Cambridge, MA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Aaldert J. Elevelt, MS, Best, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Rob van Ommering, PhD, Eindhoven, Netherlands (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Igor Trilisky, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Pieter C. Vos, MS, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Paul J. Chang, MD, Chicago, IL (*Abstract Co-Author*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Advisory Board, Bayer AG

PURPOSE

An integrated PACS tool (“Measurement Assistant” [MA], Philips) has been demonstrated in previously published work to provide efficient and accurate structured authoring of oncological RECIST measurements in AIM-compliant format. This early work on a controlled number of cases established that radiologists experienced a time penalty in “baseline” exams due to the entering and labelling new lesions, which was balanced by improved efficiency when interpretating “followup” exams due to semi automated lesion identification and navigation. We report on utilization, efficiency and learning experiences of a continuous quality improvement (CQI) project to adopt MA in the abdomen section of an academic hospital.

METHOD AND MATERIALS

A version of MA with granular interaction logging was installed on all abdomen workstations. Readers were trained and encouraged to track all measurements of confirmed oncological lesions. Utilization was tracked by detecting if MA had been used in reports with measurements. Measurement reporting time per exam (MRT) was estimated from the MA interaction log file events. A learning effect was studied by comparing (t test) number of MA interactions in each reader’s first, second and third 20 exams read with MA.

RESULTS

In the course of 30 weeks, 1,736 exams were read with MA by 36 readers. Average utilization was 77% and rose from 66% in the first four weeks to 84% in the last four. Estimated MRT was 43 seconds with MA on baseline exams and 16 seconds on followup exams. Compared to the first 20 exams, readers had 21% ($P < 0.001$) fewer interactions with MA in the second 20 exams. Between the second and third set of 20 exams, there was no significant interaction reduction ($P = 0.54$).

CONCLUSION

MA was successfully adopted in the abdomen section. Earlier reported time efficiency gains were confirmed in this study in an uncontrolled setting.   Users had no significant learning curve after the first 20 exams read with MA.

CLINICAL RELEVANCE/APPLICATION

Oncological measurements can be collected in AIM-compliant re-usable format by means of a PACS-integrated tool resulting in both improved lesion documentation accuracy and improved efficiency relative to traditional methods.

SSQ10-09 The Cost of Distraction: Quantifying the Effects of Telephone Interruptions on the Diagnostic Radiologist Using Mobile Eye Tacking

Thursday, Dec. 1 11:50AM - 12:00PM Room: S403A

Awards
Student Travel Stipend Award

Participants
Booth Aldred, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose
Marta E. Heilbrun, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Richard H. Wiggins III, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose
Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Abstract Co-Author*) Royalties, General Electric Company; Research Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;
Trafton Drew, PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The third leading cause of death in the United States is the result of medical errors. In diagnostic radiology, an estimated 30% of errors are classified as perceptual and potentially preventable. Radiologists' job is made even more difficult by telephone interruption. Correlational studies show increased interruptions are associated with more disagreements in patient diagnosis. We aim to quantify the effect of distraction on diagnostic accuracy, interpretation time, and eye-movement patterns.

METHOD AND MATERIALS

Sixteen radiologists, ranging from 4th year residents, fellows, to attending physicians participated in the study. A work-list of "emergent" studies, including six computed tomographic studies with a spectrum of critical findings, were interpreted and dictated. Each session included two interrupting phone calls with pre-recorded messages requesting the interpreting radiologist give a "wet read" on two separate studies. Telephone interruptions were counterbalanced across cases, allowing comparison of identical cases between radiologists.

RESULTS

Diagnostic accuracy was unaffected by interruption in the preliminary sample. However, after controlling for time attending the interruption, total time spent on each case was increased in the face of distraction (8-1/2min: interrupted case, 5min: uninterrupted; $t(15)=4.5$, $p<.001$). Despite this increase in overall time spent examining cases that were interrupted, time spent looking at critical findings, such as a sternal fracture, was much lower (mean dwell time: 80ms during interruption trials, 5200ms during uninterrupted trials).

CONCLUSION

Mobile eye-tracking technology allows for unobtrusive observation of radiologists behavior in realistic scenarios with emulation of true reading room challenges. Our research suggests that telephone interruptions result in substantial changes in how radiologists approach the interrupted case. Increased overall time spent may result because they have no dedicated mechanism to allow return to where they left off. This was exemplified in the significant variability of radiologists to effectively return to a case after an interruption. In future work we hope to determine whether some strategies, such as templates, may ameliorate the costs associated with telephone interruption.

CLINICAL RELEVANCE/APPLICATION

Radiology distractions lead to increased interpretation time and search pattern failure.

Honored Educators

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Richard H. Wiggins III, MD - 2012 Honored Educator

INS-THA

Informatics Thursday Poster Discussions

Thursday, Dec. 1 12:15PM - 12:45PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

Participants
Satre Stuelke, MD, Danville, PA (*Moderator*) Research Consultant, Koninklijke Philips NV

Sub-Events

IN250-SD-THA1 RECIST 1.1 Criteria and Quantitative CT Image Features to Predict Pathologic Response to Immunotherapy in Melanoma: Preliminary Findings

Station #1

Participants
Brett W. Carter, MD, Houston, TX (*Presenter*) Editor, Reed Elsevier;
Priya R. Bhosale, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose
Mohamed G. Elbanan, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Alper Duran, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Sujaya Rao, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Ebru UNLU, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Jia Sun, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei Wei, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
David Fuentes, houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (*Abstract Co-Author*) Researcher, Hologic, Inc

PURPOSE

To determine whether RECIST 1.1 criteria and quantitative CT image features can predict pathologic response to immunotherapy in patients with advanced melanoma.

METHOD AND MATERIALS

Eleven patients (4 female, 7 male; average age 59, age range 45-78) with advanced melanoma (stages III and IV) and biopsy-proven metastatic lymph nodes treated with neoadjuvant immunotherapy (nivolumab and ipilimumab) prior to complete surgical resection were included. Surgical specimens were assessed for residual viable tumor (gold standard). RECIST 1.1 measurements were performed on contrast enhanced CT (CECT) scans at two time points (prior to therapy and before surgical resection) for all patients by both radiologists and melanoma medical oncologists. Interobserver agreement and the ability of RECIST 1.1 to predict pathologic response were analyzed. Quantitative image features were extracted from lymph nodes on pre-therapy CECT scans. Histogram, gradient, co-occurrence, gray tone difference, and filtration-based techniques were used for texture feature extraction using the Imaging Biomarker Explorer (IBEX) software platform. One-way analysis of variance (ANOVA) was used to correlate texture features with viable tumor, mutation status, RECIST 1.1 response, and clinical stage.

RESULTS

At surgical resection, 5 patients had residual viable tumor and 6 had no detectable tumor. For RECIST 1.1 measurements, interobserver agreement was excellent with kappa = 0.84 (95% CI: 0.54 – 1.00). For the ability of RECIST 1.1 to predict pathologic response: accuracy, 64%; sensitivity, 100%; specificity, 33%; positive predictive value, 56%; and negative predictive value, 100%. Despite the limitations of small sample size, several texture features were identified as significant in predicting pathologic response, including contrast, entropy, busyness, and correlation, and patients with complete pathologic response (pCR) showed differences in these features.

CONCLUSION

This study showed that RECIST 1.1 measurements were at times unreliable in predicting pathologic response in a group of melanoma patients treated with neoadjuvant immunotherapy and that quantitative image feature extracted from CECT were significant for predicting pathologic response. Verification of these texture features in larger studies is necessary.

CLINICAL RELEVANCE/APPLICATION

In the prediction of pathologic response, RECIST 1.1 criteria can at times be unreliable and quantitative CT image features may add value.

Honored Educators

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Brett W. Carter, MD - 2015 Honored Educator
Priya R. Bhosale, MD - 2012 Honored Educator

IN251-SD-THA2 The Quantitative Image Feature Pipeline (QIFP) for Discovery, Validation, and Translation of Cancer Imaging Biomarkers

Station #2

Participants

Sandy Napel, PhD, Stanford, CA (*Presenter*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc; Scientific Advisor, RADLogics, Inc
Sebastian Echegaray, MS, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Dev Gude, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Olivier Gevaert, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Daniel L. Rubin, MD, MS, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To create a publicly available resource for computing image features (radiomics) from regions of interest in 2D and 3D images of cancer patients, and for creating and validating diagnostic and prognostic image biomarkers, and predictors of tumor molecular phenotype.

METHOD AND MATERIALS

Cancer researchers are actively exploring the association of radiomics in medical images with clinical data (e.g., survival, response, specific gene mutations, tumor -omics) with the ultimate goal of building predictive models. The QIFP is a standards- and cloud-based system that will allow researchers to compute quantitative features from their own or publicly available image and clinical data, or from data that are shared to the QIFP by other users, to create integrative databases including radiomics and clinical data, and to build and evaluate predictive models for survival, response, and tumor molecular phenotype.

RESULTS

The QIFP as implemented currently computes 3D features (e.g., tumor size, shape, edge sharpness, and pixel value statistics including image textures) from regions in an image series defined by DICOM Segmentation Objects (DSOs). Although these algorithms were developed in Matlab, we deployed them as shareable Docker executable-containers, linked them with a flexible workflow language, and made them available on a server that allows users to work with their own images or with existing images that are resident on the server or on a public resource, such as TCIA, and to compute radiomics features from regions defined by DSOs. Users can download and use these features in radiomics research. Future phases will include a built-in machine learning method for predictive model building, the ability for users to upload and share their own feature-generating and machine learning software in executable Docker containers, and a web-services interface allowing access to the QIFP from within their own platforms.

CONCLUSION

The QIFP, which enables data and software tool sharing for radiomics research, has the potential to greatly accelerate the development and validation image biomarkers that could be readily translated for use in diagnosis, prognostication, and accelerating the completion of clinical trials.

CLINICAL RELEVANCE/APPLICATION

The QIFP will allow the research community to share standard image feature computation algorithms, data sets, and the resulting predictive models which can then become part of the radiology workflow.

Honored Educators

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Daniel L. Rubin, MD, MS - 2012 Honored Educator
Daniel L. Rubin, MD, MS - 2013 Honored Educator

IN252-SD-THA3 Radiomic Analysis of Salivary Glands for the Prediction of Weight Loss in Irradiated Head and Neck Cancer Patients

Station #3

Participants
Minoru Nakatsugawa, PhD, Baltimore, MD (*Presenter*) Employee, Toshiba Corporation; Research support, Toshiba Corporation;
Zhi Cheng, MD, MPH, Baltimore, MD (*Abstract Co-Author*) Research Grant, Toshiba Corporation
Keith Goatman, PhD, Edinburgh, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Junghoon Lee, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Adam Robinson, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ana P. Kiess, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Xuan Hui, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Scott Robertson, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Michael Bowers, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Amanda Choflet, MS,RN, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Kazuki Utsunomiya, Otawara, Japan (*Abstract Co-Author*) Employee, Toshiba Corporation
Shinya Sugiyama, Otawara, Tochigi, Japan (*Abstract Co-Author*) Employee, Toshiba Corporation
John Wong, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Elekta AB Research Grant, Xstrahl Ltd Research Grant, Toshiba Corporation Co-founder, JPLC Associates LLC Royalty, Elekta AB Consultant, Xstrahl Ltd
Todd R. McNutt, PhD, Baltimore, MD (*Abstract Co-Author*) Research collaboration, Koninklijke Philips NV Research collaboration, Toshiba Corporation Research collaboration, Elekta AB
Harry Quon, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The quality of life of irradiated head and neck cancer (HNC) patients is significantly limited by toxicities leading to weight loss. Our recent analysis identified that radiation (RT)-induced weight loss was influenced by age and dose to parotid glands based on recursive partition models. We hypothesize that these factors reflect the importance of baseline salivary gland function and that high-throughput image analysis, known as radiomics, can quantify baseline function to further refine our model.

METHOD AND MATERIALS

Clinical and dosimetric data were systematically captured in our analytic database. Computed tomography (CT) images used for RT-planning were extracted from the picture archiving and communicating system. 79 HNC patients treated with intensity-modulated radiotherapy (IMRT) from 2009 to 2015 with imaging and non-imaging datasets were identified. Imaging data included 5,000 features of intensity, volumetry, shape and textures calculated for each of the ipsilateral/contralateral parotid and submandibular glands. Non-imaging data included dose volume histogram, tumor diagnostics and patient demographics. Weight loss (≥5kg) at 3 months post-RT was predicted by the logistic regression with the LASSO algorithm. Three models were developed with 1)all features, 2)non-imaging only and 3)imaging features only.

RESULTS

Combining imaging and non-imaging features significantly improved the weight loss prediction ($p<0.001$). The AUC/PPV of the three models was 1) 0.78/0.69, 2) 0.63/0.34, and 3) 0.64/0.42. The predictors were dose to combined parotid glands (D100), and the shape and textures of ipsilateral parotid and submandibular glands (fractal dimension, grey-level run-length and grey-level co-occurrence matrix). Selected texture predictors combined with age showed a significant trend ($p<0.05$).

CONCLUSION

Our preliminary results demonstrate that baseline imaging features of salivary glands is potentially quantifiable and can predict RT-induced weight loss when combined with non-imaging features. To our knowledge, this represents a potentially novel observation and role for radiomics in the study of normal parotid function as it relates to predicting radiation-induced xerostomia.

CLINICAL RELEVANCE/APPLICATION

Pre-radiotherapy radiomic analysis of salivary glands can measure baseline function and improve the RT-induced weight loss prediction which can support decisions for RT-planning and toxicity management.

IN253-SD-THA4 First Dynamic Study of Image Analyses from DCE-US to Evaluate of the Tumor Vascular Heterogeneity

Station #4

Participants
Baya Benatsou, Villejuif, France (*Presenter*) Nothing to Disclose
Mohamed Amine Benadjaoud, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose
Serge Koscielny, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose
Nathalie B. Lassau, MD, PhD, Villejuif, France (*Abstract Co-Author*) Speaker, Toshiba Corporation; Speaker, Bracco Group
Stephanie Pitre-Champagnat, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Until there, evaluation of therapeutic response is only based on the perfusion curve averaged over the whole tumor, and does not take into account of its vascular heterogeneity. In this context, the aim of this study is to identify predictive parameters of therapeutic response using both texture and Functional Data Analysis (FDA) of DCE-US images. The originality of our approach is based on a dynamic study of image analysis at different time points of the time-intensity curve (TIC).

METHOD AND MATERIALS

This retrospective study was performed on 62 patients with Hepatocellular carcinoma (CHC) treated by Sorafenib (NEXAVAR) included the DCE-US STIC multicentric studyDCE-US evaluations were available at: baseline; day: 7; 15; 30 and 60. For each examination, raw linear data were acquired during 3 minutes after injection of contrast agent. A region of interest (ROI), including total tumor surrounding the lesion, was defined. Ten frames have been extracted from video format at 10 specific time points of the TIC. Each image has been processed by homemade software on the total tumoral segment using thresholding with mathematical morphology, the vascular tumor signal intensity was extracted and the signal intensity outside tumor was removed. The resulting images were analyzed by three complementary approaches:i) a texture analysis based on the gray-level-spatial-dependence matrix, ii) a FDA study of the intensity histogram over the 10 images of each evaluation, iii) the ratio of low-vascularization surface on the whole tumor surface after Markovian segmentation. Finally, 14 parameters were extracted.

RESULTS

In 62 patients, 56 male and 6 female were included. Median age was 64 years old. After the validation of image processing, we extracted a total of 2270 images from the 227 DCE-US examinations. The analysis is on progress and results will be presented.

CONCLUSION

This first dynamic study of image analysis combined texture processing and FDA to evaluate the tumor vascular heterogeneity in order to determine predictive parameters of therapeutic response.

CLINICAL RELEVANCE/APPLICATION

First dynamic study of image analysis combined texture processing and FDA to evaluate the tumor vascular heterogeneity

IN255-SD-THA6 Reproducibility of CT Texture Parameters by Leveraging Publically Available Patient Imaging Datasets

Station #6

Participants
Shih-Hsin Chen, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Balaji Ganeshan, PhD, London, United Kingdom (*Presenter*) CEO, TexRAD Ltd; Director, Feedback plc; Director, Stone Checker Software Ltd; Director, Prostate Checker Ltd
Francesco Fraioli, MD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Heterogeneity is a key component of malignancy and computed tomography texture analysis (CTTA) is one possible way to quantify it non-invasively. This study aims to use a test-retest methodology to assess the reproducibility of the filtration-histogram technique of CTTA.

METHOD AND MATERIALS

The RIDER Lung CT dataset without the injection of contrast media (source The Cancer Imaging Archive – TCIA, sponsored by the Cancer Imaging Program, DCTD/NCI/NIH) was used for this purpose. For each patient, two readers drew the regions of interest (ROI) on the slice with the largest cross-section of the tumor. One operator analyzed the image data twice with a one-week interval between the two analyses. Filtration-histogram based CTTA was undertaken using TexRAD commercial research software (TexRAD Ltd, www.texrad.com - part of Feedback Plc, Cambridge, UK). The agreement of the texture parameters from CTTA analysis of repeated scans, for the same operator (intra-operator) and between the two operators (inter-operator) was assessed by intra-class correlation coefficients (ICC) and further visualized using Bland-Altman plots.

RESULTS

Our results showed that most of the filtration-histogram based CT texture parameters are generally reproducible with high ICC for the different permutations. The best ICC for the different texture quantifiers for intra-operator, inter-operator and repeated scan are as follows: Mean (0.968, 0.909, 0.787), SD (0.973, 0.960, 0.838), Entropy (0.998, 0.994, 0.993), Skewness (0.925, 0.862, 0.782), Kurtosis (0.942, 0.885, 0.689) and MPP (0.958, 0.942, 0.882). Bland-Altman plots further provided the average differences between the operators and limits of agreement for the different texture metrics, which are further useful in a clinical setting.

CONCLUSION

The filtration-histogram technique of CTTA is reproducible. This study using a test-retest methodology forms a vital part in the qualification process of CTTA as a potential imaging biomarker and its translation into clinic.

CLINICAL RELEVANCE/APPLICATION

The reproducibility of the filtration-histogram technique of CTTA suggests its potential application in routine clinical and multi-center setting.

RCC53

Computer-Aided Diagnosis: State-of-the-Art and New-Generation CAD for Precision Medicine

Thursday, Dec. 1 12:30PM - 2:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Hiroyuki Yoshida, PhD, Boston, MA, (yoshida.hiro@mgh.harvard.edu) (*Moderator*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

LEARNING OBJECTIVES

1) Learn how to effectively integrate state-of-the-art CAD techniques into clinical imaging services; 2) learn emerging radiomics/genomics-based CAD and its prospective role in precision medicine, 3) learn how CAD informatics tools can guide the diagnosis and treatment decision-making processes, and 4) learn prospective roles of new generation CAD in P4 medicine--predictive, preventive, personalized, and participatory medicine.

ABSTRACT

Computer-aided diagnosis (CAD) has become one of the major research subjects in medical imaging and diagnostic radiology. In this refresher course, advanced use of CAD in clinical practice will be presented together with emerging CAD systems and their prospective roles in clinical decision-making processes. The past researches and developments in CAD have led to the quantitative imaging (QI), which involve processes such as segmentation of lesions from normal anatomical background, followed by the analysis of the segmented lesions to yield quantitative measures of pathological, anatomical, or physiological characteristics of the lesions. Many of the techniques that were developed in the CAD fields formed the foundations of the QI analyses. How to effectively integrate the state-of-the-art CAD techniques into clinical imaging services will be first discussed. Currently, CAD is widening its applications into assessment of risk, prognosis, and response to therapies, as well as expanding its horizon to quantitative analyses of "-omics" data including genomics, proteomics, and various phenotypes, often referred to as radiomics. In image-based phenotyping, CAD methods are under active development to quantitatively characterize tumor radiomic features such as tumor morphology and physiology, merge these tumor radiomic features with clinical information to develop diagnostic, prognostic, or predictive imaging biomarkers, correlate imaging phenotypes with genotypes and/or gene expressions. The role of the next-generation CAD, radiomics/genomics-based CAD, in clinical practice will be reviewed in the next lecture. Starting as a computerized tool for highlighting abnormal lesions, CAD is now evolving into an informatics tool that mine various biobanks to retrieve tumors that have similar phenotypes and genotypes to be compared with the tumor in question and to discover imaging biomarkers linked with omics data. The new generation of CAD will have a high promise in becoming an indispensable tool for realizing precision medicine in the era of personalized medicine. The perspectives of the role of the new-generation CAD in P4 medicine will be discussed in the final lecture of the course.

Sub-Events

RCC53A CAD for Imaging Services: Integrating State-of-the-Art CAD into 3D Imaging Services

Participants

Gordon J. Harris, PhD, Boston, MA, (gjharris@partners.org) (*Presenter*) Medical Advisory Board, Fovia, Inc; Stockholder, IQ Medical Imaging LLC;

LEARNING OBJECTIVES

1) How CAD applications can be developed and validated. 2) How CAD applications can transition from a research tool to a clinical product. 3) How CAD applications can be implemented in a clinical workflow environment. 4) How academic and industry groups can partner in developing clinical CAD applications.

Active Handout:Gordon J. Harris

http://abstract.rsna.org/uploads/2016/16005054/ACTIVE RSNA CAD-RCC53A 2016 Harris handouts.pdf

RCC53B Radiomics/Genomics-based CAD: Role of Next-Generation CAD in Clinical Practice

Participants

Hugo Aerts, PhD, Boston, MA (*Presenter*) Stockholder, Genospace LLC
Stephen S. Yip, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about the motivation and methodology for Computational Imaging & Radiomics. 2) Learn about the existing and future potential role of radiomics with other –omics data and within precision medicine. 3) Learn about radionics-genomics studies in different cancer types.

ABSTRACT

RCC53C Radiomic Clinical Decision Support System: CAD for Precision Medicine

Participants

Daniele Regge, MD, Torino, Italy (*Presenter*) Speakers Bureau, General Electric Company

LEARNING OBJECTIVES

1) To describe the new informatics tools for data collection, data mining and processing of information in the omics era. 2)

1) To describe the new informatics tools for data collection, data mining and processing of information in the omics era. 2) To give examples of how this new vision adapts to the new paradigms of clinical research in the field of oncology. 3) To discuss the role of new generation CAD systems in P4 medicine.

ABSTRACT

INS-THB

Informatics Thursday Poster Discussions

Thursday, Dec. 1 12:45PM - 1:15PM Room: IN Community, Learning Center

IN

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Satre Stuelke, MD, Danville, PA (*Moderator*) Research Consultant, Koninklijke Philips NV

Sub-Events

IN257-SD-THB1 Integration of Mammographic, Ultrasound, and Clinical Metrics for Characterization of Breast Lesions using Novel Informatics Modeling with Comparison to OncotypeDX

Station #1

Participants
Philip A. Di Carlo, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Vishwa Parekh, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Susan C. Harvey, MD, Lutherville, MD (*Abstract Co-Author*) Nothing to Disclose
Christopher Umbricht, MD,PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Antonio C. Wolff, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, F. Hoffmann-La Roche Ltd
Michael A. Jacobs, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG

PURPOSE

Mammography, ultrasound(US) and MRI are imaging modalities used for breast cancer detection. The BIRADS lexicon provides a set of descriptors that facilitates consistent structure for assessment and reporting of breast lesions. To predict recurrence, oncologists use OncotypeDX, which stratifies patients into three risk groups: low, medium, and high. We hypothesize that there is a relationship between imaging features defined by BIRADS and the genetic profile of cancers. To test this, we developed a machine-learning non-linear dimension reduction(NLDR) algorithm with embedded informatics. Using these techniques, we compare BIRADS descriptors to the OncotypeDX for recurrence prediction.

METHOD AND MATERIALS

Patients(n=48) who underwent diagnostic breast imaging, were ER+, with available OncotypeDX were tested with the algorithm. The clinical and BIRADS parameters for mammography included breast density, asymmetry, microcalcifications(morphology, distribution), mass(size, shape, margins, density) and architectural distortion. Ultrasound parameters included mass presence, size, echogenicity, shape, margins, vascularity, and orientation. These parameters were assigned numerical values to reflect relative suspicion of each descriptor. There were 24 patients with low(0-17), 13 with intermediate(18-31), and seven with high risk(>31) scores from OncotypeDX. Our NLDR and informatics algorithm computes the multidimensional metrics and embeds these results into a two-dimensional heatmap for clinical decision support. Area under the Curve(AUC) and student's t-tests were calculated.

RESULTS

The top predictors were mammographic beast density, and mass margins and US directional size. These predictors resulted in a significant AUC(0.86±0.07). The mammographic tumor sizes in high risk groups were larger(1.9±0.58cm) compared to the low-risk group(1.38±0.58cm) with similar results for US measurements in the radial(2.7±1.2cm vs.1.2±0.8cm), AP (1.8±0.76cm vs. 0.98±0.61cm) and antiradial (2.1±1.3cm vs.1.0±0.58cm) dimensions. We created a visualization informatics heat map detailing the contribution of each parameter.

CONCLUSION

The most important imaging parameters determined from the informatics model were mammographic breast density, and mass margins and US size.

CLINICAL RELEVANCE/APPLICATION

NLDR Informatics modeling of clinical and imaging descriptors will provide the foundation for an advanced clinical decision support system for precision medicine

IN258-SD-THB2 Novel Algorithm for Pulmonary Nodule Malignancy Prediction

Station #2

Awards
Student Travel Stipend Award

Participants
Stephen P. Power, MBBCh, MRCPI, Cork, Ireland (*Presenter*) Nothing to Disclose
Pietro Nardelli, MD, Cork, Ireland (*Abstract Co-Author*) Nothing to Disclose
Jaspar Pahl, Cork, Ireland (*Abstract Co-Author*) Nothing to Disclose
Sean E. McSweeney, MD, Cork, Ireland (*Abstract Co-Author*) Nothing to Disclose
Kevin N. O Regan, MD, Cork, Ireland (*Abstract Co-Author*) Nothing to Disclose
Padraig Cantillon-Murphy, PhD, Cork, Ireland (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Our work describes a novel algorithm which predicts malignancy in solitary pulmonary nodules with more accurary than previously published methods.

Background

Pulmonary nodules are detected on between 20-50% of thoracic CT studies, many of them as incidental findings. The follow-up of these nodules places a significant burden on healthcare services considering only a small percentage of these nodules will eventually prove to be malignant in aetiology (1-12%). Computer aided detection systems can help to assist the radiologist in the identification and classification/malignancy prediction of pulmonary nodules.

Evaluation

We describe a novel system for semi-automatic estimation of malignancy of pulmonary nodules, with the aim of minimizing user interaction in this computer-aided identification and classification of nodules. The algorithm automatically extracts size, location, edge smoothness, growth rate, cavity wall thickness and calcification of the analysed nodule and uses these features, combined with clinical details to calculate the probability of malignancy. The algorithm works as a modular structure which consists of four sequential steps: Segmentation of lung regions to exclude unwanted structures and to identify a nodule's location. Analysis of identified nodules to extract characteristics such as size, shape, wall thickness and the presence of calcification. Segmentation of lung lobar fissure and lobes. Nodule diagnosis with estimation of likelihood of malignancy (%)The algorithm was tested on a combination of CT images available online (open-source) and from CT studies at our local institution (n =175 nodules). Estimates of malignancy was provided by reviewing radiologists and compared with the estimation produced from the algorithm.

Discussion

This work presents a novel method to predict malignancy in solitary pulmonary nodules, providing automatic extraction of a nodule's radiological characteristics.A comparison with four seperate radiologists' subjective assessment showed that the implemented algorithm is comparable to radiologists' performance. The ability of the algorithm to predict malignancy is higher than the previously published methods.

IN259-SD-THB3 Big Data in Radiology: A COPD Case Study

Station #3

Participants
Thomas J. Re, MD,MS, Basel, Switzerland (*Presenter*) Nothing to Disclose
Kevin Mader, DPhil,MSc, Zuerich, Switzerland (*Abstract Co-Author*) Employee, 4Quant Ltd; Shareholder, 4Quant Ltd
Jens Bremerich, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Flavio Trolese, Zurich, Switzerland (*Abstract Co-Author*) Officer, 4Quant Ltd
Michael Moor, BSC, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Bram Stieltjes, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The described pipeline, utilizing fully automatic PACS study retrieval and post-processing lays the groundwork for future big-data analysis of COPD imaging quantities from large radiology archives.

Background

Chronic Obstructive Pulmonary Disease (COPD) affects millions of people worldwide. Chest CT studies are often used to assess severity and progress of this disease and this has created a large pool of disease related imaging data. We suggest that a Big Data approach to the analysis of this data could provide new insight and understanding of COPD. This work describes our development and verification of a fully automatic pipeline for identifying, retrieving and analysing COPD CT data from a PACS, a prerequisite to its Big Data analysis.

Evaluation

A ground truth reference was created using a test sample of 45 COPD CT studies using a traditional semi-automatic process choosing Percentile Density 15 (PD15) and Low Attenuation Area -950 (LAA-950) as the quantities of interest. A radiologist identified/retrieved the CT studies' data one at a time via a standard PACS client, then used a semi-automatic software for segmenting lung and calculating PD/LAA values. This process required ~90hrs total radiologist time (2hr/exam). For the fully automatic pipeline, software was developed to query the PACS, identify and retrieve the CT studies of interest and perform PD/LAA calculations (RIQAE, 4Quant Ltd, Zurich, Switzerland). Once implemented, this fully automatic pipeline required under 1hr of radiologist time to prepare and under 1hr total PACS/computing time to generate the results for the 45 CT studies. Average differences in calculated quantities (PD15/LAA-950) between the two techniques was not significant (mean= 0.10%; SD=0.14%; max difference=0.61%; p-value=0.91). Subsequently, a larger cohort of 200 subjects was analyzed automatically in <3hrs.

Discussion

A fully automatic pipeline is a prerequisite for a Big-Data approach, as even semi-automatic process, requiring radiologist’s interaction, is impractical for assessing thousands of exams. In this work, we show that it is possible to automate both the data search and query and post-processing with negligible effects on final quantitative results.

IN260-SD-THB4 Implementation and Clinical Evaluation of 3D Visual Representation and Index of Imaging Diagnostic Records for Radiological Imaging Practices

Station #4

Participants
Jianguo Zhang, PhD, Shanghai, China (*Presenter*) Shareholder, AXON Medical Technologies Corp; Shareholder, Simed Medical Information Tech Inc
Liehang Shi, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Tonghui Ling, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Yanqing Hua, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Jianyong Sun, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Yuanyuan Yang, MBBS, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Mingqing Wang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

A new 3DVRI system was introduced into imaging diagnostic practices. Two evaluation results proved that doctors can much more easily and efficiently understand patient historical status by use of 3DVRI system than over use of PACS/RIS.

Background

Imaging diagnostic records (IDR) in large hospitals has become the main component of medical big data and brings huge values to healthcare services, but also introduces challenges to healthcare professionals as there may be too many imaging studiess for each patient for a doctor to review in a limited time slot. We had developed an innovation method 3D visually to represent and index IDR by using 3D anatomic model and presented it in RSNA Scientific Presentation 2011. In this presentation, we give an engineering implementation of this method and its evaluation, and comparison of the evaluation results with that by use of a clinical RIS-integrated PACS.

Evaluation

The implementation was to build 3D Visual Representation and Index (3DVRI) system including components of NLP for Chinese, Visual Index Creator (VIC), and 3D Visual Rendering Engine. The 3DVRI system has three major functions such as 3D anatomic representation of medical status of patient, quantitative description of lesions, and original data display of related DICOM studies and reports. Two evaluation scenarios were performed: the first one was to train more than 20 radiologists to play 3DVRI system to understand patients' medical status individually and answer eight questions listed in a sheet; the second was to arrange five radiologists to manipulate the 3DVRI system to find historic lesions , brief description of lesions and trend of disease development, et al., by use of the 3 major functions provided by 3DVRI system and compare the results with that by use of a clinical RIS/PACS on same 20 patients with variety of imaging studies.

Discussion

All participants in first evaluation answered questions very positively and wanted this system to assist them in reviewing the historic studies of patients. The result of second evaluation proved that 3DVRI has great advantage over the use of RIS/PACS in understanding patient's past lesion development and medical treatment conditions

IN261-SD-THB5 An Image Retrieval System for Diagnosis Support of Idiopathic Interstitial Pneumonia using a Deep Convolutional Neural Network

Station #5

Participants
Felix Nensa, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Sandra Maier, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Shu Liao, Chapel Hill, NC (*Abstract Co-Author*) Employee, Siemens AG
Xiang Zhou, Malvern, PA (*Abstract Co-Author*) Employee, Siemens AG
Yiqiang Zhan, Malvern, PA (*Abstract Co-Author*) Employee, Siemens AG
Hilmar Kuehl, MD, PhD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael Forsting, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Lale Umutlu, MD, Essen, Germany (*Presenter*) Consultant, Bayer AG

PURPOSE

Differential diagnosis of idiopathic interstitial pneumonia (IIP) presents a significant challenge in thoracic CT. Using a deep-learning convolutional neural network (CNN) we sought to evaluate whether computer assisted similar image retrieval can improve the diagnostic accuracy of a non-expert radiologist in the differentiation between usual interstitial pneumonia (UIP) and other IIP (non-UIP).

METHOD AND MATERIALS

A prototype CNN-based algorithm 1) automatically extracts salient disease patches within the lung; 2) compares such patches with patches from other patients in a database; and 3) consolidates the matching results at the patient level to retrieve similar lung studies from that database. The CNN was trained with a small database consisting of 250 CT studies in patients with IIP (50 UIP, 50 non-UIP) and additional control cases of emphysema (n=50), pulmonary sarcoidosis (n=50) and normals (n=50). A radiologist without special training in IIP performed blinded diagnosis in 50 cases of UIP and 50 cases of non-UIP that were not included in the databases. In a second read the reader was supported by the CNN, for each case presenting its top 5 similar cases (including disease labels) from the database. Consent diagnosis by a panel of certified IIP experts in a specialized center served as the standard of reference.

RESULTS

The human reader yielded diagnostic accuracy 72% (kappa=0.44) for the discrimination of UIP and non-UIP against the reference standard. In the CNN supported read the human reader improved to a diagnostic accuracy of 77% (kappa=0.54). None of the emphysema, pulmonary sarcoidosis or normal cases were falsely presented as top matches by the CNN.

CONCLUSION

IIP reading using a prototype deep-CNN yielded moderate improvement of a non-expert reader in the differentiation of UIP and non-UIP. Technical improvements of the CNN itself as well as the human-machine interaction are expected to provide significantly increased diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

Recent advancements in machine learning are poised to support radiologists in clinical routine work and may be particularly helpful in domains otherwise requiring rare specialist knowledge.

IN262-SD-THB6 Electronic Consensus Peer Review: Bringing Peer Review to the 21st Century

Station #6

Participants

Avez Rizvi, MD, Doha, Qatar (*Abstract Co-Author*) Nothing to Disclose
Zafar Iqbal, MS, Doha, Qatar (*Presenter*) Nothing to Disclose
Deepak Kaura, MD, Doha, Qatar (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Consensus peer review is not a novel concept as Alkasab et al. demonstrated in 2014. However, it's widespread use is still not ubiquitous. We hope that by showing another, more simplistic version of the consensus peer review application, further adoption can be enhanced.

Background

Peer review processes have evolved considerably from the paper format of yesteryear. The American College of Radiology released RADPEER™ to address the drawbacks of sorting and collecting a completely paper-based peer review process. However, the need to login remotely and fill out a form based, website limited adoption. Even newer integrated e-Radpeer options were developed in-house at places like Staten Island University Hospital, which addressed both the storage/sorting issues as well as adoption (SIIM Annual Meeting 2011). Nevertheless, *quality* peer review has always been an issue.

Evaluation

We have successfully tested RCPR in beta mode with a few dozen cases and anticipate several hundreds of cases in the near future.

Discussion

One-to-one peer reviews are fraught with biases and variations on interpretive subjectivity, whereas, consensus 360 peer reviews are far more objective as agreement on interpretation is reached by a range of experts within the field (Alkasab, et al). Our solution is novel in its simplicity and ease of implementation.In order to address subjectivity in traditional peer review, yet still maintain the functionality of an integrated e-peer review application, we built a Radiology Consensus Peer Review (RCPR) application. The application has the ability to "check-in" the radiologists currently in the session. Only cases from radiologists participating in the session will be reviewed via generated worklist. The application anonymizes the radiologist and only shows the body of the report and the impression. The report of the previously interpreted exam is scored by the reviewers using an ACR standardized four-point rating scale. At the end of the consensus, an autogenerated email is sent to the respective radiology faculty member if a discrepancy is found. The email is also sent to the department chair and head of quality and safety. This ensures both anonymity and quality control.

IN129-ED-THB7 Cancer and Phenomics Toolkit (CAPTk): A Software Suite for Computational Oncology and Radiomics

Station #7

Participants
Sarthak Pati, Philadelphia, PA (*Presenter*) Nothing to Disclose
Saima Rathore, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Ratheesh Kalarot, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Patmaa Sridharan, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Mark Bergman, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Taki Shinohara, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Paul Yushkevich, PhD, Philadelphia, PA (*Abstract Co-Author*) Investigator, KinetiCor, Inc
Yong Fan, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Ragini Verma, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Despina Kontos, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Christos Davatzikos, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

CAPTk provides a bridge for quick translation between academic research and clinical application, thereby enabling translation of cutting-edge research into clinically practical tools quickly and efficiently.

FIGURE

http://abstract.rsna.org/uploads/2016/16014589/16014589_uw28.jpg

Background

Availability of highly sophisticated methods that help us gain a comprehensive understanding of the underlying mechanisms of cancer, reveal substantive insight into the biological basis of disease susceptibility, treatment response, and identification of new drug targets, has skyrocketed. Translating such academic research into clinical practice is one of the biggest challenges, due to their complexity. We present CAPTk as a tool that facilitates translation of such algorithms from medical imaging research to the clinic. It replicates basic functionality of radiological workstations (accepts MRI data in DICOM & NIfTI formats with manual annotations). It is distributed under a completely free BSD-style license and is designed to be computationally efficient.

Evaluation

CAPTk has been designed for advanced image analysis pertaining to oncological conditions in the brain, breast and lung. It provides a springboard for using a number of algorithms, including but not limited to image registration, thresholding, bias correction, quantitative image analysis applications for predicting the status of Epidermal Growth Factor Receptor variant III in glioblastoma (GBM), semi-automatic mask generation of anatomical structures, evaluation of the peritumoral spatial heterogeneity in GBM, as well as analysis of normal tissues for predicting risk of future cancer. Utilizing industrially validated & open source tools (ITK, VTK, Qt), CAPTk encapsulates the core principles of good software design (usability, stability, scalability), supports all major deployment platforms and provides interfaces to help developers integrate C++ & Python applications utilizing a common interface.

Discussion

Users will see an easy-to-use graphical interface to access cutting-edge methods, along with image annotations (drawing points, tumor radius, masks), and developers can easily add applications to CAPTk while having access to the interactive & visualization routines. Examples will be showcased during the demonstration.

RCA54

3D Printing Hands-on with Open Source Software: Advanced Techniques (Hands-on)

Thursday, Dec. 1 2:30PM - 4:00PM Room: S401AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Michael W. Itagaki, MD, MBA, Seattle, WA (*Moderator*) Owner, Embodi3D, LLC
Beth A. Ripley, MD, PhD, Seattle, WA, (bar23@uw.edu) (*Presenter*) Nothing to Disclose
Tatiana Kelil, MD, Brookline, MA (*Presenter*) Nothing to Disclose
Anish Ghodadra, MD, Pittsburgh, PA, (aghodadramd@gmail.com) (*Presenter*) Nothing to Disclose
Hansol Kim, MD, Boston, MA (*Presenter*) Nothing to Disclose
Steve D. Pieper, PhD, Cambridge, MA (*Presenter*) CEO, Isomics, Inc; Employee, Isomics, Inc; Owner, Isomics, Inc; Research collaboration, Siemens AG; Research collaboration, Novartis AG; Consultant, Wright Medical Technology, Inc; Consultant, New Frontier Medical; Consultant, Harmonus; Consultant, Stryker Corporation; Research collaboration, gigmade;
Dmitry Levin, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn advanced techniques for converting a medical imaging scan into a digital 3D printable model with free and open-source software. 2) To perform advanced customizations to the digital 3D printable model with free software prior to physical creation with a 3D printer.

ABSTRACT

"3D printing" refers to fabrication of a physical object from a digital file with layer-by-layer deposition instead of conventional machining, and allows for creation of complex geometries, including anatomical objects derived from medical scans. 3D printing is increasingly used in medicine for surgical planning, education, and device testing. This advanced hands-on course builds upon the introductory course given by the same faculty. It will teach the learner advanced segmentation techniques used to convert a standard Digital Imaging and Communications in Medicine (DICOM) data set from a medical scan into a 3D printable model. Advanced manipulation of the digital model in preparation for 3D printing will then be discussed. All software used will be free. Methods described will work with Windows, Macintosh, and Linux computers. The learner will be given access to comprehensive resources for self-study before and after the meeting, including an extensive training manual and online video tutorials.

RCB54

Learn Image Segmentation Basics with Hands-on Introduction to ITK-SNAP (Hands-on)

Thursday, Dec. 1 2:30PM - 4:00PM Room: S401CD

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Tessa S. Cook, MD, PhD, Philadelphia, PA, (tessa.cook@uphs.upenn.edu) (*Presenter*) Nothing to Disclose
Philip A. Cook, PhD, Philadelphia, PA, (cookpa@mail.med.upenn.edu) (*Presenter*) Nothing to Disclose
Joe C. Wildenberg, MD,PhD, Philadelphia, PA, (joe.wildenberg@gmail.com) (*Presenter*) Nothing to Disclose
Sean Novak, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Guido Gerig, Brooklyn, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To use a free interactive software tool ITK-SNAP to view and manipulate 3D medical image volumes such as multi-parametric MRI, CT and ultrasound.2) To label anatomical structures in medical images using a combination of manual and user-guided automatic segmentation tools.

ABSTRACT

Quantitative analysis of medical imaging data is increasinly relevant in a growing number of radiological applications. Almost invariably, such quantitative analysis requires some structures of interest (organs, tumors, lesions, etc.) to be labeled in the image. Labeling anatomical structures is a complex task, particularly when the imaging data is complex, such as in the case of multi-parametric MRI or fusion of different imaging modalities. ITK-SNAP is a free, open-source, and easy to use interactive software tool that allows users to view multiple image volumes of the same anatomy and label structures using information from all volumes concurrently. For example, ITK-SNAP allows users to label tumors (core, edema, necrosis) using a combination of T1-weighted, contrast-enhanced T2-weighted, T2-weighted and FLAIR MRI. ITK-SNAP provides easy to use user-guided automatic segmentation functionality rooted in statistical machine learning and deformable modeling algorithms, as well as built in tools for manual editing and correction of segmentations. ITK-SNAP runs on Windows, MacOS and Linux platforms. During this hands-on course, the participants will use ITK-SNAP to label organs and tumors in various imaging modalities. After completing the course, participants will be well equipped for performing quantitative analyses of medical image data using ITK-SNAP and other compatible free software tools.

Handout:Guido Gerig

http://abstract.rsna.org/uploads/2016/15003102/handout_exercises.pdf

RCC54

Informatics to Support Imaging 3.0: Unmet Needs, Approaches, and Achievements

Thursday, Dec. 1 2:30PM - 4:00PM Room: S501ABC

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

RCC54A Policy and Interpretation Clinical Decision Support to Promote Imaging 3.0

Participants
Giles W. Boland, MD, Boston, MA (*Presenter*) Principal, Radiology Consulting Group; Royalties, Reed Elsevier

RCC54B Annotated Image Mark-Up and Radiomics

Participants
Daniel L. Rubin, MD, MS, Stanford, CA, (daniel.l.rubin@stanford.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the role of image annotations in capuring essential information about images in radiomics. 2) To learn about standards for capturing image annotation information, particularly Annotation and Image Markup (AIM) and DICOM-SR. 3) To see example use cases for image annotation in enabling radiomics research and clinical practice.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Daniel L. Rubin, MD, MS - 2012 Honored Educator
Daniel L. Rubin, MD, MS - 2013 Honored Educator

RCC54C Assisted Clinical Reasoning for Interpretation, Image Ordering, and Outcomes Reporting

Participants
Michael E. Zalis, MD, Boston, MA (*Presenter*) Co-founder, QPID Health Inc Chief Medical Officer, QPID Health Inc Stockholder, QPID Health Inc

RC725

Computational Perception

Thursday, Dec. 1 4:30PM - 6:00PM Room: E353B

IN PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

RC725A Status of CAD in Clinical Radiology

Participants
Maryellen L. Giger, PhD, Chicago, IL (*Presenter*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Corporation;

LEARNING OBJECTIVES

1) Provide an overview of the types & applications of CAD being developed & used today. 2) Summarize the evidence & controversies regarding clinical impact of CAD. 3) Describe future trends in CAD research.

RC725B Intersection of Imaging Informatics and Perception

Participants
Katherine P. Andriole, PhD, Dedham, MA (*Presenter*) Advisory Board, McKinsey & Company, Inc;

LEARNING OBJECTIVES

1) Provide a basic overview of imaging informatics. 2) Describe the importance of data visualization for practitioners. 3) Assess ways imaging informatics can impact image interpretation.

RC725C Review the Effects on Radiologist Interpretation of Reading Paradigms and Visualization Methods in CT Colonography CAD

Participants
Ronald M. Summers, MD, PhD, Bethesda, MD, (rms@nih.gov) (*Presenter*) Royalties, iCAD, Inc; ;

LEARNING OBJECTIVES

1) Review the time & resource constraints radiologists face clinically. 2) Discuss the role of non-radiologists interpreting radiographic images. 3) Describe crowd-sourcing & how it can apply to radiology.

ABSTRACT

RC727

Clinical Decision Support and Utilization Management: Preparing for the New CMS Mandate

Thursday, Dec. 1 4:30PM - 6:00PM Room: E451A

HP **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Keith J. Dreyer, DO, PhD, Boston, MA (*Moderator*) Medical Advisory Board, IBM Corporation
Keith J. Dreyer, DO, PhD, Boston, MA (*Coordinator*) Medical Advisory Board, IBM Corporation
Mark D. Hiatt, MD, MBA, Salt Lake City, UT, (mark.hiatt@regence.com) (*Presenter*) Medical Director, Regence BlueCross BlueShield; Board Member, RadSite; Former Officer, HealthHelp, LLC
Daniel Durand, MD, Baltimore, MD (*Presenter*) Consultant, National Decision Support Company;
Bob Cooke, Redding, CT (*Presenter*) Vice President, National Decision Support Company

LEARNING OBJECTIVES

1) Explain the need for assuring the appropriateness of ordered exams. 2) Know the role of utilization management in reducing inappropriate and unnecessary tests. 3) Identify the advantages and limitations of clinical decision support. 4) Recognize how payers are considering meeting the CMS mandate for pre-order decision support.

ABSTRACT

This course will discuss the 2017 CMS mandate for pre-order decision support for MRI, CT, and PET, including the need for assuring the appropriateness of ordered exams, the roles of utilization management and clinical decision support in reducing inappropriate and unnecessary tests, the advantages and limitations of methods to manage utilization, and how payers are considering meeting the CMS mandate for pre-order decision support.

RC753

Monitoring Radiation Exposure: Standards, Tools and IHE REM

Thursday, Dec. 1 4:30PM - 6:00PM Room: S403B

IN SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Kevin O'Donnell, Pacifica, CA (*Moderator*) Employee, Toshiba Corporation;
Kevin O'Donnell, Pacifica, CA (*Presenter*) Employee, Toshiba Corporation;
Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Presenter*) Institutional research agreement, Siemens AG Research support, Siemens AG
Tessa S. Cook, MD, PhD, Philadelphia, PA, (tessa.cook@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn key radiation exposure concepts and metrics, such as CTDI, and how to interpret them. 2) Learn about radiation exposure monitoring methods and tools including 2a) Capturing x-ray dose information with the DICOM Radiation Dose SR (RDSR) standard. 2b) (NEW) Capturing radiopharmaceutical dose information with DICOM Radiopharmaceutical Radiation Dose SR (R-RDSR) 2c) Managing RDSR objects with the IHE Radiation Exposure Monitoring (REM) and REM-NM Profiles. 2d) Integrating "CT dose screens" from legacy systems into RDSR. 2e) Pre-scan dose pop-ups on the CT console defined by the MITA Dose Check standard and AAPM guidance on their use. 3) Learn how to specify the above features when purchasing and integrating Radiology Systems. 4) Learn about practical issues and components of a site dose management program such as protocol optimization and participation in the ACR Dose Registry. 5) Learn about dose reporting requirements such asCalifornia SB-1237 and Medicare reimbursement linkage to MITA XR-29.

RC754

The IHE Process

Thursday, Dec. 1 4:30PM - 6:00PM Room: S404AB

IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Bradley J. Erickson, MD, PhD, Rochester, MN, (bje@mayo.edu) (*Moderator*) Stockholder, OneMedNet Corporation; Stockholder, VoiceIt Technologies, LLC; Stockholder, FlowSigma
Brad Genereaux, Waterloo, ON (*Presenter*) Employee, Agfa-Gevaert Group
Harry Solomon, Highland Park, IL (*Presenter*) Former Employee, General Electric Company
Bradley J. Erickson, MD, PhD, Rochester, MN, (bje@mayo.edu) (*Presenter*) Stockholder, OneMedNet Corporation; Stockholder, VoiceIt Technologies, LLC; Stockholder, FlowSigma

LEARNING OBJECTIVES

1) Understand the process by which IHE profiles are created. 2) Understand how to become involved with IHE.

ABSTRACT

The purpose of this session is to demonstrate how an idea that addresses some informatics problem becomes an IHE profile. We start by describing what an IHE profile is, and how it differs from a standard, such as DICOM. Next, we will describe the type of ideas that are good candidates for profiles, and ones that may fit better in some other effort such as DICOM. Finally, the process for creating an IHE profile from initial proposal through testing and implementation is described.

RCA55

The Cancer Imaging Archive: Using 'Big Data' for the study of Cancer Radiomics, Proteomics, Genetics and Pathology (Hands-on)

Thursday, Dec. 1 4:30PM - 6:00PM Room: S401AB

BQ **IN**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Justin Kirby, Bethesda, MD (*Moderator*) Stockholder, Myriad Genetics, Inc
Justin Kirby, Bethesda, MD (*Presenter*) Stockholder, Myriad Genetics, Inc
Lawrence R. Tarbox, PhD, Little Rock, AR (*Presenter*) Nothing to Disclose
C. Carl Jaffe, MD, Boston, MA (*Presenter*) Nothing to Disclose
Brenda Fevrier-Sullivan, BA, Bethesda, MD (*Presenter*) Nothing to Disclose
Fred W. Prior, PhD, Little Rock, AR (*Presenter*) Stockholder, Siemens AG
John B. Freymann, BS, Rockville, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn what data sets are available in The Cancer Imaging Archive (TCIA). 2) Identify and download existing TCIA data sets which match your research interests. 3) Collaborate with other researchers using Shared Lists and Digital Object Identifiers. 4) Identify metadata and support resources that include the TCIA helpdesk, FAQs, and system documentation.

ABSTRACT

Access to large, high quality data is essential for researchers to understand disease and precision medicine pathways, especially in cancer. However HIPAA constraints make sharing diagnostic clinical images outside an individual institution a complex process. The NCI's Cancer Imaging Archive (TCIA) addresses this challenge by providing hosting and de-identification services which take the burden of data sharing off researchers. TCIA now contains over 59 unique data collections of more than 28 million images. Recognizing that images alone are not enough to conduct meaningful research, most collections are linked to rich supporting data including patient outcomes, treatment information, genomic / proteomic analyses, and expert image analyses (segmentations, annotations, and radiomic / radiogenomic features). This hands-on session will teach the skills needed to fully access TCIA's existing data as well as learn how to submit new data for potential inclusion in TCIA.

RCC55

RadLex®: Standardized Terminology and the RadLex Playbook for Radiology Reporting and Procedure Coding

Thursday, Dec. 1 4:30PM - 6:00PM Room: S501ABC

IN SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Kenneth C. Wang, MD, PhD, Ellicott City, MD (*Moderator*) Co-founder, DexNote, LLC;

LEARNING OBJECTIVES

1) Describe the RadLex system of standard terms for radiology. 2) Access RadLex content through the web. 3) Identify the role of standard terminology in radiology reporting and information retrieval. 4) Explain the RadLex Playbook system for naming and coding radiology exams. 5) Define the use of Playbook codes in the ACR Dose Index Registry. 6) Develop an approach to incorporating RadLex terms and Playbook codes into clinical practice.

Sub-Events

RCC55A Introduction to RadLex®: Structure and Content

Participants
Kenneth C. Wang, MD, PhD, Ellicott City, MD (*Presenter*) Co-founder, DexNote, LLC;

LEARNING OBJECTIVES

1) Define the goals of the RadLex terminology. 2) Characterize the scope and organization of RadLex terms. 3) Access RadLex content through the web.

ABSTRACT

RCC55B 'RadLex Inside': Using RadLex for Information Retrieval, Radiology Reporting, and Beyond

Participants
Charles E. Kahn JR, MD, MS, Philadelphia, PA, (charles.kahn@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how the RadLex lexicon enables applications in radiology research, education, and clinical practice. 2) Describe how RadLex enables information retrieval. 3) Define the role of RadLex in RSNA's structured reporting initiative. 4) Discover new applications of RadLex in radiology education and decision support.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Charles E. Kahn JR, MD, MS - 2012 Honored Educator

RCC55C RadLex® Playbook: Systematic Naming and Coding for Imaging Procedures

Participants
Curtis P. Langlotz, MD, PhD, Menlo Park, CA, (langlotz@stanford.edu) (*Presenter*) Shareholder, Montage Healthcare Solutions, Inc; Spouse, Consultant, Novartis AG;

LEARNING OBJECTIVES

1) Identify the challenge related to procedure code matching across institutions. 2) Describe the RadLex Playbook. 3) Explain how the RadLex Playbook can be used to harmonize data across institutions. 4) Show how RadLex Playbook simplifies registry submission and health information exchange 5) Learn how the RadLex/LOINC playbook can be used when converting to a new radiology information system (RIS). 6) Learn about plans for making the RadLex Playbook a national standard for radiology exam codes.

RCC55D Playbook and the ACR Dose Index Registry: Implementation Challenges and Strategies

Participants
Kalpana M. Kanal, PhD, Seattle, WA, (kkanal@uw.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) What is the ACR CT Dose Index Registry (DIR). 2) Identify the challenges in ACR CT DIR. 3) What are some of the Mapping Challenges. 4) Additional Benefits of DIR.

RC854

Growing Your Business with Social Media, Tips and Tricks for Department and Practice Managers

Friday, Dec. 2 8:30AM - 10:00AM Room: E350

IN LM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants

Alex Towbin, MD, Cincinnati, OH, (alexander.towbin@cchmc.org) (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Siemens AG;
Saad Ranginwala, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

After attending this lecture, attendees will be able to:1. describe how social media can be used to promotoe a radiology practice2. name 3 social media platforms, their benefits, and contraints.

ABSTRACT

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Alex Towbin, MD - 2014 Honored Educator