

# AUR 2019 Research Paper Abstracts

Research papers are oral educational or scientific presentations that are 8 minutes in length, followed by a 2-minute discussion period. Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (medical students, residents, or 1st-year fellows) are noted in **blue**.

**Thursday, April 11, 2019**  
**1:00–2:30 PM**

**SS01: Abdominal, Cardiopulmonary, MSK**  
**Location: Holiday Ballrooms 1-2**  
**Moderator: Joseph C. Veniero, MD, PhD**  
**Diego F. Lemos, MD**

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**(SS01-01) 1:00 PM - 1:10 PM**  
**Efficacy of Remote, Videoconference Peer Teacher Training for Hands-On Musculoskeletal Ultrasound Workshops: A Pilot Study**

Netanel S. Berko, MD, *University of Pennsylvania, Philadelphia, PA*; Andrew C. Friedman; Lauren H. Goldman; Anirudh Paspulati; Leo H. Menashe; Beverly Thornhill, et al ([netanel.berko@uphs.upenn.edu](mailto:netanel.berko@uphs.upenn.edu))

**PURPOSE:** To determine the efficacy of remote, videoconference peer teacher training for hands-on musculoskeletal ultrasound workshops.

**METHOD AND MATERIALS:** Hands-on musculoskeletal ultrasound scanning workshops were designed for residents. Several residents received training prior to the workshops, and served as peer teachers during the sessions. Two sets of workshops were performed. Prior to one set of workshops the peer teachers received in-person, hands-on training, while before the other set of workshops training for the peer teachers was performed remotely, utilizing a videoconference setup. Surveys were distributed to the peer teachers and workshop participants following the workshops to determine the efficacy of the two types of training. The surveys consisted of statements with 5-point Likert scale responses regarding the training. Median scores and interquartile ranges (IQR 25th-75th percentiles) were recorded, and T-test was used to compare results.

**RESULTS:** There were 6 peer teachers and 37 learners in the in-person training group and 3 peer teachers and 12 learners in the remote training group. Peer teachers in both groups felt adequately prepared, reporting high comfort level with the material (median score for both groups: 4,  $P = 0.57$ ). Peer teachers trained remotely felt they were able to adequately answer questions (median 5, IQR 5-5) better than those who received in-person training (median 4, IQR 3.25-4.75,  $P=0.04$ ). Peer teachers in both groups found the experience enjoyable, were interested in serving as peer teachers again, and highly rated the overall experience (median 5, IQR 5-5 for both groups). The learners in both the remote group (median 5, IQR 4.75-5) and the in-person training group (median 5, IQR 4-5) deemed the peer teachers effective ( $P=0.49$ ).

**CONCLUSION:** Remote, videoconference training of peer teachers is an effective method of teaching hands-on skills. Peer teachers who received remote training reported similar levels of knowledge and comfort in teaching. Residents who were taught by the peer teachers in both groups reported that the peer teachers were effective.

**(SS01-02) 1:10 PM - 1:20 PM**  
**The Impact of Additional Tin Filtration on Contrast Enhancement, Image Quality, and Radiation Dose Reduction of Renal Lesions at Multidetector Computed Tomography: A Phantom Study**

Tugce Agirlar Trabzonlu, MD\*, *Northwestern University Feinberg School of Medicine, Chicago, IL*; Amirhossein Mozafarykhamseh\*; Vahid Yaghmai, MD ([tugce.trabzonlu@northwestern.edu](mailto:tugce.trabzonlu@northwestern.edu))

**PURPOSE:** Spectral tin filtration technique has been shown to decrease the radiation dose when compared to standard protocols. Our purpose is to evaluate the effect of the tin filtered based CT protocol on contrast enhancement, image quality and radiation dose by using a renal phantom.

**METHOD AND MATERIALS:** A phantom containing 15 tubes embedded in a structure resembling kidney was used. The tubes were filled with a serial dilution of iodinated contrast (from 0.156 mg/cc to 6mg/cc). The phantom was scanned at various six tube voltages (from 70 to 140 kV) and at 150 kV with an additional tin filter(Sn) with iterative reconstruction and scanned with 120 kV-filtered back projection (FBP) protocol. Radiation exposure was estimated by the volume CT dose index (CTDIvol). All measurements were performed by drawing regions of interest(ROIs). To examine the effect on contrast enhancement (CE), regression analysis was performed to determine the attenuation values for the tin filtered technique corresponding to 10 and 20 HU enhancements at 120 kV. To evaluate image quality, image noise (SD) and CNR were compared between Sn150kV technique and 120 kV with FBP technique. To evaluate the effect on radiation dose, regression analysis were employed for CTDIvol values for different tube voltages and for SD values for different iodine concentrations and tube voltages. Data was analyzed to determine the kV and CTDIvol value of SD value at non-filtered technique corresponding to the SD value at Sn150kV.

**RESULTS:** The CE of 10 HU and 20 HU at 120 kV corresponded to 5.02 HU and 9.8 HU at tin-filtered technique respectively ( $R^2=0.998$ ). The image noise of Sn 150 kV corresponded to image noise of 109 kV ( $R^2=1.000$ ,  $p<0.001$ ). CTDIvol was reduced by 40.3% with tin filtered technique while maintaining the same level of image noise. CNR was higher at the 120 kV-FBP group when compared to the tin filtered group( $p<0.001$ ).

**CONCLUSION:** After applying tin filtration, to evaluate a renal lesion, it is important to adjust the threshold for enhancement. Without altering the image noise, 150 kV with tin filtered technique allows approximately 40% dose reduction compared to the protocol without spectral shaping.

**(SS01-03) 1:20 PM - 1:30 PM**  
**Machine Learning for Detecting Pulmonary Nodules on Chest Radiographs: A Multi-Reader Trial with CT as the Standard of Reference**

Riddhi Borse, *Massachusetts General Hospital, Harvard Medical Sciences, Boston, MA*; Reece Goiffon; Justin Stowell; Alexis M. Cahalane; Joseph King; Benjamin M. Kozak, MD, et al ([borseriddhi@gmail.com](mailto:borseriddhi@gmail.com))

**PURPOSE:** We performed a multi-reader study to assess accuracy of machine learning based bone subtraction algorithm (Riverain Inc.) for detection of pulmonary nodules on chest radiographs (CXR) with chest CT as the standard of reference (SOR).

**METHOD AND MATERIALS:** With IRB approval, our study included posteroanterior projection CXR from 130 adult patients with (n= 103 patients) and without (n= 27 patients) pulmonary nodules who also underwent chest CT within 90 days of CXR. To establish SOR, two thoracic radiologists reviewed all CXR and CT and recorded presence,

\* Faculty financial disclosures are located in the Faculty Index.

size, and location of pulmonary nodules. All chest radiographs were exported, de-identified, and processed with the BSA algorithm. Two radiology residents and two thoracic radiology clinical fellows independently recorded presence of lung nodules on the unprocessed (UpR), and then on the bone subtracted (BsR) radiographs. They graded the findings on the BsR on a 5-point scale (1= finding on UpR not seen on BsR, 2= no change in confidence on BsR, 3= some improvement on BsR, 4= Substantial improvement, 5= finding on UpR not seen on BsR). Descriptive statistics were performed in Microsoft Excel.

**RESULTS:** Per SOR, there were 175 nodules on 130 CXR (mean size  $1.43 \pm 0.71$ ). All four radiologists noted improved detection of pulmonary nodules on BsR (43,45,34, 43 nodules) compared to UpR (28, 38, 31, 37 nodules, respectively) ( $p=0.49-0.86$ ). The mean sizes ( $\pm$ SD) of true positive nodules seen only on BsR were  $1.8(\pm 0.4)$ ,  $1.55(\pm 0.05)$ ,  $1.43(\pm 0.13)$ , and  $1.26(\pm 0.06)$  mm, respectively. These nodules were most frequently located in the right upper zone followed by the left upper zone. There were 38, 44, 22, 34 false positive nodules on UpR and 42,44, 23, 36 false positive nodules on BsR. All readers reported greater confidence for detection of lung nodules on BsR than on UpR with a percentage increase of 41.74%,48.54%,25.2% and 46.6% on BsR from the baseline UpR respectively.

**CONCLUSION:** All radiologists detected more pulmonary nodules with greater confidence on CXR processed with machine learning based bone subtraction algorithm compared to native unprocessed CXR.

### (SS01-04) 1:30 PM - 1:40 PM Accuracy of AI Based CAD for Detection of Endobronchial Nodules on Low Dose CT for Lung Cancer Screening



Ramandeep Singh, *Massachusetts General Hospital, Boston, MA*; Chayanin Nitiwarangkul; Fatemeh Homayounieh; Brent P. Little, MD\*; Manudeep Kalra, MD\*; Subba Digumarthy (*rsingh17@mgh.harvard.edu*)

**PURPOSE:** Few studies have evaluated effect of CAD on visibility of endobronchial lesions. The purpose of our study was to evaluate effect of a AI-based vessel suppression and detection algorithm (VS-D, Riverain Inc.) on conspicuity of endobronchial lesions.

**METHOD AND MATERIALS:** Our study included 40 adult patients who underwent LDCT for lung cancer screening, and had endobronchial lesions (EBL) on their LDCT. Thin sections LDCT image series (1-1.5 mm) were processed with AI algorithm to generate three images series -baseline unprocessed, vessel suppression (VS), and automatic detection (VS-D) series with annotated lung nodules. Two radiologists independently assessed the baseline images for presence, number & location of endobronchial lesions in trachea, main bronchus, lobar bronchus (LB), segmental bronchus (SB), and sub-segmental bronchus (SSB). The lesions were labeled as nodule (N), uncertain (U) and secretion (S). Same findings were then assessed with addition of VS series. Finally, VS and VS-D series were reviewed with baseline images to detect additional endobronchial nodules, if any. Descriptive statistics and Student's t test were used for data analysis.

**RESULTS:** On unprocessed images, R1 and R2 detected 79 EBL (30N, 28S, 21U) and 73EBL (29N, 18S, 26U), respectively ( $P=0.4$ ). With addition of AI-VS images, R1 and R2 detected 66 EBL (26N, 24S, 16U) and 62 EBL (26N, 16S, 20U), respectively ( $P=0.6$ ). With AI-VS, R1 & R2 detected additional 2 EBL (1N, 1S) & 1 EBL (1U), respectively, which were all located in LB. Both readers missed 13 EBL (5LB, 6SB, 2SSB) and 11 EBL (7LB, 4SB) on AI-VS. Conversely, AI-AD annotated only 2 EBL (2N) in segmental bronchus with mean size of 12mm. Average respective sizes of detected EBL on unprocessed and AI-AD series were  $7.5 \pm 4.4$  mm and  $6.9 \pm 3.8$  mm ( $p=0.39$ ). Average sizes of missed EBL on AI-VS were  $4.7 \pm 1.2$  mm and  $4.4 \pm 1$  mm respectively for R1 & R2.

**CONCLUSION:** AI- VS helps in detection of additional endobronchial nodules not seen on unprocessed images, although < 5mm endobronchial nodules in in lobar and segmental bronchi were missed on AI-VS.

Further training of AI algorithm is required to improve detectability of endobronchial nodules.

### (SS01-05) 1:40 PM - 1:50 PM Design of a Musculoskeletal Ultrasound Bootcamp for Radiology Residents

Maria A. Bedoya, *University of Pennsylvania, Philadelphia, PA*; Teresa Martin-Carreras; Stacey Elangovan; Mary H. Scanlon, MD; Netanel S. Berko, MD (*netanel.berko@uphs.upenn.edu*)

**PURPOSE:** Radiology residents receive little or no musculoskeletal ultrasound training during residency. Our goal was to design a short but comprehensive hands-on musculoskeletal ultrasound experience for radiology residents.

**METHOD AND MATERIALS:** A 3.5 hour hands-on workshop was designed. The workshop was divided into segments based on anatomic region; for each region core topics of competence were defined, including joint effusion and bursitis. Additional topics covered were major tendons and ligaments, and simulation of image-guided interventions was performed as well. During the workshop an attending radiologist demonstrated scanning technique for each anatomic region, and residents then performed scanning in small groups led by peer teachers. Residents performed scanning before and after the workshop to assess skill acquisition, and also completed a survey following the workshop to gauge confidence in performing musculoskeletal ultrasound examinations. The survey consisted of statements with 5-point Likert scale responses. Median responses and interquartile range (IQR, 25th-75th percentile) were calculated.

**RESULTS:** 12 third-year residents participated in the workshop. 2 of these residents, along with a fourth-year resident, received 2 hours of hands-on training prior to the workshop and served as peer teachers. 90% of images obtained after the workshop were diagnostic, compared with 13% before the workshop ( $P<0.01$ ). Residents reported increased confidence performing (median 5, IQR 4-5) and interpreting (5, 4-5) musculoskeletal ultrasound examinations following the workshop. Peer teachers were rated as extremely effective (5, 5-5), and residents highly rated the overall experience (5, 5-5).

**CONCLUSION:** A half-day workshop affords residents exposure to core topics in musculoskeletal ultrasound and allows them to acquire basic scanning skills. Utilization of peer teachers allowed the workshop to be performed with only one attending radiologist. Implementation of this workshop can be an important first step in increasing radiology residents' exposure to musculoskeletal ultrasound during training.

#### AUR Trainee Prize: 1st Place

### (SS01-06) 1:50 PM - 2:00 PM Automatic Segmentation and Radiomics for Dual Energy CT: Differentiating Benign and Malignant Hepatic Lesions

Fatemeh Homayounieh, *Massachusetts General Hospital, Harvard Medical School, Boston, MA*; Ramandeep Singh; Chayanin Nitiwarangkul; Bernhard Schimdt\*; Subba Digumarthy; Mannudeep Kalra, MD\* (*maryam.homayounieh@gmail.com*)

**PURPOSE:** We assessed a machine learning based Dual Energy Tumor Analysis (DECT-TA) prototype (Siemens Healthineers) for automatic segmentation and radiomics analysis of volume and rims of benign and malignant liver lesions on contrast enhanced dual energy CT (DECT).

**METHOD AND MATERIALS:** Our IRB approved study included 20 adult patients (mean age  $62 \pm 18$  years, 11 women, 9 men) who underwent contrast enhanced DECT on dual-source, 384-slice MDCT (Siemens Force). Ten patients had benign liver lesions (4 Cysts, 4 hemangiomas, 1 abscess, 1 angioliipoma) and 10 patients had malignant lesions (8 metastases, 2 hepatocellular carcinomas). Low and high kV

\* Faculty financial disclosures are located in the Faculty Index.

datasets were exported offline, de-identified and postprocessed with the DECT-TA for automatic segmentation of the overall volume as well as the four segmented rims and inner volumes of each liver lesion. For each segmentation, 585 radiomics features (including first and higher order statistics) were derived for low kV, high kV, blended datasets, virtual unenhanced and iodine volumes (5284 features per patient; 105,680 total features). Statistical analyses were performed to determine if DECT-TA radiomics can differentiate benign from malignant liver lesions.

**RESULTS:** Lesion volume and rim segmentations were acceptable in all patients. Of the 5284 radiomic features, 85 features enabled differentiation between benign and malignant liver lesions ( $p=0.044 - 0.0001$ ). Most radiomics features that enabled lesion differentiation belonged to processed DECT datasets (65/85, 76%) versus the single energy datasets (low and high kV) (20/85, 24%). Radiomics of liver lesion volume that included a portion of the normal parenchyma (33/85; 39%) were the stronger predictors of lesion histology compared to the lesion volume alone (11/85, 13%). The gray level co-occurrence matrix (GLCM), run length matrix (GLRLM) and neighboring gray tone difference matrix (NGTDM) features were stronger predictors of lesion type than other features.

**CONCLUSION:** Radiomics analyses of DECT datasets are superior to single energy CT for differentiation of benign and malignant liver lesions. DECT-TA prototype provides accurate segmentation and rapid radiomics analysis of liver lesions.

#### AUR Memorial Award

(SS01-07) 2:00 PM - 2:10 PM

### Routine Chest Radiography for the Evaluation of Pneumothorax Following Bronchoscopy

Christopher P. Centonze, MD, *University of Michigan Medical Center, Ann Arbor, MI*; Matthew S. Davenport, MD; Eric S. White MD, MS; Ella A. Kazerooni MD, MS

**PURPOSE:** To determine the utility of routine post-bronchoscopy chest radiography to detect **pneumothorax**.

**METHODS:** This retrospective quality improvement cohort study was approved by the Institutional Review Board. All outpatients ( $n=1443$ ) who underwent protocol-driven post-bronchoscopy chest radiography in one health system from January 2010 to July 2017 were identified by electronic medical record query. The prevalence of pneumothorax (with 95% confidence intervals [CI]) and clinical outcome were determined following coded review of chest radiography reports and review of the electronic medical record. The effect of smoking and lung disease on risk of pneumothorax was determined with Chi Square tests.

**RESULTS:** Of 1443 subjects undergoing interventional bronchoscopy, 6% (93/1443) were current smokers, 35% (505/1442) were former smokers, and 35% (540/1443) had known lung disease. Pneumothorax prevalence was 3.4% (49/1443; 95% CI: 2.6-4.5%) following any intervention and 4.1% (42/1032; 95% CI: 3.9-5.5%) following transbronchial intervention. In those without known pre-existing pneumothorax or a confirmed false positive diagnosis, the real overall pneumothorax rate was 2.9% (42/1443; 95% CI: 2.1- 3.9%). The risk of pneumothorax did not differ based on smoking history ( $P=0.99$ ) or history of lung disease ( $P=0.19$ ). Of 49 subjects with pneumothorax, 13 were symptomatic, and 10 had a change in management including chest tube placement ( $N=2$ ), inpatient admission ( $N=3$ ), and/or observation ( $N=7$ ). No pneumothorax-related intervention was performed in asymptomatic patients.

**CONCLUSION:** Pneumothorax following interventional outpatient bronchoscopy is uncommon, usually asymptomatic, and often clinically insignificant. Asymptomatic post-bronchoscopy patients are very low risk and may not need routine imaging.

(SS01-08) 2:10 PM - 2:20 PM

### Clinical and Imaging Features of BRAF-Mutated Non-Small Cell Lung Cancer

Dexter Mendoza, MD, *Massachusetts General Hospital, Boston, MA*; Ibiayi Dagogo-Jack; Atul Padole, MD; Jo-Anne Shepard, MD; Subba Digumarthy, MD

**PURPOSE:** BRAF mutations are rare mutations that have emerged as a potential target for the treatment of non-small cell lung cancer (NSCLC). The purpose of this study is to determine the imaging characteristics of NSCLC with BRAF mutations and determine potential differences in imaging characteristics among the three functional classes of BRAF mutations.

**METHOD AND MATERIALS:** We retrospectively reviewed medical records and pretreatment CT of patients with NSCLC with known BRAF mutations and known functional class of mutation. We investigated the imaging features of the primary tumor, associated ancillary imaging findings, and patterns of lymphadenopathy and metastasis.

**RESULTS:** Of the 105 patients (40 male, 65 female; mean age 68.2 years (+/-9.7) with BRAF-mutated NSCLC we reviewed, 43 (40.9%) patients had class I mutations, 40 (38.1%) had class II, and 22 (21.0%) had class III mutations. Patients with tumors harboring class II or class III mutations are more likely to be ever smokers and heavy smokers ( $\geq 30$  pack years) compared to those with class I. NSCLC tumors with BRAF mutations are most likely to be solid (77.1%). 26 patients (24.8%) had multifocal NSCLC at presentation. Air bronchograms, cavitation, and calcification are rare features with incidences of 4.7%, 1.9%, and 1.9%, respectively. 53 (50.4%) patients had at least N1 nodal disease and 28 (26.7%) had N3 nodal disease at the time of presentation. NSCLC with class I mutations are more likely to have intrathoracic metastases compared to those with class II and III mutations (41.9% vs 18.2%,  $p$  value = 0.003). Otherwise, the pattern of lymphadenopathy and metastasis are similar among the classes.

**CONCLUSION:** Patients with BRAF-mutated NSCLC are more likely to be solid and rarely have air bronchograms, cavitation, or calcification. Multifocal tumors at presentation are common. NSCLC with class I BRAF mutations are more likely to have intrathoracic metastasis compared to class II and class III mutations.

(SS01-09) 2:20 PM - 2:30 PM

### How to Train a Musculoskeletal (MSK) Radiologist: Building a Sub-curriculum in an LMS

Ami Gokli, MD, *Children's Hospital of Philadelphia, Philadelphia, PA*; Janet R. Reid, MD ([goklia@email.chop.edu](mailto:goklia@email.chop.edu))

**PURPOSE:** Musculoskeletal radiologists require a unique skillset to confidently manage a wide range of MSK cases in the inpatient or outpatient setting. This is especially true for those unique and complicated cases referred to tertiary care academic centers. Furthermore, recent changes in orthopedic guidelines mandate that only trained pediatric MSK radiologists should interpret pediatric MSK imaging. The purpose of this study is to train and equip pediatric radiologists with the knowledge and case background to handle this imaging at a sub-specialist level.

**METHOD AND MATERIALS:** This study focuses on the sequential steps involved in the planning and development of a well-rounded MSK curriculum using our learning management system as a platform. We review our 6-step approach to curriculum development proposed by Kern including problem identification, needs assessment, goals and objectives, educational strategies, implementation, and evaluation and assessment. Our curriculum features a multi-modality approach including vignettes, video tutorials, didactics and a plan to add simulation exercises.

**RESULTS:** Through a demonstration of its functionality within the learning management system, we validate the utility of this system, and exhibit the potential to expand this strategy to other fields of radiology. Learning analytics built into the LMS will assess navigation and use and will assist in further development of the curriculum.

\* Faculty financial disclosures are located in the Faculty Index.

**CONCLUSION:** Pediatric musculoskeletal imaging is a niche subspecialty of pediatric radiology. The goal of this educational study is to empower the pediatric radiologist with the skills and experience to confidently manage the vast array of MSK cases that present in a number of hospital settings. Once perfected, this system will be applied to other subspecialties within pediatric radiology.

**Thursday, April 11, 2019**  
**1:00–2:30 PM**

**SS02: Neuroradiology, Nuclear, Women's Imaging, Ultrasound**

**Location: Holiday Ballrooms 4-6**

**Moderator: Bruno A. Policeni, MD**

**Alison Dawn Sheridan, MD**

**NR NM BR US**

**(SS02-01) 1:00 PM - 1:10 PM**

### **The Effect of Increased Noninvasive Neck Angiography on Digital Subtraction Angiography Utilization**

Kaleb A. Todd, *University of Kansas School of Medicine, Wichita, KS*; Elizabeth Ablah; Hayrettin Okut; Kamran Ali, MD (*ktodd@kumc.edu*)

**PURPOSE:** To determine the existence of an association between Digital Subtraction Angiography (DSA) neck usage following increased Computed Tomography Angiography (CTA) neck and Magnetic Resonance Angiography (MRA) neck utilization.

**METHOD AND MATERIALS:** Medicare Part B fee-for-service data from 2013-2016 was reviewed. HCPCS (Healthcare Common Procedure Coding System) codes for conventional neck angiography (DSA), CTA neck, and MRA neck angiography were selected and abstracted. Physician specialty codes were used to identify procedures performed by radiologists, vascular surgeons, and neurologists.

**RESULTS:** From 2013 to 2016, DSA neck utilization decreased by 10.47% among all medical providers; whereas, MRA neck and CTA neck decreased by 2.69%. Among radiologists, DSA utilization decreased by 22.01% and MRA/CTA neck utilization increased by 2.02%. Among vascular surgeons, utilization of DSA decreased by 42.51% and utilization of MRA/CTA neck increased by 31.52%. Neurologists' utilization of DSA increased by 10.99%, and utilization of MRA/CTA neck decreased by 14.39%.

**CONCLUSION:** Among all providers, imaging studies of the neck have decreased in utilization. Utilization of DSA neck has decreased significantly more than non-invasive alternative studies (MRA/CTA neck), suggesting MRA/CTA neck is replacing DSA neck. Radiologists' use of DSA neck followed the overall trend in decreased usage, but radiologists had a small increase in MRA/CTA neck use. Vascular surgeons had the most decreased usage of DSA neck and the most increase in usage of MRA/CTA. Neurologists' neck imaging utilization was vastly different than overall national trends, with increased use of DSA neck and large decreased use of MRA/CTA neck. This utilization trend may in part be attributed to the increased presence of neurointensivists and their need to utilize DSA for interventions.

**(SS02-02) 1:10 PM - 1:20 PM**

### **Comparison of Mammography Performance Benchmark Metrics in Breast Fellowship Trained and Non-Fellowship Trained Radiologists in a Military Teaching Hospital**

Bohan Liu, MSc, *Uniformed Services University of the Health Sciences, Bethesda, MD*; Shannon Gaffney, DO (*shannon.gaffney.mil@mail.mil*)

**PURPOSE:** To determine if performance benchmarks differ amongst breast fellowship trained and non-fellowship trained radiologists in a military teaching hospital.

**METHOD AND MATERIALS:** Consecutive screening mammograms from January 2010 to June 2018 were reviewed. Performance met-

rics to include cancer detection rate (CDR), abnormal interpretation rate (AIR), sensitivity and specificity were reviewed for each radiologist during this timeframe. Radiologists who read less than 1000 screening mammograms during the timeframe were excluded in our data analysis. Data analysis was performed with unpaired two-tailed student t-tests in order to compare the performance metrics of breast fellowship trained radiologists to non-fellow trained radiologists and statistical significance was defined as  $P < 0.05$ .

**RESULTS:** A total of 200 breast cancers were diagnosed after 27092 screening mammograms from January 2010 to June 2018 were performed. Overall metrics for this hospital during this timeframe is as follows: CDR 7.38 per 1000 (200/27092); AIR 13.9% (3760/27092); sensitivity 94.3% (200/212); and specificity 86.3% (22731/26339). The fellowship trained group included three radiologists, who collectively read 10419 screening mammograms while the non-fellowship group included nine radiologists, who collectively read 16673 screening mammograms. After applying our exclusion criteria, screening metrics for fellowship trained radiologists is as follows: CDR 9.21 per 1000 (96/10419), AIR 9.80% (1021/10419), sensitivity 96.0% (96/100), and specificity 90.5% (8848/9776) compared to CDR 5.59 per 1000 (67/11994),  $P=0.059$ ; AIR 15.7% (1886/11994),  $P=0.049$ ; sensitivity 95.7% (67/70),  $P=0.063$ ; and specificity 83.5% (9358/11202),  $P=0.045$  for the non-fellowship trained radiologists.

**CONCLUSION:** The cancer detection rate for fellowship trained radiologists is greater than non-fellowship trained radiologists, approaching statistical significance. Moreover, the fellowship trained group has a statistically significant lower abnormal interpretation rate and higher specificity compared to the non-fellowship trained group. This is of particular importance as performance standards continue to emphasize low recall rates and decreased false positive exams.

**(SS02-03) 1:20 PM - 1:30 PM**

### **Standardized Reporting of Neck Adenopathy with the Accepted Nodal Classification Criteria**

Gregory Ngo, DO, *Robert Wood Johnson Medical School, Scotch Plains, NJ*

**LEARNING OBJECTIVES:** 1. Identify the correct size criteria for cervical lymphadenopathy according to station. 2. Be able to classify cervical lymph nodes into the correct station. 3. Be able to identify non-size pathologic criteria for cervical lymphadenopathy.

**CONTENT DESCRIPTION:** The purpose of this study was to raise awareness of the importance of using the accepted cervical nodal classification agreed upon by the American Joint Committee on Cancer (AJCC) and the American Academy of Otolaryngology Head and Neck Surgery (AAOHN) in 1991. Our goal was to clarify the confusing topic of cervical lymphadenopathy and its levels of classification in addition to implementing a convenience for its use in reports. We described significance of lymph nodes in head and neck cancer and what constituted abnormal nodes: size, morphology, shape, and margins. We described the different nodal stations in addition to providing schematic images for quick reference. The purpose of our QI project was to improve the use of the accepted standard nomenclature for reporting head and neck adenopathy on CT and MRI. Reports for patients with head and neck cancer over the past 5 years were collected, reviewed, and categorized as using the correct classification nomenclature or not. An informational PowerPoint was made and reviewed with neuroradiology attendings, and a pick list was created for convenience. Reports were then reevaluated and the outcome was positive. 25% (3/12 reports) failed to use the lymph node stations, compared to 57% preintervention (138/242 reports). 75% (9/12 reports) used the lymph node stations appropriately, compared to 43% preintervention. (104/242 reports). Topics to be covered: Purpose of educational powerpoint. Criteria for abnormal cervical nodes. Size dependent criteria for cervical lymphadenopathy. Size independent criteria for cervical lymphadenopathy. Purpose of QI project, description, and results.

\* Faculty financial disclosures are located in the Faculty Index.

**(SS02-04) 1:30 PM - 1:40 PM**  
**Characteristics of Residents Participating in the American Board of Radiology 16-Month Dual Certification Pathway in Nuclear Radiology and Diagnostic Radiology**

Jessica F. Martin, MD, *Medical University of South Carolina, Charleston, SC*; Leonie Gordon, MBChB; William J. Rieter, MD, PhD

**PURPOSE:** To examine characteristics of residents currently participating in, or who recently completed, the American Board of Radiology (ABR) 16-month Dual Certification Pathway in Nuclear Radiology (NR) and Diagnostic Radiology (DR).

**METHOD AND MATERIALS:** An anonymous survey was sent via email to residents currently participating, or who completed in the last 2 years, the ABR NR/DR Pathway as supplied by their program directors. All were enrolled in ACGME DR programs adhering to both DR and ABR NR/DR training requirements. The DR program director supervised the NR/DR training with input from nuclear medicine faculty. The survey was open for 3 weeks in September 2018. Questions included participation in the overnight call pool; appropriate amount of elective time; active participation on a cardiac nuclear medicine service; participation in a sufficient variety of IV and oral radiotherapies; plans to take the ABR Certifying exam, the ABNM (American Board of Nuclear Medicine) Certifying exam, or both; and additional comments.

**RESULTS:** Of 15 survey recipients, 7 responded (46.6%). Of these, all participate in the overnight call pool. Most receive appropriate elective time (71.4%), are active on a cardiac service (71.4%), and participate in a variety of radiotherapies (85.7%). Most plan to take both the ABR and ABNM Certifying exams (57.1%) with two planning to take only the ABR exam (28.6%) and one only the ABNM exam (14.3%). Comments included "ABNM will not let me take their exam otherwise I would take both" and "Regarding IV therapies, we had a limited experience because of low volumes at our institution."

**CONCLUSION:** Most responders receive appropriate elective time, are active on a cardiac service, participate in a variety of radiotherapies, and plan to take both the ABNM and ABR Certifying exams. More requirements within the ABNM curriculum likely explain discrepancies among responders planning to take one or both Certifying exams. Currently, only 14 out of approximately 1100 senior DR residents are participating in the ABR NR/DR Pathway and only 14 DR programs out of 169. Given the predicted shortage of nuclear radiologists in the next 5 years, the low participation rate is unlikely to ameliorate the deficiency.

**(SS02-05) 1:40 PM - 1:50 PM**  
**Clinico-Radiologic Algorithms to Improve the Evidence-Based Utilization of Imaging Studies in Children and Adolescents with Headache**

Grace M. Tewkesbury, BS, *Emory University School of Medicine, Atlanta, GA*; Anna V. Trofimova, MD, PhD; Shabnam Jain; Steven Goudy; David Wolf; Nadja Kadom, MD

**PURPOSE:** Address inappropriate imaging utilization at our institution through algorithmic guidance for the imaging management of children with post-traumatic, infectious, and sinus headaches.

**METHOD AND MATERIALS:** Literature search to identify existing headache-related consensus statements and clinical practice guidelines from relevant professional societies: American Academy of Neurology (AAN), International Headache Society (IHS), American Academy of Pediatrics (AAP), American Academy of Otolaryngology - Head and Neck Surgery (AAO-HNS), American College of Radiology (ACR), and Infectious Disease Society of America (IDSA). Supplementary literature searches were conducted for specific questions. The information was converted into visual algorithms based on clinical decision trees. Answers to yes-or-no clinical questions ultimately lead to either an imaging recommendation or an alternative workup recommendation when imaging was not indicated. Each algorithm was reviewed by a

clinical expert in the respective field (neurology, emergency medicine, otolaryngology, neuroradiology).

**RESULTS:** A total of 15 guidance documents were identified and sorted into one or more of the following categories: general/neurologic (4), trauma (5), infection (4), and sinus (5). Algorithms for post-traumatic, infectious, and sinus headache were drafted, reviewed by clinical experts, and approved with minor modifications.

**CONCLUSION:** Radiologists can take leadership in developing evidence-based educational materials to aid clinicians in appropriate imaging utilization. As next steps, our algorithms will be discussed with community providers within our regional pediatric care network and clinicians within the pediatric hospital, to meet specific needs. For example, currently included details on diagnostic signs and medical treatments could be shortened or highlighted, depending on clinician preferences. Our future projects will be directed towards choosing appropriate imaging modalities given the practice context (access to local imaging facilities versus hospital access).

**(SS02-06) 1:50 PM - 2:00 PM**  
**Reliability of Architectural Distortion Measurements Using Digital Breast Tomosynthesis**

Maggie Chung, *University of California San Francisco, San Francisco, CA*; Grayson Baird; Martha B. Mainiero, MD; Jiyon Lee, MD; Robert C. Ward, MD; Ana P. Lourenco, MD; et al (*mchung2017@gmail.com*)

**PURPOSE:** To evaluate the interobserver variability of architectural distortion (AD) measurements on digital breast tomosynthesis (DBT).

**METHOD AND MATERIALS:** This is an IRB-approved, HIPAA-compliant retrospective observer performance study using 34 selected patients with AD on DBT and pathologic diagnosis by needle biopsy and/or surgical excisional biopsy. There were 16 cancers, 14 radial scars, and 4 other high-risk lesions (atypical ductal hyperplasia, lobular neoplasia). Six fellowship-trained breast radiologists with median of 6.5 years of experience (range 1 – 25 years), blinded to results, independently reviewed DM and DBT images for each patient. There was no pre-study consensus on measurement technique. Readers recorded presence/absence of AD, view(s) on which AD was present, and measurements on DM and DBT, respectively. Interobserver variability was assessed using intraclass correlation coefficients (ICC) for anterior-posterior (AP) and medial-lateral (ML) measurements on craniocaudal (CC) views and AP and CC measurements on mediolateral oblique (MLO) views.

**RESULTS:** Of the 34 AD seen on DBT, 62-74% were not identified on DM. Among all readers, AD measurements were significantly larger on DBT relative to DM ( $p < 0.0001$ ). DBT measurements varied significantly among the readers ( $p < 0.0001$ ). ICC between DM and DBT measurements was 0.26, 0.41, 0.48, and 0.40 for CC-AP, CC-ML, MLO-AP, and MLO-CC measurements, respectively. ICC for DBT measurements among readers was 0.27, 0.34, 0.36, and 0.29 for CC-AP, CC-ML, MLO-AP, and MLO-CC measurements, respectively.

**CONCLUSION:** DBT measurements of AD are significantly larger than DM measurements. Despite greater accuracy in detection of AD using DBT, interobserver variability of measurements remains high. Standardization of AD measurements on DBT is necessary before reliable serial imaging follow-up can be utilized in the management of non-cancerous AD.

**(SS02-07) 2:00 PM - 2:10 PM**  
**Adoption of an Automated Outcomes Feedback Application by Breast Imagers Interpreting Screening Mammography with Digital Tomosynthesis**

Dorothy A. Sippo, MD\*, *Massachusetts General Hospital, Boston, MA*; Amy M. Sullivan; Amy Cohen; Constance D. Lehman, MD, PhD\* (*dsippo@mgh.harvard.edu*)

**PURPOSE:** To describe an automated outcomes feedback application for breast imagers interpreting screening mammography with digital tomosynthesis and evaluate application adoption.

\* Faculty financial disclosures are located in the Faculty Index.

**METHOD AND MATERIALS:** Partnering with our breast imaging information system vendor (Magview; Burtonsville, MD) we developed a breast imaging automated outcomes feedback application. The application, Outcomes to Radiologists Automatically Communicated for Continuous Learning (ORACCL) is integrated into our reporting system. ORACCL provides radiologists with outcome results of subsequent imaging and pathology for patients they personally recalled from screening mammography. ORACCL was developed to enable continuous learning within clinical workflow by providing radiologists with feedback to help improve future clinical decisions. For each case with available feedback, radiologists can review a summary page (Figure 1) of the case with links to relevant imaging and reports. The radiologist is asked to answer one mandatory question after reviewing the case, to stimulate critical thinking. The question asks whether review of the case will influence future clinical decisions. After a 6-month pilot period, ORACCL was fully functional and available to 12 academic and 5 affiliated private practice attending radiologists on 4/20/18. There is a time lag between screening exams performed and feedback availability. Therefore, up until 9/12/18 we tracked utilization of ORACCL to review feedback for studies performed from 3/1/18 through 7/31/18. We also determined the proportion of cases radiologists indicated would influence future clinical decisions. This work was deemed clinical quality improvement with IRB review not required.

**RESULTS:** There were 889 recalled screening exams performed over the 5 months with available feedback. From these, 635 (71%) were reviewed. The monthly proportion of cases reviewed ranged from 48% to 95%. Radiologists indicated reviewing the case would influence future clinical decisions for 17% of cases (107/635).

**CONCLUSION:** Automated outcomes feedback can be implemented in breast imaging clinical workflow and radiologists will use it. For some cases, radiologists believed feedback could influence future clinical decisions.

#### (SS02-08) 2:10 PM - 2:20 PM

##### After-Hours Emergent Breast Ultrasounds: Indications and Follow-Up Recommendations in Academic and Community Settings within the Same Hospital System

Roberta M. Strigel, MD, MS\* *University of Wisconsin, Madison, WI*; Mai A. Elezaby, MD\*, Jill Karow; Urvi Tailor; Robert K. Bour, MD; Ryan Zea, et al

**PURPOSE:** After-hours breast ultrasound exams (US) ordered by the emergency department (ED) are relatively uncommon, and are often limited. We examined the variability of indications and follow-up recommendations for these exams in our institutional academic (ACAD) and community (COMM) hospital.

**METHOD AND MATERIALS:** We performed a retrospective review of after-hours breast US ordered by the ED from 8/1/2014 to 7/31/2017. Patient demographics, location (ACAD or COMM), exam indications, imaging findings and follow-up recommendations were collected. Discrepancy between preliminary-resident and final-faculty interpretations for ACAD hospital US was calculated. Differences in proportions and continuous variables were calculated using t-test. For categorical variables, either the chi-square or Fisher's exact test was used, where appropriate depending on the cell counts.

**RESULTS:** Of 129 ED breast US, 81 (63%) were in the ACAD setting, and 48 (37%) in the COMM setting. Average patient age was 40 (range:19-63) and 34 (range:19-55) years in the ACAD and COMM hospitals, respectively (difference 5.602, 95% CI: 1.736, 9.470,  $p=0.005$ ). Practice-setting differences in exam indications were statistically significant ( $p<0.001$ ) (Chart 1). The most common exam indications were post-operative complications (43%; 35/81) at the ACAD hospital, and infection (75%; 36/48) at the COMM hospital. For ACAD hospital US, the disagreement rate between preliminary-resident and final-faculty interpretations was 1.2% (1/81). Follow-up recommendations were included in 17.3%, (14/81) of preliminary resident interpretations (95% CI: 10.7%, 27.3%), and 45% (58/129) of final faculty interpretations (95% CI: 37%, 54%). After correcting for patient age

and indication, follow-up recommendation was 2.3 times more likely to be included in the COMM than ACAD setting ( $p=0.035$ ).

**CONCLUSION:** Exam indications, patient age, and providing follow-up recommendations for ED breast US exams were significantly different between ACAD and COMM settings. Knowledge of the common indications for ED breast US in different practice settings and inclusion of appropriate follow-up recommendations helps guide clinical teams and benefits patient care.

#### (SS02-09) 2:20 PM - 2:30 PM

##### The Impact of Breast Size on Variation in Mass Location on Mammography and Magnetic Resonance Imaging

Marie Surovitsky, *NYU Winthrop Hospital, Mineola, NY*; Diane Szaflarski; Samia Sayegh; Irina Rapoport; Jason C. Hoffmann, MD\* (*Jason.Hoffmann@nyulangone.org*)

**PURPOSE:** To determine the amount of variability in the location of breast masses seen on mammography and magnetic resonance imaging (MRI) by determining mass location measured from both the chest wall and the nipple, correlating this with breast size.

**METHOD AND MATERIALS:** A single institution, retrospective analysis of 23 consecutive women with breast lesions was performed. Breast thickness was determined by compression during mammography. Ultrasound was excluded from this study secondary to variation in measurements due to operator dependence and experience. The distance of mass to nipple (DTN) and distance of mass to chest wall (DTC) were calculated utilizing MRI and mammography in cranio-caudal (CC) and mediolateral oblique (MLO) views, and this was correlated with breast thickness. The mean DTN and DTC were calculated for each patient utilizing the obtained MRI and mammographic data. The difference between the value and the mean for each imaging modality was obtained. Finally, the average of all the variability for all imaging modalities was calculated. All values obtained were ranked by average breast thickness from smallest to largest.

**RESULTS:** Average delta DTN (dDTN) and delta DTC (dDTC) values for each patient on mammography (CC and MLO) and MRI were calculated with breast thickness ranging from 3 to 9 cm, and a distance range was calculated. In smaller breasts (compression thickness of 3-5 cm), the dDTN was 0.69 cm and the dDTC was 0.58 cm. With breast compression thickness of 5-7 cm, the dDTN was 0.59 cm and the dDTC was 0.52 cm. With breast compression thickness of 7-9 cm, the dDTN was 0.85 cm and the dDTC was 0.68 cm. The average variation using both dDTN and dDTC was greatest (0.76 cm) in larger breasts (7-9 cm thick) and smallest (0.55 cm) in medium sized breasts (5-7cm thick).

**CONCLUSION:** The greatest variability in the location of breast masses on MRI and mammography is seen in larger breasts (7-9 cm). Since most of the patients who are found to have a breast mass on the screening exam will undergo biopsy and/or surgery, it is important to know the exact mass location, which is more variable for the thicker breasts.

#### Joseph E. and Nancy O. Whitley Award

#### (SS02-10) 2:30 PM - 2:40 PM

##### Development of Breast Imaging Specific Entrustable Professional Activities Using a Double Delphi

Author List: Monica M. Sheth, MD, *Northwell Health, Donald & Barbara Zucker School of Medicine at Hofstra, Great Neck, NY*; Ryan W. Woods, MD, MPH; Priscilla J. Slanetz, MD, MPH; Katherine A. Klein, MD; Alice Fornari, EdD, RDN; Petra J. Lewis, MD

**RATIONAL AND OBJECTIVE:** To develop subspecialty-specific entrustable professional activities for breast imaging radiology (EPA-BRs) through the use of a double consensus-driven, validity enhancing methodology that may be relevant to other subspecialties in radiology and medicine in general.

\* Faculty financial disclosures are located in the Faculty Index.

**MATERIAL AND METHODS:** A six-step methodology was used to develop EPA-BRs via a double Delphi process followed by educational theorists' refinement. Two groups of experts completed each Delphi process: the core group of breast imaging educators and an expert panel of national experts in breast imaging standards and appropriateness.

**RESULTS:** 5 EPA-BRs were developed, with 8 nested EPA-BRs, one of which is elective. This comprehensive list of EPA-BRs covers the role of a breast imaging radiologist in the care of a patient from detection of breast cancer to post-treatment follow-up.

**CONCLUSION:** A combined modified and classic double Delphi approach can be utilized by other graduate medical education (GME) specialties and subspecialties as a method by which GME education can be transformed into a clinical framework that more closely bridges individual competencies and real-world clinical practice.

Thursday, April 11, 2019  
1:00–2:30 PM

### SS03: Resident Education 1

Location: Key Ballroom 9

Moderator: Kamran Ai, MD

Dorothy L. Gilbertson-Dohdal, MD



#### (SS03-01) 1:00 PM - 1:10 PM

##### Impact of Focused Research Time on the Productivity of Radiology Resident Scholarly Activities

Chloe M. Chhor, MD, *Brooklyn, NY*; Patricia Clayton; Nancy R. Fefferman, MD; Cecilia L. Mercado, MD ([chloe.chhor@nyulangone.org](mailto:chloe.chhor@nyulangone.org))

**PURPOSE:** Scholarship and research activities are required by the Accreditation Council for Graduate Medical Education (ACGME), which has mandated residency programs incorporate principles of research into the residency curriculum and allocate adequate educational resources to facilitate resident involvement in these endeavors. To assist in this process, our program instituted focused research time and assessed its impact on the productivity of radiology resident scholarly activities.

**METHOD AND MATERIALS:** Focused research time of a half day per week was instituted July 1, 2015 and was granted to residents engaged in faculty mentored research projects. Progress was assessed quarterly to ensure benchmarks were met. Radiology resident scholarly activities submitted to the ACGME web-based Accreditation Data System (WebADS) between 2012-2018 were reviewed. Quantitative data about each scholarly activity which consisted of publications, conference presentations, and textbook chapters was captured. PubMed-Indexed for MEDLINE (PMID) number was used to confirm publications. The results were analyzed comparing scholarly activity productivity between the three academic years before (July 1, 2012- June 30, 2015) and three academic years after (July 1, 2015-June 30, 2018) implementing focused research time.

**RESULTS:** The total number of residents per academic year for 2012-2015 compared with 2015-2018 was similar, ranging between 37-40 residents. Prior to the start of focused research time, there were 45 publications between the 2012-2015 academic years. After initiating focused research time, the number of publications went up to 75 (a 67% increase) for the 2015-2018 academic years. Presentations at conferences prior to implementation was 112 compared to 128 after implementation, resulting in an increase of 14%. With focused research time, the number of textbook chapters increased from 4 to 15 (275% increase).

**CONCLUSION:** Focused research time of half a day per week increased the productivity of scholarly activities among our radiology residents. These findings support the value of focused research time in promoting scholarly activities.

#### (SS03-02) 1:10 PM - 1:20 PM

##### Global Radiology Training Prevalence Among Radiology Residency Programs

Hana L. Haver, MD, *University of Massachusetts, Worcester, MA*; Carolyn M. DeBenedictis, MD; Max P. Rosen, MD, MPH\* ([hana.i.haver@gmail.com](mailto:hana.i.haver@gmail.com))

**PURPOSE:** Global Radiology strives to enhance worldwide access to medical imaging services and education. To date, few reports have evaluated Global Radiology training in Radiology residency programs. At this time of growing interest in the field, the present study sought to investigate how Radiology residency programs perceive and choose to incorporate international activity into their curricula.

**METHOD AND MATERIALS:** We conducted a survey of Radiology residency program directors (identified via the Association of Program Directors in Radiology) to gain further insight into their views on Global Radiology training using SurveyMonkey. Topics included: available electives, institutional partnerships, level of resident and faculty involvement, inquiry by prospective residents and barriers to implementation. We then examined Radiology residency program web sites (n=193) for existing Global Radiology and/or Global Health training, defined by the presence of this information on the programs' publicly available webpages.

**RESULTS:** Thirty-eight per-cent (24/62) of residency programs responding to the survey offered a Global Radiology elective to their residents within the past academic year and 27% (17/62) of programs have active affiliations with medical institutions outside of the United States. Eighty-four per-cent of program directors (52/62) have received questions from residency applicants regarding opportunities to participate in Global Radiology. Furthermore, only 13% (26/193) of programs listed at least one Global Radiology and/or Global Health elective on their program webpage. These programs were predominately university-based, registered with RAD-AID International, and located on the East Coast of the United States.

**CONCLUSION:** Global Radiology training in residency has become more widely available than described in earlier reports and has been underrepresented on residency program websites. As such, we suggest that Radiology residency programs ensure that their websites reflect their Global Radiology involvement. We hope that this may facilitate prospective residents choosing an appropriate residency program, and further empower both residents and faculty members to engage in Radiology on the world health stage.

#### (SS03-03) 1:20 PM - 1:30 PM

##### The Radiology Resident as Teaching Consultant: An Innovative Peer-to-Peer Teaching Consultation Service to Strengthen Relationships with Referring Colleagues in the Era of Imaging 3.0

Michael T. Caton Jr, *Brigham and Women's Hospital, Boston, MA*; Shahr Glomski, MD; Glenn C. Gaviola, MD ([mcaton@bwh.harvard.edu](mailto:mcaton@bwh.harvard.edu))

**PURPOSE:** The American College of Radiology (ACR) Imaging 3.0 paradigm emphasizes the need for radiologists to serve as imaging consultants to referring colleagues. However, outside the reading room, teaching interactions between radiology and non-radiology residents are limited. Internal Medicine Morning Report (IMMR) is a resident-run educational program widely employed by internal medicine (IM) residencies. Although medical imaging is discussed in IMMR, radiology residents are not involved in case preparation. We aimed to develop a peer-to-peer imaging teaching consultation service (TCS) using the well-established structure of IMMR. By creating illustrative, "dynamic" teaching slides, we sought to provide salient radiology teaching material to demystify jargon, discuss appropriate imaging use, and review anatomy. We hypothesized that TCS could improve the quality of IMMR as perceived by the IM presenter.

**METHOD AND MATERIALS:** TCS was piloted over a 7-month period. Each referred case was reviewed by a senior radiology resident, who

\* Faculty financial disclosures are located in the Faculty Index.

produced a set of “dynamic” teaching slides for each case that included patient imaging overlaid with extensive annotations and animations highlighting teaching points. Slides were shared with the presenter, who could use them for preparation and include animations in IMMR if desired. TCS effectiveness was evaluated with a survey distributed to participating IM residents.

**RESULTS:** In the pilot period, 12 TCS requests were received and 10 were performed. Survey results indicated that most IM residents did not consult radiologists prior to TCS (5/6, 83%). IM residents used the “dynamic” teaching slides to both prepare for and present at IMMR (5/6, 83%). TCS improved IM residents’ perceived ability to engage their audience (6/6, 100%), confidence in teaching radiology material (4/6, 67%), ability to understand radiology reports (4/6, 67%) and appreciation for what radiologists do (6/6, 100%).

**CONCLUSION:** The TCS pilot produced successful Radiology-IM collaboration and improved perceived imaging teaching quality in IMMR. Continuous program evaluation will be performed and future work will assess the effect of TCS on radiologist confidence in real-world clinical consultations.

### (SS03-04) 1:30 PM - 1:40 PM Still Coming Out of the Dark: Enduring Effects of Simulation Based Communication Skills Training for Radiology Residents - Four Year Follow Up

Sana Majid, *University of Massachusetts Medical School, Worcester, MA*; Carolyn M. DeBenedictis, MD (*carolynn.debenedictis2@umassmemorial.org*)

**PURPOSE:** We evaluate the long-term efficacy of simulation-based communication skills training for radiology residents, and whether the improvements seen in our prior paper were long-lasting.

**METHOD AND MATERIALS:** Our simulation-based communication skills training curriculum was developed in 2014. The curriculum included a teaching module based on the essential elements of communication described in the Gap-Kalamazoo Communication Skills Assessment Form (GKCSAF), and two sets of 6 communication scenarios encountered by radiologist were created. During their first year of radiology residency, residents reviewed the teaching module and completed the 6 simulated scenarios. They then underwent debriefing sessions, received faculty and staff evaluations (using the GKCSAF). Four years later, these residents reviewed the teaching module again and repeated the same simulation but with the second set of scenarios. They again underwent debriefing sessions after the simulation. This time the residents’ communication skills were evaluated by faculty and staff using the Kalamazoo Communication Skills Assessment Tool for Radiologists (KalRad), which is the GKCSAF but validated for radiology communication. Both evaluation tools used a 5-point Likert Scale.

**RESULTS:** A total of 5 residents participated in this simulation-based skills training. The resident performance four years after initial training show not only that residents maintained their improved scores, but also that their scores improved further as compared to after the initial training. The average overall score for all but one resident increased at the 4-year follow up simulation. From 2014 to 2018, the average score of all the residents increased from 72.4% to 81.4%. Comparison of the average scores of each student across six stations from 2014 to 2018 showed a statistically significant difference between the scores after four years ( $p = 0.014$ ).

**CONCLUSION:** Simulation-based skills training is effective in not only improving communication skills scores of resident trainees in the short-term, but that these effects are long-lasting and significant. Simulation-based skills training is a valuable and efficacious method of teaching radiology residents.

### (SS03-05) 1:40 PM - 1:50 PM Preparing Residents to Lead in the Era of Artificial Intelligence: Initial Experience with a Focused Data Science Training Pathway for Senior Radiology Residents

Walter F. Wiggins, *Brigham & Women’s Hospital/Harvard Medical School, Boston, MA*; Michael T. Caton Jr; Shahar Glomski, MD; Elizabeth George, MD; Glenn C. Gaviola, MD; Katherine P. Andriole, PhD (*wwiggins@bwh.harvard.edu*)

**PURPOSE:** Artificial intelligence and machine learning (AI:ML) have taken center stage in radiology with novel applications emerging rapidly. Radiologists-in-training should embrace data science in preparation for leadership positions in ML algorithm development from the white board to the reading room. Our residency has established 4th year elective pathways in Leadership, Medical Education, and Global Health. A similar pathway in Data Science would provide a unique opportunity for residents aiming to incorporate AI:ML into their careers.

**METHOD AND MATERIALS:** We piloted an elective Data Science Pathway (DSP) for senior residents in collaboration with the MGH-BWH Center for Clinical Data Science (CCDS). CCDS is a multidisciplinary team engaged in AI:ML application development, emphasizing clinical translation. The goal of DSP was to provide a systematic introduction to AI:ML and establish a flexible experience for future residents. Two residents designed 3- and 6-month curricula tailored to their specific interests with common core elements. Residents were mentored by the CCDS Director of Research and were expected to develop hypothesis-driven research and participate in all stages of the AI:ML development pipeline. Elective time enabled full immersion into the CCDS environment.

**RESULTS:** In the 6-week pilot period, residents successfully integrated into CCDS, consulting on multiple projects, including a suite of neuroimaging applications. Residents engaged in data curation, algorithm design, quality control and clinical testing. Core concepts in AI:ML were taught through structured didactic sessions and weekly seminars. Residents contributed to CCDS productivity by curating datasets, collectively reviewing over 1500 neuroimaging studies. Initial work in the pilot period led to 5 abstract submissions with 2 accepted for presentation at a national meeting, and 3 under review.

**CONCLUSION:** The DSP provided a well-rounded introductory experience in AI:ML, resulting in both academic productivity and valuable clinical skill development via high-volume case review during data annotation. Going forward, the DSP will prepare residents to serve as leaders, rather than observers, in multidisciplinary clinical data science.

### (SS03-06) 1:50 PM - 2:00 PM Coordinator Burnout: Results from a 2017 Survey of the Association of Program Coordinators in Radiology

Suehyb G. Alkhatib, *Pennsylvania Hospital, Philadelphia, PA*; Junjian Huang, MD; Susan M. McFadden Boardman, MS; Richard Scruggs; Dayna Levin, MD (*suehyb.alkhatib@uphs.upenn.edu*)

**PURPOSE:** To evaluate the prevalence and sources of burnout in radiology coordinators.

**METHOD AND MATERIALS:** A survey was developed to evaluate causes of radiology coordinator burnout. The survey features 10 likert scale questions based loosely off the Maslach Burnout Inventory followed by 7 demographic questions and 2 open ended free response style questions. Participation was strictly voluntary. Survey distribution was via the Association of Program Coordinators in Radiology (APCR) listserv and the survey will be open until 10/25/17. The results and statistical analysis will be conducted in Qualtrics and R.

**RESULTS:** The survey was released by the APCR on 9/27/17 to 209 members and ended on 10/17/17. A total of 130 completed surveys (62%). The vast majority of respondents (96%) are women, single (65%) and have children under 18 years old (69%) with average job experience between 0-10 years (48%) and 10-20 years (31%). The median program size is between 24-40 residents. About 20% of coordinators have a co-coordinator or assistant. Job satisfaction, security, respectfulness of peers,

\* Faculty financial disclosures are located in the Faculty Index.

residents, and faculty (including program directors) were on average rated as modestly favorable. Emotional and physical tiredness at the end of the day was commonplace. Compensation was rated as a problem area by almost half of the respondents (47%) and nearly 20% answered somewhat or strongly agree to constantly searching for alternative employment. The top 3 reasons given for burnout in the open ended questions were related to overwork, lack of support and poor compensation.

**CONCLUSION:** Radiology coordinator burnout appears to stem from extraneous duties, lack of support and inadequate compensation. What is concerning is that about 1 in 5 respondents are actively seeking alternative employment. This is understandable as almost all respondents agree that being a coordinator is mentally and physically exhausting and most feel under compensated for the amount of work that is required of them. It is our duty as colleagues and beneficiaries of this group to address this underreported issue as we can all agree that coordinators are crucial to the success of a residency.

### (SS03-07) 2:00 PM - 2:10 PM Perceptual Learning Techniques to Teach CT Interpretation of the Appendix to Novice Learners

Jessica B. Robbins, MD, *University of Wisconsin, Madison, WI*;  
Jason W. Stephenson, MD; Ian A. Johnston; C. S. Green ([jrobbins@uwhealth.org](mailto:jrobbins@uwhealth.org))

**PURPOSE:** Utilize approaches from the domain of perceptual learning (PL) with the goal of teaching novices to identify appendicitis on a single CT image.

**METHOD AND MATERIALS:** On each of five days, participants viewed 160 (80 appendicitis, 80 normal) single axial training CT images. Participants were asked to categorize each image as "appendicitis" or "no appendicitis." Next, participants completed transfer tests of the same basic task with 40 previously-unseen images as well as 80 previously-seen but flipped images (40 up/down (U/D), 40 left/right (L/R)). Several training conditions were tested. Condition 1 (C1): 11 undergraduates with no prior experience with medical imaging (novice), completed training with feedback given after each training trial (correctness of response and location of the appendix). Condition 2 (C2): 9 novice participants completed the same training without being shown the appendix location in feedback. Condition 3 (C3): novices underwent the same training with the trials ordered from easier-to-harder (as opposed to random). Finally, 12 expert radiologists performed the task for comparison.

**RESULTS:** C1 participants showed significant improvement over training (Day1: 0.58+/-0.07 (mean+/-SD), Day5: 0.78+/-0.07;  $p < 0.001$ ). No significant difference was found between performance on Day5 and novel images (Day5: 0.77+/-0.09, novel: 0.75+/-0.08;  $p=0.43$ ) or left/right flipped images (L/R 0.72+/-0.11;  $p=0.26$ ). There was a significant difference between Day5 and up/down flipped images (U/D 0.68+/-0.09;  $p=0.02$ ). C2 participants showed no improvement over the training period (Day1: 0.52+/-0.06; Day5: 0.52+/-0.08;  $p=.40$ ). C3 participants improved, but performed worse at the end of training than C1 (C1: .75+/-0.08, C3: 0.68+/-0.11,  $p = .03$ ). Finally, experts significantly outperformed all novices (0.91+/-0.03,  $p < 0.001$ ).

**CONCLUSION:** PL techniques may be an effective addition to CT appendix characterization training as C1 novices were able to identify appendicitis with >75% accuracy in ~2 hours of training. However, our results imply that the types of PL techniques employed (e.g., manner of feedback) is critical to the degree of learning that is achieved.

### (SS03-08) 2:10 PM - 2:20 PM Tales of Mentoring in Radiology: The Experience of Residents and Mentors at a Single Academic Program

Joelle Wazen, *University of Massachusetts Medical School/UMass Memorial Medical Center, Worcester, MA*; Alan Goldstein, MD; Helen Hye Ryong Kim, MD; Ryan Tai; George J. Watts, MD;Carolynn M. DeBenedictis, MD ([joelle.wazen@umassmemorial.org](mailto:joelle.wazen@umassmemorial.org))

**PURPOSE:** To investigate the utility of mentoring groups in radiology residency.

**METHOD AND MATERIALS:** 5 assistant professors of Radiology and 20 radiology residents were divided into 5 groups. 1 resident from each academic year was randomly paired with a mentor group. 3 1-hour group mentoring sessions took place over the year. Individual sessions were available to residents upon request. Upon completion of the project an anonymous QI survey of 20 questions was sent out to participants to assess the utility of these mentoring sessions.

**RESULTS:** 4 mentors out of 5 responded. All 4 had prior neutral and positive experiences as mentees involving career advice and subspecialty choice. During this experience all mentors had a positive or very positive experience. 100% thought the session number and length were adequate. 25% met with their mentees outside of the 3 sessions. 75% found it helpful to have residents of different levels in their group to allow for peer to peer mentoring. All thought the mentoring program should continue. The most common topics they covered during sessions were career advice and specialty choice. 16 residents out of 20 responded. 75% had had a previous mentor experience. 83% had a positive or very positive experience previously with mentoring. For 69% the nature of the previous mentor-mentee relationship was career related and for 38.5% research related. 88% had a positive or very positive mentoring experience this year. 56% felt the number of sessions was adequate and 31% felt they were too few. 12.5% met their mentor outside of the sessions. 87.5% found having residents of different levels was beneficial. Topics that were mostly covered were Work-life balance and study skills. Topics that mentoring sessions helped mostly with were career advice, study skills and work life balance. 100% of the mentees thought the mentoring program should continue. Additional suggestions included pairing of mentor with residents of similar career interests, individual sessions, starting mentoring early in training, increasing the number of sessions etc.

**CONCLUSION:** Mentoring groups can be a valuable addition to residency training, especially in helping with career advice and work life balance.

### (SS03-09) 2:20 PM - 2:30 PM Throw Me a Bone: Effect of a Bone Biopsy Skills Workshop Utilizing Anatomically Accurate 3D Printed Models

Dorissa L. Gursahaney, MD, *University of Colorado, Aurora, CO*;  
Michael Durst, MD; Amanda Crawford, MD; Melody Carroll, PhD; Corey Ho, MD ([dorissa.gursahaney@ucdenver.edu](mailto:dorissa.gursahaney@ucdenver.edu))

**PURPOSE:** The aim of this study is to design low-cost, anatomically accurate 3D-printed bone models and to assess the effect of a practicum on trainees' (1) bone biopsy technical skills using a powered bone biopsy device and (2) self-assessed preparedness for performing bone biopsies.

**METHOD AND MATERIALS:** IRB-exempted. 26 trainees were given a brief presentation highlighting the instructions provided for the Arrow OnControl Powered Bone Access System. Subsequently the subjects performed the biopsy using 3D printed models and were graded by a predetermined rubric for aspects of technique. Following the initial attempt, a hands-on tutorial was provided with a subsequent graded biopsy attempt. In addition, prior to and following the tutorial, trainees rated the utility of the tutorial, usefulness of the bone model, and their personal anxiety / technical preparedness in performing bone biopsies (10-point Likert scale ranging from 1= not confident/anxious/useful to 10 = extremely confident/anxious/useful). The self-reported scores and grading of each trainee were compared between the two time points using Wilcoxon signed-rank test with significance level at 0.05.

**RESULTS:** Of the 24 trainees who completed pre- and post-tutorial surveys, 83.3% rated the 3D model tutorial 9-10 (extremely useful) and 16.7% gave it 7 to 8 (Mean 9.42, SD 0.88). When assessing the manual, 95.5% subjects rated it 1 (not useful) to 5 (neutral) and 4.5% gave it 8 (Mean 2.23, SD 1.875). Self-rated confidence significantly increased from an average of 2.096 (SD 1.73) to 7.29 (SD 1.71),  $z = 4.298$ ,  $p < 0.001$ . Self-described anxiety significantly decreased from an average of 7.08 (SD 2.45) to 4.58 (SD 2.45),  $z = -4.422$ ,  $p < 0.001$ . Aspects of biopsy technique were graded for 21 trainees and a Wilcoxon signed-rank test demonstrated significantly improved initial access ( $z = -3.384$ ,  $p = 0.001$ ), biopsy access

\* Faculty financial disclosures are located in the Faculty Index.

( $z = -3.561, p < 0.001$ ), sample ( $z = -2.111, p = 0.035$ ), drill technique ( $z = -3.601, p < 0.001$ ), and removal ( $z = -3.464, p = 0.001$ ).

**CONCLUSION:** The 3D-printed bone biopsy model provides an affordable, readily-available, and effective training tool to improve technical skills and confidence in performing biopsies.

Thursday, April 11, 2019  
1:00–2:30 PM

#### SS04: Resident Education 2

Location: Key Ballroom 10

Moderator: Sara Chen Gavenonis, MD  
Christopher Pattrin Ho, MD



#### (SS04-01) 1:00 PM - 1:10 PM

##### The MESH Incubator: Accelerating Core Competency in Technological Innovation, Artificial Intelligence, and Design Thinking in Radiology Training

Marc D. Succi, MD\*, *Massachusetts General Hospital, Boston, MA*; Raul N. Uppot, MD\*; Michael S. Gee, MD, PhD; Theresa C. McLoud, MD; James A. Brink, MD (*msucci@mgh.harvard.edu*)

**PURPOSE:** Radiology lacks core competency training in the basic tenants of innovation. We must train our residents, fellows, and staff in these fundamental competencies.

**METHOD AND MATERIALS:** The Medically Engineered Solutions in Healthcare (MESH™) Incubator was created at an academic radiology training program. MESH is a novel innovation center initially composed a physical invention workshop integrated in the clinical reading room and an innovator lecture series to foster industry alliances. The novel MESH Incubator Core Residency Design Curriculum (CRDC™) course was constructed to educate trainees and staff in targeted deficiencies in the fundamentals of innovation, including but not limited to artificial intelligence, machine learning, informatics, 3D printing, corporate business structures, and entrepreneurship.

**RESULTS:** Residents who completed the CRDC course were assessed using a 21-question pre- and post-course exam designed by experts in their respective fields, including in intellectual property, artificial intelligence, idea prototyping, corporate fundamentals, 3D printing, and research and grants. A paired student's t-test demonstrated a significant increase in exam scores after completion of the CRDC curriculum, with a average pre- and post-course scores of 10.43 and 18.86, respectively ( $p < .0001$ , mean difference = 8.43, 95% confidence interval (CI) = 6.11 to 10.75). Pre- and post-course Likert-type scale was employed to assess resident comfortability with different tenants of innovation in medicine (1-5, 1 = very uncomfortable, 5 = very comfortable). Results were assessed via paired student t-tests. Select examples are as follows: "How comfortable are you with creating a prototype of a device?" received scores of 1.71 pre vs 3.86 post ( $p = .0002$ , mean difference = 2.14, 95% CI = 1.50 to 2.78); "How comfortable are you with 3D printing?" received scores of 2.00 pre vs 4.29 post ( $p = .002$ , mean difference = 2.29, 95% CI = 1.59 to 2.98).

**CONCLUSION:** The MESH CRDC is the first core curriculum in technological innovation in any residency specialty program. Our data demonstrates a clear desire by our trainees to institute core competency in technological innovation as part of the radiology training.

#### (SS04-02) 1:10 PM - 1:20 PM

##### Women in Radiology: Do We See a Difference in Residency Programs?

Faezeh Sodagari, MD, *Yale University, New Haven, CT*; Pedram Golnari; Maryam Etesami (*faezeh.sodagari@yale.edu*)

**PURPOSE:** The aim of this study was to assess the recent trends in women's representation in faculty and resident positions in diagnostic

radiology residency programs.

**METHOD AND MATERIALS:** Using the American Medical Association Fellowship and Residency Electronic Interactive Database (FREIDA), diagnostic radiology residency programs in the United States were identified and the program-reported data on the practice setting and the proportions of female faculty and residents were extracted and compared between November 2015 and September 2018.

**RESULTS:** The number of diagnostic radiology residency programs increased by 5% from 184 in 2015 to 193 in 2018. A total of 181 programs were available at both years, consisting of 103 (57%) university, 54 (30%) university-affiliated, 16 (9%) community, and 8 (4%) military programs. Between 2015 and 2018, more programs reported diversity data such as female faculty (65% vs 73%), and female residents (45% vs 49%). The female faculty proportion ranged from 0 to 50% in 2015, and 0 to 52% in 2018, while the female residents' proportion ranged from 3.7% to 50% in 2015 and 0 to 51.1% in 2018. Female faculty proportion was not correlated with the female resident proportion ( $P > 0.05$ ). No significant difference was found between the female faculty proportions ( $26.1\% \pm 9.6\%$  vs  $26.6\% \pm 10.4\%$ ,  $P = .76$ ) or female resident proportions ( $24.6\% \pm 8.9\%$  vs  $24.7\% \pm 8.7\%$ ,  $P = .96$ ) in 2015 and 2018. Although statistically not significant, the university programs showed a positive trend in female faculty (26.1% to 28.8%) and female resident (23.4% to 27.2%) proportions, while the university-affiliated programs (26.4% to 25.2% and 26% to 22.1%) and community programs (27% to 18.3% and 28.5% to 23.8%) showed negative trends in these measures, respectively ( $P > .05$ ).

**CONCLUSION:** Despite efforts to increase women's representation in radiology, women are underrepresented both as faculty and trainees in the field. Although the university hospitals have slightly increased the number of female faculty and residents, the overall number of women is unchanged. Future efforts should address this issue, especially in university-affiliated and community hospitals.

#### AMSER Henry Goldberg Medical Student Award

#### (SS04-03) 1:20 PM - 1:30 PM

##### Who Are the Leaders of our Residency Programs?

Jeffrey Hirsh, *University of Virginia School of Medicine, Charlottesville, VA*; James Patrie; Michael Hanley, MD; Juliana Bueno, MD

**PURPOSE:** Characterize the current group of diagnostic radiology residency program directors (PDs) with respect to gender, academic rank and subspecialty; and determine any correlation between these characteristics and the residency programs

**METHOD AND MATERIALS:** Based on Doximity and program websites, we did a retrospective analysis of 150 residency programs (78% of total). Information regarding programs and PDs was analyzed to answer 1) Do programs with female PD correlate with higher percentage of female residents? 2) Correlation between gender of PDs and program region (South, West, Northeast, or Midwest) 3) Is there a correlation between rank of PDs and program region? and 4) Are higher ranked programs more likely to have PDs with a higher rank? Common parametric (logistic regression) and non-parametric (Wilcoxon Rank Sum test and Spearman Rank correlation) statistical methods were used.

**RESULTS:** PD gender was 68% male and 32% female. Median percentage of female residents was 26.0% (IQR: [21.0, 31.0%]) for programs with a female PD, and 25.0% (IQR: [18.0, 33.1%]) for programs with a male PD ( $P = 0.843$ ). No inter-regional differences with respect to the odds that a PD was female (Chi-square  $c_3 = 3.30, P = 0.362$ ). Full Professor PDs were more common in the West (Odds Ratio = 3.75; 95% CI: [1.23, 11.50],  $P = 0.020$ ); Associate Professor PDs were more common in the South (Odds Ratio = 2.85; 95% CI: [1.26, 6.44],  $P = 0.011$ ). Program rank was positively associated with PD rank; i.e. Full Professor PDs tended to have the highest ranked programs and Assistant Professor PDs tended to have the lowest ranked programs

\* Faculty financial disclosures are located in the Faculty Index.

(P=0.041)

**RESULTS:** PD gender was 68% male and 32% female. The median percentage of female residents was 26.0% (IQR: [21.0, 31.0%]) for programs with a female PD, and 25.0% (IQR: [18.0, 33.1%]) for programs with a male PD (P=0.843). There were no inter-regional differences with respect to the odds that a PD was female (Chi-square  $\chi^2 = 3.30$ , P=0.362). Full Professor PDs were more common in the West (Odds Ratio = 3.75; 95% CI: [1.23, 11.50], P=0.020), while Associate Professor PDs were more common in the South (Odds Ratio = 2.85; 95% CI: [1.26, 6.44], P=0.011). Program rank was positively associated with PD rank; i.e. Full Professor PDs tended to have the highest ranked programs and Assistant Professor PDs tended to have the lowest ranked programs (P=0.041)

**CONCLUSION:** Radiology PDs largely influence the satisfaction and success of their residents and perhaps the reputation of their programs. While gender distribution in PDs remains skewed with predominant male leadership, there appears to be no impact in the gender distribution of residents. We found a positive relationship between PD rank and program rank, with Full Professor PDs tending to have the highest ranked programs. Improving efforts in professional development of junior faculty who take up early leadership positions may have an important impact on the overall success of these residency programs

#### (SS04-04) 1:30 PM - 1:40 PM

### Comparison of the ACR Inservice Exam and Wisdom in Diagnostic Imaging (WIDI) Call-Readiness Exam to On-Call Performance Data from CAprilicorn: A Single Institution 3 Year Experience

Junjian Huang, MD, *Pennsylvania Hospital, Philadelphia, PA*; Benjamin Hammelman, MD; Hima Prabhakar, MD; Dayna Levin, MD (*junjian.huang@uphs.upenn.edu*)

**PURPOSE:** First and second year Radiology residents at our program take both the ACR inservice examination and Wisdom in Diagnostic Imaging (WIDI) exam. On call performance is assessed using the program CAprilicorn which allows attendings to "grade" reads. Our purpose is to compare performance on the ACR inservice examination and WIDI call readiness exam to actual on-call performance as quantified by the major change rate.

**METHOD AND MATERIALS:** A retrospective analysis of all residents who have taken the ACR inservice and WIDI exams and who have also taken at least 1 year of independent call was performed from July 1, 2015 to July 1, 2018. Data queried include year of training when exams were taken with respective WIDI and ACR scores as well as the major change rate of the following academic year. Statistical analysis was performed using two tailed Student T test, Pearson's correlation coefficient test as well as linear regression models.

**RESULTS:** Data was available for 14 residents meeting criteria for inclusion in this study and combine for a total of 22 years of standardized testing and on call data. There was a statistically significant improvement in scores in first and second time test takers for both the WIDI and ACR ( $p = .029$  and  $.018$ ). Call performance improvement (1 - major change rate) was not statistically significant ( $p = 0.075$ ) Pearson's correlation testing found moderate positive correlation between WIDI and ACR scores ( $r=0.67$ ) as well as moderate correlation between call performance and WIDI scores ( $r= 0.53$ ) as well as ACR scores ( $r= 0.66$ ). As expected linear regression models demonstrated similar negative slopes between major changes and standardized test scores. Subgroup analyses demonstrated stronger correlations of some radiology subspecialties than others.

**CONCLUSION:** Both the WIDI and ACR in service exam scores demonstrate moderate strength correlation with on call performance. Neither are great predictors of on call performance and further evaluation is warranted as more residents become eligible for this study.

#### (SS04-05) 1:40 PM - 1:50 PM

### Downward Trends in Pediatric Radiology Fellowship Participation

Rana Yazdani, *UT Southwestern Medical Center, Dallas, TX*; Cory M. Pfeifer, MD

**PURPOSE:** Graduates of radiology residency programs have been pursuing fellowships at increasingly higher rates. This study looks to characterize the trends in pediatric radiology fellowship participation as a means to inform pediatric radiology programs and radiology residents.

**METHOD AND MATERIALS:** Numbers of fellows were counted from each pediatric fellowship program during the previous four academic years using publicly available data from the Accreditation Council for Graduate Medical Education. Totals were extracted by counting the number of fellows at each program. The total for the 2018-2019 academic year is extrapolated from the number of fellows counted as of September 2018. Interest levels in pediatric radiology were approximated using survey data from the American Alliance of Academic Chief Residents in Radiology.

**RESULTS:** There has been a progressive decline in the number of accredited pediatric fellows in the United States each year since 2013 in which there were 92 fellows. The 2018 pediatric radiology graduating class was the lowest in 10 years with 55. In 2013, 8% of residents were interested in pursuing a pediatric radiology fellowship. This number reached a 6-year low for the 2017-2018 resident class. There were 56 fellows enrolled in accredited pediatric radiology programs as of September 2018. The distribution of fellows has become less varied since 2015 in which 30% of all pediatric radiology fellows were concentrated in the 3 largest programs. As of September 2018, this has shifted to 39% of all fellows in the 3 largest programs. 80% of positions filled in 2013. This has trended downward to 49% in 2018.

**CONCLUSION:** Interest in pediatric radiology has shown progressive declines since 2013. If the radiology job market continues to open up, there will be less pressure for graduates to enter fellowship which may impact the pediatric radiology job market more so than other subspecialties. As the number of pediatric radiology fellows declines, pediatric radiology fellows become more concentrated in the 3 largest programs.

#### (SS04-06) 1:50 PM - 2:00 PM

### Utilizing Audience Response to Foster Evidence Based Learning: Does It Really Work?

Omer A. Awan, MD; Farouk Dako, MD, *Temple University Hospital, Philadelphia, PA*; Talal Akhter; Sana Hava, DO; Faiq A. Shaikh, MBBS; Sayed Ali, MD; et al (*fdako123@gmail.com*)

**PURPOSE:** Radiology residency programs are increasingly using audience response systems (ARS) in educational lectures. It is imperative that this be investigated to assess if learning outcomes in trainees are actually improved.

**METHOD AND MATERIALS:** The primary objective of this randomized prospective unblinded study was to assess the effect of ARS on long term learning outcomes; with a secondary objective of understanding perceptions of ARS amongst radiology residents. 22 radiology residents were randomized into two groups of 11 residents each receiving 5 identical Musculoskeletal (MSK) radiology lectures. One group received lectures through ARS and the other through traditional didactics. A pretest and identical posttest were completed by all residents at baseline and eight months later; respectively. Residents also completed a pre and post 5 question Likert scale survey designed to measure perceptions of ARS.

**RESULTS:** Wilcoxon rank sum tests revealed no statistically significant difference between the two groups of residents on the pretest ( $p=0.47$ ) or the posttest ( $p=0.41$ ). Of the five questions designed to gauge perceptions of ARS, "How often do you study radiology outside of work?" resulted in statistical significance between groups after the lecture series via ordinal logistic regression, with the ARS group six times more likely to study compared to the non-ARS group (OR=6.52, P=0.04, 95% CI [1.1, 38.2]). There was no statistical difference in response to this question prior to the lecture series

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**CONCLUSION:** Use of ARS was associated with increased likelihood of studying radiology without significant difference in long term learning outcomes.

#### (SS04-07) 2:00 PM - 2:10 PM

##### Impact of Participation in Peer Teaching During Training on Early Career Path and Long-Term Career Goals

Netanel S. Berko, MD, *University of Pennsylvania, Philadelphia, PA*; Jill Fay, MD\*; Sonali Lala, MD; Jenna N. Le, MD; Cyrus Shabrang; William R. Walter, MD (*netanel.berko@uphs.upenn.edu*)

**PURPOSE:** To determine the impact of participation in peer teaching during residency or fellowship on early career decisions and on long-term career goals.

**METHOD AND MATERIALS:** A survey was distributed to former residents and fellows who had served as peer teachers for hands-on ultrasound training of other residents during their training. The survey consisted of questions regarding the level of interest and confidence in teaching prior to and following the peer teaching experience using 10-point Likert-scale responses. The survey also had questions about early career path, including choice of first job following training, as well as long-term career goals, in particular degree of interest in teaching. The perceived impact of the peer-teaching experience on early career path and long-term career goal formulation was also queried. Median scores and interquartile ranges (IQR, 25th and 75th percentiles) were calculated, and scores were compared using the T-test. P-value < 0.05 indicated statistical significance.

**RESULTS:** 8 former peer teachers completed the survey 1-2 years following the peer teaching experience. They reported high interest in teaching prior to the peer teaching experience (median: 8, IQR 6.75-9.25), which increased slightly after (median 8.5, IQR 7.5-10; P = 0.62). The peer teaching experience significantly increased their confidence level in teaching (pre: median 5.5, IQR 4.75-6.25; post: median 7.5, IQR 6.5-8.25; P = 0.047). The peer teaching experience was a factor in choosing the first job for all but one of the former peer teachers, with most choosing an academic setting. The peer teaching experience also played a role in formulation of long-term career goals, which included an interest in teaching residents and fellows.

**CONCLUSION:** Peer teaching during residency or fellowship increases trainees' confidence in teaching and reinforces interest in teaching. Participation in peer teaching during training plays a role in subsequent career choices, including choice of first job as well as long-term career goals.

#### (SS04-08) 2:10 PM - 2:20 PM

##### Teaching File: An Extensive Revision to Optimize Integration and Educational Value

Ami Gokli, MD, *Childrens Hospital of Philadelphia, Philadelphia, PA*; Janet R. Reid, MD (*goklia@email.chop.edu*)

**PURPOSE:** Teaching files (TF) are often under-utilized at institutions for various reasons including inefficient software programming, poorly designed user interface, or medical staff resistant to change. We demonstrate how to re-purposing a teaching file in order to bolster user acceptance and educational value by optimizing TF integration.

**METHOD AND MATERIALS:** Using a pre-existing teaching file in the Primordial® platform which was available but rarely used, we repurposed to improve functionality and user interface as well as improve ease of use and encourage integration. We demonstrate an all-encompassing 6 step approach to curriculum development based on Kern including identifying the problems, performing a targeted needs

assessment, outlining goals and objectives, including a vision for the TF and list of desired features. Multiple 5-minute information sessions were implemented at the start of the new trainee year to reinforce use prior to educational conferences. A hands-on simulation session for all residents and fellows was given by an information technologist specializing in radiology and Primordial®. Finally, we reinforced educational strategies by requiring the TF to be incorporated into interdisciplinary conferences given by attendings and fellows.

**RESULTS:** An all-encompassing approach was executed to improve functionality and increase use. Teaching File integration into the program was successful with a significant increase in utilization since its implementation. Number of teaching file entries were recorded at zero in March 2018, and after implementation of the new TF, teaching file entries steadily increased (14 - June 2018, 18 - July 2018, 34 - August 2018) with continued upward trajectory.

**CONCLUSION:** Through a deliberate and thorough process, a fully integrated, repurposed Teaching File was created and successfully integrated into the radiologists' daily routine. Radiologists at all training levels now incorporate TF into lectures, teaching file educational lectures, interdisciplinary conferences and to catalogue individual cases.

#### (SS04-09) 2:20 PM - 2:30 PM

##### Beyond Interpretation: Development and Pilot of a Noninterpretive Skills Curriculum for Radiology Residents

Shanna A. Matalon, MD, *Brigham and Women's Hospital, Boston, MA*; Glenn C. Gaviola, MD; William W. Mayo-Smith, MD; Steven E. Seltzer, MD\* (*smatalon@bwh.harvard.edu*)

**PURPOSE:** Noninterpretive skills (NIS) are an important part of a radiology residency curriculum that is now incorporated into the American Board of Radiology (ABR) study guide, for the core and certifying exams. The purpose of this study was to develop and deliver a comprehensive NIS curriculum into our 41-trainee residency.

**METHOD AND MATERIALS:** Our residency program leadership commissioned a task force to develop, optimize and pilot a NIS curriculum entitled "Beyond Interpretation" for our 41-trainee radiology residency program. Before the curriculum roll-out, residents were given a survey to assess their familiarity with NIS topics, and a pre-test based upon topics listed in ABR NIS study guide. Our curriculum consists of ten modules: 5 are congruent with the topics covered in the ABR syllabus, with 5 supplemental topics including critical thinking skills, medical education, imaging informatics, the business of radiology, and global health. Didactic lectures, case studies, practicums, journal club and public web-based content are used. At the completion of the curriculum, a survey and post-test will be provided to gauge the effectiveness of the program.

**RESULTS:** 30/41 (73%) of residents took the pre-survey. Residents felt least familiar with the topics of reimbursement, compliance and legal considerations, and business in radiology (nearly 50% reported as "not at all familiar"). Residents felt most familiar with the topics of professionalism (93% reported as "very or somewhat familiar") and safety issues (97% reported as "very or somewhat familiar"). 19/41 residents (46%) took the pre-test. The mean score on the pre-test was 14/30 (47%). Comparison between pre- and post-curriculum familiarity and knowledge will be presented.

**CONCLUSION:** Radiology residents report little a priori knowledge with most NIS. We describe a new NIS curriculum using materials from the ABR and outside sources which could be shared with other training programs.

\* Faculty financial disclosures are located in the Faculty Index.

Thursday, April 11, 2019  
1:00–2:30 PM

### SS05: Student Education

Location: Key Ballroom 12

Moderator: Mark Alan King, MD  
Mahan Mathur, MD

ED LM

#### (SS05-01) 1:00 PM - 1:10 PM

##### Medical Students' Preferences in Radiology Education: A Preliminary Assessment of A Prospective Comparison Between an Integrated Radiology Curriculum and Dedicated Radiology Clerkship

David Pryluck, MD, *Temple University School of Medicine, Philadelphia, PA*; Talal Akhter; Paul Navo; Suzanne A. Pascarella, DO; Stephen Ling, MD; Alisa Peet ([david.pryluck@tuhs.temple.edu](mailto:david.pryluck@tuhs.temple.edu))

**PURPOSE:** To assess medical students' preferences in radiology education by prospectively comparing an integrated radiology curriculum with a dedicated radiology clerkship. We hypothesize that while medical students may acknowledge the educational value of an integrated radiology curriculum, students will prefer a dedicated radiology clerkship to learn radiology.

**METHOD AND MATERIALS:** This is a preliminary assessment of an ongoing 12-month prospective study conducted at Temple University during the 2018-19 academic year. MS4 students are required to take a 4-week radiology clerkship, which consists of didactics, problem-based learning, virtual interactive patient cases, and a final exam. MS3 students will be taught radiology through required radiology subspecialty modules as part of their 6 core clinical clerkships. Modules are administered through the Canvas learning management system, and consist of independent study, virtual interactive patient cases, classroom-based workshops, and a subspecialty quiz. Modules are assigned to clinical clerkships based on curricular synergies: Chest Imaging in Internal Medicine, Body Imaging and VIR in Surgery, Neuroradiology in Neurology, Pediatric Imaging in Pediatrics, Women's Imaging in OB/GYN, and Musculoskeletal Imaging in Family Medicine. To ensure comparability of curricular content between the modules and radiology clerkship, all modules were reviewed by Curriculum Committee. Anonymous surveys were used to assess preferences in radiology education, educational value of each module component, and students' confidence in radiological appropriateness and diagnoses.

**RESULTS:** Of MS4 respondents, 60% prefer a dedicated radiology clerkship. Of MS3 respondents, 45% prefer an integrated radiology curriculum. The majority of MS3 students agree/strongly agree that an integrated radiology curriculum enhanced their learning of the respective clinical subject material, highest for neurology and surgery (72%).

**CONCLUSION:** While the majority of MS3 students agree/strongly agree that an integrated radiology curriculum enhanced their learning of the respective clinical clerkship subject material, most MS3 and MS4 students would prefer a dedicated radiology clerkship to learn radiology.

#### (SS05-02) 1:10 PM - 1:20 PM

##### Benefits of Dedicated Ultrasound Exposure for Medical Students - A 3 Year Experience

Saagar Patel, *UT Houston McGovern Medical School, Houston, TX*; Manickam Kumaravel, MD; Kimberly Brown; Girija Rajakumar ([saagar.patel@uth.tmc.edu](mailto:saagar.patel@uth.tmc.edu))

**PURPOSE:** An ultrasound education program was designed as part of an accelerated curriculum, aimed specifically for second-year medical students. Our goal was to measure the effectiveness of this teaching concept and also to assess the practicality of developing this methodology in different institutions.

**METHOD AND MATERIALS:** We analyzed existing ultrasound training for medical students and created a curriculum for 2nd year students that addressed existing gaps in ultrasound education, including instrumentation, anatomy, and ultrasound-guided procedures. Prior to immersion, all students participated in an anonymous quiz determining the baseline knowledge of the students. After week-long exposure to radiology and ultrasound, students were administered a post exposure assessment to evaluate skills and knowledge. Comparison of pre and post-exposure standardized testing results determined the efficacy of the program. Program overview of ultrasound immersion week included; hands-on education of various organ systems. Students were divided into small groups with dedicated radiology resident supervising ultrasound skills on standardized patients and intervention using phantom models.

**RESULTS:** Results are as follows: Year 1 and 2 had a 19% improvement, and Year 3 had a 39% improvement. Pre and Post immersion quiz analysis were validated with Fisher's exact and two sample t-test with p-value <0.01. A cumulative analysis across all three years showed a consistent and statistically significant improvement in medical student understanding and interpretation of ultrasound imaging. Satisfaction survey using survey monkey was administered anonymously.

**CONCLUSION:** Short and focused ultrasound education programs are useful and effective in educating second-year medical students. The standardized questionnaire demonstrates that it is possible to have a significant impact in ultrasound knowledge among students by a week of focused education. Using homemade phantoms promoted active engagement among students. This study demonstrates a definite improvement in ultrasound knowledge and the practicality of conducting such a course in any institution.

#### (SS05-03) 1:20 PM - 1:30 PM

##### Radiology Does Premedical Education: The Aide Experience

H. H. Hawkins Jr, MD, *University of Cincinnati, Cincinnati, OH*

**PURPOSE:** Little has been reported about the radiology department as an environment for premedical education and preparation. This article addresses that deficiency by presenting a 40 year experience in both academic and nonacademic settings.

**METHOD AND MATERIALS:** From 1976 to 2016 sixty-eight premedical candidates participated in year-long, intensive internship as an assistant to a radiologist. The programs were unstructured and meshed with the daily activities at the institutions. At the end of the 40 years the participants completed a survey that queried their experiences before, during, and after their year. Liberal use was made of Likert items to gather subjective information to complement object of data about pertinent career events.

**RESULTS:** Sixty-two aides completed the extensive questionnaire. They described their prior preparation and education, expectations for the year, and experiences as an aide. Despite a grade-point average 0.2 lower than the national matriculant average, their medical school acceptance rate was 95% compared to the national average of 40%. They became strong postgraduate candidates, including entry into radiology in emergency medicine at 4.6 and 3.5 times the national levels respectively. Their subjective opinions of the experience and its impact on medical school, postgraduate training, and subsequent careers were strongly positive.

**CONCLUSION:** Radiology departments are fertile environments for premedical education and preparation with rewards for both the students and the departments.

#### (SS05-04) 1:30 PM - 1:40 PM

##### A Needs Assessment of Factors Affecting Radiology Residents' Teaching of Medical Students

Stephanie Spann, MD, *University of Michigan Medical Center, Ann Arbor, MI*; Kara D. Gaetke-Udager, MD; Matthew S. Davenport, MD; Corrie M. Yablon, MD ([sspann@med.umich.edu](mailto:sspann@med.umich.edu))

**PURPOSE:** In many academic programs, the increased intensity of clinical work has caused the primary responsibility of medical student

\* Faculty financial disclosures are located in the Faculty Index.

teaching to shift from faculty to residents. There is a growing need to develop a “resident as teacher” curriculum for radiology residents to participate in educational work. To assess resident attitudes and level of preparation for educating students. Our hypothesis is that lack of preparation of residents for their roles as teachers may negatively impact both resident and student education. Study data will be used to formulate a “resident as teacher” curriculum.

**METHOD AND MATERIALS:** An IRB-approved 18-question survey was sent to 44 radiology residents at our institution. The survey included yes/no, multiple choice, Likert scale questions, and options for free text responses. The survey was delivered online (Qualtrics.com). Responses were anonymous and confidential.

**RESULTS:** 90% (40/44) responded. All residents reported 1:1 teaching of students from daily to several times per month. 48% (n=18) enjoyed it. 89% (n=8) of R1s lacked confidence in teaching radiology to students. 33% (n=2) of R2s, 11% (n=1) of R3s, and zero R4s lacked confidence. 59% (n=22) did not know how to manage students while viewing a study or dictating. 29% (n=11) felt they could not keep students engaged. All said teaching decreased efficiency. 97% (n=28) stated they lacked time to teach and keep up with clinical work, and 81% (n=31) said that working with students did not enhance their education. All free text responses included negatively charged words. 16% (n=6) said their performance evaluations by attending physicians were influenced by student teaching, with 83% (n=5) of negative evaluations citing the residents as “slow readers.” Residents said the following should be made available to help teach students: dedicated student workstations (88%; n=35), a core curriculum of self-review cases (80%; n=32), and self-directed learning modules (65%; n=26).

**CONCLUSION:** Residents perceive teaching medical students at the workstation as detrimental to resident education. Junior residents lack confidence educating. Using student-directed learning resources may alleviate the current resident teaching burden.

### (SS05-05) 1:40 PM - 1:50 PM Teaching Radiology to Generation Z: Implementing a Flipped Classroom Model for Teaching Neuroradiology to Medical Students

Edwarda D. Golden, *University of Wisconsin School of Medicine and Public Health, Madison, WI*; Jason W. Stephenson, MD; Colin D. Longhurst; Tabassum A. Kennedy, MD

**PURPOSE:** The purpose of this study was to evaluate the efficacy of a flipped classroom model for teaching neuroradiology to medical students on the neurology clerkship. The course consists of a web-based curriculum on imaging modalities, neuroanatomy, and critical diagnoses and a weekly seminar with an attending neuroradiologist.

**METHOD AND MATERIALS:** In an IRB approved study, students completed voluntary and de-identified surveys assessing their confidence using various neuroimaging modalities in a clinical setting. These surveys were administered prior to and after course completion and consisted of five questions on a 5-point Likert scale (1=not at all confident; 5=extremely confident). The post-survey also assessed overall satisfaction with the course format (1=poor; 5=excellent). To assess if there was a significant difference in pre and post scores on the five matched survey questions, a two-tailed, paired t-test was used for each question.

**RESULTS:** 461 of the 588 students rotating on the neurology clerkship from 2013 to 2017 completed both surveys. For each matched survey question, there was a statistically significant increase in post-module confidence score from pre-module confidence score: identifying structures of the brain on CT and MRI (+1.40 points;  $p < .001$ ), identifying structures of the spine on radiographs (+0.96 points;  $p < .001$ ), understanding how neuroimaging modalities worked (+1.31 points;  $p < .001$ ), distinguishing between MR sequences (+2.24 points;  $p < .001$ ), and understanding which modalities should be ordered for specific clinical concerns (+1.39 points;  $p < .001$ ). 90% (n=416) rated the web-based curriculum as very good or excellent. 84.8% (n=391) reported that the seminars were a very good or excellent alternative to traditional lectures. 84.8% (n=391) reported that

they preferred this model to traditional lectures, with a plurality reporting that they strongly preferred it (n=229).

**CONCLUSION:** The flipped classroom learning model has shown promise in undergraduate medical education. Herein, we present a successful implementation of a flipped classroom and web-based curriculum for improving medical student confidence with using neuroimaging in the clinical setting.

### (SS05-06) 1:50 PM - 2:00 PM Beginning to Advanced Radiology (BAR) Lab Bootcamp

James Korf, *University of Colorado, Aurora, CO*; Rustain Morgan; Nicole Restauri, MD

**PURPOSE:** A 2-week elective was developed dedicated to training fourth year medical students critical interpretive skills in preparation for internship. The curriculum utilized both flipped classroom and simulation methodology. Students reviewed 10 chest radiographs per day independently using a simulation picture archiving and communication system (PACS). Radiology faculty then reviewed each case in a small group setting. This poster describes curriculum design and discusses course outcomes. The purpose of this abstract is to demonstrate that it is feasible for medical students to achieve competency in a subset of core interpretive skills.

**METHOD AND MATERIALS:** Thirty medical students participated in a 2-week elective course focused on developing core radiologic interpretive skills in preparation for internship. The course methodology included independent study, flipped classroom workshops, and independent review of 10 chest radiographs per day in a simulation-learning lab using a dedicated teaching PACS. Students took a pre and post test that included multiple choice questions as well as free text interpretation of 10 radiographs encompassing course content. Qualitative course evaluations were obtained at the end of the two weeks.

**RESULTS:** Thirty fourth-year medical students successfully completed the course. Preliminary data analysis (n=15) demonstrated a statistically significant increase in student pre and post course performance on a standardized multiple choice test ( $p < 0.003$ ). Qualitative data suggests that the format of the course appealed to millennial learners with 87% of participants stating the elective was superior to far superior when compared with other fourth year elective courses, 100% of the students reported that they felt that the course prepared them for intern year to a high or very high degree and 100% indicated that the course increased their confidence in interpreting chest radiographs to a high or very high degree.

**CONCLUSION:** Simulation based education in imaging interpretation is a feasible and effective method to teach fourth year medical students a limited subset of interpretive skills in preparation for internship.

### (SS05-07) 2:00 PM - 2:10 PM A 360 for GME Program Leadership Development

Kedar Jambhekar, MD, *University of Arkansas for Medical Sciences, Little Rock, AR*; Linda A. Deloney, EdD

**PURPOSE:** Radiology Program Directors (PD) and Coordinators (PC) need feedback to improve their job performance and advance their careers. ACGME requires an annual 360° as a measure of resident competence, but no 360° evaluation of program leadership has been recommended. We developed a 360° for our PD and PC for our program in 2015 and now have 5 years of experience. We were the first to report a 360° for GME program leadership.

**METHOD AND MATERIALS:** Surveys are administered by our GME office using New Innovations to assure data are collected anonymously. Composite reports are provided to the PD and PC as formative feedback. The PD instrument has 15 items with a 5-point Likert-type scale and open-ended comment boxes. Rating groups include radiology residents and interns, radiology faculty, DIO, and General Counsel. The PC instrument has 15 different items with a similar scale and open-ended items. Raters include radiology residents and interns, CCC members, PEC members, department administrative staff, and GME office contacts.

**RESULTS:** Participation in the PD 360° remains high after five years, ranging from 21 to 46 annual respondents. Since 2016, we have also

\* Faculty financial disclosures are located in the Faculty Index.

used the PD survey for to assess Associate Program Directors. Feedback provided by the raters resulted in improvements of skills and attitudes by the PD whose overall score improved every year. A summary report was prepared as documentation of achievement in program leadership and submitted with his application for promotion to professor. The Associate PDs have likewise benefited from their feedback because it is balanced, representing multiple points of view, and thereby hard to disregard due to its broad range. The PC was unable to accept 360° feedback or make changes and left her position this year.

**CONCLUSION:** The cultivation of leadership is vital to the field of graduate medical education. Health care professionals typically learn to lead through work experiences and training rather than formal education in leadership. Strategic tools that are widely used in business, like the 360° assessment, can be adapted to GME leadership development.

**(SS05-08) 2:10 PM - 2:20 PM**

### Learning While Teaching: A Pilot Curriculum for Enhancing Resident Education by Facilitating Resident-To-Medical Student Teaching in Pediatric Radiology

Anastasia L. Hryhorczuk, MD, *University of Michigan, Ann Arbor, MI*; David Bloom; Peter J. Strouse, MD ([ahryhorc@med.umich.edu](mailto:ahryhorc@med.umich.edu))

**PURPOSE:** This project assesses resident satisfaction with faculty-developed teaching modules that R1 residents utilize to provide one-on-one teaching to medical students.

**METHOD AND MATERIALS:** 6 topical teaching modules were developed using PowerPoint. Modules were designed for a resident to teach a medical student using classic pediatric radiology cases. Residents had case annotations and curated reading materials to further their understanding of each topic. R1 residents in their initial pediatric radiology rotation received directed faculty teaching using the modules, allowing them to ask questions and review the diagnoses before instructing medical students. Modules were introduced in July 2018. R2-R3 residents, who had not been exposed to the teaching modules, were surveyed on their general experiences teaching students at the beginning of their radiology training. R1 residents who had access to the modules during their pediatric radiology rotation were surveyed on their teaching experiences utilizing the modules.

**RESULTS:** R2-R3 residents (n=12) were dissatisfied with medical student teaching during their early radiology rotations. 75% of survey respondents felt unprepared and did not enjoy teaching medical students at the beginning of their residency. 67% of respondents felt that they did not have adequate resources to teach medical students and would have liked to use more extensive teaching material. R1 residents (n=3) exposed to the teaching modules uniformly agreed that modules prepared them to teach medical students and were useful resources during their first pediatric radiology rotation. All R1 residents expressed that they learned from using the teaching modules and stated that they would benefit from having similar teaching material available on other radiology rotations. Ongoing surveys are being collected as more R1 residents complete their rotation.

**CONCLUSION:** Without directed teaching materials, resident dissatisfaction with early medical student teaching was high. Faculty-designed educational modules show potential for improving resident attitudes toward medical student teaching, while reinforcing critical educational concepts that must be mastered for independent practice.

**(SS05-09) 2:20 PM - 2:30 PM**

### Entrustable Professional Activities in the School of Medicine - First Experience as a Master Assessor and How Medical Imagers Can Get Involved

Juan M. Olazagasti, MD, *University of Virginia Health Systems, Charlottesville, VA* ([jo3d@virginia.edu](mailto:jo3d@virginia.edu))

**PURPOSE:** Behind an AAMC driven primary motivation of matching the expectations of residency programs directors and entering resident skill set, 13 Entrustable Professional Activities or EPA's were created. The goal of this paper is to explain what EPA's mean to radiologists and how you can get involved in this educational experience.

**METHOD AND MATERIALS:** We will run through the process of becoming a Master Assessor and the guidelines to follow in order to perform the task of evaluating EPA's with medical students in their clinical rotations based on my experience at the University of Virginia School of Medicine.

**RESULTS:** The EPA system is here to stay as the new landmark for medical education. Radiologists are in a unique position to be involved and evaluate several of these key activities and the time to act is now. I have thoroughly enjoyed this experience and never thought I could again see clinical medicine in this raw, first-hand view. Where can a radiologist encounter, evaluate and help a medical student diagnose a patient with hand-foot-mouth disease, a major depression episode, an acute small bowel obstruction and see a 6 month old well baby visit within one week? The comprehensive aspect of the EPA system coupled with the exquisite position we are in as multimodality imagers, place us in a unique spot for several of these EPA's including focused history and physical exam, patient handover care, oral presentation, obtaining informed consent, diagnostic imaging recommendation and interpretation, prioritization of a differential diagnosis and collaboration as a member of an interprofessional team.

**CONCLUSION:** EPA institution at the medical school level is rapidly taking hold in the clinical years as a way to standardize key elements the AAMC feels all entering interns and residents should attain. As medical imagers we are positioned in a unique way to effect positive change and measurable impact in trainee education performing some of these professional activities, while enjoying a part of clinical medicine few of us see on regular basis and improving our image outside the dark reading rooms.

**Thursday, April 11, 2019**

**1:00—2:30 PM**

### SS06: RAHSR Health Services Research Scientific Session

**Location: Key Ballroom 11**

**Moderator: Christoph Ilsuk Lee MD\***

**Moderator: Hanna Maryam Zafar MD**

**HP**

**AUR Trainee Prize: 2nd Place**

**(SS06-01) 1:00 PM - 1:10 PM**

### A Large-Scale Data Analysis of Variables Contributing to Diagnostic Errors of On-Call Residents

Peter I. Kamel, *Johns Hopkins University School of Medicine, Baltimore, MD*; Paul G. Nagy, PhD; Lilja B. Solnes, MD; Karen M. Horton, MD; Pamela T. Johnson, MD\* ([pkamell1@jhmi.edu](mailto:pkamell1@jhmi.edu))

**PURPOSE:** To use large-scale data mining to assess variables that contribute to interpretative errors in studies read overnight by radiology residents at a busy academic medical center. We specifically analyzed removal of the ACGME restriction on a night float rotation lasting more than 6 nights.

**METHOD AND MATERIALS:** Our residency program includes an independent night-float call system of previously 6 and now 7 consecutive nights. Utilizing an HL7 data-integration platform, we retrospectively parsed 202,716 studies preliminarily read overnight by 62 residents over 4 years and identified those flagged for substantial modification by the overreading attending radiologist the next day. Calculated factors such as number of consecutive nights on call, case volume, and year of training were analyzed in conjunction with exam metadata to assess for factors that affect the error rate.

**RESULTS:** 2,044/202,716 (1.0%) of cases were flagged for substantial modification. 3rd and 4th year residents had fewer errors than 2nd years (0.9% vs 1.2%,  $p < 0.001$ ). No significant difference was observed overall between the error rates of the 6th and 7th night (1.1% vs 1.2%,  $p$

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= 0.54). Subgroup analysis demonstrated that peak error rate by number of nights worked varied according to training level. No difference in error rate was identified for case volume within 95% of the mean ( $p = 0.79$ ). A statistically significant increase was noted when volume exceeded 110 cases per shift (2.2% vs 0.8%,  $p = 0.002$ ). Cross-sectional studies read within the last hour of the 12-hour shift demonstrated a higher rate of errors (3.0% vs 1.6%,  $p < 0.001$ ).

**CONCLUSION:** Residents performing independent call in a busy academic program have a low overall interpretative error rate. The error rate on the 7th night is no different from the 6th night. Factors including volumes beyond the 95th percentile and reads during the last hour of a 12-hour shift contribute to increased errors.

### AUR Trainee Prize: 2nd Place

(SS06-02) 1:10 PM - 1:20 PM

#### The Frequency of Radiographically Occult Operative Hip Fracture in Patients with Acute Hip Pain: A Systematic Review and Meta-Analysis of Individual Patient Data

Arya Haj-Mirzaian, *Johns Hopkins University School of Medicine, Baltimore, MD*; Pamela T. Johnson, MD\*; Shadpour Demehri, MD\* (*sdemehr1@jhmi.edu*)

**PURPOSE:** Owing to the low sensitivity of radiographs for diagnosing hip fractures, a large number of patients require cross-sectional imaging. We performed a systematic review and meta-analysis of studies evaluating the frequency of radiographically occult operative hip fracture to define a diagnostic algorithm based on strong evidence and current-generation high-resolution CT and MRI. We aimed to define subgroup(s) of patients with the highest risk of occult fracture and the most appropriate imaging modality to evaluate these patients.

**METHOD AND MATERIALS:** Literature search was performed using PubMed, MEDLINE, and EMBASE for original articles and abstracts published before 20 September 2018, with no language restrictions. Titles and abstracts from 2219 publications were screened by 2 authors in duplicate to determine the eligibility; if necessary, the full text was assessed. Inclusion criteria were 1. Patients with suspected hip fracture 2. No radiographic evidence of operative hip fracture (femur head/neck, intertrochanteric, or subtrochanteric) 3. Further evaluation with MRI, CT-scan, or bone scan for the final diagnosis of fracture. Data were extracted in duplicate, and overall strength of evidence was assessed.

**RESULTS:** 44 eligible studies including 3307 patients were identified. The overall frequency of occult hip fracture was 40% (95%CI, 35-45). The prevalence of occult fracture was 40% (37-47) and 30% (21-41) based on MRI and CT/bone scan, respectively. Sensitivity analyses showed the significantly higher prevalence of occult fracture in patients with radiographic isolated great trochanteric fracture (vs. no definitive fracture), 74% (54-87). In patients with no definitive radiographic fracture, age  $>70$  years (vs.  $\leq 70$ ) or suspicious radiograph (vs. normal) were significantly associated with presence of occult fracture.

**CONCLUSION:** Occult hip fracture was diagnosed in 5-7 of every 10 patients (number needed to test: 2.5). Using MRI was associated with a 1.3-fold higher probability of occult fracture diagnosis in comparison with CT or bone scan. Patients with suspected to hip fracture and normal radiographs, isolated great trochanter fracture, suspicious radiograph or age  $>70$  should be evaluated by MRI.

(SS06-03) 1:20 PM - 1:30 PM

#### Readability of Online Patient Educational Materials Related to Breast Lesions Requiring Surgery

Paul H. Choi, MD, *Tufts University, Boston, MA*; Grayson Baird; Elizabeth H. Dibble, MD; Eniola T. Falomo, MD; Megha Garg; Randy C. Miles, MD (*pchoi103@gmail.com*)

**PURPOSE:** To evaluate the readability of commonly used websites for information on breast lesions requiring excisional biopsy or lumpectomy.

**METHOD AND MATERIALS:** The most commonly used search engine, Google, was used to query breast lesions traditionally requiring surgical intervention. Location, cookies, and user information were disabled to avoid search bias. The top nine websites were identified based on average search return for each breast lesion. All relevant, patient-directed information was downloaded from each site for each lesion. Grade-level readability of online patient educational material (OPEM) was determined using generalized estimating equations (GEE), with observations nested within readability metrics including: Flesch-Kincaid reading ease index, Flesch-Kincaid grade level, Gunning-Fog score, Coleman-Liau index, Simple Measure of Gobbledygook (SMOG) index, and Automated Readability Index (ARI) with sandwich estimation. All interval estimates were calculated for 95% confidence.

**RESULTS:** Analysis of nine commonly used websites containing information on breast lesions traditionally requiring surgery demonstrated an average grade reading level of 11.7. Wikipedia was written at the highest average grade reading level (14.2), while NIH (*ncbi.nlm.nih.gov*) was written at the lowest average grade reading level (9.7). NIH was also found to have the most supplemental educational materials - including diagrams/videos - compared to other websites. OPEM on malignant breast lesions was written at a higher average grade reading level (12.3) than non-malignant breast lesions (11.4). Of all breast lesions, invasive lobular carcinoma OPEM was written at the highest average grade reading level (13.3). Information on phyllodes tumor from NIH was the only OPEM to meet the American Medical Association's set parameter of a 6th-grade reading level.

**CONCLUSION:** The benefits of OPEM are dependent upon a patient's ability to comprehend the given material. Our study indicates that the readability of current resources regarding breast biopsy results requiring surgery do not meet readability parameters set by the AMA, which may increase the potential for patient misinterpretation and/or anxiety over their results.

(SS06-04) 1:30 PM - 1:40 PM

#### Changing Characteristics of Inpatient Hospital Stays and Associated Neuroimaging in Multiple Sclerosis Patients

Celia Foster; Richard Duszak Jr, MD; Debrua Coleman; Neil Lava; Ranliang Hu, MD; Gelareh Sadigh, MD, *Emory University, Atlanta, GA* (*gsadigh@emory.edu*)

**PURPOSE:** To study changing characteristics of US inpatient hospital stays in multiple sclerosis (MS) patients, and the changing nature of associated neuroimaging utilization.

**METHOD AND MATERIALS:** Using 2006-2014 data from the Nationwide Inpatient Sample (NIS), the largest publicly available all-payer inpatient health care database in the US, we identified MS inpatient stays using discharge date Medicare Diagnosis Related Groups (DRG). Using logistic regression, we identified utilization and independent predictors of neuroimaging examinations.

**RESULTS:** A total 218,953 weighted cohort patients with MS were hospitalized a of mean 4 days (mean age 40; 69% female; 53% white), with admissions increasing from 14,696 in 2006 to 27,150 in 2014. Only 6.2% and 3.9% of patients underwent brain and spinal MRI, respectively. Inpatient brain and spinal imaging increased from 0.1% in 2006 to 7% in 2014. Total hospital charges increased from a mean \$13,268 in 2006 to \$35,398 in 2014. Patients' primary insurance was Medicare in 31%, Medicaid in 21%, private insurance in 39%, other types in 4%, and self-pay in 5%. Independent factors (all  $p$  values  $< 0.05$ ) associated with a higher utilization of neuroimaging were hospital stay  $> 4$  days (OR 1.7), primary payer other than Medicare (OR, 1.6 for Medicaid; 1.4 for private insurance), hospitalization in urban counties (OR 2.1), and non-elective admissions (OR 2.4).

**CONCLUSION:** In patients with MS, the frequency of inpatient hospitalizations, the utilization of inpatient neuroimaging, and the total charges associated with those hospitalizations have increased over time. A variety of sociodemographic characteristics are associated with a higher likelihood of imaging utilization.

\* Faculty financial disclosures are located in the Faculty Index.

(SS06-05) 1:40 PM - 1:50 PM

### Imaging Utilization Trends in Patients with Headache: Emergency Department Visits Data Analysis from 2006 to 2014

Anna V. Trofimova, MD, PhD, *Emory University, Atlanta, GA*; Richard Duszak Jr, MD; Nadja Kadom, MD; Debrua Coleman; Gelareh Sadigh, MD (*atrofim@emory.edu*)

**PURPOSE:** To assess utilization trends and independent predictors of neuroimaging in patients presenting to US emergency departments (EDs) with headache.

**METHOD AND MATERIALS:** The largest all-payer ED database in the US (Nationwide Emergency Department Sample) was used to identify ED patients with a primary diagnosis of headache from 2006 to 2014. Longitudinal trends and independent predictors of utilization of relevant neuroimaging examinations were determined using logistic regression.

**RESULTS:** A cohort of 18,146,302 patients with headache visiting EDs (mean age 38; 69% female) were identified. ED visits increased from 1,887,821 in 2006 to 2,178,309 in 2014. Relevant neuroimaging examinations were performed in 26.9% of visits, with head CT being most common (25.9%). Other tests were performed in < 1% of encounters and included brain MRI, CTA or MRA of head and/or neck, CT or MRI of cervical spine, and maxillofacial CT. The utilization of imaging increased from 2006 (18.6%) to 2014 (34.8%). Patients' primary insurance was Medicare in 14%, Medicaid in 26%, private insurance in 35%, other types in 4.9%, and self-pay in 19%. Independent predictors for higher utilization of neuroimaging were age > 40 years (OR 1.4), an ED visit after 2010 (OR, 1.6), and urban location of hospital (OR, 1.8). Lower utilization was associated with a weekend admission (OR, 0.9), female gender (OR, 0.9), and self-pay or Medicaid compared to Medicare (OR, 0.8 and 0.9 respectively) ( $p < 0.05$ ).

**CONCLUSION:** Utilization of relevant neuroimaging tests for patients with headache has nearly doubled since 2006 reaching 34.8% of all encounters in 2014. Several sociodemographic factors serve as independent predictors of likelihood of imaging utilization.

(SS06-06) 1:50 PM - 2:00 PM

### Access to Ultrasound Imaging: Qualitative Study in Northern, Remote Indigenous Communities in Canada

Scott J. Adams, MD, *University of Saskatchewan, Saskatoon, SK*; Brent Burbridge; Paul Babyn; Ivar Mendez (*scott.adams@usask.ca*)

**PURPOSE:** Access to medical imaging remains limited for many people across the world in both developing and developed countries. This study sought to explore perceptions of access, and factors which shape access, to ultrasound imaging in two neighboring northern, remote Indigenous communities in Canada.

**METHOD AND MATERIALS:** Semi-structured interviews were conducted in the northern Canadian communities of Stony Rapids and Black Lake, Saskatchewan. Interviews were audio recorded and interview transcripts were analyzed using inductive content analysis.

**RESULTS:** All participants had a general diagnostic ultrasound exam ( $n = 10$ ) or obstetrical ultrasound exam ( $n = 5$ ) performed in the past 10 years, including one participant who had both an obstetrical and general diagnostic ultrasound exam. Data saturation was achieved. Participants connected geographic isolation to the lack of availability of healthcare technologies including ultrasound imaging. This was manifest in the lack of regularly available ultrasound services (provided by an itinerant sonographer once per month), as well as barriers which became apparent when participants had to travel for ultrasound, including fear of air travel, isolation from family, financial means, and unfamiliarity with the city. Other barriers such as family and work responsibilities were exacerbated by the barrier of geography. Residents

overcame these barriers as they appreciated potential medical benefits of ultrasound, and the ultrasound study brought personal satisfaction in knowing about one's health and providing reassurance about the health of their baby.

**CONCLUSION:** This study provides a unique perspective on the challenges faced by remote community members in accessing ultrasound imaging, and suggests that geography is a central barrier to northern residents accessing prenatal and general diagnostic ultrasound. In an effort to provide patient-centered care and fulfill the social accountability missions of many academic medical centers and radiology practices, radiology groups should consider the barriers which their patients may face in accessing imaging.

(SS06-07) 2:00 PM - 2:10 PM

### Phone-omental Transformation: Modifications to Phone Answering Services Promote Communication Efficiency in a Radiology Department

Jessica Leung, BS, *Westchester Medical Center, Valhalla, NY*; William Gao; Perry S. Gerard, MD; Michael J. Seiler; Michelle LaRosa; Nicholas M. Bacher (*jleung3@nymc.edu*)

**PURPOSE:** While improving phone communication is recognized as an important factor in efficiency and patient satisfaction, the implementation of changes has rarely been quantified. In this study we identify modifications to a phone answering service and their effects on communication efficiency and schedule volume.

**METHOD AND MATERIALS:** A new phone management system was implemented in July 2010. Modifications included alert sounds after extended wait time, training of staff to address all types of incoming calls, re-organization of phone tree, implementation of "Root-Cause Identification", and appointment of a call center supervisor. Data collection from August 2010 to present was recorded daily by Avaya at a busy Northeastern suburban outpatient imaging center. Parameters included total calls, automatic call distribution (ACD) calls, abandoned calls, average time to answer, average time to abandonment, and number of scheduled patients and exams. Data was exported to Excel for analysis.

**RESULTS:** At one and two months post-modification, abandoned calls decreased from 56% to 34% respectively. The average time to answer decreased from 9.13 to 5.44 minutes, and the total calls increased from 1473 to 2410. At one year abandoned calls decreased to 3%, the average time to answer decreased to 0.28 minutes, and the total number of calls was 1670. At eight years post-modification, abandoned calls were 4%, the average time to answer was 0.22 minutes, and the total number of calls was 3213. At two months post-modification, there was a 25.2% increase in scheduled patients and a 24.5% increase in scheduled exams compared to baseline. At four years there was a 75.4% increase in scheduled patients and 71.7% increase in scheduled exams. At eight years there was a 100.2% increase in scheduled patients and 145.1% increase in scheduled exams.

**CONCLUSION:** The implementation of the above modifications has drastically reduced abandoned calls and has allowed for greater productivity as demonstrated by the large increase in schedule volume. These modifications may allow radiology imaging practices to reach new levels of efficiency while improving communication and patient satisfaction.

(SS06-08) 2:10 PM - 2:20 PM

### Do Gender Disparities Among Major Radiological Society Award Recipients Exist?

Jessica F. Martin, MD, *Medical University of South Carolina, Charleston, SC*; Lara Hewett; Leonie Gordon, MBChB; Madelene C. Lewis, MD

**PURPOSE:** To investigate gender representation among recipients of physician awards presented by major radiological societies.

**METHOD AND MATERIALS:** Records of recipients of distinguished awards given by the American College of Radiology, the Radiological Society of North America, the American Roentgen Ray Society, as well

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as those presented at the Association of University Radiologists annual meeting from 2007-2018 were analyzed. Included awards were those intended for physician recipients that recognized accomplishments over the course of a career, emphasizing leadership or overall contributions to the field of radiology. Recipients of major awards from these organizations with teaching and education as the primary focus were separately analyzed. Primary outcomes measures were total numbers and proportions of female and male physician award recipients.

**RESULTS:** During the study period, the proportion of active physician radiologists who are female increased from 20.8% (2007) to 24.7% (2015). Of the 164 awards recognizing leadership or overall contributions to the field of radiology, 35 were awarded to females (21.3%) and 129 were awarded to males (78.7%). Of the 29 awards recognizing excellence in teaching and education, 13 were awarded to females (44.8%) and 16 were awarded to males (55.2%).

**CONCLUSION:** Females are underrepresented among recipients of highly prestigious leadership awards as well as those recognizing overall contribution. In contrast, there is overrepresentation of females among recipients of awards recognizing teaching and education suggesting a general perception among representatives of major radiological societies that females are superior teachers and inferior leaders. This concept underscores the importance of continued improvement in female representation in radiology to foster a high quality teaching environment as well as continued attention to the fact that females are underrepresented in leadership roles.

### (SS06-09) 2:20 PM - 2:30 PM Mammography Utilization As Women Age: Are Guidelines Even Binding?

Cindy Yuan, MD, PhD, *University of Chicago, Chicago, IL*; Kirti Kulkarni; Brittany Dashevsky, MD, DPhil ([cindy.yuan@uchospitals.edu](mailto:cindy.yuan@uchospitals.edu))

**PURPOSE:** Recently the benefit of screening older, sicker women with lower life expectancy has been questioned with updated guidelines by the USPSTF and ACR/SBI, which separately question benefits beyond age 74 years or when life expectancy is less than 5-7 years. However, it is unclear whether these constraints are even binding.

**METHOD AND MATERIALS:** Data was drawn from the 2011-2015 Medical Expenditure Panel Survey, which included self-reported data on elapsed time since last mammogram for 36,575 women. A logistic model was employed to evaluate correlation of age and comorbidities with mammography utilization. Socioeconomic, demographic, and health status measures were also controlled for. In separate analyses, utilization was defined as a mammogram within either the previous one or two years. For non-parametric analysis, we initially utilized an indicator for every age year before also fitting a quadratic age trend.

**RESULTS:** Within the analyses described above, there was an age trend of increased utilization until age 60, with a subsequent steady decreasing trend. Furthermore, the results suggested that there was a quadratic trend in age, with an estimated peak utilization of annual mammography at age 61.4 years [95% confidence interval (CI): 60.4 – 62.4; biennial utilization: 60.1 years (95% CI: 59.2 – 61.1)]. In fact, by age 75, the “cutoff” under USPSTF, women already have 13% lower odds of annual mammograms as compared to peak utilization at age 61. Hypertension and hyperlipidemia were correlated with 2.5 and 6.8 percentage points (pp) increased annual utilization, respectively ( $p < 0.01$ ). In comparison, a prior heart attack and a prior stroke were correlated with 8.2 pp and 1.5 pp less annual utilization, respectively ( $p < 0.01$  and  $p = 0.42$ , respectively). Results were similar for biennial utilization.

**CONCLUSION:** The results suggest that, at the very least, recommendations by the USPSTF may be non-binding, since utilization has already decreased significantly by the time women are 75. Additionally, women who have sudden health shocks have lower utilization. Overall, it appears that patients and referring physicians are already adjusting as residual life expectancy decreases with increased age and comorbidity.

\* Faculty financial disclosures are located in the Faculty Index.

# AUR 2019 Research Poster Abstracts

Research posters are located in Key Ballrooms 7-8. Each poster will be presented by its author during one of the *AMA PRA Category 1 Credit™* poster sessions scheduled for 7:00-8:00 AM, Wednesday (Session 201) and Thursday (Session 301). The day and time for each poster presentation follow the presentation number. Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (medical students, residents, or 1st- year fellows) are noted in **blue**.

## Cardiopulmonary

**(R-003) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Evaluation of Limited CT Pulmonary Angiography for the Evaluation of Pulmonary Embolism in Pregnant Women**

Stuart L. Cohen, MD; Meray Mankerian, *North Shore University Hospital, Manhasset, NY*; Rakesh Shah (*mmankerian1@northwell.edu*)

**PURPOSE:** The best advanced imaging test (CT pulmonary angiography [CTA] versus lung scintigraphy) to evaluate for suspected pulmonary embolism (PE) in pregnant women is uncertain, with prior studies suggesting a higher rate of limited CTA in pregnancy. The purpose of this study is to compare the rates of limited and severely limited CTA in pregnant women in the evaluation of PE and to evaluate patient factors that influence these rates.

**METHOD AND MATERIALS:** This retrospective study evaluates pregnant women who had a CTA as the primary advanced imaging test for evaluation of PE in a large health system in 2006-2017. CTA was determined limited per a limitation described in the radiology report. Studies were defined as severely limited if the limitation was described as "severely" or "extremely" limited, as "nondiagnostic" or in the main, left, right, lobar, or "central" pulmonary vasculature. A chi-square test compared limited and severely limited rates. The following predictors were analyzed as categorical variables: race (Asian, black, white, other/unknown), maternal age (<35 years, 35+ years), trimester (1, 2, 3, unknown), patient class (inpatient, outpatient, and ED) and chest radiograph (CXR) before CTA (none, negative, positive). Univariate analysis with chi-square/Fisher's exact tests and multivariate logistic regression evaluated significant predictors of limited and severely limited studies.

**RESULTS:** Of a total of 874 tests, 33% were limited and 4% were severely limited ( $p < 0.01$ ). Among limited studies, univariate analysis showed significant differences across trimester ( $p < 0.01$ ), but not across maternal age, race, prior CXR status, or patient class, and multivariate analysis showed a significantly higher limited rate with black race ( $p < 0.05$ ) and 2/3 trimester ( $p < 0.01$ ). Univariate and multivariate analysis of severely limited studies were not significant.

**CONCLUSION:** Limited CTA studies in pregnancy are common and may be associated with gestational age and black race, but severely limited results are significantly less common, relatively rare, and without significant predictors. This information may help inform and personalize advanced imaging for evaluation of PE in pregnancy.

## Education of Medical Students

**(R-008) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Does Student Debt Affect Residency Choice?**

Leonard Morneau, *Saint Barnabas Medical Center, Livingston, NJ*; Barry D. Julius, MD

**PURPOSE:** The average debt of a United States Medical School graduate reached \$175,348 as of 2014. Medical school debt is a significant factor that influences specialty choice. Choosing a specialty is one of the most important decisions all medical students must make. This decision can be difficult because of the many years of commitment to graduate medical education. Current studies examining student debt have focused on pediatric and primary care trainees. Additionally, this study found students seeking medical education training at St. George's University had a higher average debt of approximately \$200,000. The purpose of this study was to evaluate the relationship between medical student debt and specialty choice among medical students.

**METHOD AND MATERIALS:** A longitudinal study was conducted among 3rd and 4th year students during the radiology elective. A researcher-developed survey was administered to medical students between 2012-2014. At the end of their rotation students were asked to fill out an anonymous printed questionnaire which asked how much debt they had, which specialty they were choosing to enter into, and whether or not they felt that their choice of specialty was affected by the amount of debt they had. The data collected were coded and analyzed using the Statistical Package for Social Sciences v. 24 (IBM, SPSS Inc.). A p-value  $< 0.05$  was considered statistically significant. There were no incentives offered for survey completion.

**RESULTS:** A total of 97 students completed the survey. 95% of students attending St. George's University. Results demonstrated that nearly 58.5% of students with debt  $\geq$  \$200,000 and 23.1% of students with  $\leq$  \$200,000 of debt self-reported debt as a deciding factor for the choice of specialty. There was found to be a statistically significant difference among students with debt  $\geq$  \$200,000 and those with debt  $\leq$  \$200,000 ( $p = 0.00$ ).

**CONCLUSION:** Medical student debt impacts choice of specialty effect on choice of specialty for those students graduating with  $\geq$  \$200,000 of debt. Of the students surveyed in this study, the majority of those who said specialty choice was affected by debt chose Anesthesiology as their specialty of choice.

**(R-009) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Productivity and Efficiency in Dictating Cases of Fourth-Year Medical Students and Faculty Members in a Diagnostic Radiology Subinternship Course**

Trung T. Nguyen, BS; Julie Champine, MD; Kristen A. Bishop, MD\*, *University of Texas Southwestern, Dallas, TX* (*trungt.nguyen@utsouthwestern.edu*)

**PURPOSE:** The purpose of the project is to improve diagnostic radiology subinternship course by setting productivity standards for medical students completing cases across different modalities of radiology and the necessary resources needed for future subinternship.

\* Faculty financial disclosures are located in the Faculty Index.

**METHOD AND MATERIALS:** This diagnostic radiology subinternship course was only available to fourth-year medical students at UT Southwestern Medical Center and were only available for four weeks during: August and September 2017, July and August 2018. The medical students dictated cases and these indicated reports were then extracted from the EPIC program and each data point was recorded for the specific day, faculty member, modality, hospital and service in which the report was done and the data points were then similarly recorded on a Microsoft excel spreadsheet. The specific modalities of radiology were categorized as: outpatient ultrasound, inpatient ultrasound, x-ray, or CT. The control days were the days the same faculty member, without the student, was on the identical service and looking at the same modality. The control days were chosen to be the days on the same month or the adjacent months as the subinternship days and those data points were also placed on the spreadsheet. A t-test was done to compare the statistical significance of the number of reports done on days with the students and without. Similarly, a t-test was done to compare the number of student reports on each modality in the first five days of the selective to the last five days of the subinternship.

**RESULTS:** The t-test comparing the first five days and the last five days of the subinternship for each modality yielded there was a statistical significance of increase in each modality. Additionally, a t-test comparing faculty members on the subinternship days with the students and controls without the students yielded that there was not a significant difference between the number of reports on each day.

**CONCLUSION:** The progression of an increase of completed cases could be used as a standard and goal for future students. Additionally, faculty members do not seem to be significantly slowed by supervising the students, which is encouraging for the growth and continuity of this subinternship.

#### (R-010) Thursday • 7:00 AM - 8:00 AM • Hard copy poster Preclinical Radiology Elective Taught by Senior Medical Students: Does it Work?

Randall Z. Olmsted, *Baylor College of Medicine, Houston, TX*; Luke Gilman; L. Alexandre Frigini, MD (*Olmsted.Randall@gmail.com*)

**PURPOSE:** Although radiology education is often included in the preclinical curriculum, there is little known about the efficacy of student-taught lectures. The purpose of this study was to determine the effect of a senior student-taught preclinical elective on radiology competency and confidence in second-year medical students.

**METHOD AND MATERIALS:** 24 second-year medical students were enrolled in a preclinical radiology elective. The elective met for two hours a week for six weeks and was taught by senior medical students who had already completed their radiology clerkship. Resident mentors assisted instructors with lecture design, content, and delivery. Prior to the first class, enrolled students completed a 40-question knowledge exam and self-assessment. At the course's conclusion, students took the same knowledge exam and self-assessment. Self-assessment items were scored on a scale from 1-7, where 1 represented "poor" and 7 represented "excellent." Students were not made aware the test would be identical, and instructors refrained from overtly discussing exam questions or answers.

**RESULTS:** There was a significant increase of 26.4 points in the overall exam score (46.8% pre-course vs. 73.1% post-course,  $p < 0.001$ ). Similar increases were seen in each subsection: imaging indications (53.1% vs. 67.7%,  $p = 0.002$ ), neurology (63.3% vs. 90.0%,  $p = 0.001$ ), chest (46.7% vs. 66.7%,  $p < 0.001$ ), musculoskeletal (47.4% vs. 85.4%,  $p < 0.001$ ), and genitourinary/gastrointestinal radiologic pathology (53.1% vs. 67.7%,  $p < 0.001$ ). On the self-assessment, students reported significantly increased comfort with their overall radiology knowledge (2.63 vs. 4.96,  $p < 0.001$ ). They were also more comfortable presenting a radiologic study on rounds (1.63 vs. 4.75,  $p < 0.001$ ). There was no significant difference in interest in pursuing radiology as a career (4.13 vs. 4.67,  $p = 0.06$ ).

**CONCLUSION:** A radiology elective taught by senior students with resident mentorship significantly improves preclinical students' radiology competency and confidence. Further research is needed to compare these results to faculty or resident-taught lectures.

#### (R-011) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster Development and Evaluation of an Interactive Lecture for Third- and Fourth-Year Medical Students on Appropriate Ordering of Imaging Studies

Christopher Myczkowski, MD, *Vanderbilt University Medical Center, Nashville, TN*; Neal W. Langdon, MD; Cari L. Motuzas, MD

**PURPOSE:** A gap in training regarding appropriate ordering of imaging studies exists among medical students. This training gap may play a role in the continuing increase in expensive and sometimes unnecessary imaging studies being performed nationwide. Developing a strong knowledge base of appropriate imaging studies to order in a wide variety of clinical scenarios is crucial for physicians-in-training.

**METHOD AND MATERIALS:** Radiologists at Vanderbilt developed a two-hour interactive lecture, given as part of a four-week elective course in radiology. The first half of the lecture discusses the ACR Appropriateness Criteria, radiation doses, and common clinical scenarios which cause confusion in the ordering of imaging studies. The second half of the lecture is a case based, interactive exercise covering six cases. Eleven questions were written regarding appropriate ordering of imaging studies. In the 2017-2018 academic year, questions were mixed throughout weekly quizzes. For the 2018-2019 academic year, the questions will be given at the beginning of the course, and again at the end of the course to better measure effectiveness of the lecture.

**RESULTS:** For the 2017-2018 academic year, knowledge quizzes generated from a pool of questions and were taken by 35 students at the beginning of their first week of the course and at the end of the third week. Four one-month courses were tested in this manner. Question topics included appropriate imaging ordering as well as general radiology questions. An average score of 65% was obtained on the initial quiz. An average score of 84% was obtained on the quiz at the end of the third week. For the 2018-2019 academic year, quizzes dedicated to appropriate imaging ordering will be given at the beginning and end of each course.

**CONCLUSION:** Lectures on appropriate ordering of imaging studies and other radiology topics have proven effective in improving student knowledge. Dedicated quizzes on appropriate ordering of imaging studies in the 2018-2019 academic year will further assess the effectiveness of this educational tool.

#### (R-012) Thursday • 7:00 AM - 8:00 AM • Hard copy poster Using A Radiology Research Project as a Tool To Integrate Medical Students Into a Radiology Innovation Team

Rick A. Artrip, BS, *Penn State College of Medicine, Hershey, PA*; Brian Drury; Alison L. Chetlen, DO; Michael M. Moore, MD (*rartrip@pennstatehealth.psu.edu*)

**PURPOSE:** As emerging technologies continue to integrate themselves into everyday life there is a growing demand to incorporate them throughout the healthcare system. These challenges call for an interdisciplinary team of physicians, data scientists, and computer programmers that can successfully discover solutions to health care delivery problems. A recent research project allowed medical students to become integrated into a radiology innovation team. Exposure to this side of Radiology is seldom part of medical school curricula and introduction to these concepts is an important supplement to pre-clinical education providing a complete picture of the specialty.

**METHOD AND MATERIALS:** At Penn State Medical Center, the Division of Radiology Innovation and Value Enhancement (DRIVE) team aims to identify ways in which care management can be optimized

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through data analysis. Medical students completed an innovative chat-bot project for DRIVE, intended to educate patients about breast biopsy procedures. Students helped in a variety of ways from study designs/protocol, technology development/deployment in a clinical setting, data analysis, and publication writing.

**RESULTS:** Incorporating students into the DRIVE team afforded them a unique opportunity to work with an interdisciplinary team to address fundamental challenges in healthcare. With guidance from different team members, students were successful in launching and showcasing the effectiveness of a novel technology in a clinical setting.

**CONCLUSION:** The skills obtained from participating with a radiology innovation team are indispensable for students interested in a career in Radiology. Students were able to draw upon the skill set of an interdisciplinary team to tackle an ever-present health care issue of patient education. Students were allowed to experience a research project from start to finish and given instruction on how to implement a novel idea in a healthcare setting, obtain value from raw data, and effectively communicating findings of a research project to members of the radiology community all skills that are becoming extremely important for the modern-day Radiologist.

**(R-013) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

**Residents as Teachers: Effectiveness of Small Group Medical Student Tutorials Lead by Radiology Residents**

Lily L. Wang, MBBS, MPH, *University of Cincinnati Medical Center, Cincinnati, OH*; Michael B. Burch, MD; Eric B. England, MD; Carl C. Flink, MD; Monica O. Saccucci (*lily.wang@uc.edu*)

**PURPOSE:** We aim to evaluate the effectiveness of a small group MS tutorial on CXR interpretation taught by residents and to assess the effectiveness of resident learning through teaching MS.

**METHOD AND MATERIALS:** 17 radiology residents participated. 110 MS voluntarily signed up for a 50-minute tutorial. Each group consisted of 1-2 residents and 6-8 students. A survey was given to MS before and after the tutorial regarding their subjective level of comfort to identify and describe basic anatomy and acute pathology (Likert scale: 1 – least, 5 – most comfortable). 4 days before teaching the MS, residents attended a teaching session by a senior resident and an attending radiologist. A survey regarding subjective levels of comfort in identifying and describing basic anatomy and pathology was given to the residents at 3 time points: before and after the teaching session for the residents, and after the tutorial with MS. Descriptive statistics were obtained. Paired t-tests were used.

**RESULTS:** For MS, the confidence in interpreting and describing CXR anatomy/acute finding was poor to average before the tutorial (anatomy mean 3.0; acute finding mean 2.5). There was a significant difference between before and after the tutorial in their ability to identify and describe basic normal anatomy (mean 3.9) and acute findings (mean 3.6), as well as in developing a search pattern when interpreting a CXR ( $p < 0.01$ ). The residents were comfortable with describing and identifying basic anatomy/pathology before the teaching session (mean  $> 4$ ). There was significant improvement in comfort level describing and identifying basic anatomy/acute findings after the tutorial ( $p < 0.04$ ). There was no significant difference between after the teaching session and after the tutorial.

**CONCLUSION:** Small group MS tutorials on basics of CXR taught by residents is an effective method for both MS and resident learning. MS find interactive tutorial sessions helpful in learning to describe basic CXR findings. MS's subjective comfort level increased after the tutorial. Residents also had improved comfort level after instruction on teaching the tutorial to MS.

**(R-014) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**The Effect of AMSER Case of the Month on Student Involvement in Academic Radiology**

Rina K. Petek, BA, *Lake Erie College of Osteopathic Medicine, Horseheads, NY*; Katherine A. Klein, MD; Matthew S. Hartman, MD

**PURPOSE:** Most medical students are not exposed to radiology early on in their education, making it difficult to approach research in the field. In our project, we sought to improve medical student involvement in radiology research by encouraging students to submit an AMSER Case of the Month.

**METHOD AND MATERIALS:** A record of students who published an AMSER Case of the Month was collected from the AUR website. There was a total of 24 students who had their cases published and a total of 26 published cases. Participating students submitted cases from 9 institutions. Following their submission, students were contacted through email with a survey which assessed their experiences using the Likert scale. Students were asked questions about previous interest in radiology, previous scholarly experience, experience with AMSER Case of the Month, and demographic questions. The AUR AMSER website traffic data was collected from AUR Academic Management Services.

**RESULTS:** A total of 19 out of 24 students completed the survey for a response rate of 79%. Survey results demonstrated an increased interest in a career in radiology after completing an AMSER Case of the Month. Of the 79% of students who replied, 100% of students responded that the process of writing up their case was valuable. Additionally, 84% of respondents indicated that they were more likely to get involved with scholarly activity after having had their case published. Published students spent an average of 5.2 hours in the process producing their case. Overall, students indicated that the AMSER Case of the Month was an approachable project for medical students to get involved in both scholarly activity and radiology. Between the publication of the first AMSER Case of the Month on January 1, 2018 and September 24, 2018, the webpage has amassed 1755 page views with 915 unique views.

**CONCLUSION:** Our project demonstrated that submitting a case through AMSER Case of the Month was a valuable experience to students and that it increased students' interest in radiology research. With student feedback, we will continue to refine this project in an effort to increase awareness of AUR and AMSER Case of the Month among students completing radiology rotations across the country.

**(R-015) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Get to Them Early: Fostering Early Interest in Radiology Through a Radiologist-led Medical Student Anatomy Curriculum**

Valerie George, *Wake Forest Baptist Medical Center, Winston-Salem, NC*; Christopher Lack; Thomas West, MD; Frederick S. Jones, MD; Kevin D. Hiatt, MD; Carol P. Geer, MD; et al (*cpgeer@wakehealth.edu*)

**PURPOSE:** Early exposure to radiology in medical school introduces it as a career option and can serve as a necessary avenue for increasing diversity in the field. Radiologists are among the best-equipped to teach clinically relevant anatomy. We examined if a radiologist-led first year medical student anatomy course would lead to increased interest in radiology as early as the first year of medical school.

**METHOD AND MATERIALS:** Radiology faculty, residents, and senior medical students developed a region-based radiological anatomy course which was integrated into the anatomy curriculum for first year medical students beginning in 2016. Key anatomy was labeled on CT and MRI studies in axial, coronal, and sagittal planes and provided to students on a digital scrollable platform as pre-learning. Then, medical students attended 8 two-hour workshops led by Radiology faculty where they practiced identifying anatomic structures on interactive DICOM CT and MRI series in small groups. The regional anatomy covered in each lab correlated with material being covered in cadaver lab. In addition, clini-

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cal cases were introduced during each session to highlight the importance of understanding anatomy when trying to decipher pathology. Course evaluations and medical student participation in shadowing in the Radiology department were monitored during the 2016 and 2017 sessions and compared to previous years.

**RESULTS:** First-year medical student interest in radiology increased, with a two-fold increase in first-year medical students shadowing in the reading room. All evaluations of the radiology curriculum in the anatomy course rated the course as “good” or “excellent”, which are the two highest evaluation options.

**CONCLUSION:** Formal Radiologist-led anatomy education in the first year of medical school improves students’ subjective assessment of their anatomy education and correlates with an increased number of first year medical students who choose to participate in shadowing in the Radiology department. Early exposure to the field of radiology as a career choice will be one important method to increasing student interest in the field and diversity in radiology.

**(R-016) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

**Incorporating Radiology into Preclinical Undergraduate Medical Education: Results from Collaborative Learning Group Session Surveys**

Jerry Slater, *University of Florida College of Medicine, Gainesville, FL*; Erinn Cooke, MD, MPH; Laura Gordon

**PURPOSE:** Undergraduate medical education involves broad exposure to a variety of topics in basic science and clinical medicine. An often neglected and under-represented area in undergraduate medical education is medical imaging. Dedicated radiology courses in the preclinical years are especially rare. However, an understanding of imaging is important for all students regardless of their chosen specialty since almost every medical specialty utilizes imaging.

**METHOD AND MATERIALS:** As an institution, we have attempted to bridge this gap with a two-pronged approach: didactic lectures in radiology and, more recently, incorporation of case-based radiology teaching into collaborative learning group sessions. In these sessions, radiology residents and clinical faculty facilitate discussion of clinical cases with imaging findings. This format allows students to think clinically and learn to develop differential diagnoses while promoting understanding of radiological concepts with the support of an imaging expert and clinician. This also places the radiologist at the center of imaging education and provides radiology residents with professional growth. Surveys were distributed to students and faculty to assess the educational effectiveness and exposure value of the collaborative learning group sessions in radiology.

**RESULTS:** There was an overall positive response from students and faculty alike. We have seen an increase in the number of students interested in radiology, including students applying to radiology and the number of students taking advanced electives.

**CONCLUSION:** With multiple benefits including increased exposure to radiology and radiologists, the collaborative learning group sessions have proved a valuable addition to our preclinical undergraduate medical school curriculum. Other institutions interested in expanding their preclinical radiology education could consider similar approaches.

**(R-113) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #10**  
**Radiology Residency Director’s Assessment of a Hands-On Radiology Sub-Internship**

Alex J. Newbury, MS, *University of Massachusetts, Worcester, MA*; Carolynn M. DeBenedictis, MD; Christopher A. Cerniglia, DO, MEng; Aaron Harman; Hao S. Lo, MD ([alex.newbury@umassmed.edu](mailto:alex.newbury@umassmed.edu))

**PURPOSE:** To our knowledge, there are few medical student rotations incorporating active radiology report dictation and performance of image-guided interventional procedures. We set out to highlight the novelty and importance of such an advanced elective as assessed by radiology residency directors.

**METHOD AND MATERIALS:** Survey data were collected and managed using REDCap electronic data capture tools and sent out through the APDR list serv. The survey included the following questions: “Are you aware of any residency applicants who have completed an Advanced Elective with significant hands-on experience with report dictation and image-guided procedures?,” “How helpful would completion of such an Advanced Elective be in your assessment of a residency candidate?,” “What characteristics of residency applicants would be better evaluated by completion of a hands-on Advanced Elective?,” “To what extent would a hands-on Advanced Elective be predictive of first year resident performance?,” and “What qualities of first year radiology residents would be improved by completion of a hands-on MS4 Advanced Elective?”

**RESULTS:** Of the 298 faculty on the APDR listserv, we received 72 responses (response rate of 24.1%). 81.9% stated that they were not aware of any residency applicants completing an advanced elective as we described, 40.3% reported that an Advanced Elective would be very helpful or helpful in assessing a residency candidate, and 65.3% reported that an Advanced Elective would be slightly or somewhat predictive of PGY-2/R1 performance. When asked about what qualities of first year radiology residents would be improved by completion of a sub-internship, “confidence with chosen field of residency,” “comfort with the language of radiology,” and “time spent learning the process of reading and interpreting” were the most common, 81.9%, 68.1%, and 54.2%, respectively.

**CONCLUSION:** The APDR faculty surveyed felt that by completing a hands-on sub-internship, fourth year medical students are better prepared, both in terms of the process and language of radiology, and confidence in choosing radiology as their field of residency.

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**(R-114) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #8**

**Lines and Tubes: Assessing the Effectiveness of the Flipped Classroom for Teaching 4th Year Medical Students**

Joseph W. Owen, MD, *University of Kentucky College of Medicine, Lexington, KY*; Douglas E. Lukins, MD; James P. Luba; Andres R. Ayooob, MD

**PURPOSE:** To assess the importance of in-class participation for teaching radiographic assessment of line and tube placement.

**METHOD AND MATERIALS:** A flipped classroom approach was used to teach assessment of line and tube placement on radiographs. Pre-class material included 3 screencasts: endotracheal tubes, central venous catheters, and enteric tubes. After the screencasts, a 15 question pre-test was administered with “unknown” cases. Students were asked to identify appropriately positioned and malpositioned lines and tubes. An in-class session was offered where students assessed “unknown” radiographs in small groups, followed by a classroom wide discussion of each case. The in-class session was recorded and available for review online. A 15-question post-test was administered following the in-class session. The level of student participation was divided into three groups: (1) screencast and in-class participation, (2) screencast and on-line review of the in-class session, and (3) screencast only. After IRB approval, pre-test score, post-test score, cumulative grade point average (GPA) were determined for each student, and grouped by level of participation. Linear regression analysis assessed for correlation between test scores and GPA. One-way ANOVA analysis compared the group means of the pre-test, post-test, and gain (difference between pre and post test scores). Statistical analyses were completed in SPSS 25.

**RESULTS:** There was no correlation between pre-test scores and GPA ( $R=0.144$ ,  $p=0.161$ ). There was no difference in the pre-test means of the student scores base on level of participation ( $F(2, 90) = 0.605$ ,  $p=0.548$ ). One-way ANOVA analysis reveals a significant difference in the post-test means of the student scores ( $F(2,90)=4.909$ ,  $p=0.009$ ). Tukey HSD post-hoc analysis shows a significant difference between group 1, in-class participant (mean=13.1, sd=1.3), and group 3, screencast only (mean=11.5, sd=1.8). The difference between group 1, in-class participant, and group 2, online review (mean=12.2, sd=1.8), approaches significance ( $p=0.052$ ).

**CONCLUSION:** In-class small group participation led to improved ability to correctly assess line and tube positioning when compared to screencast viewing alone.

**Education, Other**

**(R-022) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Image-Rich Didactic and Interactive Practicum Intervention and Its Effects on High School Students' Perceptions of Radiology**

James E. East, *University of Vermont, Burlington, VT*; Marc Hammond; Liam du Preez; Naomi M. Davidson

**PURPOSE:** To determine if an interactive didactic session would alter perceptions of Radiology in a group of high school students. High school students may not consider radiology as a career due lack of exposure and general lack of knowledge of the field. We hypothesized that an interactive didactic session and image rich presentation would positively alter high school student perceptions of Radiology.

**METHOD AND MATERIALS:** A 30-minute image-rich presentation was given to 56 high school students. A hands-on practical session was then given involving the ultrasound of normal anatomy in a standardized patient. The sessions were led by Radiology Residents and 1st year medical students planning to pursue Radiology as a career. A questionnaire comprising of 10 questions was given before and after the presentation and hand-on session. An independent t-test was performed on the pre- and post-test answers. Incomplete answer forms were excluded from analysis.

**RESULTS:** A statistically significant change was identified in questions addressing views of a radiologist's duties in the context of team-based patient care as well as “A Radiologist's duties are largely accomplished alone, without much interaction with other care teams” ( $p=0.03$ ), “A Radiologist's role in the hospital is largely one of support rather than a “front line” diagnostic role” ( $p=0.01$ ). There was no significant difference in the pre- and post-test answers for the remaining 8 questions which addressed day-to-day work of the radiologist as well as considering radiology as a career possibility.

**CONCLUSION:** By utilizing an image-rich presentation and hands-on didactic ultrasound session perceptions of Radiology by high school students were positively changed. High school students changed their perceptions of the role of Radiologist in patient care. Questions involving the students' incorporation of radiology into their career plans, and day-to-day work of a radiologist were not significantly changed by the intervention. This provides insight for our group to develop better ways to instruct high students in the future

**(R-023) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Early Exposure to Radiology for High School Students – Does it work?**

Saagar Patel; Rohan Manickam; Kimberly Brown; Girija Rajakumar; Manickam Kumaravel, MD, *University of Texas Houston, Houston, TX*; (Saagar.patel@uth.tmc.edu)

**PURPOSE:** A radiology education program was created to introduce high-school students to radiology through a week-long course. We devised a method for measuring effectiveness of the program and to assess the feasibility of teaching this methodology for various audiences with variable knowledge levels. The objective is to introduce high-school students to the specialty of Diagnostic and interventional imaging and spur interest for future generations of radiologists.

**METHOD AND MATERIALS:** Discussions were held with a local public Independent School District, which had an interest in health professional education. Proposal for exposure of high school students to a short week to radiology in an outpatient department was made. Prior to immersion, all students participated in an anonymous quiz determining the baseline knowledge of the students. After week-long exposure to radiology, students were administered a post exposure assessment to evaluate knowledge. Comparison of pre and post-exposure standardized testing

results determined the efficacy of the program. During the week, students had a total of six hours of exposure to the various sections in the radiology outpatient department. The students were exposed to the basic functions and concepts of radiography, ultrasound, CT (Computerized Tomography), nuclear medicine and MRI (Magnetic Resonance Imaging).

**RESULTS:** Evaluation of the radiology exposure week was performed by standardized questionnaire administered to 24 participating students. Average improvement following course: 36%. Pre-test standard deviation: 26.8%; Post-test standard deviation: 10%. Pre-test standard error mean: 5.5; Post-test standard error mean: 2.0. Statistical analysis between pre- and post-test had a p-value <0.00001.

**CONCLUSION:** Short focused radiology education programs are useful and effective in educating high school students to the fundamental concepts in radiology. This effectiveness of this program is evidence that similar programs can be applied to other institutions with a curriculum tailored to the audience.

**(R-121) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #7**  
**Clinician Responses to Disease-Specific Reporting in a Community Setting**

Yasha Parikh, *Mount Auburn Hospital, Boston, MA*; Alejandro M. Heffess, MD; Caitlin M. Connolly; J. Pierre Sasson, MD; Peter E. O'Halloran, MD; Alyssa Simeone; et al (*yasha.parikh@mah.harvard.edu*)

**PURPOSE:** Radiology reporting is constantly evolving. The original narrative style gave way to structured reporting. Now, practices are adopting Disease-Specific Reporting (DSR), which allows radiologists to provide reports with more objective data and specific follow up recommendations. The purpose of our study was to assess clinical perception of disease-specific reporting.

**METHOD AND MATERIALS:** Our 200 bed hospital (Mount Auburn Hospital) implemented DSR for BI-RADS, TI-RADS, gynecologic malignancies, and others. To assess overall physician perception of DSR, an email survey of nine questions was sent to over 300 physicians via listserv. A disease specific TI-RADS report and an older structured thyroid ultrasound report were provided for reference. Questions included whether physicians noticed a trend towards DSR, which type of reporting was preferred, and if DSR improved clinical practice.

**RESULTS:** 64 surveys were received from physicians with varying specialties and practice experience. ANOVA analysis revealed that physicians across all specialties did not notice a trend towards DSR ( $P=0.725$ ). While objectively more physicians who noticed a trend did prefer DSR, the number was not statistically significant, with a P value of 0.444. Overall, there was no preference of DSR over structured reporting ( $P=0.540$ ).

**CONCLUSION:** These results are important considerations when implementing new reporting styles with the goal of improving patient care and fulfilling the needs of referring physicians. The data show that the desires of our colleagues are mixed, even within specialties. Free response feedback further solidified this notion, with some physicians asking for more specific follow up guidelines, and others asking for only objective information about what is seen in the image. The second half of the study will implement widespread use of DSR with the goal of illuminating the clinical value of these reporting changes and addressing shortcomings of DSR found in the initial results. Ultimately, there must be a reporting style which is both informative and still valuable to the referring clinicians who utilize the reports to improve patient care.

**(R-122) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #9**  
**Back to Basics: Improving MRCP Quality via Dialogue With Our Technologists**

Junjian Huang, MD, *Pennsylvania Hospital, Philadelphia, PA*; Jonathan Fournier; Kheng L. Lim, MD; Jonathan D. Dorff, MD (*Junjian.Huang@uphs.upenn.edu*)

**PURPOSE:** In our modern age, technology has changed the way we work and communicate. While there are clear advantages of digital communication, the heavy reliance on electronic means such as email and messaging via secured electronic medical record can dehumanize the workplace. We observe this from the introduction of a "QA" icon on our picture archiving and communication systems (PACS), which serves as a quick and efficient electronic method to communicate potential image quality issues. However, we postulate that informal face-to-face dialogue between radiologists and technologists can be an effective method of quality improvement and assurance. The purpose of this study is to ensure inclusion of the distal common bile duct (CBD) on axial MRCP sequences via in-person conversation between the attending radiologist and the MRI technologists.

**METHOD AND MATERIALS:** A retrospective study of all consecutive MRCP studies between 7/1/17 and 1/19/18 was performed to evaluate for adequacy of imaging of the CBD. A didactic lecture regarding biliary anatomy and physical demonstration on how to choose the appropriate field of view was provided to the technologists by an attending physician on 1/19/2018. This lecture was performed in the MRI control room with demonstrations performed on the computer systems the technologists use. Data was prospectively collected from 1/20/18 until 6/5/18.

**RESULTS:** A total of 146 consecutive studies were included in this study, 73 pre intervention and 73 post intervention. Prior to intervention, there were 12% ( $n=9$ ) of studies in which the CBD was not completely imaged on axial MRCP images compared to post intervention where only 5% ( $n=4$ ) of studies were suboptimal in this regard.

**CONCLUSION:** Our study demonstrates that despite a short period of intervention, face-to-face communication in a non-threatening work environment can be effective in bringing positive change.

\* Faculty financial disclosures are located in the Faculty Index.

**(R-123) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #8**  
**MRI Tutorials - How to Develop a Comprehensive MRI Curriculum**

Ami Gokli, MD, *Children's Hospital of Philadelphia, Philadelphia, PA*;  
Janet R. Reid, MD (*goklia@email.chop.edu*)

**PURPOSE:** MRI training can be fragmented and disorganized, with an abundance of resources dedicated to image interpretation, separate scattered sources of information reserved for physics, and almost no tools to explain “real-life” MRI - image manipulation, patient positioning and/or technologist responsibilities. Trainees begin MRI rotations with variable levels of experience and expertise, and the information they retain will vary because of this. Aimed at a fellow level of training, we are developing a comprehensive curriculum for pediatric body MRI in order to facilitate a seamless transition into independent attending radiologists.

**METHOD AND MATERIALS:** Our needs assessment consisted of 81 pediatric radiologists completing a needs assessment survey, and 5 current fellows participating in a focus group to identify knowledge gaps. Identified areas with limited instruction during training were technical including: setting up an MR service, coil selection, field inhomogeneity correction. The most commonly identified areas needing increased attention within the curriculum included: coil choice and patient positioning (n=42, 52%); differences between contrast agents (n=40, 49%); field strength (n=33, 41%); and strategies for motion correction (n=33, 41%). Based on group preference for shorter lectures and emphasis on learning via video education/tutorials, a curriculum for “real life” MRI was developed.

**RESULTS:** We will discuss pearls and pitfalls of curriculum development with particular attention to video-based learning. After creating the first video “knee MRI”: patient positioning, coil selection and image optimization, we share our experiences with video development, actor interaction to encourage engaging learning, and tools to create attention-grabbing sources of information. This curriculum will be available on our LMS, available in the reading room and on mobile devices, for on-the-go learning catering to the millennial trainee.

**CONCLUSION:** While traditional teaching emphasizes image interpretation utilizing printed books/articles, we have demonstrated a need for teaching technical and practical aspects of MRI. This has been done using a video-based approach and short, focused topics based on learner preferences.

## Education of Residents

**(R-033) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Facilitating Technology Use in Education: CREATE-ing Harmonious Asynchrony**

Joseph S. Fotos, MD; Jeanine Beatty-Chadha, MEd, *Penn State College of Medicine, Hershey, PA*; Anita Ankola, MD; Kathrine Rineer

**PURPOSE:** The Collaborative Radiology Education in Asynchronous Training Environments (CREATE) Group serves as a collaboration resource for educators in the Department of Radiology in developing asynchronous training content. Consisting of four principal educators, CREATE assists Department of Radiology faculty in creating and implementing new educational materials intended to promote active learning, in augmenting and refining existing materials, and in the effective uses of technology in teaching and learning.

**METHOD AND MATERIALS:** The CREATE group has facilitated development of educational materials using a variety of methods and processes including 1) development of research-based criteria for effective e-learning content; 2) workshops to disseminate educator tools to improve learner interactivity; and 3) individual faculty feedback encouraging reflective practices regarding existing electronic educational materials.

**RESULTS:** The CREATE group has augmented multiple online Learning Management System (LMS) modules created by Abdominal Imaging faculty with topics such as foundational knowledge on image interpretation. We have held two small group sessions for the Abdominal Imaging Division faculty in order to share examples of interactivity best practices to improve educator skillsets. Personalized educator advising sessions are in progress to help transform traditional PowerPoint files into engaging online module format.

**CONCLUSION:** The CREATE Group has been well received by the Abdominal Imaging Division. As we continue forward, we will refine our needs assessment strategy to identify new areas within the Radiology curriculum able to benefit most from asynchronous training. We will develop an appropriate assessment tool to evaluate our impact on trainee learning. All academic departments face an increased demand on their faculty's and trainees' time. The importance of educator support in efficiently developing strong asynchronous training opportunities for both residents and medical students cannot be overstated. We believe our collective educational products will address potential gaps in radiology education and achieve a consistent training experience for our residents and medical students.

**(R-034) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Reporting Times and Resident Satisfaction After Addition of Overnight Faculty**

Matthew Jenson, MD, *Mallinckrodt Institute of Radiology, St. Louis, MO*;  
Paul L. Wasserman, DO; Alexandra High, DO

**PURPOSE:** Study the effects of transitioning from a resident dependent overnight call system to an in-house overnight radiology faculty member system with resident support. We analyzed how this change effected report finalization time from a large level 1 Trauma center. We also assessed resident satisfaction of the overnight call experience, and of the residency at-large, pre and post intervention, to see whether resident perception of the program has changed.

**METHOD AND MATERIALS:** The radiology department transitioned to overnight attending coverage in an effort to improve quality of service by reducing turn-around-time of final reports. To achieve this, a new in-house Emergency Radiology division was created to work overnight. The time to final report for emergency cases (including trauma) was analyzed 6 months before, and 3 months after the implementation of the new division. Surveys were sent to all residents to assess their satisfaction of the night float rotation and to see if their perception of the educational program had changed because of the implementation

\* Faculty financial disclosures are located in the Faculty Index.

of the new division. The surveys specifically included questions regarding perceived levels of autonomy and supervision.

**RESULTS:** The overall mean time for emergency studies to get a final report was 481 minutes prior to and 111 minutes after the changes were implemented. The resident surveys demonstrated improved resident satisfaction in the nightfloat block after the changes were implemented, increasing from 1.9 to 3.9 on a 5 point Likert scale, with 5 being the best. Overall residency satisfaction increased from 2.6 to a 3.3 on a 5 point Likert scale, with 5 being the best. Residents also graded their perceived levels of autonomy and supervision on a 5 point scale. Resident perceived autonomy and supervision both moved closer to the “ideal” ranking after the changes were implemented.

**CONCLUSION:** The addition of overnight faculty has led to a reduction in the time it takes for emergency studies to get a final report. Resident survey results demonstrate these changes have led to increased resident satisfaction.

**(R-035) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**A Resident-to-Resident Mentorship Program: Improving Education, Elevating Wellness, and Reducing Financial Stress**

Michael J. Talarico, MD, *Dartmouth Hitchcock Medical Center, Lebanon, NH*; Allison O. Backer, DO; Jonathan A. Farrell; Matthew Alfano; Krishna Patel, MD; Stephanie P. Yen, MD (*Michael.j.talarico@hitchcock.org*)

**PURPOSE:** Identify the needs of current residents and implement specific strategies to improve the resident experience at our institution targeting education, wellness and financial stress.

**METHOD AND MATERIALS:** An initial anonymous 10-question survey was administered to the radiology residents to gauge the state of resident morale, desire for mentorship, and perception of program support for resident wellness. Based on these results, a multi-faceted resident-to-resident (R2R) wellness initiative was developed and implemented by senior residents with the support of the program director and department chair. Initiative highlights include: a R2R mentorship program, chief rounds/town halls, case of the day, organization and increased funding for board preparation, and American Board of Radiology (ABR) annual dues coverage. A 6 month follow-up anonymous 35-question survey re-assessed resident perceptions of the initiative, the overall effect on wellness and identified additional areas for future improvement.

**RESULTS:** 100% of residents desire a mentorship program. 80% of residents feel that a group comprised of co-residents from each residency class is the best mentorship framework. 93% of residents report a positive difference in resident moral after implementation of the R2R program. 100% of residents would like the R2R case of the day to continue, with 95% reporting learning new material. 100% of R3 residents feel more organized in preparing for the ABR board exam after the development of a study plan.

**CONCLUSION:** Resident wellness is a tenant of thriving residency programs and is increasingly recognized as a department investment that enhances resident satisfaction and success. Though the concept of “wellness” is inherently personal, we identified common themes within our resident cohort that could be targeted for improvement. Our resident-driven wellness initiative, supported by department leadership, has improved education, mentorship, social wellbeing, and has reduced financial stress.

**(R-036) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Cloud-Based Peer to Peer Education and Archiving System: Using Productivity Software in Radiology Education**

Arun Nagaraju; Christopher M. Straus, MD; Pritesh Patel, MD, *University of Chicago Medicine, Chicago, IL*

**PURPOSE:** Radiologists and trainees today are challenged with ever increasing breadth of knowledge. With these advances comes difficulty in keeping an increasingly complex knowledge base both organized and current. Material must be stored in a structured and accessible database and promote learning and reference. Traditional methods of learning like pencil and paper and PACS caselists are lacking. One lacks visuals and the other often lacks remote access. Modern software assists in filling this gap. Examples include Google Docs, Microsoft OneNote, and Evernote and though not specifically developed for radiology, they offer frameworks from which information can be organized. Our experience has identified Evernote as having distinct advantages and this presentation will detail its integration into resident education and shared collaboration.

**METHOD AND MATERIALS:** Over the course of 4 years we tested 4 commercially available digital notes programs. Selection was based on 12 users’ judging ease of use, portability, collaborative tools, and file type support. Three products considered did not satisfy end users while Evernote satisfied our criteria. Utilization was over three years and included extensive use case testing, feedback, and add-on exploration. Demonstration of how to utilize this product in the educational work flow will also be discussed.

**RESULTS:** This application has been adopted by a dozen residents and attendings at our institution. Over the past 4 years it has allowed trainees and mentors have instant communication. An attending shares a small caselist of trauma cases with a resident before a call shift. Two residents collaborate before a scientific exhibit. Limitations include software installation, ensuring HIPAA compliance, and cost.

**CONCLUSION:** Evernote is a cloud based collaboration application available for major desktop and mobile platforms that creates a searchable collaborative archiving tool, supporting our residents and faculty. Independence of the traditional PACS and storage of HIPAA cleared files offers the ability to utilize this material later throughout one’s career, an invaluable tool for both initial education and future maintenance of certification requirements.

**(R-037) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Resident Wellness: Can a Monthly Social Fund Help?**

Ujas N. Parikh, MD, *New York University School of Medicine, New York, NY*; Chloe M. Chhor, MD; Kamran Munawar; Cecilia L. Mercado, MD

**PURPOSE:** Recent national surveys demonstrate a high burnout rate among residents and radiologists. Creating a culture of wellness is an important part of a residency training program. To assist in this process, foster a cohesive residency class and help achieve a work-social, work-life balance, our program instituted a monthly social fund. The purpose of this presentation is to describe the function of a social fund and assess its potential benefit on resident wellness.

**METHOD AND MATERIALS:** The monthly social fund initiative began in the 2014-2015 academic year. A subcommittee of residents are selected yearly to help plan and organize monthly events. Some of the social events include dinner parties, movies in a park, painting, sight-seeing, bowling, archery tag, and holiday parties. A voluntary, anonymous survey was distributed to all radiology residents assessing their perception of the social fund.

**RESULTS:** 27/37 (73%) residents participated in the survey. Majority of participants believe the monthly social activities add to resident wellness (25/27; 93%) and decrease resident burnout (24/27; 89%).

\* Faculty financial disclosures are located in the Faculty Index.

All residents believe the social events help foster interpersonal relationships in and out of the hospital. 18 of 27 (67%) residents believe the social fund was a positive influence when choosing to rank our institution for residency. Comments were made that radiology residency can be somewhat isolating, and residency socials create a sense of camaraderie. Others noted that social events offer an opportunity to obtain advice from senior residents who are completing mini-fellowships and have matched into fellowships.

**CONCLUSION:** Creating a culture of wellness is multifaceted and complex. Results of our survey demonstrated overwhelming support for a residency social fund for monthly activities. Monthly funded social events may positively impact resident wellness. Residencies should consider implementing a structured social committee and fund.

**(R-038) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

**Timing of Junior Call Responsibilities and the Impact on Major Missed Radiographic Findings by the Radiology Resident**

Diane Szaflarski, *NYU Winthrop Hospital, Mineola, NY*; Laura Madsen; Sirisha Koneru; Jason C. Hoffmann, MD\* ([Jason.Hoffmann@nyulangone.org](mailto:Jason.Hoffmann@nyulangone.org))

**PURPOSE:** To examine the relationship between first year resident on-call radiograph recall rates and timing of the start of junior call.

**METHOD AND MATERIALS:** An IRB-exempt single institution retrospective analysis was performed at an institution where first-year residents have begun their call at different time points, depending on the academic year. Recall forms completed by radiology attending physicians for first-year resident missed findings on radiographs during the on-call period from the first two months of when the residents started taking call were evaluated over a nine-year period (2009-2018). Radiographs read by junior residents while on call are not reviewed and finalized until the next day by the attending at our institution. A recall form is submitted by the attending for any important finding missed by the resident. Residents were grouped into early start (July), intermediate start (September-November) and late start (January). Total number of recalls for each time period was divided by the total number of first year residents for that year.

**RESULTS:** During the study period of 2009-2018, recalls were available for review in 8 of the 9 academic years (not available for 2014-15). For the eight years of available data, a total of 142 recalls were submitted in the first two months of junior resident call for a total of 33 first-year residents (total average of 4.3 recalls per resident). Residents beginning call in July had an average of 3.9 recalls per resident in the first two months, those with an intermediate start had an average of 4.5 recalls per resident and those with a late start had an average of 5.3 recalls per resident.

**CONCLUSION:** First year radiology residents who begin their call immediately in the academic year do not receive more on-call radiograph recalls than residents who start call 3 or 6 months later. Additional studies are needed to evaluate the reproducibility at other institutions and to evaluate reasons for this, which may include varying degrees of vigilance by the residents based on timing of starting junior call, different levels of resident proficiency, and variable attending perceptions as to what constitutes the need for a recall.

**AUR Trainee Prize: 3rd Place**

**(R-039) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Simulated Hip Aspiration Utilizing a 3D-Printed Model for Radiology Resident Education**

Corey J. Hiti, MD, *UC Davis Medical Center, Sacramento, CA*; Jasjeet Bindra, MD; Cyrus Bateni, MD; Aaron J. Lee; Ian Julie ([cjhiti@ucdavis.edu](mailto:cjhiti@ucdavis.edu))

**PURPOSE:** To determine the efficacy of simulated hip aspiration training utilizing a 3D-printed model for radiology resident education.

**METHOD AND MATERIALS:** A simulation hip aspiration training module was developed utilizing a 3D-printed model of the bony structures of the hip derived from a CT scan of the pelvis. These 3D-printed bones were embedded within a gelatin-based medium and a fluid pocket was incorporated in the region of the hip joint capsule. The 3D-printed structures yielded a high degree of anatomical fidelity and were compatible with fluoroscopic and ultrasound imaging. First-year radiology residents of two consecutive classes at an academic institution were provided a 1 hour Powerpoint-based didactic session, followed one week later by a hands-on training session with fluoroscopy-guided and ultrasound-guided techniques for hip aspiration led by two musculoskeletal attending radiologists. Pre and post-session knowledge assessment was tested with 6 multiple choice questions, performed immediately prior to the didactic session and following the completion of the hands-on portion of the training seminar.

**RESULTS:** A total of 14 first year radiology residents participated in the training sessions. 12 residents completed all components including taking the pre- and post-test, attending the didactic session, and participating in the hands-on training session. Pre-test mean score was 2.08 and post-test mean score was 3.92. Scores demonstrated a statistically significant increase [ $p < 0.01$ ; 95% CI (1.0-2.6)] following the training sessions.

**CONCLUSION:** Hands-on training for hip aspiration with 3D-printed models can supplement traditional instruction to increase relevant technical knowledge of first-year radiology residents. This model can also be utilized to meet procedural competence requirements for residents prior to performing the procedure on real patients.

**(R-040) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

**Assessing Radiation Safety Education in Residency**

Abeer Mousa, *University of Arizona College of Medicine-Phoenix, Phoenix, AZ*; David Lee; Mary J. Connell, MD; Albert Roh; Courtney L. Mitchell, MD ([mary\\_connell@dmgaz.org](mailto:mary_connell@dmgaz.org))

**PURPOSE:** The purpose of this study is to assess the existing radiation safety training across radiology residency programs in the United States.

**METHOD AND MATERIALS:** A survey of 15 questions was designed to assess resident knowledge of radiation safety. It highlighted key concepts from the Radiological Society of North America (RSNA) Radiation Protection online modules deemed important by two program directors. It was administered to radiology residents of all levels in two residency programs. The survey was anonymous, and residents were instructed to complete the survey in a monitored setting without the use of outside resources.

**RESULTS:** Seventeen of 30 (57%) residents completed the survey, which included 8 first-year radiology residents (R1), 4 second year-residents (R2), 2 third-year residents (R3), and 3 fourth-year residents (R4). The survey scores increased with each training level. The R1 mean score was 48%, with the R2, R3, and R4 levels having mean scores of 57%, 70%, and 71%, respectively. The most missed question, of which 2 of 17 (18%) residents correctly answered, involved understanding of cancer risk following levels of ionizing radiation. The other most missed questions focused on repercussions of exceeding dose limits (24%), average background radiation dose (29%), and occupational radiation exposure in pregnancy (29%).

\* Faculty financial disclosures are located in the Faculty Index.

**CONCLUSION:** The results of this study identify shortcomings in formal radiation safety training in residency program curricula. Residents were not knowledgeable in aspects of radiation safety that are vital to practical success as a radiologist. A survey of program directors nationwide regarding radiation safety in the curriculum is currently being conducted, which will provide more insight from a program director standpoint.

**(R-041) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Improving Faculty Evaluations of Residents From 30% to 99%: 5 Steps to Getting This Done!**

Glenn C. Gaviola, MD, *Brigham & Womens Hospital, Boston, MA*; Tony W. Trinh, MD; Jeffrey Guenette, MD; William W. Mayo-Smith, MD ([gaviola@bwh.harvard.edu](mailto:gaviola@bwh.harvard.edu))

**PURPOSE:** Timely completion of resident evaluations by faculty members is an ACGME mandate, but achieving this goal can be a challenging in a large academic medical center. We report the impact of our quality improvement initiative to achieve this goal in five key strategic steps

**METHOD AND MATERIALS:** Our institutional GME office requires that 80% of the clinical rotations have at least one resident evaluation completed by a faculty member. Prior to January 2017, our program did not meet this requirement. Our program consists of 41 residents with over 120 clinical faculty members, across 14 clinical divisions. To achieve GME compliance, a redesign of our newly established Educational Division was performed. We identified 5 key steps to improve our completion rate and promote high quality, meaningful evaluations: 1. Identify a primary core teaching faculty member for each clinical rotation and charge them with the responsibility of resident education and evaluation completion; 2. Develop a standardized 4-week block schedule; 3. Streamline the evaluation instrument; 4. Provide an evaluation template that is easily replicated; and 5. Hold core faculty members and program coordinators accountable for timely completion. These steps were implemented in January 2017, and our evaluation completion rate was tracked and reported by the GME office semiannually.

**RESULTS:** Semiannual data provided by our local GME office since July 2014 showed an average completion rate of 50% through July 2016, with a low of 30% in January 2016, and high of 62% in July 2014. After implementation of our 5 key strategic steps in January 2017, we achieved compliance within 1 academic year: with a completion rate of 72% in the first half and 99% in the latter half.

**CONCLUSION:** Using the 5 key strategic steps described, it is feasible to achieve timely completion and documentation of meaningful resident evaluations by faculty members for each clinical rotation within an academic year.

**(R-042) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Examining the Role of Formal Moderate Sedation Education in Radiology Residency Training**

John P. Tobben, *IU Health, Indianapolis, IN*; Daniel Murphy; Jason Childress; Jessica Smith

**PURPOSE:** The number of imaging guided, minimally invasive procedures performed by radiologists has continued to expand. Moderate sedation is routinely employed during many procedures performed by both interventional and diagnostic radiologists. However, formal education with regards to levels of sedation, pre-procedural assessment, medications used routinely in sedation, intra-procedural monitoring, and post-procedural care is widely lacking in residency training. To that end we intend to assess the benefits of a formal educational intervention on trainee confidence and knowledge with regards to moderate sedation.

**METHOD AND MATERIALS:** A brief survey instrument was administered to residents of all years of training. This survey included questions regarding demographics, subjective self assessment of confidence re-

garding moderate sedation, and several knowledge-based multiple choice questions. An educational intervention was then administered in the form of a resident-led educational module. The subjective self-assessment and knowledge based survey questions were then re-administered following the intervention to assess for benefits of the educational module.

**RESULTS:** A large majority of residents felt that more formal education on procedural sedation was necessary. Formal educational intervention by means of an interactive educational module improved both resident confidence in moderate sedation as well as resident knowledge regarding pre-procedural assessment, intra-procedural monitoring, sedation medications, and post procedural care.

**CONCLUSION:** Formal education improved both resident confidence and knowledge with regards to moderate sedation and should be implemented more universally throughout residency training programs.

**(R-043) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**What's the Basis for Interesting Cases? Opportunities, Challenges, and Pitfalls of Creating a Radiology Resident-Driven Interesting Case Competition**

Brian L. Dubin, MD, *David Geffen School of Medicine at UCLA, Los Angeles, CA*; Iram Dubin; Garth B. Brandal, MD; Kristen Olinger; Lindsey Storer, MD; Suna F. Hakim, BS; et al ([bdubin@mednet.ucla.edu](mailto:bdubin@mednet.ucla.edu))

**PURPOSE:** Radiology residents are immersed in interesting cases that provide educational value to the resident, colleagues, ordering physicians, and patients. The purpose of this exhibit is to describe the rationale, benefits, challenges, and pitfalls of launching an interesting case competition for radiology residents.

**METHOD AND MATERIALS:** Radiology residents from our program were invited to submit cases for an interesting case competition (ICC). A standardized submission form and protocol was established by the ICC committee, which allowed applicants to submit de-identified patient medical images, histopathologic results, clinical data, and a literature review. Judges were selected by the ICC committee to anonymously review and score the submitted cases. Cash prizes were awarded to the top three finalists at the residency annual graduation ceremony.

**RESULTS:** Nine cases were submitted and scored by nine faculty judges. The combined average scores ranged from 2.95-4.47 out of a maximum total score of 5.00. Diagnoses of the winning cases included intracranial mature cystic teratoma, Type B interrupted aortic arch, and portal vein thrombosis with hemobilia. Residents expressed enthusiasm with regards to the cash prizes (1st place: \$150; 2nd place: \$100; 3rd place: \$50) and the opportunity to publish cases in a teaching atlas. Residents who chose not to submit cases identified the relatively lengthy submission form with detailed instructions as their greatest barrier. Novelty of the competition and minimal advertisement by faculty may have also contributed to the relatively low number of submissions. In an effort to increase the number of submissions for future competitions, we plan to significantly reduce the amount of time required to submit cases, publicize winners of the previous competition, and encourage faculty to promote the competition to residents.

**CONCLUSION:** Interesting case competitions offer a rewarding educational experience to residents, provide an excellent forum for radiology departments to showcase resident contributions, and facilitate the creation of an institutionally-derived teaching atlas.

\* Faculty financial disclosures are located in the Faculty Index.

**(R-044) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Teaching Value Based Imaging Care in Radiology Residency: A Successful and Innovative Method**

Steffen Haider, *Columbia University, New York, NY*; Daniel Manson; Subani Chandra; Elise Desperito, MD ([ed2202@cumc.columbia.edu](mailto:ed2202@cumc.columbia.edu))

**PURPOSE:** The ACR's 3.0 Imaging Initiative, which began in 2013, is the initiative in radiology to provide value based imaging care, the goal of which is to move the focus of clinical work and reimbursement from the amount of work (volume based care) to more focus on the quality and type of care that is given by radiologists. The skills needed to become a radiologist who provides value to a medical team must be taught during radiology residency training.

**METHOD AND MATERIALS:** The radiology program director and one of the internal medicine associate program directors created a planning committee, which also included chief residents from both specialties, to develop a joint internal medicine/radiology conference. A total of 8 conferences was planned, scheduled 1 per month for the 2017-2018 academic year. The topics chosen for the conferences included common clinical presentations such as change in mental status and back pain. Based on the topic of the conference, the chief resident from internal medicine chose a patient currently or recently on clinical service with an interesting case presentation. An internal medicine resident and a senior radiology resident (R3 or R4) then worked together to design the 60 minute conference. The week prior to the actual conference, the presenting residents rehearsed the case in front of the program directors who gave them feedback regarding teaching points to highlight and the overall organization and content. An internal medicine and a radiology resident worked together to create 3 questions for the pre- and post-test given at the beginning and immediately after the conference.

**RESULTS:** Data was collected and analyzed from the pre and post tests given for 7 of the 8 conferences. The overall p value for both medicine and radiology residents was <0.01.

**CONCLUSION:** No prior publications describe this type of interdisciplinary, interactive, resident run, conference between internal medicine and radiology residency programs. This conference provides the radiology resident the opportunity to practice his/her public speaking skills, discuss imaging options, describe ACR appropriateness criteria, explain imaging findings, and thereby develop the skills of a true consultant integral to the medical team.

**(R-135) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #4**  
**Radiology Oncall: The Menu is Broader Than Just Bread and Butter!**

Charles Ko, *Einstein Medical Center, Philadelphia, PA*; Ryan J. Smith, MD; Peter S. Wang, MD; Ryan K. Lee, MD; Brett Cerniglia ([kocharle@einstein.edu](mailto:kocharle@einstein.edu))

**PURPOSE:** The number of advanced CT studies ordered by the emergency department (ED) has been postulated to be growing at a rate disproportionate to the basic CT studies, though no formal review has been performed until now. The aim of this study is to confirm that this perceived disproportionate growth of advanced CT imaging exists and to gauge the residents' comfort level for interpreting advanced CT imaging on call.

**METHOD AND MATERIALS:** Our institution is an independent academic medical center in an urban setting as well as a level 1 trauma center and stroke center. The total number of ED CTs from January 2014 to August 2018 was reviewed. Nine studies are divided into two categories: advanced and basic. RVU cutoff of 2.0 was used to separate basic from advanced imaging. With this definition, advanced studies include: CT C/A/P, aortic dissection, runoff CT angiogram, and CT GI bleed. Basic studies include: CT PE, CT abdomen/pelvis, and CT brain. Additionally, fifteen radiology residents were surveyed to rank their comfort level with interpreting the nine different studies on a scale of 1 to 10. A score of 10 indicated the most amount of comfort and a score of 1 indicated the least.

**RESULTS:** The average rate of advanced CTs ordered by the ED has increased six times as much as basic CTs. At this rate, by 2020 over 30% of the studies ordered by the ED will be advanced imaging. CT angio of the brain/neck has the steepest growth rate. A paired samples t-test was performed utilizing SPSS statistical analysis software to compare resident comfort level in reading advanced studies and basic studies. There is a statistically significant decrease in comfort level for advanced studies (M = 5.8, SD = 2.3), when compared to basic studies (M = 7.2, SD = 2.1) conditions;  $t(14) = 4.5, p = 0.001$

**CONCLUSION:** The number of advanced CT studies ordered by the ED is growing at a disproportionate rate compared to basic CT studies. However, radiology residents feel the least comfortable interpreting advanced studies while on call. Therefore, training programs preparing residents to take independent call should be aware of the growth trend and ensure their residents are adequately prepared to interpret advanced CT studies.

**(R-136) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #9**  
**Customizable Call Prep: Modality-Specific Resident Competency Assessment Using an Online Call Simulator**

Kevin D. Hiatt, MD; Frederick S. Jones, MD, *Wake Forest, Winston Salem, NC*; Valerie George; Carol P. Geer, MD ([fjsjones@wakehealth.edu](mailto:fjsjones@wakehealth.edu))

**PURPOSE:** There are existing tools available for resident assessment; however, these do not allow for selection of the modalities included in the assessments and therefore are difficult to tailor to unique call structures of different programs. This project's purpose is to provide quantitative evaluation of resident competency before taking independent call using a web-based call simulation and assessment tool that is modality-specific.

**METHOD AND MATERIALS:** Over the past two years we have built a call preparation website that now includes over 1,300 DICOM cases. The self-assessment tool was built on this existing platform. With subspecialty attending oversight, modality-specific lists of "must see" diagnoses were matched with cases of varying difficulty either from cases already on the website or from our internal PACS. Cases from our PACS were anonymized and uploaded to the website. For each unique radiologic study, a nested list of multiple choice questions was developed to provide a binary objective assessment of the range of potential pathology on any given study. Each case also includes a "preliminary report" form where residents type a brief conclusion. Cases were then randomized and combined into one assessment (~110 cases) which ten junior residents will take this November. After completion, residents will have access to their scores, their answers, and the correct answers. Residents will also have access to write ups for the cases, including findings, diagnosis, a sample report, and a discussion. Assessment results will be provided to our program director, who will discuss the results during individual meetings with residents prior to the start of call. Assessment results will also be provided to the Clinical Competency Committee (CCC).

**RESULTS:** Results from this assessment will be in our final presentation. In addition, residents will complete a survey to evaluate the assessment's usefulness and these results will be included in the final presentation.

**CONCLUSION:** Our tool enables modality-specific online resident call assessment, which is easily customized to the unique call structures of different programs. We anticipate this will be a useful learning tool and facilitate resident call preparation.

\* Faculty financial disclosures are located in the Faculty Index.

(R-137) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #9

**Collaboration, Collegiality, and Sharing of Resources: Innovation of a Visiting Professor Exchange Program Between Academic Institutions**

Biren A. Shah, MD\*, *Virginia Commonwealth University Health, Richmond, VA*; Janice Y. Jeon; Erin P. Crane (*bshah728@gmail.com*)

**PURPOSE:** The aim of this study is to determine the effectiveness of a visiting professor (VP) exchange between two academic radiology departments by asking the residents and faculty at both institutions to complete an anonymous survey.

**METHOD AND MATERIALS:** A VP exchange program was created between two academic university hospitals based on a cooperative inter-institutional arrangement whereby a breast imaging faculty member from the visiting institution travels to a host institution to provide a VP lecture on a topic on breast imaging to the radiology residents and faculty, tour the breast imaging facilities of the host institution, and meet with the faculty radiologists at the host institution. Three faculty members from each institution will have participated in this lecture exchange program. A survey was given to the radiology residents and a separate survey was given to the VP. The surveys were collected and sent to the PI for data analysis.

**RESULTS:** Results to date, reflecting 83% completion of this project, have resulted in 63 resident respondents. The final lecture will conclude in 11/2018. 85% or greater of residents indicated they enjoyed having a VP, learned something new and clinically applicable, learned something relevant for ABR board preparation, and was a great addition to their current lecture series. 100% of faculty strongly agreed/agreed they enjoyed giving a presentation, touring the host institution facilities, meeting the host faculty, and want to participate in the exchange program again.

**CONCLUSION:** Resident education aims to develop physicians who will excel in practice and board examinations. Diagnostic radiology curriculum is often limited to that particular institution and its respective faculty. By developing a collaborative inter-institutional faculty lecture exchange program, residents can be exposed to additional didactic topics and experts, to strengthen, supplement, and diversify their learning experience. In addition, the faculty participants in the lecture exchange have opportunity to meet the host faculty. The data thus far supports that a collaborative inter-institutional faculty lecture exchange program is viewed highly favorably by both residents and attending radiologists.

(R-138) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #3

**Operator Experience Associated with Lung Biopsy Outcomes: A Cross-Sectional Study of Diagnostic Radiology Residents - Does the Level of Training Matter?**

Ken E. Schmanke, *University of Kansas School of Medicine-Wichita, Wichita, KS*; Rosalee Zackula; Zach Unruh; Wesley A. Burdick; Jesse Trent; Kamran Ali, MD

**PURPOSE:** Efficient execution of image-guided percutaneous biopsy is a procedural competency milestone in both diagnostic and interventional radiology training. Despite importance of achieving such mastery, literature on its attainment or the effect of resident experience level on outcomes is limited. The purpose of this study was to evaluate resident performance as measured by nondiagnostic (ND) and complication percentages, on CT-guided transthoracic core needle biopsies (TTNB) of the lung.

**METHOD AND MATERIALS:** A 12-year retrospective cohort study was conducted using charts from an academic hospital, 2006-2018, to evaluate TTNBs. Inclusion criteria were  $\geq 18$  years of age and  $\geq 1$  follow-up CT scan and chest x-ray. Complications were classified according to the Society of Interventional Radiology Guidelines. Variables were region, patient position, approach, needle gauge, number of cores, lung parenchyma and total tissue traversed by needle, and lesion size.

**RESULTS:** Reviews included 1,317 charts; 126 were excluded in cases where a resident did not participate or the patient enrolled in another study. Of the 1,191 cases 53% were male, 47% female; average age, 67 years; median lesion size, 3.2 cm. A total of 51 residents conducted biopsies under supervision. Case distribution was 41%, 26%, 18%, and 15% for PGY2-5, respectively. Incidence of ND outcome was 11.7%. Results showed 139 ND cases, 218 benign, and 834 malignant. Resident year by ND outcome was not significant;  $p=0.430$ . Incidence of major complication was 12.4%; 143 were pneumothoraxes requiring intervention. Incidence by PGY2-5 was 13.0%, 13.3%, 12.9%, and 9.2%, respectively. Results were not significant by resident experience;  $p=0.488$ . Of 87 cases re-biopsied, 39% ND and 18% benign cases were reclassified to malignant. 95 ND cases were not re-biopsied.

**CONCLUSION:** Of 1,191 biopsies analyzed, nearly 12% were ND and approximately 12% had major complications; neither associated with resident level of experience. Results suggest outcomes are not significantly affected by level of training. Programs may benefit from affording opportunities for younger PGY classes to participate in procedures. ND cases may benefit from repeat biopsy procedure.

\* Faculty financial disclosures are located in the Faculty Index.

## Health Services for Radiology

**(R-046) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

### **Trends and Predictors of Imaging Utilization by Modality: A 13-Year Single-Institution Study**

Kelvin L. Chan, *Ohio State University Medical Center, Columbus, OH*; Mina S. Makary, MD; Luis Perez Abreu, MD; Barbaros S. Erdal; Luciano M. Prevedello, MD; Xuan V. Nguyen, MD\*, PhD (*Kelvin.Chan@osumc.edu*)

**PURPOSE:** Assess trends and demographic predictors of imaging utilization at a university-affiliated health system.

**METHOD AND MATERIALS:** In this retrospective study, a listing of all system-wide clinical encounters in the study period (2004-2016) containing gender, age, race/ethnicity, and encounter year was obtained from the electronic medical record. Using custom programming in Python 3.6.1, this was merged with a listing of diagnostic radiology encounters (N = 6,157,303) in the study period to create a de-identified dataset of 1,628,980 unique patients containing demographic variables and counts of each imaging modality type by year. In a given year, patients with  $\geq 1$  clinical encounter in that year are defined as active. We calculated per capita imaging utilization as mean number of imaging studies per active patient per year. Subgroup analyses were performed.

**RESULTS:** Over the 13-year period, total diagnostic exams rose 6.8% a year (285,947 to 622,196 exams per annum), while the active population size grew 7.0% a year (244,238 to 543,290 active patients per annum). On a per capita basis, utilization peaked in 2007 at 1.33 studies/patient/ year before dropping to approximately 1.06 from 2011 to 2015. In 2016, per capita utilization was 0.22 for CT, 0.10 for MR, 0.20 for US, 0.03 for NM, 0.51 for radiography, and 0.07 for mammography. Compared to 2004, ultrasound utilization doubled, whereas NM utilization decreased by almost half and radiography utilization decreased slightly. CT, MR, and mammography showed no significant change. Three-way ANOVA of annualized per capita diagnostic imaging utilization showed statistically significant effects of gender, race/ethnicity, and age ( $p < 0.0001$ ). Utilization was higher in males than females. Blacks had higher utilization than non-Hispanic whites, and Asian/Pacific Islanders and Hispanics had lower utilization than non-Hispanic whites. Utilization increased progressively with age, except for a decline after age 75.

**CONCLUSION:** Per capita utilization peaked in 2007, with subsequent decline in later years, concordant with national survey-based data. Utilization varied significantly by age, gender, race/ethnicity, and modality.

**(R-047) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

### **Preparing Radiologists for Medication Administration: Creation of a Comprehensive Radiology Medication Online Resource**

James W. Davis, MD, *University of Michigan, Beverly Hills, MI*; David Bloom; Peter J. Strouse, MD (*jwdavis11@gmail.com*)

**PURPOSE:** This project evaluates radiology trainee preparation for administering medications, with the primary focus on acute anaphylactoid reactions to contrast media. Additionally, the project evaluates the impact of a comprehensive radiology medication website on trainee competence and confidence.

**METHOD AND MATERIALS:** A survey was sent to ACGME accredited radiology programs for voluntary participation. Trainees were asked to provide PGY level, but no additional identifiers were used. Participants provided answers to two clinical scenarios pertaining to management of acute contrast reactions in adults and children. Subsequent questions asked the participants to rate their confidence with medication protocols commonly used by radiologists, and how long it would take

to look up unknown information. They were then asked what source or combination of sources they would reference in these situations. Participants were introduced to RadMeds.com and given 3 months to become familiar with the website. A similar survey will be sent to assess trainee competence and confidence at that time.

**RESULTS:** 84 radiology trainees participated in the survey, accounting for 168 case scenarios. In these scenarios, 28/168 (17%) potentially lethal doses of Epinephrine were chosen. 35/84 (42%) participants treated both cases incorrectly, 13 of whom were very confident or confident in their ability to manage anaphylactoid reactions. 5/84 (6%) participants treated both cases correctly. 19/84 (23%) indicated that it would take them more than 3 minutes to locate the information to manage a contract reaction. 47/84 (56%) indicated that it would take them more than 3 minutes to locate information regarding IR medications. 53/84 (63%) indicated that it would take them more than 3 minutes to locate information to prepare for joint injections. No individual resource was identified that would assist in all situations, rather trainees listed multiple resources which they would reference.

**CONCLUSION:** Many trainees are not adequately prepared for medication administration and may make harmful decisions as a result. We believe that introduction of the website RadMeds.com will assist in trainee preparation, potentially decreasing administration errors.

## Informatics

**(R-052) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

### **Electronic Communication for Improved Wet Read Efficiency**

Hayden A. Salts, MD, EVMS, *Norfolk, VA*; Sarah Shaves, MD

**PURPOSE:** The purpose of this study was to determine if providing a direct electronic form of communication between the radiology department and the ED would improve efficiency, accuracy and speed of wet read notification.

**METHOD AND MATERIALS:** Prior to this study, the on-call the radiology resident was responsible for notifying the ED physician of a wet read through an ED receptionist. This process was fraught with inadequacies; the radiology resident could be on a long hold and the added possibility of error in the wrong wet read being assigned to the wrong patient. The radiology department proposed integrating its communication algorithm through a notification system in the electronic medical record instead of relying on the ED receptionist. Before making any changes in the algorithm, six weeks of call logs between the emergency department and the radiology resident call room were obtained and reviewed. This data was tabulated and used as a control. After the integration, data was logged for an additional six weeks. A survey was sent out to the eight radiology residents that served in the call pool as well as the ED residents and attendings.

**RESULTS:** A total of 810 phone calls were made to the SNGH ED during the six-week preintervention period, average of 19.3 per night. In the six weeks after the intervention, this number dropped to 106, average of 2.6 per night. This was an 87% drop in number of calls. The duration of time on the phone also decreased by 38%. Eight of the radiology residents responded to the survey, 71% said they felt like they spent less time communicating noncritical findings. Twenty-two ED physicians responded to the survey 69% felt there was no change in the time getting a read and 41% felt it was faster.

**CONCLUSION:** After the intervention, there was a modest drop in number and duration of calls which improves the efficiency of the radiology resident. The post survey demonstrated the radiology resident feeling less encumbered by phone calls to the ED. The ED felt that this system improved their turnaround time or kept it the same.

\* Faculty financial disclosures are located in the Faculty Index.

## Interventional Radiology

**(R-056) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Medical Student Knowledge and Interest in Interventional Radiology Following a Rotation Integrated in the Surgery Clerkship: Survey Results**

Mark G. Kleedechn, MD, *University of Wisconsin, Madison, WI*; Orhan Ozkan; Ann O'Rourke; Michael Woods; Paul Laeseke (*mkleedechn@uwhealth.org*)

**PURPOSE:** To evaluate how early exposure to interventional radiology (IR) affects medical students' knowledge and interest in IR and diagnostic radiology.

**METHOD AND MATERIALS:** IR was integrated as an elective 2-week rotation in the surgical and procedural care block as part of the 2nd-phase of our new medical student curriculum, which begins in the spring of students' second years. Students were required to write inpatient consult notes, round on inpatients, present in rounds, see patients in clinic, attend multidisciplinary conferences, and review background materials about IR patient care, procedures, and training pathways. Pre and post-rotation surveys were e-mailed to students to gauge their knowledge and interest in interventional and diagnostic radiology. We hypothesized that students' interest and knowledge would increase following their rotations.

**RESULTS:** 15/20 (75%) pre-rotation and 9/14 post-rotation (64%) students responded to the survey. 71% of pre and 89% of post students knew IR had its own new residency program. 47% of pre and 60% of post students knew integrated IR residency was a new training pathway. 33% of pre and 55% of post students knew ESIR was a new training pathway. 33% of pre and post students knew independent IR residency was a new training pathway. 33% of pre and 55% of post students knew IR had admitting privileges at our hospital. 33% of pre and 78% of post students knew IR had a clinic at our hospital. Levels of interest in becoming an IR were zero (0% pre, 0% post), low (33% pre, 22% post) moderate (40% pre, 33% post), high (20% pre, 44% post), and extremely high (7% pre, 0% post). Levels of interest in becoming a diagnostic radiologist were very low (0%), low (60% pre, 22% post) moderate (27% pre, 33% post), high (7% pre, 11% post), and extremely high (7% pre, 11% post).

**CONCLUSION:** Medical students with an IR rotation in their second and third years gained an appreciation for IR as a clinical specialty. Knowledge of IR residency improved with the rotation, but knowledge of the specific training pathways remained relatively low. Students were more likely to rate their interest in pursuing IR and diagnostic radiology as high or very high following their rotations.

## Musculoskeletal Radiology

**(R-149) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #6**  
**MRI Occult Meniscal Tears of the ACL Deficient Knee: Characterization of Occult Meniscal Tears and Association with Medial Femoral Condyle Rim Bone Contusions**

Nicholas P. Fleege, *University of Iowa Hospitals and Clinics, Iowa City, IA*; Darus L. Bennett, MD, MA; Kenjiro Ohashi, MD; Howard O'Rourke, MD (*nicholas-fleege@uiowa.edu*)

**PURPOSE:** Identifying meniscal tears by MRI, specifically lateral meniscal tears, has a larger than expected error rate in the presence of an anterior cruciate ligament (ACL) tear. The purpose of our study was to search for a bone contusion that is associated with occult meniscal tears with a concomitant ACL tear, specifically a contusion of the rim of the medial femoral condyle (RMFC). We also categorized the type, size, and location of these occult meniscal tears, and the sex of the patients with these tears.

**METHOD AND MATERIALS:** This was a retrospective study that examined characteristics of occult meniscal tears and their association with an RMFC contusion. Institutional Review Board (IRB) approval was obtained. The date range of the study was from June 2009 through December 2015. A total of 6,392 knee MRI reports were reviewed. The study group included 22 patients; the control group included 110 patients. Relevant statistical values were calculated.

**RESULTS:** The most common type of occult meniscal tears were small radial and small longitudinal tears of the posterior horn of the lateral meniscus. Occult meniscal tears were associated with RMFC contusions in the study group ( $p=0.0457$ ), particularly in males ( $p=0.0003$ ). In males with a torn ACL, the sensitivity of an RMFC contusion for an occult meniscal tear was 80%.

**CONCLUSION:** In males with an ACL tear, there was a significant association between a contusion of the RMFC and an occult meniscal tear (commonly small radial or peripheral tears). RMFC contusions were reliably identified by radiologists in this study.

\* Faculty financial disclosures are located in the Faculty Index.

# AUR 2019 Instructional Poster Abstracts

Instructional posters are located in Key Ballrooms 7-8. Each poster will be presented by its author during one of the *AMA PRA Category 1 Credit™* poster sessions scheduled for 7:00-8:00 AM, Wednesday (Session 201) and Thursday (Session 301). The day and time for each poster presentation follow the presentation number. Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (medical students, residents, or 1st- year fellows) are noted in **blue**.

## Abdominal Radiology

### (E-001) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster Daily Case Review With Attendings Is the Most Effective Learning Experience According to Residents - A Unique 10 Step Approach to Daily Case Review

Gregory Ngo, DO, *Robert Wood Johnson Medical School, Scotch Plains, NJ*; Francis Kang; Jeffrey S. Kempf, MD; Judith K. Amorosa, MD

**LEARNING OBJECTIVES:** --Residents will be able to organize case review with attending radiologists according to a simple 10 step process. --Residents will understand the seldom discussed required steps in order to be prepared for review with the attending radiologist, including an approach to reviewing, analyzing cases, how to be helpful during readouts and how to get the most out of every case. --Residents will learn how to expedite case review by employing current technology for the review process with access to EMR, previous images, reference materials, guidelines and other learning materials.

**CONTENT DESCRIPTION:** Residents were surveyed about methods of learning radiology. Choices included books, articles, conferences, consulting with other residents, consulting with clinicians, review courses, group sessions, and daily case reviews. Daily case reviews was ranked highest as a method of learning radiology. Because of the importance of daily case review with attendings, we analyzed the various components of preparation for case review based on our faculty's experience and on the experience of two organized, technically advanced residents who introduced a new methodology into an established traditional learning method. 10 components of preliminary preparation for case review were analyzed: 1. Clinical indication 2. Relevant medical/surgical history 3. Preview images of current imaging exam 4. Review of prior imaging exams 5. Review of prior exam reports if available 6. Review current study, including creating a preliminary report with a suggested diagnosis 7. Readout with attending 8. Discussion of diagnosis, differential considerations, recommended additional confirmatory imaging exams 9. Point of care references, consulting guidelines, ACR AP, white papers 10. Summary of review by resident and attending We trained our residents through conference and hand-outs to adopt the 10 step daily review, followed by evaluation of the new method by residents and faculty.

### (E-002) Thursday • 7:00 AM - 8:00 AM • Hard copy poster What's Behind Your Reflection? A Multimodality Approach to Evaluation of Anorectal Disease

Daniel Hynes, *Baystate Medical Center, Springfield, MA*; Nicolas Vassel; Tara M. Catanzano, MD

**LEARNING OBJECTIVES:** Anorectal disease poses challenges to clinicians and radiologists alike due to the broad range of imaging characteristics on presentation. Anorectal disease encompasses a spectrum of inflammatory fistulous/abscess disease, pelvic floor disorders and malignant processes of the anus and rectum. Complex anatomy and tissue planes below the peritoneal reflection poses challenges for evaluation of posterior pelvic organs, particularly in the inflamed state. Utilising Ct and MRI we evaluate the spectrum of anorectal disease in a pictorial analysis highlighting key features and diagnostic patterns of each disease process

**CONTENT DESCRIPTION:** Review pathophysiology of anorectal disease and anorectal malignancy. Discuss epidemiology, predisposing risk factors, distinctive imaging characteristics of benign and malignant anorectal disease and complications. Focused discussion on rectal carcinoma (adenocarcinoma, Squamous cell carcinoma) and inflammatory disease of the anorectum – ulcerative colitis, crohn's disease, fistulous disease and anorectal abscess. Multimodality review of imaging to include, CT and MRI with sample cases and advantages of the individual modalities. Discuss current ACR appropriateness criteria for imaging, current management guidelines and follow up recommendations. Accurate characterisation of inflammatory, infectious, neoplastic and tumor like disorders of the rectum and anal canal is imperative to provide the best service to our patient. Understanding the disease process aids in examination modality choice to attain high yield information. While the anatomy is complex, a sequential, logical and reproducible step wise approach to evaluation of the posterior pelvic organs can reduce indecision and anxiety felt by clinicians and radiologists alike when these cases are encountered

### (E-101) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #1 Taking Consensus Guidelines to the Frontlines: An Illustrative Guide to Reporting MR Enterography in Patients with Small Bowel Crohn's Disease

Shanna A. Matalon, MD, *Brigham and Women's Hospital, Boston, MA*; Leslie K. Lee, MD; Ramin Khorasani, MD, MPH (*smatalon@bwh.harvard.edu*)

**LEARNING OBJECTIVES:** 1. Understand the typical demographics and pathophysiology of Crohn's disease 2. Recognize features of active inflammatory disease 3. Identify the presence of and grade severity of stricturing disease 4. Distinguish between different types of penetrating disease 5. Develop a checklist for extraintestinal manifestations

**CONTENT DESCRIPTION:** 1. This instructional education poster will serve as an illustrative guide for interpreting MR enterography in patients with small bowel Crohn's disease (SBCD) 2. Introduction: Background about Crohn's disease and role of MR enterography in diagnosing, assessing severity and phenotype and treatment response in patients with SBCD 3. Illustrative review of the findings associated with active inflammatory disease, stricturing disease and penetrating disease and how to grade severity 4. Review of extraintestinal findings associated with Crohn's disease (such as sacroilitis) or treatment of Crohn's disease (such as femoral avascular necrosis from steroids) 5. Case examples with an easy to use templated report

### (E-102) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #5 Classic Hepatobiliary Scintigraphy with a Twist

Blake Haas, *University of Kentucky, Lexington, KY*; Riham El Khouli, MBBS, MD; M. Elizabeth Oates, MD (*beha245@uky.edu*)

**LEARNING OBJECTIVES:** 1. To understand the expected biodistribution of Tc-99m IDA in the hepatobiliary and gastrointestinal (GI) systems. 2. To describe classic patterns and characterize diagnostic features of various conditions on dynamic and static planar scintigraphy in adults and children. 3. To recognize potentially misleading artifacts and unexpected findings that may be clinically relevant.

\* Faculty financial disclosures are located in the Faculty Index.

**CONTENT DESCRIPTION:** I. Overview: mechanism and pharmacokinetics of Tc-99m IDA localization. II. Review: typical hepatobiliary scintigraphy protocols. III. Each case: history, image(s), diagnosis, discussion, pearls or pitfalls. IV. 12 representative cases: 1) Normal hepatobiliary system with incidental pelvic kidney; 2) "Hot" liver lesions (focal nodular hyperplasia); 3) "Cold" liver defect (Left Ventricular Assist Device); 4) "Cold" liver defect (patient's hand); 5) Heterotaxy and biliary atresia (neonate); 6) Common bile duct obstruction with renal transplant; 7) Allograft with intermittent bile leak (serial scans); 8) Two-compartment gallbladder: one dysfunctional, one functional (CCK); 9) Type 1 choledochal cyst; 10) Marked enterogastric bile reflux (normal stomach); 11) Marked bile reflux into esophagus after Billroth surgery; 12) Malpositioned small intestine (adult). V. Take-home highlights. VI. Selected references.

**(E-103) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #10**

**Demystifying MRI Rectal Cancer Staging: An Illustrative Guide**

Shanna A. Matalon, MD, *Brigham and Womens Hospital, Boston, MA*; Leslie K. Lee, MD; Atul Shinagare\*, Michael H. Rosenthal, MD, PhD; Francesco Alessandrino; Ramin Khorasani, MD, MPH; et al (*smatalon@bwh.harvard.edu*)

**LEARNING OBJECTIVES:** 1. Understand the key MRI sequences in rectal cancer staging, including the importance of obtaining oblique planes 2. Recognize pertinent anatomy (i.e. muscularis propria, anterior peritoneal reflection, mesorectal fascia, anal sphincter complex) for T and N staging 3. Review critical distinctions in T and N staging and treatment implications (such as T2 versus T3 disease and the relevance of inguinal lymph nodes in low rectal tumors)

**CONTENT DESCRIPTION:** 1 This instructional education poster will serve as an illustrative guide for MRI rectal cancer staging. 2. Introduction: MRI rectal cancer staging is highly important, as it dictates clinical management, including whether a patient may go straight to surgery or require neoadjuvant chemoradiation. However, it can be quite challenging, given the complexity of anorectal anatomy and rectal cancer staging system. 3. Review of pertinent anatomy, including illustrations and MRI images demonstrating relevant anatomy, including layers of rectal wall, anal sphincter complex, peritoneum and mesorectal fascia. 4. Review of important findings in T and N staging and implication in treatment planning, including troubleshooting common pitfalls, such as T2 versus T3 disease and the relevance of inguinal lymph nodes. 5. Summary of high-yield MRI sequences and how and why to obtain oblique planes

**(E-104) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #2**

**Ditch the Snail Mail! Integrating Free, Eco-Friendly 2018 Technology Into Fellowship Recruitment: How We Did It**

Julia G. Seol, MD, *Brigham and Womens Hospital, Boston, MA*; Daniel Souza; Stuart G. Silverman, MD; William W. Mayo-Smith, MD

**LEARNING OBJECTIVES:** The application process for non-Match fellowships often relies on paper systems fraught with inefficiencies and administrative challenges. Many programs continue to rely on hand-written forms, administrative assistants, postal services, and hard-copy documents. Millennial applicants expect tasks to be performed online and evaluate programs on their online presence. A user-friendly online application is therefore important to attracting top candidates. The purpose of this project is to describe the practical aspects and impact of implementing a paperless application system for non-Match fellowships.

**CONTENT DESCRIPTION:** For the 2020 fellowship year and prior to implementation of the new online system in May 2018, we received 8 application packages via mail, which consisted of an application form, personal statement, photo, CV, score reports, and 3 letters of recommendations (LORs). Upon receipt, our assistant scanned all documents and created hard-copy folders for each applicant. This process was burdensome and presented many opportunities for human and system error. We crafted an online form using the free form builder JotForm ([www.jotform.com](http://www.jotform.com)) for applicants to input data and upload files. This was integrated with the free cloud-based storage system Google Drive ([www.google.com/drive](http://www.google.com/drive)). With this setup, each applicant's data was automatically placed into individual folders and added to a database. We could then easily work with the data to systematically evaluate candidates. 50 candidates applied for 9 positions. For the 42 candidates who applied via the new system, the application was submitted entirely online except for LORs, which we received by mail and scanned into the candidates' digital folders. We created a slide for each candidate within a summary PowerPoint file, and used this for the admission committee's group discussions and candidate rankings. Once the application season concluded in July 2018, applicants were surveyed about their experience with the new system. Given the success of the system in its inaugural year, we intend to continue its use and create a process that can be adopted by other fellowships in our institution and other programs nationwide.

**(E-105) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #2**

**Image-Guided Atlas of Post-Surgical Anatomy**

Ryan S. Dolan, MD, *Emory University, Atlanta, GA*; Aarti Sekhar, MD (*ryan.dolan@emory.edu*)

**LEARNING OBJECTIVES:** Introduce a resource for teaching expected post-surgical anatomy to radiology residents, surgical residents, and medical students using cross-sectional imaging.

**CONTENT DESCRIPTION:** We are creating a web-based resource intended for radiology residents, as well as surgery residents and medical students, to familiarize them with normal (expected) anatomy following common surgeries using cross-sectional imaging (predominantly CT). Although many great textbooks and electronic databases exist for teaching normal anatomy, no centralized resource exists for teaching anatomy following surgery. For each surgery, annotated images and cine clips will demonstrate the major steps of the surgery using multiple examples in all three planes. This resource will be subdivided into sections, including hepatopancreatobiliary (e.g. Whipple, distal pancreatectomy and splenectomy, partial hepatectomy), bariatric/gastric, colorectal, genitourinary, and gynecologic. In addition, common complications will be highlighted to demonstrate important surgery-specific pathologies to consider.

**(E-106) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #7**

**Prostate Cancer MRI - What Residents Need to Know**

Dan I. Cohen-Addad, *Suny Downstate Medical Center, Brooklyn, NY*

**LEARNING OBJECTIVES:** Review MR imaging features of the normal prostate and key imaging landmarks. Describe multiparametric MRI features of prostate cancer and common pitfalls. Discuss the growing value of multiparametric MRI in prostate cancer work-up

**CONTENT DESCRIPTION:** Prostate cancer is the most common malignancy and the second most common cause of cancer-related death in men. Prostate cancer behavior is heterogeneous, from indolent tumor to aggressive ones. Leading to a need to estimate early the potential behavior. Epstein criteria (Gleason score  $\geq 7$ , volume  $>0.5$  cc, or extraprostatic extension) are suggesting of clinical significant

\* Faculty financial disclosures are located in the Faculty Index.

tumor that may need treatment, while clinically insignificant tumor may undergo active surveillance. With abnormal screening including elevated prostate-specific antigen (PSA) or digital rectal examination, non-targeted random transrectal ultrasound (TRUS)-guided biopsy is offered. Because the biopsy is non-targeted it may not accurately represent the aggressiveness of the tumors. MRI was traditionally used for treatment planning and monitoring with a locoregional staging of a biopsy-proven prostate cancer. However, with the emergence of functional sequences such as diffusion-weighted imaging [DWI], dynamic contrast-enhanced imaging [DCE], and MR spectroscopy, the localization and characterization of prostate cancer became more accurate. Further, with new standardize criteria such as the PI-RADS prostate, MRI became more approachable. We review the basic principle of mp MRI, including clinical application, prostate anatomy MRI features and common pitfalls (central gland, thickening of the surgical capsule, neurovascular bundle, Stromal BPH nodules, post-biopsy hemorrhage, prostatitis). Prostate cancer features and key imaging sequences used in the different anatomic location. As well as multiple examples of low-grade Gleason score which were upgraded by mpMRI. Mp MRI contributes to the evaluation of clinically significant cancer and more accurate clinical management. With its increasing usage, this review provides a foundation for prostate MRI.

## Cardiopulmonary

### (E-107) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #9

#### Diagnostic Value of the Lateral Chest Radiograph with Emphasis on the Crista Pulmonis

Megan Albertson, MD, *University of Nebraska Medical Center, Omaha, NE*; Matthew J. DeVries, MD

**LEARNING OBJECTIVES:** While participating in this activity the learner will: 1) Identify normal anatomic structures on lateral chest radiographs. 2) Recognize subtle clues to pathology on lateral chest radiographs by using defined landmarks. 3) Apply knowledge of normal anatomy and abnormal findings to multiple unknown cases to develop higher confidence in utilizing the lateral chest radiograph in real life practice.

**CONTENT DESCRIPTION:** Background & Purpose: Traditional teaching of lateral chest x-ray interpretation is often limited to basic hilar anatomy and abnormalities of the clear spaces, whereas more inconspicuous areas including the crista pulmonis (comprised of the infrahilar window, bronchus intermedius line, and the azygoesophageal recess) are often underappreciated and overlooked. Radiologists in training and in practice should be familiar with normal lateral chest radiograph anatomy and be able to detect subtle abnormalities, which could prevent delayed diagnosis and improve care for our growing patient population. This educational exhibit will review normal anatomy on lateral chest radiographs and will demonstrate the useful findings on lateral chest radiographs with emphasis on the crista pulmonis and other hiding places through multiple example cases. Key Findings: Important normal hilum anatomic structures on lateral chest radiographs include the bilateral upper lobe bronchi, bilateral main pulmonary arteries, bronchus intermedius, infrahilar window, and the azygoesophageal line. The more well known findings on lateral radiographs include obliteration of clear spaces, (retrosternal, retrocardiac, and Raider's triangle), the spine sign and the donut sign. Abnormalities of the crista pulmonis are often overlooked in search patterns and can be quite subtle. These findings include fullness of the infrahilar window, thickened bronchus intermedius stripe, and displacement or fullness of the azygoesophageal line/recess. Attention to these specific landmarks may provide early detection of posterior hilar adenopathy, pneumonias, or masses in patients who may not otherwise progress to CT imaging in a timely manner.

### (E-108) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #7

#### Improving the Quality of Sub-Optimal CT Pulmonary Angiography

Paul Fang; Hung Lin, MD; Prajakta Bhimalli, *SUNY Downstate Medical Center, Brooklyn, NY*; Stephen Waite; Jennifer Martino

**LEARNING OBJECTIVES:** First to understand how to evaluate the quality of a CT pulmonary angiogram, second to learn what are the factors that could potentially cause suboptimal quality, and third to learn how to modify CT pulmonary angiogram protocol to improve the quality of the study

**CONTENT DESCRIPTION:** Many pulmonary artery CT angiograms (CTPA) performed at our institution were suboptimal/nondiagnostic, therefore noninterpretable. This is a serious patient safety concern as pulmonary embolism (PE) is a common and potentially fatal, and CTPA is the standard for diagnosis. As nondiagnostic CTPA are a management dilemma, our objective was to determine the percentage of limited CTPA, etiology of limitations, and to devise strategies for improving diagnostic quality. A retrospective examination of 218 CTPA's between March 1st 2017 and May 31st 2017 was conducted to obtain a baseline percentage of suboptimal studies. All studies were reviewed for imaging quality by trained radiologists, and assessed for motion, contrast enhancement, noise, and artifact. Hounsfield Units (HU) of less than 200 measured in the main pulmonary artery (MPA) was considered suboptimal opacification. Potential contributing factors were identified and modified based on current literature recommendations. Subsequently, we evaluated 173 studies between January 1st and February 28th 2018 in the same manner. The percentage of CTPA with limited results in our institution was unacceptably high at 42%. After modifications, the percentage of limited CTPA was improved to 26.5%, a nearly 50% reduction. There remain non-modifiable factors, such as excessive respiratory motion, pre-existing cardiopulmonary disease, and body habitus. Further improvement may be achieved through caudal-cranial imaging acquisition and practicing breathing instruction prior to scanning.

## Education of Medical Students

### (E-004) Thursday • 7:00 AM - 8:00 AM • Hard copy poster

#### Medical Student Advisory Board: Mentoring for Success

Jeanne G. Hill, MD, *Medical University of South Carolina, Charleston, SC*; Seth T. Stalcup, MD; Leah C. Davis, DO; Milad Yazdani, MD; Brian Flemming; Meryle J. Eklund, MD; et al ([hillj@muscc.edu](mailto:hillj@muscc.edu))

**LEARNING OBJECTIVES:** Define the process and rationale for an advisory board for radiology residency applicants. Identify barriers to successful advising. Identify strategies to promote successful matching.

**CONTENT DESCRIPTION:** Given the inherent variation in the knowledge and experience of individual advisors, a single medical student may receive stellar, adequate, inadequate or even misleading advice about the radiology residency application process. To standardize and optimize the advising process, we developed a committee of radiology educators to mentor and advise those students considering applying to radiology residencies at a single institution. We will discuss some of the common material shared among committee members including national matching data, local matching data, characteristics of those who were both successful and unsuccessful in matching in the past, and templates for letters of recommendation. Based on three years of experience with this model, we will share barriers to successful advising and potential strategies to promote a successful match for every student. Finally, we will provide satisfaction and impact survey results from the students who have participated in the process.

\* Faculty financial disclosures are located in the Faculty Index.

**(E-005) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster****Transforming the Smartphone Into a Portable Attendance Tracking and Immediate Feedback Tool During Residency Training and Medical Student Elective**

Amanda B. Allen, DO, *University of Illinois at Chicago, Chicago, IL*; Jeffrey T. Kuwahara, MD; Zhihua Li; Yu-hui Huang, MS; Karen L. Xie, DO (*Karenlin@uic.edu*)

**LEARNING OBJECTIVES:** • Identify the benefit of a simple, efficient and effective method using a smartphone to track attendance for lectures, rotations, and activities. • Describe an immediate two-way feedback system incorporated into the attendance tracking tool for the evaluation of learners and teaching staff. • Demonstrate the simple implementation of the attendance tracking and immediate feedback tool which can be easily integrated to an established teaching curriculum.

**CONTENT DESCRIPTION:** The Radiology department at the University of Illinois provides training for 33 Radiology residents and hosts an average of 160 medical students each year for a required 4-week radiology clerkship. Traditional attendance has been done manually with sign-in sheets. Maintaining a record of lecture/conference attendance and monitoring the rotation participation requires a lot of administrative effort and time. In the age of digital technological innovations, we have integrated an easy to use smartphone applications with the ability to track attendance for both residents and medical students. One of these methods utilizes QR scanners for daily resident attendance at lectures. Each resident is provided an individual QR Code to scan with a mobile app before and up to 10 minutes after conference has started. This gives residents the responsibility of signing-in and attending conferences in a timely manner, which in turn encourages the conference participation and engagement. The second tool we developed utilizes Qualtrics software to build a survey form that operates on the smartphone. Daily attendance of scheduled rotation in different imaging sections are recorded by medical students with the verification by preceptors at the end of the day. In addition, immediate two-way feedback entry is implemented, allowing the preceptors to rank students' performance, and students to leave their comments on the teaching staff. The results can be viewed and analyzed easily at any time by medical education staff. This process fosters more frequent direct feedback and evaluations throughout the rotations for both students and preceptors.

**(E-006) Thursday • 7:00 AM - 8:00 AM • Hard copy poster****Integrating Longitudinal Learning of Radiology into the Preclinical Medical Education Curriculum**

Jeffrey T. Kuwahara, MD, *University of Illinois, Chicago, IL*; Amanda B. Allen, DO; Yu-hui Huang, MS; Karen L. Xie, DO (*karenlin@uic.edu*)

**LEARNING OBJECTIVES:** • Describe the integrated radiology curriculum to improve the preclinical medical education through radiological-pathology and radiological-anatomy correlation, and teaching the effectiveness and utilization of imaging as an essential diagnostic tool. • Analyze the effectiveness of the integrated radiology curriculum to improve medical students' understanding of the vital role of radiologists and diagnostic imaging in patient care, and to increase the interest of radiology as a career choice among specialties.

**CONTENT DESCRIPTION:** In 2016, the University of Illinois College of Medicine began an overhaul of the medical school curriculum, to integrate the basic, clinical and social sciences with the goal of preparing the new generation of physicians to meet the evolving challenges and demands of health care. The new curriculum is structured through longitudinal learning in three phases: the preclerkship, the core clerkships,

and the advanced clerkships. Our radiology department has the opportunity to contribute to the teaching of radiology throughout all three phases with the development of an integrated longitudinal radiology course. The replaced 'legacy' curriculum introduced radiology during the M4 years, which is an elective with the disadvantage of limited and late availability to the students. With the new curriculum, radiology content is integrated with organ system based block schedules during the preclerkship years. Exposure to radiology during the preclinical years has enhanced the learning of anatomy and pathophysiology through visualization of the normal and pathological conditions via multimodality imaging. Introduction of the utility of imaging as diagnostic tools enhances the learning of effective clinical practice and increases the students' interest of radiology as a specialty career choice. To bring radiology from the dark room to the classroom, a combination of online learning modules, pre-recorded video presentations, and live lecture and workshops were developed and taught by radiologists, focusing on providing radiology correlations with pathology and anatomy, as well as teaching how imaging is an important diagnostic tool for clinical care.

**(E-007) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster****To Be An Osteopathic Resident - Does It Make a Difference?**

Nassier Harfouch, MD, *Staten Island University Hospital Northwell Health, Staten Island, NY*; David S. Sarkany, MD; Mark Raden; Berenice Lopez Leal; Danielle Delre, DO (*dsarkany@northwell.edu*)

**LEARNING OBJECTIVES:** 1) Describe osteopathic and allopathic students' perceptions towards the radiology residency application process for osteopathic students. 2) Assess if type of degree (DO or MD) affects the residency work environment. 3) Discuss possible changes in perceptions by current radiology residents about an osteopathic vs allopathic degree.

**CONTENT DESCRIPTION:** There has been a large rise in graduating seniors from osteopathic medical schools applying and entering ACGME radiology residencies in the past recent years with mixed reaction by residency programs. Anecdotally, there are views which consider osteopathic students less competitive than allopathic students. A survey was sent to both current allopathic and osteopathic radiology residents/fellows to assess if there is a "prejudice" against osteopathic residents during the interview process or even during residency. We believe the information gleaned from this survey will be very important in understanding radiologists' perceptions, and possible misconceptions, while developing a more cohesive group of radiologists in the USA and world.

**(E-109) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #5****SAFE - A Scaffold Curriculum to Teach Safe, Appropriate, Timely, and Value Based Imaging to Medical Students**

Janet A. Neutze, MD\*, *Hershey Medical Center, Hershey, PA*; Allene S. Burdette, MD; James M. Brian, MD; Pamela L. Brian, MD; Patrick J. Chiarolanio, BA; Alison L. Chetlen, DO (*jneutze@pennstatehealth.psu.edu*)

**LEARNING OBJECTIVES:** To create an organized, easily remembered scaffold- approach curriculum to teach safe, appropriate, timely and value-based imaging to medical students.

**CONTENT DESCRIPTION:** When surveyed, medical students indicate that their motivation for taking radiology electives is to learn how to interpret imaging studies. For some, this is done with the intent of becoming a radiologist. For others, it is done with the intent of learning "basic" radiology that can be used during the course of their practice, regardless of specialty. Classic radiology electives have been created to meet this

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expectation, with students spending time at view boxes, learning radiologic anatomy and looking at unknown radiology studies. An important element of radiology education that has not been previously stressed to students has come to the forefront with increased public awareness of the need to reduce unnecessary radiation and other imaging exposure and to contain costs incurred as a result of clinically unnecessary imaging. Addressing this need will provide students with knowledge and skills to be able to choose the safest and most appropriate imaging examinations now and in future practice. The Radiology Medical Student Education directors have refined the goals of the Diagnostic Radiology medical student electives to not only fulfill the students' educational expectations, but also to provide them with a skill-set that will be relevant to all medical specialists, knowing that all physicians will use imaging in their subsequent practices. Addressing these goals brought about the creation of the program with mnemonic SAFE: Safety -Appropriateness-(Interpreting) Films- Expedite and Execute (please see figure for elaboration). We stress that the rationale for imaging choices should be applied in that order; that is, without safety and appropriateness practiced FIRST, even the best imaging interpretation may not result in the indicated and desired value-based health care we are striving to provide. We have designed this program to align with the American College of Radiology's "Imaging 3.0" goals of providing appropriate, timely and value-based imaging to all patients and for all clinicians.

**(E-110) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #2**

**It Takes a Village: A Multi-Faceted Approach to Engaging Medical Students and Improving Radiology Recruitment**

Erin N. Gomez, MD, *Johns Hopkins University School of Medicine, Baltimore, MD*; Christopher R. Bailey, MD; Robert P. Liddell, MD; Brian Holly; Donna Magid, MD, MEd; Lilja B. Solnes, MD; et al ([egomez8@jhmi.edu](mailto:egomez8@jhmi.edu))

**LEARNING OBJECTIVES:** • Evaluate recent trends in the number of medical students applying in Radiology • Detail efforts made to improve medical student recruitment

**CONTENT DESCRIPTION:** Since 2010, the number of radiology applicants at our institution has comprised less than 5% of the graduating class. However, in 2018, the number has tripled. Although external factors may influence the number of students pursuing radiology, our department has made significant efforts to improve recruitment.

**Interactive Didactics**

Anatomy lectures were changed to interactive sessions led by faculty, engaging students in image interpretation. A hands-on body CT lab was incorporated into the radiology elective, where students interpret cases independently at the workstation followed by review with faculty.

**Interest Groups & Networking Events**

Medical students have had increased interaction with radiology residents through the Radiology Interest Group, which features "hot seat" sessions showcasing residents' skills. A happy hour style Career Night demonstrates the breadth of subspecialty practice with tables staffed by each division. In 2013, a dedicated IR interest group was formed which includes networking events, expert panels, and funding for travel to conferences.

**Research, Clinical Experiences and Quality Improvement**

Radiology research projects were offered to first year students as part of the Scholarly Concentrations program. IR began offering a dedicated sub-internship and a medical student symposium with didactics and hands-on skills stations. Students were invited to collaborate on research about reducing unnecessary imaging in the High Value Practice Academic Alliance.

**Peer Mentoring**

An increased presence in the medical school has afforded radiology residents more opportunities to mentor students and offer guidance about clinical rotations, the residency application process, and research.

These efforts have provided medical students with early exposure to radiology and demonstrate faculty and resident investment in their success. We feel that these improved educational, clinical and professional experiences have contributed to the increased number of radiology applicants at our institution.

**(E-111) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #1**  
**Achieving a Collaborative Focus within POCUS Education**

Michael B. Groswald, *Indiana University School of Medicine, Indianapolis, IN*; Brandon P. Brown, MD, MA ([brpbrown@iupui.edu](mailto:brpbrown@iupui.edu))

**LEARNING OBJECTIVES:** 1. Comprehend the necessity of multidisciplinary collaboration as a vital ingredient in point of care ultrasound (POCUS) education for medical students. 2. Outline the steps required for a successful multidisciplinary POCUS education. 3. Identify methods to enhance collaboration within ultrasound education, and identify the role of radiology within this model.

**CONTENT DESCRIPTION:** While much ink has been spilled in the medical literature regarding POCUS, determining how radiologists can best collaborate with non-radiology physician colleagues has been less studied. While some have attempted a competitive approach, it is possible that the best training for the next generation of physicians will be found through multidisciplinary collaboration. This presentation describes our experience in meeting the need for ultrasound education across nine medical campuses in the state of Indiana. A medical student-led planning committee was organized to develop a multi-center, live-streamed ultrasound learning initiative impacting over 250 students at the Indiana University School of Medicine. A partnership between Radiology, Critical Care, and Emergency Medicine faculty highlighted the potential of ultrasound to teach anatomy and pathology across organ systems. Didactic components were combined with interactive live scanning to enable students to practice ultrasound techniques using student models. Our experiences highlight how POCUS education can add value for students in their clinical work, enhance appreciation for the diverse applications of ultrasound, and cultivate productive relationships among the involved specialties. This presentation outlines the steps we took to accomplish our initiative through in-depth interviews with the multidisciplinary participating faculty. We review the necessary resources for a successful, large-scale intensive educational initiative involving multiple medical specialties, and describe how this was effectively implemented at our institution. Despite perceived differences, there are opportunities for diverse specialists to work together in introducing ultrasound to future physicians.

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**(E-112) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #9**

### **Virtual Autopsy Project - A New Curricular Tool in Medical Student Anatomy Education**

Pallavi S. Utukuri, MD, *Columbia University, New York, NY*; Joshua L. Weintraub; Steven M. Erde; Jay H. Lefkowitz; Jasnit S. Makkar; Paulette Bernd (*psu2103@cumc.columbia.edu*)

**LEARNING OBJECTIVES:** 1. Review current practices of teaching radiology in early medical school education. 2. Describe a novel approach of engaging millennial medical students with radiology in the first year of medical education, with example cases utilized by students at our institution. 3. Preliminary results of feasibility and perceptions of the tool, with review of future directions of this project.

**CONTENT DESCRIPTION:** Historically, the principal form of learning anatomy has been through cadaveric dissection. In recent years, various additional pedagogical resources have shown to aid in teaching anatomy. These include plastination, computer based learning (CBL), living anatomy and medical imaging. Several schools across the world today have an imaging anatomy curricula as part of the Gross Anatomy course, which typically includes didactic lectures and small group sessions on identification of basic radiographic and CT anatomy. At our institution, we expounded on this idea. Each cadaver underwent a CT scan, which was analyzed by a radiology-resident, typically PGY 3 – 5 level trainee, who generated a radiology report. The first year anatomy students utilized the CT data set with the provided radiology report, the gross dissection and relevant histology to postulate a cause of death. These “virtual autopsy reports” allow for a hybrid learning environment where the learning of radiographic anatomy is enhanced with an active and direct involvement with imaging. Preliminary results regarding perceptions of this project were significantly positive. Survey results at completion revealed the majority of the students surveyed felt this project allowed for gaining insights into the clinical manifestations of disease and abnormal physiology by reviewing the pathology slides and the CT scans. Additionally, the students also felt they were more engaged during the Clinical Gross Anatomy course knowing they would have to prepare a virtual autopsy report. Several areas of improvement were also elucidated, however the successful completion of this project demonstrates that this tool can successfully integrate the basic sciences with the clinical sciences at a much earlier stage of training.

## **Education, Other**

**(E-017) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

### **Structured Radiology Curriculum for Emergency Medicine Residents: Improving Patient Care and Interdepartmental Teamwork through Collaborative Education**

Alex J. Solomon, MD, *The John Hopkins Hospital, Baltimore, MD*; Erin N. Gomez, MD; P. Logan Weygandt; Linda J. Regan; Pamela T. Johnson, MD\*

**LEARNING OBJECTIVES:** -Create and implement a focused radiology curriculum for emergency medicine (EM) residents -Assess the effectiveness of the curriculum in improving EM resident ordering appropriateness, image interpretation, and identification of critical findings

**CONTENT DESCRIPTION:** EM residents assess and treat a diverse population of patients and pathologies. In an acute care environment, EM residents are expected to order imaging studies appropriately and, in many cases, identify critical findings before images are interpreted by a radiologist. Despite these expectations, many EM training pro-

grams do not include dedicated radiology instruction focused on high-value imaging and basic interpretative skills. This pilot curriculum was developed utilizing a modified Kern’s approach to medical education. Our institution’s Radiology and EM departments collaborated to identify content areas on which to focus including: appropriate ordering, orthopedic plain films, body CT, and emergency neuroradiology. The goal of the curriculum is to optimize image ordering practices and improve radiographic interpretative skills among first-year EM residents. The required two-week course includes a combination of independent study (self-directed online tutorials, lectures, and quizzes) and in-person instruction (daily conferences, reading room experience, and a case interpretation assessment followed by one-on-one feedback from a senior radiology resident). EM residents can augment the required curriculum with additional time in the emergency or neuroradiology reading rooms and supplemental online modules. The course also includes dedicated time for electrocardiogram review per the needs of the EM department. All fourteen EM interns are enrolled for the 2018-2019 academic year. They will complete pre- and post-course surveys and competency assessments to allow for formal evaluation, the results of which will be presented in this exhibit. Radiology is a critical component of high-quality emergency care. This curriculum represents an opportunity for interdepartmental collaboration with the prospect of improving patient safety, care, and outcomes.

### **AUR Trainee Prize: 2nd Place**

**(E-018) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Creating a Resident-Run Residency Program Website and Social Media Presence**

Timothy Iafe\*, *LAC+USC Medical Center, Los Angeles, CA*; Charles H. Li, MD; Miriam Romero, MD; M. Victoria Marx, MD

**LEARNING OBJECTIVES:** In this exhibit, we will demonstrate the various aspects of creating and maintaining a resident-run program website and social media presence. We will demonstrate metrics used to analyze the resident-run website, including the number of unique visitors, pageviews, and where our site is being accessed from. We will present metrics to analyze the effect of our social media outreach on popular platforms such as Twitter and Instagram. We will discuss how we will assess the impact of our content on resident recruitment through interviewee surveys.

**CONTENT DESCRIPTION:** Residency program websites are common and frequently used by prospective applicants as sources of information. Based on a recent survey of 180 radiology residency websites, factors commonly featured on these websites include data on current residents, benefits, training facilities, resident research, schedules, and recent fellowship placements. However, most of these websites are designed by the institutions with faculty input, not the residents themselves. Social media, while pervasive in today’s society, is also not yet widely used by programs. We have developed a resident-run website with the above information, as well as news highlights of our current residents, resident resources for various rotations, and an active social media account on Twitter. We plan to execute other regularly occurring content, such as “case of the week” or medical student presentations. As of August 9, 2018, our resident-run website (*uscrads.com*) is online, featuring current resident profiles, recent fellowship appointments, program/call schedule summaries, news updates, and an array of resident resources. The website has received over 270 unique visitors and nearly 800 pageviews in the preceding 30 days, and it is the third search result on Google for “usc radiology residency”. Also, a resident-run Twitter account (*@usc\_rads*) is live and active with

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approximately 1-2 unique posts per week. Our Twitter account has generated over 6,000 impressions in the preceding month. We plan to assess the impact of this online content on the upcoming resident application season through interviewee surveys.

**(E-019) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

**More than Radiation Exposure: A Review of Safety in the Radiology Department—From an Emergency Fire Evacuation to an Active Shooter**

Travis D. French, *NYU Winthrop Hospital, Mineola, NY*; Jung Yun; Abieyuwa Eweka; Enrico Perez; Thomas Harvey; Jason C. Hoffmann, MD\*; et al (*Jason.Hoffmann@nyulangone.org*)

**LEARNING OBJECTIVES:** In today's complex work environment, no organization or hospital is immune from danger or violence, including the radiology department. While violence in the radiology workplace is relatively uncommon, all staff members must be vigilant and embrace concepts of situational awareness to provide a safe work environment for patients and staff members. This exhibit aims to educate radiologists and trainees about a wide range of radiology department safety topics so that they can act appropriately and safely in these scenarios.

**CONTENT DESCRIPTION:** Review the landscape of the changing workplace environments in medicine, including hospitals and outpatient centers, with a focus on the radiology department. Relevant literature review, demonstrating the incidence of violence against healthcare workers: Number of incidents is increasing, significantly under-reported, includes both verbal and physical assault, affects thousands of healthcare workers in the United States annually. Review the four phases of emergency management and apply this to various safety scenarios in the radiology department: Mitigation, preparedness, response, and recovery. Provide the learner with basic concepts and strategies to safely navigate a verbal or physical assault scenario in the radiology department. Examples of safety scenarios in the radiology department and how to handle them, including (but not limited to): fire, smoke, verbal assault, physical assault (including fight, bomb, and active shooter scenarios), and prolonged loss of electricity, medical gasses, or water.

**(E-020) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

**Visa Alphabet Soup: The Mastercard Knowledge Every Program Director Needs**

Parthiv N. Mehta, MD, MBBS, *Baystate Medical Center, Springfield, MA*; Tara M. Catanzano, MD (*parthiv.mehtamd@bhs.org*)

**LEARNING OBJECTIVES:** Almost one-quarter of physicians in graduate training and practice in the United States (U.S.) are graduates of international medical schools (IMGs). Visa types that can be offered to IMGs vary by institution and region. The alphabet soup of visa types often confuses even the most experienced of Program Directors. The ongoing immigration crisis and uncertainty surrounding visa issuance to foreign nationals has further intensified the confusion and stigma that is attached to IMGs applying for residency spots. A literature search in traditional databases reveals that there are only a few sources that provide credible data to a program director or GME staff on medicine specialty training visas. This has long been the domain of lawyers and a select few in the GME offices. The purpose of this exhibit is to highlight the crucial features of each visa category in simple, easy to read format. The information shall be addressed from a program director's point of view.

**CONTENT DESCRIPTION:** All foreign nationals must arrive on and hold a valid visa status throughout their training as well as employment. The J-1, O, H-1 and EB visa categories will be discussed. An overview of each visa category will be provided, including advantages,

disadvantages, restrictions and legal provisions. This article shall also seek to clear some commonly held beliefs and misconceptions regarding visa processing and maintenance of legal status. This exhibit aims to highlight the salient features of all available visas that may be granted by a residency program to a potential candidate. The aim of the authors is to provide an easy accessible resource describing the various available visa categories. The reader will be provided with must know facts about each visa category including selection, acceptance, renewal, restrictions and provisions.

**(E-021) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

**Leveling the Playing Field – Straight Lines in Radiology**

Robert T. Swanson, BS, *Pennsylvania State College of Medicine, Hershey, PA*; Janet A. Neutze, MD\*; Allene S. Burdette, MD

**LEARNING OBJECTIVES:** 1. Describe the types of interfaces that create straight lines in radiologic imaging. 2. Understand the physical and imaging elements needed to create straight lines in radiologic imaging. 3. Consider various diagnoses that include straight lines as part of their findings.

**CONTENT DESCRIPTION:** To the naked eye, the human body has no naturally occurring straight lines. However, straight lines exist in imaging and have various benign and pathologic etiologies across all organ systems. Straight lines in radiology arise from three interfaces: air-fluid, fluid-fluid, fat-fluid or any combination of the three. There are physical and imaging requirements necessary to demonstrate straight lines radiographically, including gravity, non-miscible components and inherent contrast differences in those components. All imaging modalities (CT, MRI, plain film and ultrasound) can effectively demonstrate straight-line interfaces. Knowing why straight lines occur and recognizing common causes can facilitate image interpretation. The purpose of this presentation is to review why straight lines occur in radiologic imaging and showcase a range of common and uncommon radiographic and clinical examples that manifest with straight lines.

**(E-115) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #3**

**A Review of Radiology Residency Program Websites for Information Pertaining to International Applicants**

Kavya Puchhalapalli, *Medical College of Wisconsin, Wauwatosa, WI*; Manav Bhalla, MD (*kpuchhalapal@mcw.edu*)

**LEARNING OBJECTIVES:** 1. Describe the representation of the International Medical Graduates (IMGs) applying for residency in the US, and discuss about a unique, often undescribed, minority of applicants who are international students graduating from US medical schools. 2. Introduce the additional challenges faced by this set of applicants, in terms of visa sponsorship, etc., while applying for residencies in the US. 3. Report in detail the dearth of international applicant-specific information provided on websites of individual residency programs, and national residency matching organizations/ programs.

**CONTENT DESCRIPTION:** In 2017, there were 43,157 PGY-1 applicants, of which 12,355 (28.6%) were IMGs: 59% non-US IMGs (non-US citizen/ permanent-resident with a foreign MD), and 41% US IMGs (US citizen/ permanent-resident with a foreign MD). A total of 27,688 PGY-1 positions were filled, including 6,591 (23.8%) positions filled by IMGs: 57.8% non-US IMGs and 42.1% US IMGs. The two categories of applicants requiring visa sponsorship by residency programs are non-US IMGs, and international students (non-US citizen/ resident) with US medical degrees. The latter category although receives mention in residency match program websites, it is not detailed or well understood. In fact, we were unable to find match statistics for these applicants. However, data shows that there were 274 international students

\* Faculty financial disclosures are located in the Faculty Index.

matriculating into US medical schools in 2017. Together, these two categories of applicants comprise about a quarter of the total applicant pool. Despite forming such a large proportion, there is inadequate information on the web catered towards these applicants. To better describe the areas of information deficiency, we reviewed websites of individual radiology programs. We collected data on various elements including information on, acceptance of international applicants, visa sponsorship, current student make-up (US citizen/ permanent resident vs international). This helped us identify and understand the specific deficits in information for international students and will better equip us to propose necessary website amendments to residency programs/ match organizations in order to assist future applicants.

**(E-116) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #1**  
**One Step Forward Towards Enhancing Diversity & Inclusion in Radiology: How We Did It**

Siobhan Alexander, MD, *University of Virginia Medical Center, Charlottesville, VA*; Mohammad Halalibeh; Sukhdeep Grewal; Eduard de Lange; Juliana Bueno, MD ([jmb3dt@virginia.edu](mailto:jmb3dt@virginia.edu))

**LEARNING OBJECTIVES:** 1. Identify strategies to initiate and establish a program to enhance Diversity & Inclusion in a Radiology Residency Program 2. Illustrate the strategies we used in our initiative which can be replicated by other programs as a way to promote Diversity and Inclusion in a Residency Program 3. Demonstrate the importance of taking action in these initiatives and show the potential of the local, regional and national impact that such programs can have

**CONTENT DESCRIPTION:** Since the early 1980's, there has been a positive shift in the demographic makeup of physicians to include more female and underrepresented minorities (URMs). Unfortunately, this has not translated proportionately within the field of Radiology when compared to other medical specialties. In fact, Diagnostic Radiology residency programs rank 17th with respect of the number of women and 20th for URMs out of the 20 major residency specialties, including Surgery\*. To counteract this, there has been increasing interest in enhancing diversity within Radiology Departments to better reflect the demographic changes in the general physician population. Many Radiology Departments and residency programs are looking into different avenues to implement strategies that foster a friendlier, more open, and more inclusive learning and work environment. When it comes to creating a sustainable program, there can be perceived challenges that hinder its implementation. This educational poster will illustrate the strategy we used at our institution to initiate a successful leadership program in Diversity and Inclusion. With the overarching goal of enhancing diversity within Radiology through medical and pre-medical student recruitment, we have developed an initiative based on mentorship, opportunity, and leadership. Specific information regarding the structure of the initiative, leadership positions among residents and faculty, funding and outreach strategies, as well as the short- and long-term goals of the program will be presented. Reference: \*Chapman, C. H., Hwang, W., Both, S., Thomas, C. R., & Deville, C. (2014). Current Status of Diversity by Race, Hispanic Ethnicity, and Sex in Diagnostic Radiology. *Radiology*, 270(1), 232-240.

**(E-117) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #4**  
**Improving Interprofessional Relationships in Radiology**

LeAnn M. Shannon, MD, *Vanderbilt University Medical Center, Mount Juliet, TN*; Melissa A. Hilmes, MD; Sudha P. Singh, MBBS, MD

**LEARNING OBJECTIVES:** 1) Distinguish between career paths in the radiology workplace and recognize the extent of the degrees and CME necessary to be accredited in each field. 2) Employ knowledge based

on first-person accounts by these professionals about how their experience and skillsets are best respected and utilized in a team setting. 3) Use the information presented to develop stronger interprofessional relationships within the radiology workplace in hopes of strengthening the radiology team and providing better patient care.

**CONTENT DESCRIPTION:** As radiologists, we are well-versed in communicating with other physicians about our patient's imaging studies, and as fellow physicians, we share a kinship by understanding the basis of what each of those peers has undergone to reach their current position in healthcare. However, in an increasingly team-based healthcare system, it is important to recognize the opportunities for building lasting interprofessional relationships not only with other departments in the hospital, but within our own. One way of doing this is to improve knowledge of radiologists and their trainees regarding the paths leading into other professions within the radiology community. Interviews of other radiology professionals were conducted by resident and attending radiologists in order to learn more about their educational backgrounds and elicit professional opinions about how their experience and skillset could be better valued in a team setting. The above-mentioned interviews were conducted with medical physicists, nurse practitioners, sonographers, fluoroscopy/interventional/nuclear medicine technologists, and speech pathologists. Information will be presented regarding the degree, certification, and CME required to work in each field. The skillset each profession brings to the table in the radiology department will also be discussed, as well as opinions on how best to utilize those skillsets in an inclusive team environment that will better serve our shared goal of improving patient care.

**(E-118) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #4**  
**Radiology Around The World: A Brief Review of How Radiologists are Trained and Practice in Different Parts of the Globe**

Suraj Parekh, *Staten Island University Hospital, Staten Island, NY*; David S. Sarkany, MD ([sparekh2@northwell.edu](mailto:sparekh2@northwell.edu))

**LEARNING OBJECTIVES:** • Briefly review the current training paradigm options to become a board certified diagnostic radiologist in USA. • Using the countries currently served by the RAD-AID organization as examples, one should be able to understand how different countries around the world train physicians to be radiologists and imagers. • Also learners will be able to describe the role of radiology and medical imaging in these different nations especially how it pertains to patient workflow and throughput in both the inpatient and outpatient settings

**CONTENT DESCRIPTION:** Many medical specialties participate in global health and recently there has been an increase in Radiology's role on the global scale. Through creating a global health elective in radiology at my institution I have researched how medical imagers/radiologists are trained in many different parts of the world and how radiologists contribute to patient care using the organizations currently served by RAD-AID as an example. This exhibit will highlight the training pathway to practice this wonderful field around the world and how this may be similar and differ from the pathways in the United States. I also want to emphasize what role radiologist play in patient care as this differs widely with the limited imaging technology some countries have. Examples will be provided from countries with similar and different socioeconomic status as the US. Finally a review of what RAD-AID is currently doing to help bridge the gap in medical imaging technology and resources to provide better care to developing nations.

\* Faculty financial disclosures are located in the Faculty Index.

**(E-119) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #4**  
**The Value-Added of Emergency Radiology in Academic Institutions**

Lee A. Myers, MD, *University of Southern California, Los Angeles, CA*; Morgane Naveau; Van Nguyen; Nicholas M. Beckmann, MD; Ali Gholamrezanezhad; Keith D. Herr, MD; et al ([leemyers@med.usc.edu](mailto:leemyers@med.usc.edu))

**LEARNING OBJECTIVES:** 1. Discuss unique features of Emergency Radiology (ER) that have an impact on patient triage and disposition of patients from Emergency Medicine and Trauma services. 2. Review techniques of “list triage” and the “primary imaging survey” to quickly and efficiently identify life-threatening injury or other emergent conditions. 3. Analyze how ER can decompress clinical responsibilities in other subspecialty divisions and consequently improve teaching quality in those divisions.

**CONTENT DESCRIPTION:** While the scope of ER practice is variable and often dictated by the needs of any given institution, there are three unique characteristics that are invariable across all settings: (1) subspecialty expertise in trauma and acute care imaging, (2) facility with the use of rapid and efficient “list triage” and “primary imaging survey” for life-threatening processes, and (3) an emphasis on decreased time to disposition as a result of expedited turn-around-time. We will discuss how each of these unique factors works towards impacting the care of the acutely ill or injured patient. This presentation will emphasize the ER-specific practices of “list triage” and “primary imaging survey.” In brief, list triage is the prioritization of acute care imaging work list based on patient acuity, much in the same way an emergency physician attends to the sickest patients first. “Primary imaging survey” can be described as quickly reviewing real time or near-real time imaging, often alongside primary providers, to alert providers to life-threatening conditions that may require immediate intervention. The growing need for 24/7 faculty coverage at academic trauma centers with a special emphasis on rapid patient disposition has led to a growing reliance on the creation and growth of ER divisions. We will describe a positive “ripple effect” of these expanding divisions on other radiology subspecialties within a radiology department: Through a division of labor, these other divisions enjoy more time to focus clinical and educational efforts related to their specific subspecialty, whereas acute imaging interpretation and teaching increasingly become the purview of ER division faculty.

**AUR Trainee Prize: 1st Place**

**(E-120) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #10**

**WiRed: Widgets in Radiology Education - How Cheap Commercial Software Can Provide Micro-Learning to Students and Residents at the Workstation**

Meagan Chambers, MS, MSc, *Dartmouth Medical School, Hanover, NH*; Victor Pizzitola, MD; Natalie Del Favero; Natalia Obrecht; Mike H. Bao; Stefan Tigges, MD\*; et al ([Meagan.Dechen.MED@Dartmouth.edu](mailto:Meagan.Dechen.MED@Dartmouth.edu))

**LEARNING OBJECTIVES:** Through this poster learners will be able to: 1. Recognize the benefits of integrating micro-learning into the clinical environment. 2. Develop interactive and didactic ‘widgets’ using affordable commercial software that focuses on key learning concepts using preexisting or new material. 3. Integrate widgets into the learning environment using hyperlinks and QR code and share them between institutions.

**CONTENT DESCRIPTION:** Rationale for producing educational ‘widgets’ Teaching time on clinical services is often extremely limited and

many of the key points that we repetitively teach our learners may get omitted due to lack of time, context or varying faculty contact. Millennial learners often learn best through the introduction of interactive micro-topics when topics naturally arise. This learning needs to be accessible to all learners on any devices, anywhere. Applications within resident and student education Suitable topics which can be adapted to the widgets software, including examples in popular teaching categories/specialties will be given. Widget accessibility options, and formats for integration into teaching environments will be demonstrated.

**Developing widgets:** Participants will be introduced to the Bookwidgets™ software and will be able to explore different widget formats (e.g. slide shows, mini lecture links, sliding overlaid images, interactive clickable images, multiple quiz formats). Participants will be shown how to develop simple and complex multistep widgets and will be introduced to methods for integrating widgets into modules, eBooks, websites or other resources. Finally, participants will learn how to share widgets between institutions.

**Poster interactivity:** Widgets can be accessed via all mobile devices using the free Bookwidgets™ app or weblinks. QR codes will be provided on the poster to allow viewers to access all demonstrated widgets. Once accessed these modules can be reviewed later or shared at their own institutions.

## Education of Residents

**(E-024) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Applications of Learning Theory to Radiology Curriculum**

Timothy S. Wulfestieg, DO, *Tripler Army Medical Center, Honolulu, HI* ([timothy.s.wulfestieg.mil@mail.mil](mailto:timothy.s.wulfestieg.mil@mail.mil))

**LEARNING OBJECTIVES:** 1. Understand the factors that add to a subject’s “complexity.” 2. Comprehend the three barriers to instruction of complex subjects. 3. Understand how learners work with information: How it is received, processed and stored. 4. Be able to articulate “memory schemata” and why it’s useful to instruction. 5. Be able to describe “mental modeling” and how it can be applied to instruction. 6. Understand the “cognitive load” of a curriculum, and subsequently how to prepare a lecture that stays within the confines of this mental load. 7. Understand how a radiology lecture can be enhanced by: 1)Controlling information input, 2)Teaching methods of information processing, and 3) Encouraging compilation of long term memory.

**CONTENT DESCRIPTION:** Cognitive psychology is a discipline focused on how people process information. This presentation shows how the learning theories of cognitive psychology can be applied to radiology to maximize curricular potential. Radiology is a “complex subject,” requiring a great depth of knowledge, having a high quantity of conceptual elements, and a high degree of interactivity between concepts. The barriers of complex learning are related to: cognition, subject complexity, and the barriers of the curriculum itself. Memory schemata are shown as a method to enhance learning and subsequent retrieval of information. Mental modeling will be shown as a problem solving heuristic rooted in long term memory. Cognitive load will be discussed, and how it relates to the finite nature of working memory and attention. All discussed concepts will be applied to an example radiologic curriculum for the plain film diagnosis of osteoarthritis (OA). Schematic memory is encouraged by reviewing cellular pathology of OA (which ties new OA knowledge to old knowledge of basic pathophysiology). A mental model heuristic is provided in which a pathologic joint mechanism can be envisioned, leading to cellular dysfunction with expectant xray findings. Subject complexity is lowered by defining joint

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anatomy and teaching a search pattern. Finally, long term memory is encouraged by repeated skills practice with subsequently less support information.

**(E-025) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

**Staying Lean: Increase Productivity and Efficiency of Radiology Practices with the LEAN Approach**

William Gao; Jessica Leung, BS, *Westchester Medical Center, Valhalla, NY*; Perry S. Gerard, MD; Michelle LaRosa; Ajay Patel, MD; Oliver Furusato Hunt (*william.gao@wmchealth.org*)

**LEARNING OBJECTIVES:** 1. Understand the LEAN approach improvement methods and how it applies to radiology, such as areas of deficiency and factors to improve efficiency and productivity. 2. Implement a standardized methodology to improve availability of radiology imaging services and procedures, the timeliness of imaging reports and procedure reporting to clinicians, and satisfaction of clinicians and patients. 3. Explore ways to grow revenue and maintain growth while maintaining quality

**CONTENT DESCRIPTION:** Radiology is a significant source of revenue within healthcare and the potential for additional revenue comes with increased patient capacity. The LEAN approach, which emphasizes process analysis, is of particular relevance to radiology, which relies on a continuous flow of patients and uninterrupted workflow for efficient operation. The LEAN approach can decrease clinical and technical errors, shorten patient and report wait time, improve patient outcomes, increase employee productivity, reduce cost, and improve patient and referring clinician satisfaction. Some of the most important components to maintaining the referral base include timely patient scheduling, punctual reporting of results to referring physicians, providing an expected level of technical expertise, and understanding aspects of the current radiology processes that are limiting the ability of the radiology practices to appropriately ensure the referral base. The goal of a LEAN transformation is to establish a framework for growth. LEAN promotes growth while preserving quality; it continuously analyzes the practice's management systems and workflows to free up resources and eliminates waste. The resulting efficiency and productivity gains improve the quality and reliability of services a radiology practice provides to patients and clinicians, while at the same time also lower costs. The objective of this project is to educate future radiologists the basic principles of LEAN and to explore ways the LEAN approach improve organizational performance, efficiency, safety, teamwork, and employee commitment

**(E-026) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

**How We Made Bigger Become Better: Logistic Challenges and Solutions of Resident Teaching Conferences at a Large Academic Medical Center**

Christopher Ball, *UT Southwestern Medical Center, Dallas, TX*; Jeremy T. Hall, MD; Adam W. Jaster, MD; Michael C. Morriss, MD; Marco C. Pinho, MD; Jeannie K. Kwon, MD

**LEARNING OBJECTIVES:** 1. Discuss difficulties inherent to delivery of a radiology curriculum at a large academic center with multiple hospitals and training sites 2. Explain the process of developing a revised curriculum structure incorporating concerns raised by residents and faculty and the approach used to achieve widespread buy-in to extensive curriculum changes 3. Assess impact of changes on curriculum

**CONTENT DESCRIPTION:** Concurrent with the physical expansion of our academic medical center, concerns regarding the conference schedule structure including significant travel time, time off of service,

reliance on teleconference software, a low level of in-person conference attendance and poor presenter/attendee interaction were surfacing. Concerns regarding decreased resident engagement and passivity during conferences led to a restructuring of the delivery of the residency curriculum. A curriculum task force including the program director, assistant program directors, several division chiefs and multiple residents was created to study the current state of issues and develop a proposal for a new curriculum delivery method. The task force used an iterative process to develop the plan, forming three different teams that developed a plan separately, then selected the best ideas from each team to create a hybrid model consisting of three hours of decentralized small group interactive conferences per week and a weekly block of half-day formal didactic conferences which is attended by the entire group of residents. Early stakeholder buy-in was achieved following a series of meetings with the department chair, each division chief and their curriculum liaisons, and a town hall with the residents. Quarterly follow up surveys will assess the impact of the new structure on the degree of interaction during formal educational opportunities and how well the curriculum is preparing residents to achieve clinical excellence. Additionally, these surveys will provide opportunity for early detection and correction of any issues. We will describe our experience restructuring the delivery format of the radiology curriculum, review steps taken to achieve wide spread buy-in, and discuss lessons learned.

**(E-028) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

**The Proposal for an Integrated Internship Year Within Radiology Training Programs: A University Hospital Experience**

Kevin Junus; Robert A. Koenigsberg, DO, *Hahnemann University Hospital - Drexel University College of Medicine, Philadelphia, PA*

**LEARNING OBJECTIVES:** Explore the state of current radiology training programs with respect to the required clinical postgraduate year-1 (PGY-1) and the benefits of developing an integrated PGY-1 year into radiology programs

**CONTENT DESCRIPTION:** Introduction – The value of the mandated clinical year for the first year of training for radiology residencies has been debated, especially with little standardization between possible internships in internal medicine, general surgery, or a mix, formally known as transitional years (TY), which are often not at university-based hospitals or affiliated with a medical school. The number of radiology residency programs that offer PGY-1 clinical years, or “categorical” spots, has remained not only small, but also unchanged since 1994. Trends in Radiology Training Programs – Within the 2018 National Resident Matching Program match, 31 (or 16% of) radiology programs offered included PGY-1 spots. Of the 31, 18 programs included PGY-1 years that were entirely separate from the department (e.g. offered by Internal Medicine). 13 programs offered a clinical year that was integrated with the radiology program, including the authors’ institution, Drexel University College of Medicine at Hahnemann University Hospital (DUCOM). It is the only new categorical program within the past four years, featuring a TY curriculum that also includes three months in the emergency department and early immersion with the radiology department. Benefits on an integrated program – The benefits include standardization to an otherwise variable PGY-1 experience for greater focus toward development of radiology-specific clinical or surgical skills; time for additional scholarly work; development of intradepartmental relationships; and early immersion into the radiology department (didactic sessions, early experience in the call pool of residents). Conclusions – A majority of radiologists believe the internship year was valuable to their development, but also acknowledge that the variability of training programs may be a detriment to the field. As

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established at DUCOM, programs with integrated clinical years may better serve our trainees in radiology.

**(E-029) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Our Expanding Curriculum of Health and Wellness for Radiology Residents: From Inside to Outside the Hospital**

Halley Park, Rutgers, *Robert Wood Johnson Medical School, New Brunswick, NJ*; Ani Peshtani; Anupriya Barot; Catherine King, MD; Jeffrey S. Kempf, MD ([JKempf@Univrad.com](mailto:JKempf@Univrad.com))

**LEARNING OBJECTIVES:** 1. To identify reasons why radiology residents are at increased risk of emotional exhaustion, decreased personal achievement, and overall physician burnout. 2. To describe the many dimensions of maintaining resident health and wellness, while developing resiliency in order to help engage Radiology trainees to optimal levels of emotional well-being. 3. To learn our multifaceted approach of creating a wellness curriculum for our Radiology residency, both inside the classroom as well as recent expansion to outside of the hospital, to improve emotional and physical well-being that can ultimately lead to improved patient care.

**CONTENT DESCRIPTION:** Focuses on health and wellness for radiologists have been a popular topic of interest recently due to increased rates of physician burnout. Factors contributing specifically to radiologists include increased emphasis on high relative value units, demand for faster turnaround time, and continued expectation of high quality reports. Additionally, sedentary nature of the profession generates greater health risks that are associated with lack of physical activity at workplace, unhealthy habits of food and water intake, and improper posture and ergonomics. As a Quality Improvement project in 2016, a 9-week curriculum was implemented consisting of weekly emails containing health tips designed specifically for radiologists. The goal was to promote healthy behaviors and increase overall physical activity at workplace. Pre-curriculum survey showed 40% of the respondents feeling very sedentary and 32%, sedentary throughout the workday. Post-curriculum survey showed 76% of the respondents feeling "helpful to extremely helpful," which was successful in that our radiologists reported improved overall quality of life at workplace. Because of overwhelmingly positive responses, the contents of the entire 9-week curriculum were made available on the shared network to be accessed by our radiologists when needed. Radiology residents face a unique set of challenges associated with being a trainee such as long work hours, high volume of complex cases, multiple interruptions, and insufficient knowledge. While being a physician in training can be indicative of being at an increased risk of burnout, healthy habits and behavior can be learned and reinforced during one's training early on so that they become useful tools for the rest of one's career. At our institution, an internal survey of the residents with 85% response rate reported top two factors contributing to resident burnout to be multiple interruptions (88.2%) and high case volume (82.4%). Resident health and wellness committee was created to continue promoting healthy behavior with the expansion of the curriculum, now including activities both inside and outside the hospital environment. The exhibit will contain our original 9-week wellness curriculum, specifically topics that were reported to be most useful, which are ergonomics and exercises at the workstation. The newly expanded portion of the wellness curriculum includes activities inside the hospital with monthly group lunches and seminars given by guest lecturers specialized in nutrition, mental health and meditation, and financial planning. Activities outside the hospital includes group physical activities such as outing at a local golf driving range and group hiking. Our summer step challenge encouraged physical activity both at and outside the workplace. Top two winners were publically praised and rewarded with a gift. Near future plan includes doing community service as a group. Mid-year survey was performed amongst residents to evaluate the effectiveness of the expanded

health and wellness curriculum with the response rate of 85%. 82.4% reported feeling improved quality of life at workplace when compared to pre-expanded curriculum and 11.8% reported maybe. Some of the limitations of the study includes lack of surveys amongst the residents prior to initiating the expanded portion of the curriculum. Additionally, pre-curriculum survey involved both radiology trainees and attending physicians.

**(E-030) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**"Doc, Do You Want a Delay?" Junior Resident's Guide to Active Contrast Extravasation and the Utilization of Delayed Phase Computed Tomography (CT) Imaging at a Level I Trauma Center**

Andrea M. Winter, MD, *Saint Louis University, Clayton, MO*; Ece I. Akduman, MD ([andrea.winter@health.slu.edu](mailto:andrea.winter@health.slu.edu))

**LEARNING OBJECTIVES:** Junior residents starting call at our institution are asked by the CT technologists to review trauma "panscans" and decide if delayed imaging is indicated. Delayed phase imaging can play a critical role in the interpretation of body CT for grading visceral organ lacerations, urinary system injury or assessing for contrast pooling/contrast extravasation indicative of vascular injury and thus expediting appropriate management. For the junior resident who has little practical experience with active contrast extravasation and the typical injuries encountered at a Level 1 Trauma Center, making this call can initially be stressful. This poster will increase the learner's conceptual understanding of active contrast extravasation and the role targeted delay phase imaging can play in diagnosis. Learners will become familiar with several commonly encountered conditions in which delayed phase imaging helps in correct grading of hepatic, splenic or renal injuries, urinary tract extravasations, splenic or hepatic pseudoaneurysms versus active contrast extravasations and active hemorrhage in the pelvis in the setting of pelvic fractures. Practical tips and review of a proposed "panscan" initial search pattern will increase the learner's confidence when determining if delayed phase imaging is medically necessary.

**CONTENT DESCRIPTION:** - Introduction to contrast extravasation and the role delayed phase scan can play in diagnosis and management of traumatic injury in the abdomen and pelvis. - Review of common cases in which delayed phase imaging can change the diagnosis and/or management in patients with hepatic/splenic or renal injuries, splenic/hepatic pseudoaneurysm vs active contrast extravasation and active hemorrhage in pelvis in the setting of pelvic fractures. - Review of common "mimickers" of active contrast extravasation. - Tips for the beginner radiologist and proposed "search pattern" for assessing the need for delays.

**(E-031) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Painless Practice of Procedure Skills: Introducing New Residents to Fluoroscopically-Guided Lumbar Puncture Using An Inexpensive Homemade Phantom**

Douglas E. Lukins, MD, *University of Kentucky, Lexington, KY*; Abdunnasser Alhajeri; Harit Kapoor; Joseph W. Owen, MD

**LEARNING OBJECTIVES:** 1. Construct a homemade phantom using materials that can be obtained from online retailers at a fraction of the cost of a commercial procedure phantom

**CONTENT DESCRIPTION:** Fluoroscopically-guided lumbar puncture is a basic procedure that all radiology residents are required to perform. A trainee must learn to translate the three-dimensional anatomy of the lumbar spine to a two-dimensional fluoroscopic image, and they must acquire the manual dexterity necessary to guide a needle under fluoroscopy into the central canal of the spine. Typi-

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cally, this experience is obtained by performing the procedure on patients under the close watch of an attending physician. A procedure phantom allows a trainee the opportunity to practice lumbar puncture in a low-risk environment. However, commercial procedure phantoms are expensive. Our aim is to provide a step-by-step guide on how to construct a simple reusable lumbar puncture phantom using materials that can be obtained from online retailers at a fraction of the cost of a commercial phantom. Clear ballistic gel is available for purchase from online retailers (Amazon.com, Clearballistics.com) for approximately \$16 per pound. A poly-vinyl chloride (PVC) lumbar spine can also be purchased online for \$30-50. Ballistic gel is a synthetic gelatin designed to have the density and elasticity of human skeletal muscle, and is stable at room temperature. PVC has a density similar to human bone. Ballistic gel can be melted with a slow cooker, or in the oven at 250 degrees, and poured into a mold containing the PVC spine. The resulting phantom allows residents to practice lumbar puncture technique with realistic landmarks, and a tactile feel similar to passing a needle through muscle tissue. The gel can be reformed hundreds of times with minimal degradation. The phantom can also be used to simulate CT-guided and ultrasound guided procedures. For less than \$100, a lumbar puncture phantom can be created to enhance resident training at a fraction of the cost of commercial phantoms.

**(E-032) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Blueprints for Developing a Resident Wellness Committee as a Framework to Address the 2018 Update of the ACGME Common Program Requirements: 5 Impactful Strategies for Success**

Glenn C. Gaviola, MD, *Brigham & Womens Hospital, Boston, MA*; Jessica Mann; Matthew A. Haber; Jisoo Kim; Jennifer W. Uyeda, MD\*

**PURPOSE:** The 2018 ACGME Common Program Requirements Update included a focus on resident well-being and self-care, requiring residency programs to promote “policies and programs that encourage optimal resident and faculty member well-being”. While this mandate provides a broad scope, a specific framework to achieve this goal is lacking. We propose the development of a Resident Wellness Committee as the framework and report the 5 impactful strategies we utilized in its success.

**METHOD AND MATERIALS:** In 2017, when the request for comments period opened to address the 2018 Update to the ACGME Common Program Requirements, we convened a Residency Wellness Committee (RWC). A resident chair and a faculty advisor were appointed by the Program Director, and members of the RWC included the chief residents and a peer-selected resident representative from each resident year, along with the Program Director and Coordinators. The RWC was tasked to identify ways to help provide a program strategy to address the proposed ACGME mandates focusing on resident well-being and prevention of burnout.

**RESULTS:** Since the development of our RWC in 2017, we retrospectively identified 5 key strategies contributing to the success of the RWC : 1. Identify and secure sustainable funding from the departmental administration; 2. Develop a parallel effort with faculty members in the promotion of a Faculty Wellness Committee to encourage a holistic departmental approach; 3. Develop monthly gatherings and social events to promote peer and faculty interactions outside of the work atmosphere including both social and humanitarian/volunteer efforts; 4. Dedicate a monthly resident Wellness conference focusing on topics of wellness promotion and burnout prevention, including time for personal reflection; and 5. Establish an annual all-Resident Wellness Retreat to develop annual goals, gather feedback and promote quality improvement of the RWC.

**CONCLUSION:** The development of a Resident Wellness Committee provides a useful framework for addressing the 2018 ACGME mandates focusing on resident and faculty well-being. Five key strategic steps were identified as providing a timely and feasible method for implementation and success within an academic year.

**(E-124) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #6**

**A Practical Approach to Teaching at the Workstation: Applying the One Minute Preceptor Model of Clinical Teaching to Radiology Resident Education**

Andres R. Ayoob, MD, *University of Kentucky, Lexington, KY*; James T. Lee, MD; Joseph W. Owen, MD (*andres.ayoob@uky.edu*)

**LEARNING OBJECTIVES:** Following review of this exhibit, participants will be able to: 1. Prime a radiology resident for image interpretation 2. Integrate the One Minute Preceptor model of teaching into their clinical workflow

**CONTENT DESCRIPTION:** Given that most resident teaching occurs in the context of a busy clinical practice, in which time is at a premium, an efficient and effective model of precepting is essential for success. Although the One Minute Preceptor model of clinical teaching is well documented in the medical education literature, there is little describing its application to radiology education. This poster will describe a learner-centered approach to teaching at the workstation and review practical tips to integrate this method into clinical practice: • Priming the learner to set objectives for the teaching encounter: (1) providing appropriate background information, (2) reviewing relevant medical information, and (3) identifying important tasks to be performed • Implementing the five-step microskills of the One Minute Preceptor to assess and instruct: (1) get a commitment, (2) probe for supporting evidence, (3) teach a general rule, (4) reinforce what was done right, and (5) correct mistakes. A case-based example with sample images and a representative dialogue will be used to illustrate the One Minute Preceptor Model.

**(E-125) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #2**

**Can Telecommunication Software Combat the Potential Negative Effects of 24-hour Attending Radiologist Coverage on Resident Education? Perspective from an Academic Radiology Practice**

Saivenkat Vagvala, *Medical College of Wisconsin, Milwaukee, WI*; Parag P. Tolat, MD; Petar Duvnjak, MD (*pduvnjak@mcw.edu*)

**LEARNING OBJECTIVES:** 1. Discuss the evolving paradigm in radiology resident education with emphasis on shift to 24/7 attending supervision. 2. Provide unique perspectives from our own experiences using telecommunication software.

**CONTENT DESCRIPTION:** At academic institutions, overnight call has historically been provided by radiology residents; however, in recent years, there has been a growing trend towards providing 24-hour attending coverage. The impetus for this paradigm shift stems from the belief that closer resident supervision on call may lead to fewer medical errors, lower patient mortality, decreased call-back rates and overall improved medical care during call, especially as case volumes increase. One of the concerns arising from this change is the potential negative effect on resident autonomy and education, as indicated by recent surveys from academic radiology practices. In order to offset some of the potential negative effects on resident education, our department has equipped radiology workstations with HIPAA-compliant telecommunication software (Skype; Microsoft, Redmond, WA), which allows for indirect attending supervision of on-call residents remotely from home or clinical offsites. Our institution utilizes telecommunication software not only to supervise residents, but

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also to increase exposure of cases to on-call residents that they may not have been exposed to during their typical clinical experience. In doing so, interesting cases or “Aunt Minnies” can be communicated to residents via screenshots or real-time viewing via screen sharing. This software also allows the resident to review the case at a later time if clinical duties preclude a detailed case analysis. Despite concerns regarding the negative implications of 24-hour attending coverage on resident education, the observed trend away from resident-run coverage will likely continue given the perception of a higher standard of care by many clinicians. We believe that utilization of telecommunication software in radiology education can help mitigate the potential negative effects of this inevitable paradigm shift in radiology residency training.

### A<sup>3</sup>CR<sup>2</sup> Research Award

**(E-126) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #8**

#### **Promoting Resident Well-Being: A Three-Pronged Approach to Combat Components of Burnout and Increase Resident Wellness**

Elainea N. Smith, MD, *University of Alabama - Birmingham, Birmingham, AL*; Jessica G. Zarzour, MD; Rachel F. Oser, MD; Michael A. Coker, BA; Robert A. Esposito; Anand R. Patel, MD; et al ([elaineasmith@uabmc.edu](mailto:elaineasmith@uabmc.edu))

**LEARNING OBJECTIVES:** 1) Understand the components of burnout, as well as its causes and numerous negative implications. 2) Discuss a proposed three-pronged approach to combatting resident burnout. 3) Present short-term results of implementation of this program, using AC-GME, GME, and program initiated surveys, as well as the Maslach Burnout Inventory - Health Services Survey and ongoing resident feedback. 4) Review weaknesses of the program and potential areas of growth.

**CONTENT DESCRIPTION:** A. Breakdown of definitions of burnout, including negative effects a. Discuss the causes of burnout amongst residents B. Present the proposed three-pronged approach to combatting burnout and improve resident wellness: 1) Bi-annual resident activities, which focus on camaraderie to address emotional exhaustion and depersonalization a. Fall retreat for residents and program directors with team building activities b. Spring family day activity to foster work life balance 2) Implementation of a formalized resident mentoring program to foster personal accomplishment and combat depersonalization a. Simultaneous peer-to-peer and faculty-to-peer mentoring programs b. Discuss common barriers to successful mentoring relationships and plans to combat them c. Understand the important building blocks of a mentoring relationship 3) Development of training materials for chief residents, program directors, and mentors to help foster mentoring and combat emotional exhaustion C. Overview of short term gathered data, including: a. ACGME and GME annual program evaluation surveys b. Program initiated semi-annual evaluations c. Maslach Burnout Inventory - Health Sciences Survey results, which is a standardized survey commonly used to objectively measure burnout d. Subjective resident feedback D. Summary of successes, weakness, and future plans of the resident wellness initiative.

**(E-127) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #3**

#### **Team Building in the Modern Era: A Radiology Escape Room**

Rachel P. Pahls, *University of Arkansas for Medical Sciences, Little Rock, AR*; Kedar Jambhekar, MD; Linda A. Deloney, EdD ([repahls@uams.edu](mailto:repahls@uams.edu))

**LEARNING OBJECTIVES:** Describe the rationale and process for using an Escape Room as a team-building and educational activity that

promotes learner engagement through collaboration, creativity, and critical thinking.

**CONTENT DESCRIPTION:** We created an escape room experience for R1 residents during orientation. An escape room is a fun, safe game where a team must discover clues and solve a mystery to escape a “locked” room. The project was funded by the 2018 APDR Jerome Arndt grant from the APDR. Our escape room is portable and inexpensive, using small props and a variety of paper-based challenges. A team of 4 to 6 players assembles inside a themed room. The game master explains the challenge and the rules and exits the room. The door closes and the clock begins counting down. The team has one hour to find clues and solve radiology themed puzzles and riddles. The game encourages and creates a communication challenge, which can be compared to real life practice. The escape room engages residents, since players instantly become active competitors with vested interest in winning. Strategy, problem solving, and cooperation are keys to success. These topics are explored in a debriefing session immediately after the activity. We believe that escape room experiences may cultivate grit, which research has shown can be a better predictor of success than standardized tests. Grit has been associated with decreased burnout and increased psychological well-being among residents. Each player took Duckworth’s 12-Item Grit Scale before and after the ER. The paired t-test analysis demonstrated a significant increase in grit from 3.7 to 4.1. Additional information during debriefing was obtained about team performance and participant evaluation. Overall feedback about game quality and value was rated as 4.8 (1-5 scale). We conclude that an escape room is an achievable and modern way to create a challenging and entertaining method of interactive learning and team building for residents. While our escape room is radiology focused, this concept could be adapted for any GME program. The game design package can be shared with other graduate medical educators and used to foster inter-professional collaboration.

**(E-128) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #2**

#### **“Mock Call”: Preparing Radiology Residents for Overnight Shifts via Peer-Led, Hands-On Simulation**

Erin N. Gomez, MD, *Johns Hopkins University School of Medicine, Baltimore, MD*; Christopher R. Bailey, MD; Pamela T. Johnson, MD\*; Lilja B. Solnes, MD ([egomez8@jhmi.edu](mailto:egomez8@jhmi.edu))

**LEARNING OBJECTIVES:** • Design and implement a series of hands-on teaching sessions that simulate the volume, pace and professional demands of Radiology residents’ overnight call • Assess the perceived utility of mock call sessions completed by rising second year Radiology residents • Compare mock call to other preparatory experiences during the first year of residency

**CONTENT DESCRIPTION:** At our institution, Radiology residents begin interpreting images independently overnight during their second year of training (R2). While on-the-job training with respect to all modalities takes place during the first year (including daily didactics and teaching at the workstation), the volume, pace and number of critical findings encountered overnight is significantly greater than during daytime hours. With this in mind, our curriculum includes a number of preparatory experiences such as rapid-fire Emergency case review sessions and diagnostic quizzes aimed at improving identification of pulmonary embolism, acute appendicitis and intracranial hemorrhage. This year, we designed and implemented a week of “mock call” for rising R2s. Sessions totaled 10 hours of simulation over 5 days. Residents were seated at diagnostic workstations and asked to interpret and dictate 20 Emergency Radiology cases (plain film, CT, ultrasound and MRI) in a 90-minute period, followed by 30 minutes of case review and questions. Sessions were facilitated by upper level residents who contributed the cases for interpretation and stood by to accept critical

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findings and simulate phone calls, questions from technologists, and technical difficulties. Participants were surveyed at the end of the week. Residents reported improved confidence in the interpretation of emergent cases (mean Likert scores of 4.58 vs. 7.16). In addition to the ability to dictate and scroll and one-on-one peer teaching, many described the sense of urgency imparted by the volume, case difficulty and realistic interruptions as course highlights. Mock call was ranked highly when compared with existing preparatory exercises, with 100% rating the sessions "Very Useful" or "Extremely Useful." All agreed mock call should be implemented again the following academic year.

**(E-129) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #2**

**There's an App for That: Radiology Resident Activity Tracking Using the Web-Based Application Trello™**

Andrew Jung, MD; Bridget Micka, MA; Kellee Oller, MD; Todd R. Kumm, MD; Summer J. Decker, PhD (*sdecker@health.usf.edu*)

**LEARNING OBJECTIVES:** Recognize that tracking resident scholarly activity is historically inaccurate by current systems, such as self-reporting in evaluation management programs or tracking travel reimbursement requests. Outline how a web-based project management system, Trello, can be utilized by residency programs track projects and provide resources within a creative space for mentorship.

**CONTENT DESCRIPTION:** The ACGME requires residency programs to track resident day-to-day tasks including scholarly activity & educational requirements. Many of the resources available to residencies can be cumbersome & lack customizability. These systems are difficult to navigate, making users less likely to report the necessary information. USF Radiology sought to collaborate with our colleagues in Internal Medicine (IM) to try a free online project management system called Trello. The purpose of this presentation is to share 2 large-program experiences with this new interactive system & demonstrate how it impacted our program's data collection. Trello is a collaboration tool that empowers users to track of multiple tasks through the use of project boards. The USF IM residency program has integrated Trello into its resident education as a more streamlined method for faculty to track reported scholarly activities as well as progress on individual projects. Its integration has improved tracking of research & enabled effective dissemination of information in a central hub. Based on this, Radiology implemented Trello to track mentored research, conference travel reimbursement, abstract deadlines & a didactic conference calendar. The calendar has helped to meet ACGME educational program core requirements & provides a central location for presentations & daily conference surveys. It also serves as a study tool for residents to reference prior to their board exams & obtain survey data for annual reporting. Overall, Trello has been shown to be a user-friendly online tracking system that is highly customizable to the needs of departments and programs. While front-end building can take time, it is easy to create a robust platform for active resident participation.

**(E-130) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #7**

**Commonly Missed Emergent and Non-Emergent Overnight Radiology Diagnoses in a Community Setting**

Jiao Wang, MD, *Bryn Mawr Hospital, Bryn Mawr, PA*; Michael S. Ferrell, MD; W. Scott Enochs, MD, PhD (*wangj@mlhs.org*)

**LEARNING OBJECTIVES:** Review common radiology resident overnight call discrepancies in the community hospital setting. Illustrate the importance of reviewing past discrepancies as a learning tool for residents about to take independent overnight call. Compare the differences in ACR RadPeer scores given by resident and attending radiologists.

**CONTENT DESCRIPTION:** At Bryn Mawr Hospital in suburban Phila-

delphia, radiology residents take overnight Diagnostic Radiology call from 10pm-7am and issue preliminary reads that are over-read by the day attending in the morning. Residents are indirectly supervised by Nighthawk with direct supervision available. Discrepancies between the resident overnight and day attending reads are retrospectively reviewed, scored and recorded using the original ACR RadPeer scoring system by an independent attending physician. A score of 1 indicates the reviewer concurs with the original overnight interpretation. A score of 2 indicates a difficult diagnosis, not ordinarily expected to be made. A score of 3 indicates a diagnosis should be made most of the time. A score of 4 indicates the diagnosis should be made almost every time or was a misinterpretation of the findings. Significant discrepancies are collated and presented at a quarterly "missed case" conference. For this study, ACR RadPeer scores given by an attending radiologist and radiology resident for the 2017-2018 academic year were compared. The three most commonly missed emergent diagnoses and the three most common missed non-emergent diagnoses are highlighted. Both attending and resident radiologists gave similar scores of 3 or 4 for acute surgical cases such as acute appendicitis and aortic rupture/hemorrhage. For non-emergent cases, the radiology resident ACR RadPeer scores were often greater than those given by the attending radiologist. Inter-observer variability between resident and attending scores was greater for discrepancies in emergent than in non-emergent cases. It is well established that reviewing and scoring overnight discrepancies is beneficial to radiology residents prior to starting call. Residents understand the impact of these discrepancies on patient care similarly to attending radiologists.

**(E-131) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #8**  
**Historical Development and Increasing Importance of Patient Satisfaction Surveys**

Dan I. Cohen-Addad, *Suny Downstate Medical Center, Brooklyn, NY*; Kevin Hewitt (*dan.cohen-addad@downstate.edu*)

**LEARNING OBJECTIVES:** Review the history of quality and safety in healthcare. Discuss the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, its relationship with the Value-Based Purchasing program, and its increasing importance to hospitals and physicians.

Learn the relevance of patient satisfaction surveys to radiology and provide potential options to improve scores.

**CONTENT DESCRIPTION:** US healthcare is currently aiming to reduce its cost while improving the quality of care. As a result, many programs were developed providing incentives based on quality such as the Physician Quality Reporting System (PQRS) and more recently the Merit-based Incentive Payment System (MIPS). Among many quality measures, there is an increasing role in patients' satisfaction surveys. Such as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) by the Medicare & Medicaid Services (CMS).

As part of the increasing focus on trainee's education in regards to patient safety and quality improvement (Section VI of the ACGME). We elaborate on the history of health care quality measures with a specific focus on patients' satisfaction surveys. The historical review includes the life stories of Semmelweis and Ernest Codman. The foundation of the American college of surgery. The joint commission. Avedis Donabedian and the Donabedian model. Press Ganey survey and Leapfrog group. The Agency of Health Care Research and Quality (AHRQ) and HCAHPS. We briefly review key historical moments in the health financing system including the diagnosis related program (DRG), the Protection and Accountable Care Act (PPACA) and the Value-based program (VBP). We discuss in detail the HCAHPS survey; methodology, sampling criteria, composition. Scoring mechanism including different weighting factors, achievement,

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improvement, consistency and overall scores. And specifically, HCHAPS financial linkage to reimbursement via the VBP. We briefly review the hospital compare scores. Finally, we focus on its specific relevance to radiology departments including confounding factors and potential ways to improve survey results.

**(E-132) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #6**

**Implementation of Comprehensive Simulation Based Procedural Training for Cross-Sectional Interventional Procedures in A Diagnostic Radiology Residency**

Brianna Oliver, *University of Michigan, Ann Arbor, MI*; Mishal Mendiratta-Lala, MD

**LEARNING OBJECTIVES:** After reviewing this educational exhibit, participants will be able to: - Understand the importance of implementing a comprehensive simulation-based cross-sectional interventional radiology (CSIR) procedural training program in a diagnostic radiology residency - Identify tools which can be used to evaluate procedural and technical competencies both before and after simulation training; additionally, discuss the ACGME competency learning objectives which are relevant when implementing a simulation-based cross-sectional training program, such as: cognitive objectives, psycho-motor objectives, affective objectives and transfer objectives - Implement a simulation-based CSIR training program at their institution by exploring one example of a successful program, as we provide a step-by-step outline of the components of a simulation-based training program, including sample competency evaluation tools.

**CONTENT DESCRIPTION:** The aim of this educational exhibit is to highlight the importance of a CSIR resident training program, as well as introduce participants to a successful sample program, which can be seamlessly integrated into any residency program at nominal cost. - Participants will first be introduced to evaluation tools relevant to assess gains in knowledge and procedural skills. - Additionally, participants will become familiar with the ACGME learning objectives which can be addressed by a CSIR training program. - Finally, a detailed outline highlighting the different parts of a sample training program from the pre-assessment training, procedural training and post-assessment evaluation, will be provided. - Sample evaluation tools will be provided, such as procedure checklist, pre and post-training test questions, and sample objective structured assessment of technical skills (OSATS) rating scales as it pertains to an ultrasound-guided procedure.

**(E-133) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #1**

**So You Want to Be a First-Year Radiology Resident Advisor: The Essential Job Description and 8 Key Strategic Steps to Ensure Success**

Jennifer W. Uyeda, MD\*, *Brigham & Womens Hospital, Boston, MA*; Glenn C. Gaviola, MD

**LEARNING OBJECTIVES:** 1. Develop a comprehensive job description for a first-year Radiology resident advisor 2. Create a first-year resident advisor role in a Radiology residency program that can be adapted by academic institutions nationwide 3. Identify key time points and issues specific to first-year Radiology residents that can be alleviated by a dedicated first-year resident advisor

**CONTENT DESCRIPTION:** The first year poses unique challenges frequently encountered at the start of Radiology residency training. Mentoring and advising first-year Radiology residents are crucial to ensure success as they transition to residency. Specific & unique challenges of first year residents include: -Transitioning from internship where there is a team-based approach to patient care & consistent pa-

tient interaction, to the more individualized environment in Diagnostic Radiology with less patient interaction -Adapting to new & constantly changing learning environments with each rotation, which frequently occur -Learning an abundant amount of Radiology knowledge & interpreting multiple imaging modalities covering multiple organs -Adjusting to a possibly new living environment such as a new city & surroundings, as a result of the NRMP Match, & may be unfamiliar or unwelcomed. Key strategic steps to implementing a successful first-year Radiology resident advising program: 1. Call to congratulate, welcome medical students to the residency program on Match Day 2. Review ERAS applications of the incoming first-year residents & memorize names 3. Welcome first-year residents during orientation & schedule initial one-on-one meetings with each of them 4. Develop monthly gatherings, social events including a first-year bonding event & welcome first-year resident party for all residents 5. Schedule mid-year group meeting & one-on-one meetings 6. Establish annual all-resident Wellness Retreat to discuss quality improvement, wellness promotion & burnout prevention, and personal reflection 7. Match faculty mentors to each first-year resident, at the conclusion of the year, who will serve as mentors for the remainder of the residency 8. Having an "open door policy" with high accessibility and availability

**(E-134) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #4**

**When Mistakes are the Teacher: Resident Leadership at Morbidity and Mortality Conference as Education in Professionalism and Quality Assurance**

Thomas Reher, *Indiana University School of Medicine, Indianapolis, IN*; Amanda Kleppe; Cortney Sostarich; Brandon P. Brown, MD, MA ([tareher@iupui.edu](mailto:tareher@iupui.edu))

**LEARNING OBJECTIVES:** Evaluate potential barriers to teaching and learning professionalism in radiology residency. Outline the essential steps in creating an education-driven morbidity and mortality conference that minimizes disruption and maximizes value. Illustrate the value of integrating residents into recurring sessions that discuss diagnostic error.

**CONTENT DESCRIPTION:** National organizations such as the Joint Commission and the ABR mandate a focus on quality assurance (QA) and professionalism, including standards of performance improvement, national patient safety goals to reduce medical error, and professionalism education for physician trainees (1,2). Yet finding concrete methods to teach these concepts while keeping them firmly embedded within the context of clinical work can be challenging (3). Today, nearly everything touched by a radiologist leaves a digital trail, meaning that for radiology, errors are more accessible than ever before. Addressing one's own mistakes and those of one's peers can be a difficult topic to approach, and a commonly encountered reluctance to discuss diagnostic error can diminish the inherent educational potential. Even when such discussions are part of the culture, making the most of these opportunities requires tremendous tact and humility. This presentation describes our experience with a resident-run "morbidity and mortality" (M&M) conference in our diagnostic radiology section, utilized as a high-yield teaching opportunity in such diverse areas as challenging pathology, QA, and professionalism. Resident management of the M&M conference as part of an ongoing QA project provides a safe environment to learn about diagnostic error, to improve our level of care, and to practice professionalism in action. In our presentation, we outline a process to anonymously record diagnostic errors, when discovered, in a manner that minimize disruption to workflow and which can contribute to future improvement for the entire department. Furthermore, we discuss the benefits of this system to patient care, other physician colleagues, and to cultivation of resident leadership.

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Finally we show how this could be easily adopted in other departments and at other institutions.

## Health Services for Radiology

### (E-045) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster Ideal Design and Structure of Departmentally Sponsored Women in Radiology (WIR) Organizations

Kirti Magudia, MD, PhD, *Brigham and Womens Hospital, Boston, MA*; Olga Laur; Sonia Sahu; Cory Robinson-Weiss, MD; Catherine Phillips, MD; Stacy E. Smith, MD (*kmagudia@bwh.harvard.edu*)

**LEARNING OBJECTIVES:** 1. How to request departmental support for a Women in Radiology (WIR) organization 2. What are three major categories of events for a Women in Radiology (WIR) organization 3. Who should lead a Women in Radiology organization (WIR) and how should the leadership be structured in order to promote a sustainable organization

**CONTENT DESCRIPTION:** 1. This instructional education poster will serve as a guide to creating and sustaining a successful Women in Radiology (WIR) organization. 2. Introduction: Nationally, there are fewer female than male radiologists at both the training and attending levels, with proportionally less women in leadership positions. WIR organizations can facilitate networking between female radiology faculty and trainees, provide formal skills development, serve as a forum to share experiences, help develop valuable mentor-mentee relationships, increase the career success and ambition of female faculty and trainees, improve recruitment efforts for female staff and trainees, and advance advocacy issues. 3. Initial development of a WIR organization includes the creation of a mission statement, identifying a faculty sponsor with strong trainee involvement, and obtaining Department Chair support. 4. Sample proposal for a WIR organization including goals, proposed yearly calendar and budget breakdown. 5. WIR email list management, including an alumni list for improved networking when applying for fellowship and attending positions. 6. WIR events include: welcome event at the beginning of the academic year, faculty roundtable, skills workshops, keynote speaker, social events, interdepartmental programs and end of the year celebration with achievement recognition and awards ceremony. Consider timing of events ranging between weekdays and weekends as well as morning, evening and during resident conference time. 7. Promote sustainability of the WIR organization by making sure that junior residents are involved early and often, faculty advisors are not overburdened, and expressing appreciation to the Department Chair after every event. 8. Conclusion: Summarizing reasons to start a WIR organization, and tips for developing a successful organization.

### (E-139) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #10 Long Distance Ultrasound Imaging: Technical Developments, Clinical Applications, and Integration of Telerobotic Ultrasound Systems into Clinical Practice

Scott J. Adams, MD, *University of Saskatchewan, Saskatoon, SK*; Ivar Mendez; Paul Babyn; Brent Burbridge (*scott.adams@usask.ca*)

**LEARNING OBJECTIVES:** 1. Describe how telerobotic ultrasound systems enable sonographers to remotely perform ultrasound examinations and enable radiologists reading off-site to remotely scan to confirm findings; 2. Discuss clinical applications of telerobotic sonography, and review clinical studies evaluating the feasibility and diagnostic accuracy of telerobotic sonography; and 3. Identify telecommunications requirements for telerobotic ultrasound systems and describe how telerobotic sonography can be integrated into the workflow of radiol-

ogy practices.

**CONTENT DESCRIPTION:** Sonography is not readily available in many communities across the developed and developing world because of the need for highly-trained users to perform examinations of diagnostic quality. Additionally, with increasing pressures to perform studies after-hours, there is a growing need for 24/7 sonographer coverage, and with the rise of teleradiology, radiologists reading off-site are not able to confirm findings by scanning at the bedside. These challenges have motivated efforts to harness advances in robotics and telecommunications to develop telerobotic ultrasound systems—ultrasound systems which allow sonographers or radiologists to manipulate an ultrasound probe from a distant location via a robotic arm, allowing users to remotely perform a diagnostic ultrasound examination. In this exhibit we will describe clinical applications of telerobotic ultrasound systems, including their utility for echocardiography, abdominal, pelvic, obstetrical, and vascular imaging. We will describe strategies for the development of telerobotic ultrasound clinics and their integration into the workflow of radiology practices. We will describe the benefits and limitations of telerobotic sonography, and describe ongoing research and development in the area of telerobotic sonography.

### (E-140) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #10 Radiology's Role in Mass Casualty Incidents: A Review of the Florida International University Bridge Collapse

Kristina A. Siddall, MD, *Aventura Hospital and Medical Center, Aventura, FL*; Jeffrey Lieberman; Orlando C. Enrizo, MD

**LEARNING OBJECTIVES:** The purpose of this educational exhibit is to provide a summary of radiology's role in a mass casualty incident. Following review of the exhibit, the learner should be able to: 1) Describe triage tags and the preparation of a radiology department for an MCI; 2) Explain radiology workflow during an MCI; and, 3) Understand the spectrum of imaging findings in MCI victims of a bridge collapse.

**CONTENT DESCRIPTION:** We describe the experience of the trauma hospital responsible for treating the victims of the catastrophic failure of the Florida International University pedestrian bridge on March 15, 2018. The aim of this exhibit is to summarize the events following the accident, specifically the triage of the victims at the scene, the activation of the disaster plan by EMS, the prioritization in the emergency department and the preparation of the radiology department for imaging the victims. We analyze radiology workflow, including the acquisition CT and radiography images, the viewing of images on PACS and the considerations for resolving patient identification. We also present the imaging of each of the trauma victims.

### (E-141) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #10 Demonstrating the Value of Artificial Intelligence in Medical Imaging: Strategies for Economic Evaluation of Artificial Intelligence Algorithms

Scott J. Adams, MD, *University of Saskatchewan, Saskatoon, SK*; Bjorn Hunter; Paul Babyn (*scott.adams@usask.ca*)

**LEARNING OBJECTIVES:** 1. Describe various perspectives which can be taken in economic evaluation of AI algorithms, including a societal perspective, payer perspective, or radiology group practice perspective; 2. Describe variables which must be considered in economic evaluations of AI algorithms; and 3. Describe how decision analytic models can be used for economic evaluation of artificial intelligence (AI) algorithms for lesion detection and characterization.

**CONTENT DESCRIPTION:** Artificial intelligence (AI) algorithms are rapidly being developed in medical imaging, with many algorithms

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demonstrating high accuracy and the potential to improve patient care. However, as AI algorithms begin to be implemented in radiology practices, it will also be important to conduct analyses to demonstrate the economic value of AI algorithms. In this exhibit, we will introduce a framework for the economic evaluation of AI algorithms, with a focus on two applications which are particularly promising for widespread clinical implementation—automated detection and classification of imaging findings. We will describe various perspectives which can be taken in economic evaluation, including a societal perspective, payer perspective, or radiology group practice perspective. We will describe variables which must be considered in economic evaluations of AI algorithms, and introduce decision analytic models and how they can be applied when evaluating AI algorithms for lesion detection and characterization. Finally, we will present case studies of economic evaluations of AI algorithms for lung nodule detection and lung nodule risk stratification. This exhibit will serve as a primer on economic evaluation of AI algorithms, which may be helpful for radiologists, radiology managers, health economists, payers, and industry developers taking the next step in the evaluation of AI algorithms.

## Informatics

**(E-048) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

### **How to Set up a Radiology Department 3D Printing Team: 2 Institutions' Experiences**

Summer J. Decker, PhD, *University of South Florida College of Medicine, Tampa, FL*; David H. Ballard, MS

**LEARNING OBJECTIVES:** -Understand the current status of 3D printing in medicine including types of constructs, using imaging data to make constructs, and reimbursement strategies - Describe the initial resources including personnel, workflow, and financial considerations needed to start and maintain a 3D printing laboratory facilitated by a radiology department - List the current 3D printing-related professional societies and resources available to radiologists

**CONTENT DESCRIPTION:** 3D printing has been actively used in medicine since the late 1980s, but has increasingly more incorporated played more of a clinical role for preoperative planning as technology has improved and positive outcomes have been shared. 3D models and prints have shown their clinical value through numerous publications, increasingly more frequent in radiology literature. In the past few years, there has been a surge of interest amongst hospitals and radiology departments around the US surrounding the technology as published data has demonstrated 3D printing's value in preoperative planning, education, and other uses. Today many institutions are quickly trying to set up 3D printing teams but, with limited direction and warning of pitfalls often being only anecdotal, it has proven to be difficult for some. Challenges in obtaining reimbursement and maintaining operational costs are additional hurdles. Growing 3D printing interest in radiology has led to the RSNA developing a 3D Printing Special Interest Group and the AUR Radiology Research Alliance's new 3D Printing Working Group's educational initiatives. The purpose of this presentation is to share the experiences of 2 different institutions to show how they established their 3D printing teams from the equipment to infrastructure requirements. In addition to discussing basic needs and potential hurdles, it will share current resources available to interested parties in how to collaborate and set up a 3D Printing Lab.

**(E-049) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Print Your Own 3D Models: Guide to Rendering 3D Printable Models from the CT Scan with Free and Open Source Software**

Milind Patel, MD, *Henry Ford Hospital, Detroit, MI*

**LEARNING OBJECTIVES:** - Role of 3D printing in medicine - Know the general process of converting DICOM file to STL file and STL file post-processing for 3D printing - Know the equipments and materials required to print 3D models - Understand types of 3D printing technology available today and their pros/cons

**CONTENT DESCRIPTION:** Radiologist uses 3D image renderings of the 2D images to understand anatomy and diagnose disease on day to day basis. However, 3D models of these renderings were rarely printed. 3D printing is relatively newly adopted technology in medicine. Due to decreasing costs and evolving data in 3D printing, '3D printing laboratories' are now emerging. Radiologists should be familiar with basic knowledge of 3D printing as it relates to their field. By understanding the image acquisition, post-processing, and the 3D printing process; radiologists can shape the multidisciplinary process of 3D printing in medicine. - Converting DICOM file into STL file with free and open source software available today, such as 3DSlicer - Cleaning and re-rendering the STL file for 3D printing using free software Meshmixer. - Slicing and optimizing the print setting to produce accurate models. - Knowing the types of 3D printers such as Fused Deposition Modeling (FDM), Stereolithography (SLA), Digital Light Processing (DLP), and Selective Laser Sintering (SLS) - Understanding the advantages and disadvantages of the different 3D printing technologies The role of 3D printing in medicine is emerging and radiologist can play important role in shaping this technology. Image acquisition to 3D printing is a multidisciplinary process, which can be learned with basic technical knowledge. From printing 3D models for preoperative planning to print rudimentary organs, the role of the 3D printing in modern medicine is ever-expanding.

**(E-050) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**The Next Step: A Novel Tool Integrating Evidence-Based Algorithms with the Local PACS Interface for Imaging Guidelines**

Prajna Chopra, MD, *University of Vermont Medical Center, Burlington, VT*; John Haines; Dmitriy Akselrod, MD; Judy Tam; David P. Keating, MD ([prajna.chopra@uvmhealth.org](mailto:prajna.chopra@uvmhealth.org))

**LEARNING OBJECTIVES:** Describe the development of a novel tool designed as an on-demand resource containing evidence-based follow up algorithms for reference integrated with the local picture archiving and communications system (PACS) when there is need for imaging follow up/recommendation. Discuss the technical process behind allowing access to the tool on the local workstation. Demonstrate the ease of use, utility and benefit of incorporating such a tool into daily practice.

**CONTENT DESCRIPTION:** Incidental findings are a common occurrence in radiology with the increasing use of cross sectional imaging and the higher image quality from technological advances. When incidental findings are discovered, the next step is not always obvious - recommendations for follow up not only vary among radiologists but also with the clinical physician. In an attempt to minimize variability, the American College of Radiology's (ACR) white papers and the Fleischner Society's guidelines for pulmonary nodules were developed, using evidence based research. Supplementary guidelines have also been developed for use when there is need for imaging follow up, such as the ACR Reporting and Data systems (ACR-RADS). While these

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resources are invaluable, the time spent finding the appropriate articles results in decreased efficiency and is a deterrent for the radiologist. Given the increasing volume of imaging studies, the lack of easy access to evidence based recommendations may result in inappropriate or absent recommendations by the radiologist. To improve efficiency and standardize recommendations at our institution, a local server based tool containing the evidence based algorithms provided in these papers, the WIRe (originally White Paper Indexed Resource, but as the scope has expanded, the name has remained), was developed for on-demand access at the PACS (picture archiving and communication system) work station by radiologists, radiology residents and fellows. This tool has improved efficiency, resulting in more consistent, evidence based recommendations, and increased collaboration between radiologic subspecialties and other clinical departments.

**(E-051) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

**Key Concepts in Imaging Informatics for the Radiologist**

Andrew Z. Liu, MD, *Columbia University, New York, NY*; Simukayi Mutasa, MD ([azl7001@nyp.org](mailto:azl7001@nyp.org))

**LEARNING OBJECTIVES:** I. Understanding cloud computing, block chain, and machine learning. • What are they and how do they work? • How can they impact radiology II. The radiology assembly line: • What steps are involved from when a study is first ordered to when a report is generated and sent to the providers and communicated to the patient. • How is each step currently achieved? • How can new technology influence each of the steps in performing a radiology study? III. PACS, inputs and outputs: • Introduction to data storage, retrieval, viewing, analysis, and reporting. • Current platforms and their common features • How are new technologies being incorporated?

**CONTENT DESCRIPTION:** With the advent of countless medical and imaging softwares, evolving technology changing the way we store, analyze, and display data, and our newsfeeds inundated by new machine learning programs capable of making imaging findings, where do we stand as Radiologists? What will we need to know to be a part of the evolution? This presentation is designed to empower radiologists unfamiliar with key technologic concepts and the elements that impact radiology workflow. The presentation will explain concepts of cloud computing, block chain, and machine learning in minimal technical terms. We will review the steps involved in the radiology workflow and how the above concepts can impact the process of each step. We will also review the common features of current PACS platforms and examples of current advances that incorporate machine learning and cloud computing into improving PACS functionality. At the end of the presentation, the audience will gain a basic grasp of key technologic terms and the radiology workflow. The audience will also gain further insight in how to evaluate new PACS and other new imaging software.

**(E-142) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #5**

**Data Management for Reproducible Research: Spreadsheets and Beyond**

Andrew B. Ross, MD, *University of Wisconsin School of Medicine and Public Health, Madison, WI*; Vivek Kalia, MD, MPH

**LEARNING OBJECTIVES:** 1. Describe the importance of data management for reproducible research. 2. Apply best practice principles for project management with logical folder organization, back up, version control, and change tracking. 3. Create spreadsheets for data organization using techniques for reproducibility and easy data analysis.

**CONTENT DESCRIPTION:** Although research methodology varies widely, most research projects progress through a predictable series of stages: data acquisition, data cleaning, data analysis, presentation

of findings, and archiving work. Even experienced researchers may progress through this workflow in an ad hoc way solving the problems of the moment with little thought to documentation or reproducibility of research findings. Consequently, most of us have encountered some variation of one of these familiar problems: after completing your analysis additional data become available but you can't remember all of the steps you took to get your initial results; a research assistant cleaned your spreadsheet data by hand and can't remember how they recoded some of the variables; getting your analysis back from your statistician is delayed by a lengthy back and forth as to how the data are organized; etc. Fortunately, modern computational science practices have evolved for project management, data organization, and workflow. Previously these tools required more advanced programming knowledge, but the advent of tools like OpenRefine with a graphical user interface have made them accessible to anyone with basic computing skills. This educational exhibit describes modern principles of research project management including planning, file and folder management, back up, data entry and cleaning, data analysis, and archiving. The skills described are appropriate both for entry level investigators on small projects and primary investigators running large projects with multiple collaborators. Successful implementation of these project management techniques will lead to efficient, reproducible research.

**(E-143) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #5**

**Implementation of a Structured Virtual Reality Education Curriculum to Enhance Radiology Procedural Training**

Mohammad Elsayed, MD, *Emory University School of Medicine, Atlanta, GA*; Patricia Balthazar, MD; Frederic J. Bertino, MD; Ryan B. Peterson, MD; Jonathan Martin, MD; Nabile M. Safdar, MD; et al

**LEARNING OBJECTIVES:** Procedural training within radiology presents many challenges, with residents often experiencing a lack of structured teaching. Virtual reality (VR), which is an immersive simulation that creates the perception of being present within a non-physical world, can be utilized to provide standardized procedural training. The objective of this exhibit is to (1) review the challenges of procedural learning in radiology and (2) describe the implementation of a virtual reality education curriculum to standardize and enhance radiology residents' procedural training.

**CONTENT DESCRIPTION:** After a review of multifactorial challenges to procedural teaching in radiology, the implementation of a VR educational curriculum is outlined. An IRB waiver was obtained to video record radiology faculty performing procedures in simulation mannequins. A list of radiology procedures was generated, and clinical attendings willing to be recorded teaching the procedures were identified. A GoPro 360 Fusion camera was used to record VR videos. A native GoPro rendering application and Adobe Creative Cloud were utilized to post-process the videos which were uploaded to a YouTube 360 VR channel. We generated an easily accessible online directory of VR videos which simulates the experience of being taught a procedure in real time by a radiology attending. Residents rotating on procedural services (including interventional radiology, neuroradiology, abdominal imaging, and musculoskeletal imaging) will be provided viewing box headsets (Google Daydream or Cardboard VR) to watch relevant VR videos before performing a procedure. This way, regardless of which attending is on service that day or level of resident experience, residents participating in this pilot program now have a standardized foundational educational experience for procedures in diagnostic and interventional radiology rotations. Finally, we outline future plans to create an open access VR video database that may be easily adopted in other residency programs.

\* Faculty financial disclosures are located in the Faculty Index.

## Interventional Radiology

### (E-054) Thursday • 7:00 AM - 8:00 AM • Hard copy poster Unique Considerations in the Evaluation and Management of Gastric Varices

Thaddeus J. Maguire, *Medical College of Wisconsin, Milwaukee, WI*; Parag J. Patel, MD\* (*tmaguire@mcw.edu*)

**LEARNING OBJECTIVES:** 1. Define and characterize portal hypertension using direct and indirect clinical evidence. 2. Understand the relevant anatomy, pathophysiology and flow dynamics underlying the development common portosystemic shunts. 3. Map the tributaries and terminals of the two primary portosystemic collateral pathways responsible for gastric variceal drainage. 4. Appreciate the different clinical implications and management between varices drained via the gastroesophageal or gastrophrenic systems. 5. Understand the role and indications for Transhepatic Intrahepatic Portosystemic Shunts (TIPS) in treatment of varices. 6. Understand the mechanics and applications of the most commonly used Transvenous Obliteration techniques including Balloon-Occluded Retrograde (BRO), Balloon-Occluded Antegrade (BATO) 7. Identify potential post-treatment complications. 8. Define sinistral portal hypertension.

**CONTENT DESCRIPTION:** Introduction: Portal Hypertension can result from any process which impedes the flow of blood through the liver sinusoids back into the systemic circulation. In Western countries, the vast majority of portal hypertension arises secondary to intrinsic hepatic disease such as cirrhosis. It is important for practicing and training Radiologists to recognize associated imaging findings as they may precede clinical symptoms. In the setting of altered pressured gradients, varices may develop at natural anastomoses between the portal and systemic circulations. While less common than esophageal varices, gastric varices are associated with more substantial, and potentially fatal bleeding. Content: This review will explore the diagnosis, characterization and management of gastric varices for Interventional Radiologists using practical example cases featuring multiple imaging modalities. The pathophysiology of portal hypertension will be reviewed. Relevant anatomy and shunt physiology will be presented. The classification of varices- based on location, morphology and route of drainage- will be discussed with respect to its impact on management. Clinical evaluation and treatment strategies will be outlined, with a focus on pertinent endovascular techniques.

### (E-055) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster

#### Beyond “Just a Pinch and a Burn”: A Review of Local Anesthetic Agent Use and Precautions for Diagnostic and Interventional Radiology Residents

Mrunal Tailor, MD, *University of South Florida, Tampa, FL*; Todd R. Kumm, MD; Kerry L. Thomas, MD (*mtailor@health.usf.edu*)

**LEARNING OBJECTIVES:** Upon completing this review the learner will: • Understand the pharmaceutical profile of commonly used local anesthetic agents. • Identify and manage common and uncommon adverse reactions of local anesthetic agents. • Select alternative management strategy when common local anesthetics are contraindicated.

**CONTENT DESCRIPTION:** Introduction: Lidocaine is the local anesthetic drug most often used for image guided interventional procedures. Lidocaine is safe, effective and is generally well tolerated. On occasion, allergy or intolerance to lidocaine is encountered. In this review, we compare and contrast the pharmaceutical profile of commonly used anesthetic agents, describe the identification and management of allergic and adverse events, and offer a multidisciplinary strategy for the patient with a contraindication to available local anesthetic agents. Pharmaceu-

tical profile of local anesthetic agents • Types of local anesthetic agents (amide and ester) • Most commonly used agents • Dosing and drug differences

**Allergic and Adverse Events:** Identification and treatment • Allergy • Non-allergic Adverse events Strategy for the patient with contraindication • Distinguish true allergy from non-allergic event. Tips for history taking and documentation • Establish safety profile for alternate local anesthetic • When to get help: Allergist or Anesthesia consultation? • Non “-caine” drug strategies

**Conclusion:** For image-guided procedures, understanding the pharmaceutical profile of available local anesthetic agents is essential for providing safe and effective patient care. Lidocaine is well-tolerated and has an excellent safety profile. However, adverse and allergic events with local anesthetics can occur. A proactive patient management strategy is essential to provide comprehensive and safe care plan for the rare patient with a contraindication to local anesthesia.

### (E-144) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #3

#### A (Not Always) Clear and Present Danger: Techniques in Imaging and Intervention for Acute Aortic Syndromes

Thaddeus J. Maguire, *Medical College of Wisconsin, Milwaukee, WI*; Parag J. Patel, MD\* (*tmaguire@mcw.edu*)

**LEARNING OBJECTIVES:** 1. Define and describe the different Acute Aortic Syndromes (AAS.) 2. Identify common risk factors and clinical presentation of Acute Aortic Syndromes. 3. Understand the pathophysiology of Aortic Dissection, Intramural Hematoma, Penetrating Atherosclerotic Ulcer (PAU) and Aortic Aneurysm. 4. Understand the imaging modalities and techniques required for proper evaluation of Acute Aortic Syndromes. 5. Recognize and evaluate Aortic Dissection, Intramural Hematoma and PAU on cross-sectional imaging and differentiate common mimics. 5a. Properly measure an aorta and identify a false lumen on CT. 6. Characterize critical sequelae such as rupture, pseudoaneurysm, branch vessel occlusion and cardiac tamponade. 7. Understand available endovascular interventions for the thoracic aorta. 8. Recognize indications and contraindications for endovascular intervention. 9. Understand routine post-operative management and imaging. 10. Identify common post-intervention complications.

**CONTENT DESCRIPTION:** Acute Aortic Syndrome (AAS) refers to a collection of related pathologies which can potentially result in rapid clinical decompensation and death. In the absence of significant trauma, a high index of clinical suspicion is often required to establish the diagnosis and avoid delaying any necessary intervention. Radiologists and trainees must be familiar with these conditions as well as potential pitfalls in diagnostic evaluation. In the present review, the non-traumatic Acute Aortic Syndromes will be explored through a series of instructional vignettes developed from cases encountered at the author’s home institution. The risk factors and pathophysiology underlying these disorders will be compared and contrasted. Techniques for protocoling and interpreting cross-sectional imaging will be highlighted. Case discussions will include currently available options and indications for medical, surgical and endovascular management. Using multiple imaging modalities, pertinent endovascular therapies will be reviewed in greater depth with included pearls for planning and deploying intervention. Follow-up imaging will be used to underscore potential short and long term complications.

\* Faculty financial disclosures are located in the Faculty Index.

(E-145) Wednesday • 7:00 AM - 7:15 AM • E-poster, Station #6

### Embracing a Culture of Radiation Safety in the IR Suite: Keys to Success and Implementation of the Radiation Safety Time-Out

Sofya Kalantarova, *NYU Winthrop Hospital, Mineola, NY*; Diane Szaflarski; Ezra Margono; David Gregorius; Jason C. Hoffmann, MD\* (*Jason.Hoffmann@nyulangone.org*)

**LEARNING OBJECTIVES:** This exhibit reviews key concepts of radiation safety and its impact on interventional radiology (IR) patients, physicians, and staff members. This exhibit aims to educate IR attendings, trainees, and staff members about how to maximize radiation safety device incorporation in the IR suite. Implementation of a Radiation Safety Time-Out before starting a procedure is detailed, as it can help to embrace and strengthen the culture of radiation safety in IR.

**CONTENT DESCRIPTION:** Review concepts of radiation safety in the IR suite, including patient, operator, and staff safety. Discuss key radiation safety terms, including Kerma, Air kerma, and Scatter Radiation. Describe critical information about radiation dose, including absorbed dose, equivalent dose, effect dose, and entrance skin dose. Detail technological developments that have led to improved radiation safety in the IR suite, including automatic exposure control, shaping filters, electronic image magnification, and protective equipment. Review how radiation exposure is measured. Report current limitations for patients and IR staff members. Discuss the various effects of radiation exposure. Review the evolution of radiation safety culture in IR. Describe key points of how to further improve the radiation safety culture, with focus on implementing a radiation safety time-out at the start of each procedure.

## Musculoskeletal Radiology

(E-057) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster

### Sorting Through the Sclerosis: An Approach to Sclerosing Bone Dysplasias

Lynn Della Grotta, *Wake Forest Baptist Health, Winston Salem, NC*; Scott D. Wuertzer, MD

**LEARNING OBJECTIVES:** 1. Review the demographics, pathophysiology, clinical features, and key radiographic features of sclerosing bone dysplasias. 2. Discuss acquired osteosclerosis disorders that can mimic sclerosing bone dysplasias. 3. Provide an algorithmic approach with case examples to identify skeletal dysplasias and differentiate them from the acquired osteosclerosis disorders.

**CONTENT DESCRIPTION:** Sclerosing bony dysplasias are a group of disorders characterized by excessive bone accumulation. They can be hereditary or non-hereditary and some have known genetic mutations. Hereditary causes range from innocuous osteopoikilosis to sometimes debilitating osteopetrosis. Non-hereditary dysplasias include melorheostosis and intramedullary osteosclerosis. Acquired osteosclerosis disorders or "skeletal dysplasia mimics" include systemic diseases such as sickle cell anemia, tuberous sclerosis, and sclerotic metastases. The location and appearance of the sclerotic lesions as well as the patient's history and associated clinical findings help to identify the subtypes of sclerosing dysplasias and differentiate them from their mimics. In this exhibit, we will describe these key distinguishing features and present an algorithm to help the radiologist accurately diagnose sclerotic lesions. We will illustrate this algorithm through case examples.

(E-058) Thursday • 7:00 AM - 8:00 AM • Hard copy poster  
Femur Stress - Can You Take It?

Saagar Patel, *UT Houston McGovern Medical School, Houston, TX*; Manickam Kumaravel, MD (*saagar.patel@uth.tmc.edu*)

**LEARNING OBJECTIVES:** The learner will be exposed to: • The biomechanics and pathophysiology of stress induced fractures and injuries to the femur. • Various imaging presentations of stress injuries of the femur including radiographs, CT and MRI. • Understand treatment modalities and become proficient in avoiding pitfalls and to recognize complications.

**CONTENT DESCRIPTION:** • This exhibit will discuss detailed macro and micro anatomical features of the femur and associated soft tissues such as muscles, tendons and cartilage. • A review of biomechanics of the femur with consideration to modeling and remodeling process of the femur will be provided. Emphasis will be placed on structural integrity and composition of trabecular bone and its response to stress. • Multiple cases, using various modalities such as radiographs, CT, and MRI, will be used to review presentations of stress related injuries to the femur. Treatment options and imaging follow up will also be discussed. • The learner will be exposed to key concepts of stress related injuries and to be aware of pitfalls.

(E-059) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster

### Differentiation of Benign and Malignant Lipomatous Soft Tissue Tumors

Hassana Barazi, MD, MBA, *West Virginia University School of Medicine, Morgantown, WV*; Melinda K. Smith, MD, MA

**LEARNING OBJECTIVES:** This exhibit provides a review of imaging findings that are associated with musculoskeletal lipomatous tumors. The exhibit will provide the viewer with information to add or reinforce knowledge of these entities utilizing ultrasound, computed tomography and magnetic resonance imaging. After viewing this exhibit, the participants should have a clear understanding of the diagnostic appearance of the disorders described.

**CONTENT DESCRIPTION:** Lipomas, Benign Lipoma Variants, Atypical Lipomas/Well Differentiated Lipomas and Liposarcomas

(E-060) Thursday • 7:00 AM - 8:00 AM • Hard copy poster  
Radiologic Findings of Developmental Anomalies and Symptomatic Developmental Variants of the Extremities

Layla Nasr, *West Virginia University School of Medicine, Morgantown, WV*; Thuan-Phuong Nguyen (*Layla.nasr@hsc.wvu.edu*)

**LEARNING OBJECTIVES:** The main objective is to present a spectrum of developmental anomalies (such as tarsal coalition, Madelung deformity, pseudoarthrosis, digitation anomalies), as well as symptomatic developmental variants (such as symptomatic accessory ossicles and hip morphology related to femoroacetabular impingement) of the extremities. This is aimed at teaching the learner/trainee to: 1. Describe the anatomy related to the different types of tarsal coalition and the joints that are involved. 2. Describe the anatomy related to pseudoarthrosis of the tibia and fibula. 3. Recognize the different accessory ossicles and their associated syndromes (os navicular syndrome, ankle impingement syndromes, carpal bossing, etc...). 4. Recognize the pincer-type acetabular and CAM-type femoral head morphologies which may be related to FAI. 5. Recognize the anatomy related to digitation anomalies. 6. Describe the anatomy of Madelung's deformity.

**CONTENT DESCRIPTION:** 1. Display radiographic, CT, and MR findings related to tarsal coalition. 2. Display radiographic findings related to tibial and fibular pseudoarthrosis. 3. Display radiographic and MR findings of syndromes related to accessory ossicles of the hand and foot. 4. Display radiographic and MR findings related to femoroacetabular

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impingement - related morphology. 5. Display radiographic findings related to digitation anomalies and Madelung's deformity.

**(E-061) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

**Acute Shoulder Injury: An Imaging Overview**

Andrew Cibulas, MD, MS, *Florida Hospital, Orlando, FL*; Alexander Leyva, MD; George Cibulas, MD, PhD; Jack A. Porrino Jr, MD; Laura W. Bancroft, MD\*; Kurt F. Scherer, MD; et al (*andrew.cibulas.md@flhosp.org*)

**LEARNING OBJECTIVES:** Acute shoulder injury is commonly encountered by clinicians, surgeons, and radiologists. Comprehensive and concise evaluation of the shoulder by the radiologist is essential to accurately relay findings that have a direct impact on acute and long-term management. In this pictorial review, we discuss the imaging features identified in various acute shoulder injuries on ultrasound, conventional radiography, computed tomography, and magnetic resonance imaging.

**CONTENT DESCRIPTION:** An overview of imaging findings of acute injuries to the acromioclavicular joint, the glenohumeral joint, the rotator cuff, the glenoid labrum, the tendon of the long head of the biceps brachii muscle, and the proximal humerus will be outlined. An emphasis will be placed on radiographic features that have an immediate impact on patient management.

**(E-062) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**

**Musculoskeletal Death: A Diagnostic Imaging Review**

Alexander Leyva, MD, *Florida Hospital, Orlando, FL*; Andrew Cibulas, MD, MS; Jack A. Porrino Jr, MD; Christopher W. Wasyliv, MD; Laura W. Bancroft, MD\*; Kurt F. Scherer, MD; et al (*alexander.leyva.md@flhosp.org*)

**LEARNING OBJECTIVES:** Pathologic conditions of the musculoskeletal system leading to cellular death of bone, muscle, fascia, subcutaneous adipose tissue and skin are commonly encountered by the practicing clinician and radiologist. Etiologies are varied, and prompt recognition of these processes is critical in prevention of further morbidity and mortality, where possible.

**CONTENT DESCRIPTION:** In this pictorial review, we discuss the pathophysiology, clinical presentation, and diagnostic imaging features of a curated selection of these entities, including avascular necrosis, bone infarct, sequestrum in chronic osteomyelitis, myonecrosis, necrotizing fasciitis, and gangrene. Typical radiographic, computed tomographic, and magnetic resonance imaging findings are outlined.

**(E-063) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

**Early Bisphosphonate-Related Changes in the Proximal Femur**

Gregory M. Lee, *Kansas City, MO*

**LEARNING OBJECTIVES:** • Review current literature and research regarding bisphosphonate-related change in the proximal femur, including stress-related fractures and cortical thickening • Understand early changes that occur from use of bisphosphonates, including subtle cortical thickening or lucencies • Realize the importance of detecting subtle change that may progress to complete insufficiency fractures, in the setting of bisphosphonate use • Early changes may have absent marrow edema

**CONTENT DESCRIPTION:** • Demonstrate case series of bisphosphonate related change in the proximal femur. • Case 1: Bilateral bisphosphonate related stress fractures of different ages. Older fracture demonstrates edema and subtly seen on scout images from CT abdomen

pelvis exams. On the contralateral side, there is slow progression with cortical thickening WITHOUT edema on MRI • Case 2: Subtle lucency and cortical thickening in the lateral proximal femur by radiograph. No associated marrow edema on subsequent MRI, which again demonstrates thickening. In the setting of bisphosphonate use, suspicious for early stress related changes • Case 3: More conspicuous bisphosphonate-related insufficiency fracture with large amount of cortical sclerosis and lucency spanning half shaft width without complete transverse fracture • Additional images (XR, CT, MR) demonstrating typical findings, including periosteal and endosteal thickening, "black line", focal radiolucency • Suggest that marrow edema not necessarily present early in the setting of bisphosphonates

**(E-146) Wednesday • 7:20 AM - 7:35 AM • E-poster, Station #5**

**Heterotopic Ossification: What the Radiologist Needs to Know**

Matthew Fiala, *McGovern Medical School, Houston, TX*; Saagar Patel; Bilal Mujtaba, MD

**LEARNING OBJECTIVES:** 1) Identify the CT, MRI, and plain film presentations of Heterotopic Ossification in various stages. 2) Summarize the underlying pathophysiology and expected clinical course of Heterotopic Ossification. 3) Review imaging of mimetic diseases and how to properly distinguish them.

**CONTENT DESCRIPTION:** Heterotopic ossification is a commonly occurring condition referring to ectopic bone formation in soft tissues. It can be broadly categorized in to three etiologic subtypes: neurogenic - stemming from central nervous system injury, orthopedic - from fractures, fixations, joint replacements, etc., and trauma - related to burns and high velocity impacts. Heterotopic ossification has been correlated with the severity of the trauma, infection, total burn coverage and cytokine concentration in affected tissues, however the underlying mechanisms of formation remain unclear. Literature has suggested multiple sources for the formation of ectopic bone, pointing to muscle satellite cells, smooth muscle cells, and even endothelial cells. Patients presenting with heterotopic ossification typically complain of inflammatory symptoms including pain, swelling, erythema, and warmth along with joint immobility, which appear anywhere from 3 to 12 weeks after the precipitating event. The most common sites of occurrence, in decreasing order, are the hips, knees, shoulders, and elbows. The gold standard for diagnosing heterotopic ossification is through imaging studies, mainly x-ray and computerized tomography. The downfall to these types of imaging is that they are not able to detect calcifications for at least 6 weeks after the inciting trauma. Three-phase bone scintigraphy is the most sensitive method for detecting heterotopic ossification, with the earliest detection being 2.5 weeks post trauma. Early screening methods used before imaging studies include alkaline phosphate levels and 24-hour PGE2. A rapid increase in 24-hour PGE2 urinary secretion has also been shown to suggest heterotopic ossification and would indicate further imaging studies. Upon detection with imaging, biopsies have been suggested to confirm diagnosis, however current recommendations are to perform follow up imaging in four weeks.

**(E-147) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #4**

**Forearm Trauma: What the Radiologist Needs to Know**

Malik M. Mossa-Basha, *University of North Carolina, Durham, NC*; Troy Maetani, MD

**LEARNING OBJECTIVES:** Learning Objective Statements: 1. To review mechanisms of forearm trauma. 2. To gain awareness of fracture classification. 3. To learn what information is important to the Orthopedic Surgeon for surgical management.

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**CONTENT DESCRIPTION:** Topics Covered: 1. Forearm Anatomy 2. Mechanisms of Injury 3. Surgical Classification • Association for the Study of Internal Fixation (ASIF) guidelines 4. Fracture-Dislocation Injury • Monteggia • Galeazzi • Essex-Lopresti

**(E-148) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #3**  
**A Review of Osteochondroses: More than Just Bone Necrosis**

Malik M. Mossa-Basha, *University of North Carolina, Durham, NC*; Troy Maetani, MD

**LEARNING OBJECTIVES:** LEARNING OBJECTIVES: 1. To gain awareness of the different types of osteochondroses 2. To review the diagnostic imaging criteria of osteochondroses 3. To learn about the management of osteochondroses

**CONTENT DESCRIPTION:** OSTEOCHONDROSES 1. Definition 2. Pathophysiology 3. Types -Kienbock's -Legg-Calve-Perthes -Scheuermann's -Kohler's -Freiberg Infraction -Osgood-Schlatter's -Panner's -Sever's -Sinding-Larsen-Johansson -Blount's -Kummel's -Preiser's -Osteochondritis Dissecans 4. Diagnostic Imaging Criteria 5. Clinical Presentation 6. Management

## Neuroradiology

**(E-065) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Imaging Evaluation of Intraventricular Lesions**

Ankit V. Gandhi, *Thomas Jefferson University Hospital, Philadelphia, PA*; Michael Poplawski; Sandeep P. Deshmukh, MD

**LEARNING OBJECTIVES:** 1. Be able to distinguish the common intraventricular masses by using key CT and MRI features. 2. Develop a systematic approach to intraventricular pathology using patient demographics, location, and imaging appearances. 3. Be familiar with unusual intraventricular manifestations of common non-intraventricular and iatrogenic entities.

**CONTENT DESCRIPTION:** • Present common intraventricular masses arising from the ventricular wall/septum pellucidum, choroid plexus, and periventricular region. • Stratify and narrow the differential diagnosis of intraventricular pathology by solid tumors, cysts, infection, calcification, and avid enhancement pattern along patient demographics. • Showcase unusual intraventricular manifestations of common non-intraventricular entities.

**(E-066) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Spinal Pneumorrhachis: A Subtle Indicator of Clinically Significant Pathology**

Matthew Alfano, *Dartmouth Hitchcock Medical Center, Lebanon, NH*; Ryan M. Brandt; Allison O. Backer, DO; Michael J. Talarico, MD; Stephen J. Guerin, MD (*matthew.t.alfano@hitchcock.org*)

**LEARNING OBJECTIVES:** Classify the different causes of spinal pneumorrhachis and identify pertinent findings on example cases. Understand the implications of spinal pneumorrhachis and be able to identify possible causes due to the location of the findings. Understand the treatment of spinal pneumorrhachis as well as, the associated findings that can change management.

**CONTENT DESCRIPTION:** Key Anatomic or Pathophysiologic Issues and Imaging Findings. Pneumorrhachis is primarily classified by cause including: trauma, infection, extension from increased pulmonary pressure, degenerative changes, and iatrogenic introduction. It is further described as primary or secondary, and either extra- or intradural, with

trauma and iatrogenic causes being by far the most common (Oertel MF, et al). While not often symptomatic in itself, pneumorrhachis is commonly an indicator of wider and more significant pathology that must be recognized. In order to ensure the best outcome for a patient, one must not only recognize the often-subtle findings, but also recommend the correct work-up to uncover and evaluate the cause. In order to help illustrate the diagnostic dilemmas often encountered, several case examples from our institution using both computed tomography and magnetic resonance imaging will be presented, and subsequent work up will be discussed in order to develop a guiding framework for use in practice.

**Conclusion:** Pneumorrhachis can be caused by a wide range of clinical conditions. While the finding of air in the spinal canal is often not the cause of the presenting symptoms, the underlying source of air in the spinal canal can have significant bearing on patient outcome if not addressed appropriately. Therefore, both being able to identify the presence of pneumorrhachis and recommend the appropriate work up for associated findings can have an important impact on patient care.

**(E-150) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #1**  
**Stroke Imaging: Interpreting CT Perfusion and Its Implications in Mechanical Thrombectomy**

Ryne Dougherty, *Michigan Medicine, Ann Arbor, MI*; Matthew Mangano, MD; Julius Griauzde, MD

**LEARNING OBJECTIVES:** • Explain the pathophysiologic basis for CT perfusion • Demonstrate an approach to reading CT perfusion cases • Review the imaging features of the recent mechanical thrombectomy trials

**CONTENT DESCRIPTION:** In 2015, four landmark trials were published which re-defined the treatment algorithm of acute ischemic stroke. Following the publication of the MR CLEAN, ESCAPE, EXTEND-IA and SWIFT PRIME trials, mechanical thrombectomy with or without IV tpa became the gold standard treatment in the first 6 hours following symptom onset. More recently, the eligibility time-frame for mechanical thrombectomy was extended with the publication of the DAWN and DEFUSE-3 trials. These trials lengthened the time interval for with CT and MR perfusion playing a central role in patient selection. Perfusion imaging in these trials aimed to identify the ischemic core (non-salvageable tissue) and the penumbra (tissue at risk). CT perfusion (CTP) is an effective diagnostic tool to evaluate acute ischemic stroke. It has been shown to increase the diagnostic certainty for both expert and non-expert readers. CTP aims to quantify cerebral blood flow (CBF) and cerebral blood volume (CBV), the volume of blood within an imaging voxel. These parameters are used to calculate the mean transit time (MTT) which is the average transit time of the contrast bolus through the specific volume of brain. Areas of matched perfusion abnormalities on CBV and MTT represent the ischemic core while areas of mismatched perfusion abnormalities on CBV and MTT represent the penumbra.

**(E-151) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #1**

**It Is a Parotid Lesion! What Can This Be?**

Dmitriy Shnayderman, *Medical College of Wisconsin, Milwaukee, WI*; Stacy D. O'Connor, MD; Youssef Farhat; Joseph Budovec, MD *Medical College of Wisconsin, Milwaukee, WI*

**LEARNING OBJECTIVES:** Parotid lesions and abnormalities can incidentally be discovered on both CT and MRI of the head. Ultrasound is a useful modality to further investigate the abnormality. The purpose of this presentation is to review parotid anatomy, ultrasound characteristics of common and rare lesions, both malignant and benign, with pathologic correlations.

**CONTENT DESCRIPTION:** Acute parotid processes may manifest as an enlarged, tender, or hyperemic parotid gland, representing typi-

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cal pathologies such as an abscess or sialolithiasis. Chronic pathology could be found incidentally on a multiplanar imaging. Both benign and malignant masses can present as hypoechoic salivary gland lesions with a broad differential diagnosis. Pleomorphic adenoma, also known as benign mixed tumor, is a solid, hypoechoic, well-defined lesion, with homogenous internal echoes and posterior acoustic enhancement. Warthin tumors, when small, can present as an elliptical, solid reniform mass with heterogenous architecture. Larger masses can have cystic and solid components with septations and debris. Mucoepidermoid carcinoma can present as either a low or high-grade mass. Low-grade masses have well-defined margins and are predominantly homogenous. High-grade masses are ill-defined and hypoechoic, with necrosis and hemorrhage. Additional mass lesions including metastatic clear cell carcinoma, Merkel cell carcinoma, granulomatous inflammatory changes, plasmablastic lymphoma, superficial ulcerated angiosarcoma, oncocytoma, follicular cell lymphoma, melanoma, and other masses will be discussed in detail in the final presentation. Although ultrasound is a helpful modality to characterize the lesion and rule out acute pathology, precise diagnosis of a mass lesion is difficult to make by ultrasound alone. Pathologic correlation continues to play an important part in the final diagnosis.

**(E-152) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #5**  
**Headaches - What a Pain!**

David Wang, *University of Cincinnati Medical Center, Cincinnati, OH*; Lily L. Wang, MBBS, MPH; John M. Hazenfield, MD ([wang2dv@ucmail.uc.edu](mailto:wang2dv@ucmail.uc.edu))

**LEARNING OBJECTIVES:** After this education exhibit, the reader should be familiar with the MRI appearance of intracranial hypotension and hypertension. The reader should be familiar with the presenting clinical symptoms, including diagnostic criteria. Finally, the reader will gain an understanding of the treatment options available.

**CONTENT DESCRIPTION:** Chronic headaches are a common presentation and indication for imaging. An under-recognized cause of headaches is intracranial hypotension or hypertension. Although etiology may be idiopathic, a proportion of these cases will have an identifiable secondary cause. Delayed diagnoses can cause continued patient discomfort. There are typical imaging appearances on magnetic resonance imaging (MRI) to help the radiologist suggest the diagnosis. The key imaging findings will be presented. For intracranial hypotension, subdural effusions, smooth pachymeningeal enhancement, convex superior pituitary border, loss of CSF within the optic nerve sheaths, rounded transverse sinuses and brainstem sagging are depicted on MRI. For intracranial hypertension, empty pituitary sella, enlarged Meckel's cave, arachnoid pits, prominent optic nerve sheath CSF, lateral transverse sinus stenosis and slit-like ventricles are demonstrated on MRI.

## Interventional Radiology

**(E-153) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #9**  
**Lumbar Puncture Technique**

David Wang, *University of Cincinnati Medical Center, Cincinnati, OH*; John M. Hazenfield, MD ([wang2dv@ucmail.uc.edu](mailto:wang2dv@ucmail.uc.edu))

**LEARNING OBJECTIVES:** After this exhibit, the radiologist will be familiar with the fluoroscopic landmarks for performing a lumbar puncture, how to optimize views on standard and c-arm fluoroscopy. The reader will be aware of different needle types, needlecraft and how to accurately measure opening pressure.

**CONTENT DESCRIPTION:** Lumbar punctures are common procedures, which can be performed with or without imaging guidance. Usually difficult lumbar punctures are performed with fluoroscopic

guidance and therefore it is important for the radiologist to be aware of the ways to optimise patient positioning, fluoroscopic views, anatomic landmarks and accurate measurement of opening pressure. Anatomical landmarks are annotated on fluoroscopic images. Key features and techniques are explained, including different needle types to reduce the likelihood of post dural puncture headaches. The features explained will help radiologists optimize their lumbar puncture techniques.

**(E-154) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #3**  
**Cervical Lymphadenopathy for Staging Head and Neck Cancer: What the Radiology Resident Needs to Know**

Gregory Ngo, DO, *Robert Wood Johnson Medical School, Scotch Plains, NJ*; Peter Girgis; Jeffrey S. Kempf, MD; Steven M. Schonfeld, MD ([ngogreg1@gmail.com](mailto:ngogreg1@gmail.com))

**LEARNING OBJECTIVES:** 1. To learn how to classify nodes into the correct cervical lymph node stations according to AJCC and AAOHNS criteria. 2. To identify size criteria for pathologic lymphadenopathy for each nodal station. 3. To learn non-size pathologic criteria for cervical lymphadenopathy including morphology, shape and margins.

**CONTENT DESCRIPTION:** The purpose of this educational exhibit is to raise awareness of the importance of using the accepted cervical nodal classification agreed upon by the American Joint Committee on Cancer (AJCC) and the American Academy of Otolaryngology Head and Neck Surgery (AAOHNH) in 1991. This exhibit clarifies the confusing topic of cervical lymphadenopathy and its nodal station levels. The significance of lymph nodes in head and neck cancer and its impact on treatment and prognosis will be presented. There are four major criteria for evaluating abnormal cervical lymph nodes including size, morphology, shape, and margins. Changing the size cutoff impacted the sensitivity and specificity for pathologic lymphadenopathy. Size independent criteria for lymphadenopathy included morphology, shape and margins, and distribution of nodes. Nodal stations will be described, and schematic images provided for improved visual learning and quick reference. Finally, examples of head and neck malignancies and primary drainage basins will be presented.

## Pediatric Radiology

**(E-155) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #6**  
**Pediatric Nuclear Medicine: Educational Intervention for Attendings On-Call**

Jennifer Gillman, MD, *Hospital of the University of Pennsylvania, Philadelphia, PA*; Janet R. Reid, MD; Sabah Servaes, MD; Hongming Zhuang, MD, PhD; Lisa States ([jennifer.gillman@uphs.upenn.edu](mailto:jennifer.gillman@uphs.upenn.edu))

**LEARNING OBJECTIVES:** 1) Identify emergent pediatric nuclear medicine studies and their indications. 2) Describe important findings and pitfalls when reviewing the following pediatric nuclear medicine scans: Meckel's scan, gastrointestinal bleeding study, hepatobiliary scan, brain death scan, renal transplant evaluation. 3) Understand the frequency of on-call nuclear medicine studies at a tertiary pediatric hospital and the educational intervention put in place to prepare pediatric radiology attendings and trainees for these studies.

**CONTENT DESCRIPTION:** Exposure to pediatric nuclear medicine during residency and pediatric fellowship is limited and not uniform across training programs. At our institution, a tertiary care pediatric hospital, attendings with expertise in nuclear medicine cover emergent pediatric nuclear medicine exams performed after hours. To shift responsibility to in-house attendings, a learning module was created as part of an institutional comprehensive learning management system. The goal of this module is to train faculty in the indications, protocols, diagnostic

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criteria, potential pitfalls and problem-solving techniques when reading emergent pediatric nuclear medicine exams. Review of emergency cases performed between July 1, 2017 and June 30, 2018 revealed 54 studies with 12 (22.2%) read after hours. These studies include Meckel's scans, gastrointestinal bleeding scans, hepatobiliary scans for biliary leak or acute cholecystitis, brain death scans and renal transplant evaluations. Of all studies performed, 13.3% of Meckel's scans (n= 4/30), 22.2% of brain death studies (n = 2/9), 28.6% of gastrointestinal bleeding studies (n= 2/7), 33% renal transplant scan (n=1/3), biliary leak (n=0/1), cholecystitis 75% (n=3/4) were read on-call. For emergency studies performed after regular hours, continuing medical education (CME) is important to ensure competency, comfort and confidence among on-call attending staff. In this educational exhibit, the learner will develop an approach to reading emergent pediatric nuclear medicine studies, to better understand important imaging findings and potential pitfalls.

## Women's Imaging

**(E-067) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

### **When Multiple Masses Are Not All Benign: Recognizing Malignancy in the Setting of Multiple Benign Masses**

Fara Shikoh, MD, *University of Kentucky, Lexington, KY*; Wendi A. Owen, MD

**LEARNING OBJECTIVES:** 1. Recognize when it is appropriate to use the rule of multiple masses in every day practice. 2. Use a systematic approach to mammographic interpretation in patients with multiple masses. 3. Identify suspicious features in order to detect malignancy in the setting of multiple benign masses, metastatic disease to the breast, and multifocal/multicentric disease.

**CONTENT DESCRIPTION:** Radiologists interpreting mammograms commonly encounter patients with multiple masses. Previous research has shown that patients who have at least 3 circumscribed masses with at least one in each breast have a very low likelihood of malignancy. It has been reported that multiple benign circumscribed masses are recognized and classified as Breast Imaging Reporting and Data System (BI-RADS) category 2 in 1.7% of screening mammograms. The majority of these masses are either cysts, complicated cysts with debris, or fibroadenomas. Despite the low likelihood of malignancy, the presence of multiple masses can present an interpretative challenge in patients that develop malignancy due to the visual distraction of multiple masses and potential obscuration of malignant masses. Evaluating patients with multiple masses requires careful attention to each mass to identify any mass with different or suspicious features. Additionally, patients can present with multiple malignant masses, as in the cases of metastatic disease to the breast and multifocal/ multicentric breast cancer. This poster will describe a systematic approach to evaluating patients with multiple masses and review features that warrant further evaluation with ultrasound and/or diagnostic mammogram. Awareness of suspicious features when approaching multiple breast masses is vital to accurate diagnosis as well as prompt and appropriate management and treatment.

**(E-068) Thursday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Pelvic Floor Dysfunction: An Imaging Update Comparison of MRI and Conventional Fluoroscopic Defecography**

Daniel Hynes, *Baystate Medical Center, Springfield, MA*; Nicolas Vassel; Tara M. Catanzano, MD

**LEARNING OBJECTIVES:** Review pathophysiology and epidemiology of pelvic floor disorders. Highlight appearance on conventional fluoroscopic defecography and MR defecography with key features on each sequence. Outline features of rectal intussusception, rectal prolapse, rectoceles, enteroceles and pelvic floor dysfunction. Discuss best prac-

tice imaging techniques underscoring advantages and limitations of each modality.

**CONTENT DESCRIPTION:** Pelvic floor dysfunction is a complex disorder involving pelvic viscera whose symptoms can range from inconvenient to debilitating. Three compartments are often involved to varying degrees. Traditionally fluoroscopic examination with rectally instilled barium describes anatomic geometry and primarily focused on the posterior compartment. MRI technique allows better dynamic anatomic delineation and functional assessment of the anterior and middle pelvic compartments. Dynamic MRI imaging is advantageous when planning urogynecologic surgery. Defecography is performed to evaluate rectal prolapse, pelvic floor disorders, constipation, incomplete defecation and fecal incontinence. Pelvic descent is gauged relative to a line drawn from the tip of the coccyx to the pubic symphysis. During defecation the pubococcygeus muscle should be seen to relax with widening of the anorectal angle. Excessive straining may lead to intussusception and rectocele formation with anterior herniation of the rectal wall into the posterior vaginal wall observed during cine fluoroscopy. Rectoceles often cause incomplete defecation and intermittent soiling. MRI adds information on additional pelvic organ prolapse such as cystoceles. Conventional fluoroscopic defecography continues to provide important anatomic information in diagnosis and post surgical follow up of pelvic floor disorders. Familiarity with the technique and interpretation of both conventional and fluoroscopic defecography adds value to patient care.

**(E-069) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**

### **Radiologic and Pathologic Correlation of Benign and Malignant Lesions in the Male Breast**

Babita Panigrahi, MD, *Massachusetts General Hospital, Boston, MA*; Shirley Chou, MD; \* Constance D. Lehman, MD\*, PhD; Randy C. Miles, MD ([bpanigrahi@amgh.harvard.edu](mailto:bpanigrahi@amgh.harvard.edu))

**LEARNING OBJECTIVES:** Objective 1: Review the clinical presentation and imaging management of lesions in the male breast. Objective 2: Review the mammographic and ultrasound features of benign versus malignant entities in the male breast, including features of classically benign pathology and those that prompt biopsy.

**CONTENT DESCRIPTION:** Management of pathology in the male breast can be difficult due to variable clinician experience and the rare occurrence of male breast cancer. Areas of clinical concern, including lumps, pain, nipple retraction or discharge, are initially evaluated with bilateral 2D mammography. Classically benign lesions such as gynecomastia do not require further imaging workup. Indeterminate findings, including lesions that are not subareolar or those that appear mass-like, can be further evaluated with spot mammographic views, digital breast tomosynthesis and/or ultrasound. Greater than 90% of male breast lesions are benign, and greater than 80% of these are gynecomastia. Gynecomastia, further classified into nodular, dendritic, or diffuse glandular subtypes, can be recognized by its classic appearance on mammography. Fat-containing lesions including lipomas, fat necrosis, or intramammary lymph nodes, inflammatory conditions such as mastitis or abscesses, and vascular lesions such as hemangiomas or varices may also present in the male breast. Lesions related to lobular proliferation such as fibroadenomas or fibrocystic change are rare in men due to a paucity of lobules stimulated by estrogen. Factors increasing the risk of male breast cancer include advanced age, genetic predispositions such as the BRCA2 mutation, and hormonal conditions. Greater than 90% of male breast cancers are invasive ductal carcinoma, NOS. Papillary carcinomas are more common and invasive lobular carcinomas are less common in males compared to females. Metastases and soft tissue sarcomas can also occur. Suspicious imaging features should prompt image-guided biopsy for accurate diagnosis. Learning to distinguish

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classically benign from malignant imaging features is important to decrease unnecessary biopsies and surgeries.

**(E-070) Wednesday • 7:00 AM - 8:00 AM • Hard copy poster**  
**Resident Guide to After-Hours Emergent Breast Ultrasound: Indications, Common Imaging Findings, and Appropriate Recommendations**

Mai A. Elezaby, MD\*, *University of Wisconsin, Madison, WI*; Jill Karow; Urvi Tailor; Robert K. Bour, MD; Ryan W. Woods, MD, MPH; Amy Fowler; et al ([melezaby@uwhealth.org](mailto:melezaby@uwhealth.org))

**LEARNING OBJECTIVES:** 1. To become familiar with the indications of after-hours breast ultrasound examinations ordered by the emergency department in the academic versus community hospital settings. 2. To highlight the role of ultrasound in the diagnosis of various breast emergent conditions with discussion of ultrasound imaging findings. 3. To discuss the appropriate follow-up recommendations to improve patient care.

**CONTENT DESCRIPTION:** 1. The appropriate indications and imaging work-up of clinical breast findings presenting in the emergency department setting. Differences in the indications in the academic versus community settings will also be discussed. 2. Pictorial review of the imaging findings in the following conditions: • Mastitis • Breast abscess • Breast malignancy presenting as painful breast lump • Spontaneous and post procedure breast hematoma/bleeding • Complex cystic and solid mass in postmenopausal patient presenting as swelling and erythema. • Skin-based infection. • Post-operative fluid collections in the setting of breast reconstruction 3. The appropriate follow-up recommendations for clinical breast findings presenting to the emergency department to improve patient care.

**(E-156) Thursday • 7:40 AM - 7:55 AM • E-poster, Station #7**  
**Teaching Basic Fetal Heart Ultrasound Using an Interactive, Sharable Online Platform**

Meagan Chambers, *Dartmouth Medical School, Hanover, NH*; Matthew R. Caley; Petra J. Lewis, MD ([Meagan.Dechen.MED@Dartmouth.edu](mailto:Meagan.Dechen.MED@Dartmouth.edu))

**LEARNING OBJECTIVES:** By viewing the poster and linking to the interactive online module via a QR code, the participant will be able to: 1. Identify normal anatomy on the standard ultrasound views of the fetal heart. 2. Compare and contrast normal and common anatomical abnormalities seen in the same views.

**CONTENT DESCRIPTION:** The fetal morphology scan is a key routine exam performed between 18-20 weeks gestational age and includes several routine views of the fetal heart. Identifying fetal cardiac anatomy on ultrasound—both normal and abnormal—is challenging for residents who are more familiar with CT anatomy. Recognizing abnormalities that need further evaluation with fetal echocardiography is essential. We have developed an interactive online educational module using BookWidgets to introduce residents to the standard cardiac views done during this exam with comparisons to a CT angiogram reformatted in the same projections. This module can be readily accessed via a mobile device or computer using a QR code or weblink. Residents will become familiar with key anatomical landmarks in each view, as well as more commonly encountered abnormalities. In the interactive online format, residents can easily compare CTA and fetal anatomy in each view via overlapping 'sliding' images, as well as comparing normal and abnormal findings in a similar manner. Images with 'hot spots' allow residents to identify key anatomical features. Links to further learning are included in the module. Existing digital educational modules for fetal cardiac ultrasound are limited to power point, lecture, or webpage

format, making this platform unique. The poster will demonstrate the normal anatomy and comparative abnormalities. The live application will be accessible via a printed QR code on the poster and can be shared for use at their institution by the code or weblink.

**(E-157) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #8**  
**Pushing Beyond the Basics: Imaging Evaluation of Pelvic Organ Prolapse**

Kristen Olinger, *UCLA, Los Angeles, CA*; Lucy Chow; Maitraya Patel, MD; Phyllis Glanc\*; Neeraj Lalwani, MD; Simin Bahrami, MD ([kolinger@mednet.ucla.edu](mailto:kolinger@mednet.ucla.edu))

**LEARNING OBJECTIVES:** After review of this presentation, participants will be able to discuss the detailed anatomy of the pelvic floor, multimodality imaging techniques available for diagnosis, and spectrum of imaging findings of prolapse within each pelvic floor compartment.

**CONTENT DESCRIPTION:** Pelvic organ prolapse (POP) is a significant problem among women, with a 20% lifetime risk of requiring surgery. Current modalities to diagnose pelvic floor dysfunction include defecography, MRI, and ultrasound. MRI evaluation may underestimate the true extent of prolapse and have limitations due to cost and access. While defecography has been considered gold standard imaging for the posterior compartment, disadvantages include exposure to ionizing radiation and suboptimal evaluation of the anterior and middle compartments. Ultrasound can provide a functional and anatomical assessment of the pelvic floor in a dynamic fashion. Moreover, ultrasound is an inexpensive, well-tolerated technique without radiation, and its use is aligned with current healthcare goals to provide high-value, cost-effective imaging. This exhibit will provide a comprehensive review of POP including risk factors and clinical presentation, anatomy of the pelvic floor, multimodality imaging techniques, US, MRI and fluoroscopic imaging findings, and surgical and non-surgical treatment options. Cases to be reviewed include: anterior compartment prolapse (cystocele, urethrocele, cystourethrocele), middle compartment prolapse (uterine prolapse, vaginal vault prolapse), and posterior compartment prolapse (rectocele, enterocele, sigmoidocele, peritoneocele).

**(E-158) Thursday • 7:00 AM - 7:15 AM • E-poster, Station #8**  
**Benign Vascular Masses of the Breast and Their Radiologic and Histopathologic Characteristics: A Pictorial Review**

Kurt Techawatanaset, MD, *Froedtert Hospital/Medical College of Wisconsin, Milwaukee, WI*; Oleksandr Kravtsov; Julie M. Jorns; Shadie S. Majidi, MD; Anubha Wadhwa; Solomon Cherian

**LEARNING OBJECTIVES:** 1. Recognize the radiologic features of benign vascular masses of the breast. 2. To consider these entities in the differential diagnosis when evaluating breast masses. 3. Become familiar with the basic histopathologic characteristics of benign vascular masses of the breast.

**CONTENT DESCRIPTION:** Benign vascular masses of the breast are entities that can pose diagnostic quandaries. These masses include hemangiomas, angioliomas and very rarely lymphangiomas which have classic but also variable radiologic and histopathologic characteristics. These lesions may demonstrate features that overlap with other entities including malignancy and should be considered in the differential diagnosis when evaluating breast masses. We aim to provide a discussion of the most common clinical presentations of benign vascular masses, illustrate the range of their radiologic features, as well as touch on their histopathologic characteristics in the form of a multimodality pictorial review. The radiologic features of benign vascular

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masses of the breast will also be contrasted to the imaging features of specific malignant masses that may share similarities. Fifty cases of benign vascular masses, including but not limited to hemangiomas and angiolipomas, were evaluated after a query of thousands of pathology cases at our institution performed between 2011 and 2018. A range of representative examples of each type of lesion were selected for this presentation.

**(E-159) Wednesday • 7:40 AM - 7:55 AM • E-poster, Station #7**

**Complex Cystic Breast Masses: Imaging and Management**

Anubha Wadhwa, *Medical College of Wisconsin, Milwaukee, WI*; Katherine H. Cavallo, MD

**LEARNING OBJECTIVES:** 1. What are complex cystic breast masses? Should we biopsy them? To understand the differences in imaging features of complicated cysts and complex cystic breast masses and guide appropriate BI-RADS and management. 2. Discuss the need for utilizing good ultrasound technique for categorization of cystic breast masses. 3. Identify common benign and malignant diagnosis of complex cystic breast masses. 4. Review the appropriate biopsy techniques for sampling these masses and understanding radiologic-pathologic correlation.

**CONTENT DESCRIPTION:** 1. Discuss ultrasound classification of cystic breast masses and categorization of complex breast cysts. Complex cysts are defined as cysts with thickened septa, thickened wall or associated solid component whereas complicated cysts have low level internal echoes or mobile debris. Radiologists should be familiar with their imaging features and be able to differentiate complex cysts from complicated cysts and assess the appropriate BI-RADs for them. 2. Malignancy rates in complex cystic breast masses and why do we need to biopsy them. 3. Essential ultrasound techniques for imaging cystic breast masses including elastography. How improper technique may sometimes lead to a missed diagnosis. Role of MRI in their evaluation. 4. Review the commonly seen benign pathologies presenting as complex cystic masses such as fibrocystic disease, papillomas, galactoceles, fat necrosis etc. 5. Discuss high risk lesions and malignancies associated with this imaging such as lobular neoplasia, DCIS, poorly differentiated invasive cancer, necrotic cancers, papillary and mucinous cancers etc. Radiologists need to be aware of malignancies presenting as complex cystic breast masses; need for correlation with mammography and additional predictors of malignancy. 6. Biopsy techniques and devices for appropriate sampling of these masses (core needle biopsy preferably using vacuum-assisted device and targeting the solid component). 7. Clinical-radiologic-pathologic correlation for complex cystic masses of the breast.

**(E-160) Thursday • 7:20 AM - 7:35 AM • E-poster, Station #6**

**3D Printed Breast Models as a Novel Teaching Tool for Learning BI-RADS in Breast MRI**

Lumarie Santiago, MD, *Univ of Texas MD Anderson Cancer Center, Houston, TX*; David Spak; Valentina Diaz; Elsa Arribas

**LEARNING OBJECTIVES:** The Breast Imaging-Reporting and Data System (BI-RADS) for breast MRI uses morphology and enhancement descriptors that allow standardized reporting and issuance of management recommendations based on the probability of malignancy for a particular lesion. Enhancement features may be evaluated using computer aided detection (CAD) systems, but morphologic features are most often evaluated by the interpreting radiologist. This exhibit delivers practical information on: 1. The utilization of MRI BI-RADS descriptors in lesion assessment and management. 2. Review of traditional teaching methods that include graphical representations and imaging examples of MRI BI-RADS descriptors. 3. Incorporating 3D printed breast models as a valuable educational resource to teach MRI BI-RADS descriptors.

**CONTENT DESCRIPTION:** 1. Review of the 5th edition MRI BI-RADS lexicon and the associated positive predictive value of each descriptor. 2. Illustrate traditional teaching methods including graphical representations and case examples of each MRI BI-RADS descriptor. 3. Demonstrate the implementation of 3D printed breast models depicting MRI BI-RADS morphologic descriptors to enhance understanding of the MRI BI-RADS lexicon.