

# AUR 2017 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 **green**.

**Wednesday, May 10, 2017**  
**2:00–3:30 PM**

## **SS01: Resident Education 1**

**Location: Grand Ballroom West**

**Moderators: Ana P. Lourenco, MD**  
**Priscilla J. Slanetz, MD, MPH**

**ED** **LM** **SQ**

### **(SS01-01) 2:00–2:10 PM**

#### **Best Practices in Trainee Development: a Successful Resident Curriculum in Leadership and Professionalism**

Christopher A. Sinsabaugh, MD, *Indiana University School of Medicine, Indianapolis, IN*; Aaron P. Kamer, MD; Nicholas A. Koontz, MD; Radya G. Osman, MD; Darel E. Heitkamp, MD; Richard B. Gunderman, MD, PhD ([rbgunder@iu.edu](mailto:rbgunder@iu.edu))

**PURPOSE:** The purpose of this presentation is to describe the Resident Leadership Curriculum at our institution and discuss data regarding its potential benefits later in practice.

**METHOD AND MATERIALS:** Over the past six years, radiology residents at our large university program were offered the opportunity to join a voluntary resident development curriculum that focused on leadership skills, professionalism, health policy, and healthcare economics. The curriculum for this leadership group included many components such as: resident-led discussion of current papers in health policy, professionalism, and the business of healthcare; a book club; attaining resident leadership positions at national radiology meetings; strong resident activism in the Indiana Radiological Society's Resident & Fellow Section (IRS RFS); and individual resident leadership projects. The leadership group conducted regular two-hour meetings every two weeks. Food was provided and residents were excused from clinical duties to accommodate the 2-hour meeting time. Meeting time was used to discuss papers, provide feedback for resident leadership projects, and plan goals for upcoming national meetings. A web-based survey was sent to the last 6 graduating classes who participated in the leadership group to assess the potential benefits of this curriculum to radiologists in practice.

**RESULTS:** A survey of resident alumni who participated in the Leadership Curriculum over the past six years showed that 70% of committing respondents felt better prepared for their careers as practicing radiologists having been in the group. 31% of participants have already assumed major leadership roles in their groups just a few years into practice, such as hospital medical director and executive committee. Areas in which participants specifically felt that the leadership curriculum helped them in practice included: communication, interacting with referring physicians, career development, the business of radiology, team building, and interacting with hospital administrators.

**CONCLUSION:** The Resident Leadership Curriculum at our institution is a robust development program that produces substantial benefits to participants in radiology practice.

### **(SS01-02) 2:10–2:20 PM**

#### **Resident Education and Turnaround Time; Considerations for Academic Health Care Centers**

Carl Flink, MD, *University of Cincinnati, Cincinnati, OH*; Eric B. England, MD; Jason N. Itri, MD, PhD; Jason F. Broomhall, MD; Emily Orscheln, MD ([eric.England@uc.edu](mailto:eric.England@uc.edu))

**PURPOSE:** Turnaround Time (TAT) has become a focus of many radiology departments. Whether implemented as an independent quality initiative or guided by leadership, TAT is now a word in our daily vocabulary and always in the back of our minds during the work day. The resulting improvements in TAT have helped referring physicians make timely decisions regarding patient care and improved patient throughput. Because academic radiology departments are responsible for teaching residents AND providing timely interpretation of imaging studies we want to examine more closely the impact that residents have on TAT and the the impact TAT metrics have on resident involvement in interpretation of ED studies.

**METHOD AND MATERIALS:** TAT data was gathered for Emergency Department Studies from July'14-Sept'14 and July'15-September'15. Criteria used to sort data include type of study, patient location, TAT and whether a resident interpreted the study along with an attending.

**RESULTS:** 18,247 ED studies from 2014 and 29,603 ED studies from 2015 were reviewed. TAT was significantly greater when residents were involved in interpretation; increasing from .35hr (21min) to .67 (40min) (P value < .05). TATs for XR and CT demonstrated similar relative increases .32 to .57hr and .46 to .85hrs respectively. Additionally, resident involvement in interpretation of ED studies decreased from 65% to 52% which remained consistent across modalities.

**CONCLUSION:** We found that when residents were involved with interpreting studies the average TAT increased by 19 minutes. This could be considered the cost in time of resident involvement in studies. Additionally, we found that resident involvement in ED studies decreased to approximately 50% from 65% the year prior. The escalating focus on turn around time has had a profound impact on workflow in radiology departments and academic centers must keep resident education in mind when establishing performance metrics.

### **(SS01-03) 2:20–2:30 PM**

#### **Flying solo: Impact of 24 hour attending radiologist coverage on resident recruitment**

Anjali R. Cherukuri, MD, *University of Vermont Medical Center, South Burlington, VT*; Robert D'Agostino, MD; Vivek Kalia, MD, MPH; Joshua P. Nickerson, MD

**PURPOSE:** To assess the effect of 24 hour (24H) attending coverage on the rank lists of current and future radiology residents at the time of rank list submission.

**METHOD AND MATERIALS:** An anonymous survey was created (SurveyMonkey, Palo Alto, CA) and sent to APDR requesting distribution to their residents. Questions were: 1. What year are you? 2. Did you interview at programs both with and without 24H attending coverage? 3. Was 24H attending coverage a positive or negative attribute for a program when you interviewed? 4. Did 24H coverage factor in to how you ranked programs? 5. Comments?

**RESULTS:** Of 762 respondents there were 53 MS4 students, 86 preliminary year residents, 176 R1s, 172 R2s, 147 R3s, and 128 R4s. 693 of the total respondents reported interviewing both at programs with and programs without 24 hour attending coverage. Overall, 27% of respondents felt 24H coverage was a positive attribute, 39% a negative

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attribute, and 34% indifferent. Subdivided by year the responses were: the MS4 class, 11% positive, 38% negative, and 51% indifferent; the prelim class, 34% positive, 45% negative, and 21% indifferent; the R1 class, 40% positive, 35% negative, and 26% indifferent; the R2 class, 26% positive, 36% negative, and 38% indifferent; the R3 class, 24% positive, 41% negative, and 35% indifferent; and the R4 class, 17% positive, 42% negative, and 41% indifferent. With regards to effect on rank list submission, overall 12% of respondents ranked 24H coverage programs higher, 24% ranked them lower, 64% did not consider it a significant factor. Subdivided by year the responses were: the MS4 class, 2% ranked higher, 36% lower, and 62% not a factor; the prelim class, 13% higher, 14% lower, and 73% not a factor; the R1 class, 20% higher, 13% lower, and 66% not a factor; the R2 class, 13% higher, 30% lower, and 58% not a factor; the R3 class, 12% higher, 24% lower, and 64% not a factor; and the R4 class, 6% higher, 32% lower, and 61% not a factor.

**CONCLUSION:** Perceptions regarding 24H attending coverage may vary across training level, but data suggests there are other factors more important to applicants, leaving 24H coverage without a significant impact on most applicants' rank lists.

### (SS01-04) 2:30–2:40 PM

#### Resident engagement in formal strategic planning: empowering the ultimate stakeholders

Desiree E. Morgan, MD\*, *University of Alabama at Birmingham, Birmingham, AL*; Jessica G. Zarzour, MD; Cheri L. Canon, MD\*

**PURPOSE:** To engage radiology resident physicians in formal strategic planning to improve their house-officer experience

**METHOD AND MATERIALS:** One month after a transition in the diagnostic radiology program director occurred at our institution, a strategic planning process was launched to include resident physicians in the process of training program improvement, from the trainee perspective. Sequential monthly meetings were held during midday conference time for: discussion of formal strategic planning concepts; distribution of SWOT template with instruction; SWOT summary presentation; brainstorming; priority/focus area assignments and team sign up; team reports; and resident team leader presentation to departmental leadership. Follow up of resident recommendations with outcomes of program change were recorded. Program mean scores and those relative to trainee engagement on annual ACGME surveys were reviewed before and after the 6 month strategic planning period.

**RESULTS:** 100% resident physician participation occurred (9 PGY5, 6 PGY 4, 10 PGY3, 10 PGY 2). After identifying six focus areas including Book and Travel Fund, Call, Resident on Resident Learning, Digital Learning, Mini-fellowships, and Business Course; residents assigned themselves to teams, selected a leader, and gathered data to support recommendations for change. Following team reports, the residents prioritized the most important areas for change. Each team leader presented the data, prioritization, and recommendations for his or her focus area to the chair and leadership committee made up of vice chairs, division directors and section chiefs. Two areas required additional departmental funds directed towards education (provided), one involved participation by another school at our university (new course started), one resulted in no change, and two remain in progress. ACGME scores improved in all categories, although some individual scores remained below 80%.

**CONCLUSION:** Resident physicians enthusiastically engage in strategic planning with positive effects on ACGME program score results. Our experience suggests these important stakeholders should be recognized and empowered to contribute when program improvements are sought.

### (SS01-05) 2:40–2:50 PM

#### Musculoskeletal Imaging Education of 1st year Residents: Performance and Satisfaction of Two Approaches to Workflow

Jasjeet Bindra, MD, *UC Davis Medical Center, Sacramento, CA*; Leon Lenchik, MD; Robert D. Boutin; Bahram Kiani, MD, MHA; Cyrus Bateni, MD; Scott D. Wuertzer, MD (*jbindra@ucdavis.edu*)

**PURPOSE:** To determine if organization of a PACS worklist by chronological order versus anatomic 'body-part' based order influences first-year radiology resident performance, resident satisfaction, or faculty satisfaction.

**METHOD AND MATERIALS:** In an IRB-approved, prospective study conducted at two major academic institutions, first-year residents on first musculoskeletal imaging rotation were randomly divided into two groups based on chronologic or anatomic 'body-part' sorting of their worklist. Residents in the chronologic group (CG) sorted their worklist based on the date of the study with the oldest studies first. Residents in the anatomy group (AG) sorted their worklist based on an anatomic region for the day (for example, Day 1: Shoulder, humerus, elbow; Day 2: Forearm, wrist, hand). At the end of the 4-week rotation, residents took a 25-question, image-based examination to assess musculoskeletal imaging knowledge and completed a satisfaction survey, which assessed experience, teaching, and workload on a scale of 1 to 5 (1=poor; 5=excellent). For each resident, the musculoskeletal faculty completed a similar survey that assessed the experience, teaching, and workload on a scale of 1 to 5. Data from the two institutions were collated, and the CG and AG groups were compared.

**RESULTS:** There were 11 residents in the CG group and 12 in the AG group. The numbers of correct answers on the post-rotation examination were slightly higher in the AG group (15.25) than the CG group (14.5). Resident satisfaction scores relating to overall experience were higher in the AG group (4.7) than the CG group (4.2). Resident satisfaction scores relating to teaching and workload were similar or very close in the two groups. Faculty satisfaction scores relating to experience were higher for the AG group (4.6) than CG group (4.1). Faculty satisfaction with teaching was also higher for the AG group (4.9) than CG group (4.2), and workload was similar in the AG group (3.5) and CG group (3.4).

**CONCLUSION:** For first-year residents rotating on the musculoskeletal service, organizing the PACS worklist by anatomic region rather than by date improves learning and increases resident and faculty satisfaction.

### (SS01-06) 2:50–3:00 PM

#### Do Residency Selection Factors Predict Radiology Resident Performance?

Vikas Agarwal, MD; Matthew T. Heller, MD\*, *University of Pittsburgh Medical Center, Pittsburgh, PA*; Gregory M. Bump, MD; Ling-Wan Chen; Barton F. Branstetter IV, MD; Nikhil Amesur, MD; et al (*agarwalv@upmc.edu*)

**PURPOSE:** The purpose of our study is to determine whether objective information in medical student residency applications predicts success as radiology residents as defined by objective clinical performance data.

**METHOD AND MATERIALS:** We performed a retrospective cohort study of residents who entered our institution's residency program through the National Resident Matching Program as postgraduate year-2 residents and completed the program over the past two years. Medical school grades (core clinical clerkships of medicine, surgery and obstetrics/gynecology), selection to Alpha Omega Alpha (AOA), U.S. Medical Licensing Examination (USMLE) Step 1 and 2 scores, publication in peer-reviewed journals at the time of residency interview, and whether the applicant was from a peer institution were the variables examined. Medical schools attended were categorized as peer and non-peer institutions as defined by the University of Pittsburgh Medical School. Performance during radiology residency was determined by calculating each resident's cumulative discolorance rate for on-call cases that the resident interpreted and gave a preliminary

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interpretation. This was done using the preliminary report generator in our PACS which has a system to adjudicate for the presence of substantial discordances defined as a difference between the preliminary resident and final attending interpretation that could immediately impact the care of the patient. A logistic regression was performed to determined significant variables.

**RESULTS:** Twenty-seven residents met inclusion criteria and provided preliminary reports on-call for a total of 58,628 studies. The mean substantial discordance rate was 1.15% (range 0.31-2.97%). Higher USMLE step 1 scores and surgery grades, publication prior to residency, and election to AOA honor society were all statistically significant predictors of lower substantial discordance rates (p values 0.01, 0.002, 0.01, 0.002 respectively).

**CONCLUSION:** Predicting resident clinical performance from objective application variables remains difficult. Higher USMLE scores and surgery grades as well as election into AOA and a history of publications are variables that are statistically associated with resident clinical performance.

### (SS01-07) 3:00–3:10 PM

#### Breast Boot Camp and Alphabet Soup: A Novel Curriculum that Meets ACGME, NAS, MQSA, ABR, ACR/SBI, wRVU Demands

Sheryl G. Jordan, MD, *University of North Carolina School of Medicine, Chapel Hill, NC*; Sheila Lee, MD; Eun Langman, MD (*sheryl\_jordan@med.unc.edu*)

**PURPOSE:** Not infrequently, there are competing forces in play for today's radiology educators. Fulfilling resident requirements of the ACGME Program Requirements in the Next Accreditation System era, the Mammography Quality Standards Act, the new examination format of the American Board of Radiology, and adhering to curricular guidelines of the ACR/Society of Breast Imaging themselves pose considerable challenges to breast imaging faculty. Add to that constraints placed by institutional resident block schedules and our desire for high resident and graduate evaluation satisfaction scores as well as stellar clinical performances. We describe a novel curriculum we have developed that (mostly) serves all masters.

**METHOD AND MATERIALS:** IRB-exempted, the study collates all current ACGME, NAS, MQSA program requirements, ACR/SBI guidelines, and assesses pre- and post-implementation scored data to evaluate the breast imaging curriculum. The following were assessed: ACGME, MQSA, ACR/SBI publications, ABR Core scores, EValue resident assessment scores, ad hoc resident survey scores.

**RESULTS:** Pre-curricular results indicate low resident on-block engagement/satisfaction, and below average scores on the ABR Core-Breast exam. The new Breast Boot Camp curriculum in novel manner fails to divide the three blocks during residency into the conventional diagnostic service residency year 1, screening/procedure residency year 2, advanced techniques residency year 3 per the literature. Instead, our residents complete Breast Boot Camp repeatedly during R1, R3, and R4 years. Ed modules, BIRADS 5th ed atlas, biopsy workshops, high case volumes to include procedures, engaging didactics, MQSA by QC technologist, RadPath and MDC conference curricula all contribute to success. Data points are as follows: EValue 2009–2012 service ranked 8/17 with score percentage 79.72 versus EValue 2012–2016 service ranked 2/18 with score percentage 89.18. Further the latter number has increased significantly YOY, and Breast is now bested only by AIRP. ABR Core-Breast scores Pre-implementation 2013 335, 2014 320, Post-implementation 2015 542, 2016 566. We are now oversubscribed as a R4 selective.

**CONCLUSION:** Breast Boot Camp is novel, compliant, and extremely successful curriculum.

### (SS01-08) 3:10–3:20 PM

#### Efficacy of Online Training for Improving Intern Physician Knowledge of Radiology Ordering

Hailey Allen, MD, *University of Wisconsin, Madison, WI*; Amanda Smolock, MD, PhD; Andrew Scarano; Mircea Cristescu, MD, MBA (*hallen@uwhealth.org*)

**PURPOSE:** Whereas physicians in most specialties participate in the ordering of diagnostic imaging tests for their patients, very little formal education about the ordering of imaging tests is provided to medical trainees, often-times leading to incorrectly or inappropriately ordered diagnostic examinations as well as increased work and lost time for both ordering physicians and radiologists. We sought to evaluate whether an online module would be effective in educating new interns on frequently encountered clinical scenarios requiring basic knowledge of appropriateness criteria, contrast use guidelines, and institution-specific procedural request protocols.

**METHOD AND MATERIALS:** In July 2015, incoming interns from all departments at our institution were instructed to complete a 15-question online quiz which included questions on basic imaging appropriateness criteria, contrast use guidelines, and institution-specific procedure ordering protocols. Four weeks later, interns were emailed an extensive training module on all material assessed in the online quiz. Following an additional four week interval, interns were again emailed the previously distributed exam. Data was analyzed from individuals who completed the module and pre-/post-testing.

**RESULTS:** A total of 45 incoming interns completed the online teaching module, as well as both pre- and post-module quizzes. Overall scores improved for 82% of interns (37/45) and worsened for 7% (3/45). Improvement in the total number of correct answers obtained was noted in 13/15 (87%) of questions, with the average score increasing from 8.6/15 ( $\pm 1.6$ ) to 10.5/15 ( $\pm 1.6$ ). The question with the lowest number of correct answers on the pre-test which subsequently improved was related to institution-specific division of procedure services.

**CONCLUSION:** Online teaching may be an effective way to educate interns on commonly encountered issues in ordering imaging examinations and identify specific areas of knowledge deficiency. Further study is required to evaluate the longitudinal effects of online teaching interventions on order appropriateness over the course of physician training.

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(SS01-09) 3:20–3:30 PM

### Effects of Increasing the Number of Applicants Interviewed in the Radiology Match: What We Can Learn from Other Specialties

Muneeb Shah, BA, *Nova Southeastern University, Fort Lauderdale, FL*; Christopher M. Straus, MD\* (*ms3211@nova.edu*)

**PURPOSE:** To explore and predict the effect of the recent increase in radiology residency interviews, both offered and attended, by comparing radiology to other specialties.

**METHOD AND MATERIALS:** A review of the literature was performed using PubMed, identifying multiple studies conducted in specialties other than radiology (neurosurgery, orthopedics, urology, dermatology, and ENT). The data was then applied to the NRMP radiology applicant survey from 2009–present.

**RESULTS:** Reported data reveals that the number of interviews offered by each program has increased, with a proportional increase in interviews attended by applicants; 67% and 25%, respectively. Yet despite these increases, both programs and applicants are falling lower on their respective NRMP rank lists (-17%). This change also represents an increase in average cost per applicant, approximately \$1500 (from \$6000 to \$7500), with no appreciable benefit to either party. Interviewing cost of the total applicant pool in 2015 was \$6,037,500, and if this trend continues uninterrupted, we project the cost to increase by approximately 18% ( $R^2=1$ ). Other specialties face a similar issue; survey data revealed that only 20% of applicants were willing to limit the number of interviews due to cost and more interviews correlated with an increase in reported travel-related risks.

**CONCLUSION:** Analysis of NRMP data demonstrates no meaningful benefit to either radiology programs or students, despite a significant increase in the number of interviews, student costs, and travel-related risks. As students pursuing other specialties have been shown to be unwilling to self-restrict interviews, Radiology Programs may need to take the initiative to introduce a solution to reverse this trend. Possibilities include a collective limit to the number of interviews offered to any individual applicant or offering interviews over a more concise time period, thereby introducing a physical limit to the number of interviews each applicant can attend.

Wednesday, May 10, 2017

2:00–3:30 PM

### SS02: Resident Education 2

Location: Regency Ballroom 1

Moderators: Carolynn M. DeBenedectis, MD  
Martha B. Mainiero, MD



(SS02-01) 2:00–2:10 PM

### RadioActivity: A Radiology Resident Wellness Pilot Study

Lawrence Wood, Jr, BS, *Medical University of South Carolina, Charleston, SC*; Madelene C. Lewis, MD; Seth T. Stalcup, MD (*woodla@musc.edu*)

**PURPOSE:** The work of radiologists is often sedentary in its design. Long hours of sitting in a reading room with many meals consumed from a hospital cafeteria may eventually lead to inadequate physical activity and poor nutrition that can be detrimental to a radiologist's health. Educating radiology residents early in their careers and giving them the tools to improve their wellness behaviors has the potential to increase their work satisfaction, work performance, and extend their careers.

**METHOD AND MATERIALS:** This pilot study was the first step in examining the current state of radiology resident wellness. 11 radiologists at the Medical University of South Carolina participated in an intervention program consisting of structured physical activity and wellness education. Subjects completed a pre and post wellness survey and had their body composition analyzed before and after the intervention using the InBody assessment tool. Their activity and sleep habits and sleep were monitored during the study using the Fitbit wearable accelerometer device.

**RESULTS:** The intervention increased daily caloric expenditure and active minutes of the cohort. Males saw a decrease in weight and body fat percentage but an increase in lean muscle mass. In contrast, females had an overall decrease in weight with loss of lean muscle mass and minimal body fat loss. In the post-survey, subjects reported that they now were more likely to run or walk as forms of exercise and had an interest in having a designated workout room for radiology residents equipped with resistance bands, free weights, or treadmills. Also, the survey revealed subjects now have a higher state of mental wellness, feel more confident about themselves, and place a greater emphasis on physical health and exercise.

**CONCLUSION:** From this pilot study, the data trends support the potential of a wellness intervention and lay the groundwork for the development of an effective and universal resident wellness curriculum in future RadioActivity studies.

(SS02-02) 2:10–2:20 PM

### Design and Impact of a MSK Image-Guided Procedure Curriculum for Radiology Residents

Nicholson Chadwick, MD, *VCU Health, Richmond, VA*; Kevin B. Hoover, MD, PhD\*; Curtis W. Hayes, MD\*; Peter J. Haar, MD, PhD; Josephina A. Vossen, MD, PhD; Kathleen Miller; et al (*nicholson.chadwick@vcuhealth.org*)

**PURPOSE:** The generic competency-based milestones for radiology resident education afford programs the opportunity to innovate ways in which residents achieve these goals. We aim to develop a musculoskeletal (MSK) image-guided procedure curriculum and study its impact on various performance metrics: fluoroscopy time, overall procedure time, technical competency, and patient satisfaction.

**METHOD AND MATERIALS:** A two year prospective study was developed at our institution. Fluoroscopy and total procedure times were recorded during resident-operated MSK procedures. Patients were

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asked to rate their level of discomfort before and following the procedure and overall satisfaction on a scale of 1 to 5. Resident technical competency was assessed by the type of attending assistance during the procedure: none, verbal, physical, or completion of procedure. This data was recorded one year prior to and one year following implementation of the MSK image-guided procedure curriculum. The curriculum included the creation of an introductory checklist and online module that focused on the various aspects of joint injections in the MSK section. This checklist was reviewed with each resident in person by a radiology physician assistant on the first day of their rotation. The resident also underwent an orientation to the fluoroscopy suite prior to any actual procedures.

**RESULTS:** Over the study period, 314 resident operated MSK procedures were conducted: 196 pre curriculum and 118 post curriculum. There was a significant difference in fluoroscopy time (32.2 seconds pre- vs 26.3 post-,  $p < 0.05$ ). The overall rate of attending assistance decreased (13% pre- vs 9% post-). There was no significant difference in overall procedure time or average reduction in patient discomfort between the two groups. The level of patient satisfaction for both groups remained 4/5 or "satisfied."

**CONCLUSION:** We successfully designed and implemented a MSK image-guided procedure curriculum for residents. The post-curriculum group demonstrated a statistically significant decrease in fluoroscopy time usage with lower rates of attending assistance. These performance metrics can be applied towards achievement of competency-based milestones during residency.

### (SS02-03) 2:20–2:30 PM Implementation of a Global Health Curriculum and track for the Brigham and Women's Hospital (BWH) Radiology Residents: A model for Global Health Curriculum in Radiology Residency Program

Alejandra Duran-Mendicuti, MD, *Brigham & Women's Hospital, Boston, MA*; Oren Johnson, MD; Sharath Bhagavatula, MD

**PURPOSE:** To establish and implement a formal Global Health Curriculum for the radiology residents at the BWH, offer a Global Health track for the R4 year of training, and provide the framework for implementing similar curriculum across radiology residency programs.

**METHOD AND MATERIALS:** BWH Radiology department is one of the academic institutions in the US and Canada that provides volunteer reads via teleradiology of the imaging studies of Partners in Health (PIH) sponsored University Hospital of Mirebalais (HUM) in Haiti, given lack of on-site radiologists. Volunteer residents interpret studies from HUM with a volunteer attending after work hours. The Mirebalais / BWH teleradiology program is the sustainable foundation for a 4-year curriculum. Resident requirements vary throughout the residency with graded responsibility. The resident participates in 5-10 sessions per year, prepares and presents interesting cases during a Global Health conference for the residents and develops teaching tools for HUM clinicians. At the end of the third year (R3), the resident can apply to the Global Health track, which includes: a departmental and PIH approved on site project at HUM, attendance to the Harvard Disaster Response Course, additional field ultrasound training, attendance to lectures on grant submission to foundations, and attendance at a Global Health conference. A certification of completion will be awarded to the resident by the BWH Radiology Department.

**RESULTS:** Development of this program has attracted significant resident interest: Thirteen out of forty (32.5%) residents have volunteered their time: R1 (2), R2 (3), R3 (3) and R4 (5). Number of cases read, interesting educational cases and exam quality issues are tracked on a secure on line data base. One R4 resident is currently completing the Global Health Track.

**CONCLUSION:** Our Global Health Curriculum within the radiology residency aims to increase resident fund of knowledge and interpretative skills by exposure to pathologies less frequently encountered in the US, while developing and responding to resident interest and fulfill-

ment obtained from humanitarian work. The Global Health track aims to prepare the future leaders in the growing field of Global Health in radiology.

### AUR Trainee Prize: 3rd Place

### (SS02-04) 2:30–2:40 PM Trainees Add Value to Patient Care by Decreasing Addenda Utilization in Radiology Reports

Patricia Balthazar, MD, *Emory University School of Medicine, Atlanta, GA*; Christina S. Konstantopoulos, BS; Carson Wick, PhD; Ariadne K. DeSimone, MD, MPH; Srinii Tridandapani, MD, PhD\*; Kimberly E. Applegate, MD, MS

**PURPOSE:** To evaluate the impact of trainees and other factors on addenda use in radiology reports.

**METHOD AND MATERIALS:** IRB-waived retrospective study performed in a tertiary care pediatric hospital. We included all radiology reports from 01/2016-06/2016, extracted from the institutional radiology data repository. The following factors were also extracted: trainee involvement, imaging modality, patient setting (emergency, inpatient or outpatient), order status (routine vs. stat), time of interpretation (regular work hours – weekdays, 8am-5pm – vs. off-hours), radiologist years of experience and gender. We grouped imaging modalities as advanced (CT, MRI, PET) and non-advanced (others); and radiologist experience as  $\leq 20$  years and  $> 20$  years since medical school graduation. Our outcome measure was addenda rate in radiology reports. Addenda were classified into categories of predominant error: under-reading, over-reading, poor communication, insufficient history, or poor technique. Statistical analysis was performed using multivariate logistic regression.

**RESULTS:** The overall rate of addenda was 418/129,033 (0.3%). Reports were created by 27 radiologists and 72 trainees, 46% were finalized during off-hours, and 16% involved a trainee. Reports generated without trainee were 12 times more likely associated with addenda than reports with trainee involvement (OR=12.2,  $p < 0.0001$ ). Advanced imaging was more likely associated with addenda than non-advanced studies (OR=4.7,  $p < 0.0001$ ). Reports generated for patients in emergency or outpatient settings had a higher likelihood of addenda than inpatients (OR=1.5,  $p=0.037$ ; and OR=1.3,  $p=0.039$ , respectively). Routine orders also had a higher likelihood of addenda compared to stat orders (OR=1.35,  $p=0.013$ ). There was no difference in addenda use by radiologist gender ( $p=0.162$ ), radiologist experience ( $p=0.787$ ), emergency vs. outpatient setting ( $p=0.406$ ), or time of interpretation ( $p=0.368$ ). Top reasons for addenda were under-reading (44%) and poor communication (37%).

**CONCLUSION:** No trainee involvement was the best independent predictor of addenda use in radiology reports, with 12 times increased odds. Trainees may provide added value for patient quality and safety by decreasing errors.

### (SS02-05) 2:40–2:50 PM Ensuring the Stepwise Transition to Independent Practice: An Effective Fourth Year Resident Curriculum for the Core Exam Era

John M. Ponting, MD, *Indiana University, Indianapolis, IN*; Colleen Maden, MD; Jason M. Ford, MD; Kevin L. Smith, MD; Nakiisa M. Rogers, MD; Brian White, MD; et al ([ponting@iupui.edu](mailto:ponting@iupui.edu))

**PURPOSE:** This presentation is designed to share our institution's best practices in preparing fourth year radiology residents for independent practice.

**METHOD AND MATERIALS:** We determined to make the 4th year a transformative experience to improve efficiency, multitasking, patient care, and clinical service. The 2015-2016 academic year was the first year of our 4th year transitional curriculum. We encouraged the 4th years to participate in the following electives: 1) Private practice general radiology 2) Afterhours ER radiology 3) Afterhours neuroradiol-

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ogy 4) Special electives focusing on specific skills 5) Clinical electives with subspecialty clinicians 6) Acting fellow in body MRI, and (7) Body procedures. Many of these electives were performed at our busy suburban hospitals where there are no other trainees competing for resources. Additionally, 4th year residents were matched with a multidisciplinary conference to manage for the year. After the academic year ended, a survey was sent to this initial class to assess the program and elicit feedback.

**RESULTS:** Of the 15 fourth year residents participating, 12 (80%) completed the survey. The following electives were most popular, with # of electives in parentheses: Private practice general radiology (24), Afterhours ER radiology (18), Afterhours neuroradiology (12) and Body procedures (11). The vast majority felt that the private practice general radiology electives were great experiences for transitioning to independent practice. All 12 fourth years participated in managing multidisciplinary conferences and 80% felt that it was also a good experience for transitioning to practice. General radiology electives at the satellite hospitals were found to offer good mixes of fast-paced high-volume general diagnostic radiology with high volumes of basic procedures such as fluoroscopy, joint injections, lumbar punctures, and solid organ biopsies. Residents found value in being able to run the services and troubleshoot problems.

**CONCLUSION:** Establishing a structured curriculum for 4th year residents including general radiology electives, afterhours coverage, procedure electives, and managing multidisciplinary conferences helps in their transition to independent practice.

### (SS02-06) 2:50–3:00 PM Improving Novice Radiology Trainees Perception Skills using Fine Art

Thomas R. Goodman, MBBChir, *Yale University School of Medicine, New Haven, CT*; Michael Kelleher

**PURPOSE:** To determine if fine art perception training improved performance in novice radiology trainees.

**METHOD AND MATERIALS:** On the first day of their residency, 15 radiology residents underwent a basic radiology perception test where they were each shown 15 different radiographs that each had a significant abnormality. The trainees were not expected to make a diagnosis but were simply asked to identify where the abnormality was. This was followed by a focused session of interpretation training at a local art gallery where art gallery experts taught the trainees how to thoroughly analyze a painting. Following this fine art session, the residents were once again shown 15 different radiographs and asked, in the same manner as before, to identify the location of the abnormality. The results of both radiograph assessments were then compared.

**RESULTS:** The 15 residents correctly identified the areas of abnormality on 35/225 cases pre-art training with a mean score of 2.33 and a standard deviation of 1.4. Following art training, the figure for correctly identifying the area of abnormality rose to 94/225 cases with a mean score of 6.27 and a standard deviation of 1.79 ( $p < 0.0001$ ).

**CONCLUSION:** The implementation of a focused teaching session on perception improved 1st year residents ability to localize imaging abnormalities. This improvement was significant ( $p < 0.0001$ ). Most errors in radiology occur due to failures of perception rather than failures to correctly interpret a finding and, as such, it behooves the profession to ensure that perception training is adequately addressed as part of a radiology training curriculum. Using an art gallery may be a novel, effective transitional starting point for novice radiology trainees.

### (SS02-07) 3:00–3:10 PM Busy resident call shifts: Do increased CT volumes correlate with higher discrepancy rates for preliminary interpretations?



Benjamin Wildman-Tobriner, MD, *Duke University Hospital, Durham, NC*; Victoria Parente, MD; Brendan Cline; Ranish D. Khawaja, MBBS, MD; Charles M. Maxfield, MD

**PURPOSE:** To investigate whether increasing CT volume correlates with higher resident on-call discrepancy rates.

**METHOD AND MATERIALS:** This IRB approved, HIPPA compliant, retrospective study of 2261 CT scans of the abdomen/pelvis from 121 weekend senior resident call shifts between 2011-2015 (1st quarter of each year, further data in progress) compared resident preliminary reads to next-day final reads. Discrepancies noted in the final report were recorded as a "miss" and sorted by severity. The total CTs per shift and the "peri-study" volume were also noted. "Peri-study" volume was defined as the sum of CTs read within 30 minutes of any single CT, an estimate of how busy a resident might be at a given time. CT volume per shift and miss rate per shift were then calculated and compared by quarter using linear regression. Scan volume per shift and peri-study volume were then evaluated as predictors of misses using logistic regression.

**RESULTS:** CT volume per shift increased each year and rose 24.5% between quarter one (Q1) 2011 and Q1 2015 (mean 58.4 v 75.0 CTs/shift,  $p < 0.01$ ). Over the same period, the overall miss rate was 3.6% and did not increase over time ( $p = 0.40$ ). When compared to shifts with  $< 55$  CTs, shifts with 55-75 or  $> 75$  CTs did not have an increased odds ratio of having a miss during the shift ( $p = 0.33$  and  $0.51$ , respectively). Scans read with a peri-study volume of  $\geq 5$  CTs had an odds ratio (of a miss) of 1.6 compared to studies with a peri-study volume of  $< 5$  ( $p = 0.029$ ).

**CONCLUSION:** Despite increasing CT volumes during call shifts over a five year period, discrepancy rates for preliminary interpretations remained stable, suggesting residents maintained performance despite interpreting more studies. However, the odds of a miss were increased when the peri-study volume was 5 or more CTs, i.e. periods when residents were busier and likely felt more stress.

### (SS02-08) 3:10–3:20 PM Development and implementation of an engaging case-based learning curriculum utilizing convenient email and social media platforms: preliminary findings and assessment of utilization trends

Nicholas A. Koontz, MD, *Indiana University School of Medicine, Indianapolis, IN*; Brandon P. Brown, MD, MA; Sean C. Dodson, MD; Mark S. Frank, MD; Darel E. Heitkamp, MD (*nakoontz@iupui.edu*)

**PURPOSE:** We demonstrate successful design, implementation, and initial assessment of an ongoing case-based learning curriculum utilizing the convenience and reach of email and social media (SoMe) platforms.

**METHOD AND MATERIALS:** This investigation was performed at an academic radiology department with large diagnostic radiology residency and full complement of radiology fellowship programs. Utilizing an image-rich, unknown case format, a "case of the day" (COD) was sent twice weekly to trainees and attending radiologists via email and Twitter. The following day, a link to a YouTube mini-lecture detailing the diagnosis, natural history of the disease, key imaging findings, and tips on how to approach the case was sent via email and Twitter. Viewership data was collected and an anonymous survey of COD utilization was distributed. Summary statistical analysis was performed.

**RESULTS:** 172 radiologists received CODs, including 85 trainees and 97 attendings. SoMe content was made public. Over 5 weeks, 10 CODs were sent. Mean email case viewership was 54.7% ( $n = 94$ ,  $std = 7$ ,  $range = 78-100$ ) and mean email answer viewership was 46.5% ( $n$

= 80 std = 11, range = 61-94). Mean Twitter case impressions (times people saw Tweet) were 556 (std = 232, range = 317-1062) and mean Twitter answer impressions were 687 (std = 296, range = 239-1393). Mean Twitter case engagements (times people interacted with Tweet) were 68 (std = 23, range 36-106) and mean Twitter answer engagements were 66 (std = 31, range = 17-124). Mean YouTube views were 47 (std = 13, range 29-71). 65 radiologists completed the survey. Trainees were proportionally more likely to utilize COD (92%, n = 35) than attendings (80%, n = 20). Of all respondents who used COD, 100% reported email viewership (n = 56), followed by YouTube (38%, n = 21) and Twitter (14%, n = 8). For those having not viewed the YouTube mini-lectures, 82% (n = 32) reported being "too busy" and 18% (n = 7) reported "lack of interest". 95% (n = 62) of respondents reported positive favorability of the new COD.

**CONCLUSION:** Email and SoMe are effective platforms for distributing enduring educational radiology content. Email was more commonly utilized than SoMe outlets, but lacks extramural visibility of SoMe.

### (SS02-09) 3:20-3:30 PM iPads for Residents: Is a Residency-Managed Program Still Useful After 2 1/2 Years?

Erich Boomgarden, MD, *Indiana University School of Medicine, Indianapolis, IN*; Aaron P. Kamer, MD; Marc D. Kohli, MD; Darel E. Heitkamp, MD ([apkamer@iupui.edu](mailto:apkamer@iupui.edu))

**PURPOSE:** This presentation is designed to share our institution's first 3 years of experience providing 60 residents with iPads containing a variety of electronic resources.

**METHOD AND MATERIALS:** Each of our 57-60 residents was provided with a 32GB Apple iPad device loaded with a variety of educational, productivity and clinical resources after 9 months of planning by a small group of interested faculty and residents.

We administered surveys to the residents to assess their use of electronic resources and tablets before implementation and at 1 and 2 1/2 years after implementation. The surveys evaluated use of electronic resources and of study time allocation and solicited comments on the use of the tablets.

**RESULTS:** Participation rates for the three surveys were high and similar at 65% (38/60), 58% (35/60) and 61% (35/57) for pre-, 1-year post- and 2.5-year post- surveys, respectively. The electronic resource rated as most useful by the residents was access to e-books, with 80% and 86% saying the resource was "Highly Useful" at 1- and 2.5-years, respectively. Audience response apps were also perceived as useful, with at least 65% of residents at both times categorizing these apps as Moderately or Highly Useful. Other educational and productivity apps such as bookmarked online resources, medical reference apps, note-taking apps and password storage apps were more variably seen as useful. Clinical applications like the native PACS app and remote access to electronic medical record (EMR) were perceived as less useful. Residents had several suggestions for improving the program. These included having more storage available and more streamlined and organized access to books. Praise for the program and requests to continue were also among the suggestions.

**CONCLUSION:** After 2 1/2 years of administering iPads to the residents in our program, the most useful resource remains having access to electronic educational texts. The EMR application lags behind in usefulness, likely at least in part to lack of a user-friendly interface. With the helpful feedback provided from our residents, the residency's iPads program will continue, improving upon organization of resources and device storage.

Wednesday, May 10, 2017  
2:00-3:30 PM

### SS03: Medical Student Education

Location: Regency Ballroom 3

Moderators: Christopher M. Straus, MD\*  
Petra J. Lewis, MD\*

ED

#### (SS03-01) 2:00-2:10 PM Current Trends in the Radiology Match: Earlier Interview Invitations and Prolongation of the Interview Season

Muneeb Shah, BA, *Nova Southeastern University, Fort Lauderdale, FL*; Christopher M. Straus, MD\* ([ms3211@nova.edu](mailto:ms3211@nova.edu))

**PURPOSE:** This study aims to identify recent trends in the radiology residency interview process and explore the ramifications of these findings.

**METHOD AND MATERIALS:** Data on the dates of interview invitations was gathered from online radiology specific forums (AuntMinnie.com and StudentDoctor.Net) between 2006 and 2016, as interviewing patterns are considered proprietary information by radiology departments.

**RESULTS:** The data demonstrates that the number of programs offering interviews before October 1st has increased from 21 to 62 programs over the last 10-years, with the most dramatic increases occurring after 2013. Interviews, which were once over a 10-week period, are now extended over 20-weeks, with an increasing number of programs offering invites before applications are complete. A linear regression analysis predicts that more than 80% of programs will begin extending invites from incomplete files ( $R^2=0.94$ ) in 2021.

**CONCLUSION:** Both programs and applicants are acting in a manner that they believe will improve their individual outcomes in the NRMP. Unfortunately, these behaviors appear to have created a self-perpetuating cycle with no clear benefit. In an effort to match more qualified applicants, programs have started the interview season earlier each year. This has generated a select cohort of applicants who can individually accept and attend more interviews, thus decreasing the relative distribution of interviews among all applicants. These findings can partially explain why there has been a need to increase the number of candidates a program must rank in order to fill their positions (given that each applicant can only match to a single program) and the perception that programs are matching less desirable candidates. Ultimately, these changes to residency selection do not improve outcomes, but instead introduce a substantial cost to radiology departments and increase the reliance on quantifiable application metrics. Proposed changes include a more formal analysis by the APDR with consideration of limiting the interview period or waiting until a specific specialty-wide date to begin offering invites.

#### AMSER Henry Goldberg Medical Student Award

#### (SS03-02) 2:10-2:20 PM Ultrasound Implementation in Undergraduate Medical Education: Effectiveness of the Ultrasound Workshop

Sarah T. Flanagan, MPA, *Louisiana State University Health Sciences Center Shreveport, Shreveport, LA*; Anna Y. Li, BS; Howard Morgan; Daniel V. Harper, BS; Sommer Kirsch; Horacio R. D'Agostino, MD ([sflana@lsuhsc.edu](mailto:sflana@lsuhsc.edu))

**PURPOSE:** Ultrasound (US) undergraduate medical training in American medical schools varies widely. The purpose of this study was to evaluate a simple and inexpensive US workshop model to introduce medical students to the fundamentals of US equipment, image interpretation and basic US-guided procedures.

**METHOD AND MATERIALS:** A 5-hour US workshop consisting of 2 hours of didactic lectures, 2.5 hours of mentored small-group instruc-

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

tion at the simulation lab, and 0.5 hour for completing 15-question pre- and posttests was offered to the first 20 students enrolled via school-wide e-mail invitation. Didactic lectures included basic principles of US equipment operation (knobology), Extended Focused Assessment of Sonography in Trauma (E-FAST), deep venous thrombosis (DVT) US diagnosis, and US-guided needle localization for vascular access and thora/paracentesis. Online modules and educational videos were incorporated into the lectures. The simulation lab hands-on experience was organized in 5 stations. Each station had an instructor, US machine, phantom or live model (medical student) and 4 students that rotated every 30 minutes. Workshop effectiveness was evaluated qualitatively and quantitatively by instructor observation of student performance and paired sample t-test analysis of pre- and posttest results, respectively.

**RESULTS:** Qualitatively, by the end of the workshop all students were able to turn on US machines and select US transducers for either diagnostic or US-guided procedures, learned where to look to diagnose DVT and could use US to guide needles safely. Quantitatively, the average scores on the pretest and posttest were 55.33% and 93.33%, respectively, demonstrating an average improvement of 38% ( $p < 0.0001$ ).

**CONCLUSION:** An US workshop model was effective in enhancing medical students' US education. A dramatic improvement from pretest to posttest was shown after participating in the workshop. US education within the curriculum allows students to hone skills for diagnosis and safe US-guided percutaneous procedures fostering competence in a valuable tool for their clinical practice.

### (SS03-03) 2:20–2:30 PM

#### "Keeping Active": Comparison of Active Learning Techniques in Teaching Neuroanatomy to First-Year Medical Students

Alex Kingsbury; Andres R. Ayoob, MD\*, *University of Kentucky, Lexington, KY*; Wayne Cass, PhD; Samuel Franklin, PhD (*andres.ayoob@uky.edu*)

**PURPOSE:** To compare the effectiveness, as measured by student's test scores, of two active learning strategies used to teach imaging anatomy in a first-year neuroanatomy course: audience response incorporated into a traditional didactic lecture versus audience response in the context of a "flipped classroom" approach.

**METHOD AND MATERIALS:** A single two-hour in-class session was available to teach basic imaging principles and cross-sectional imaging anatomy in a first-year medical student neuroanatomy course. All learning materials were prepared and delivered by the same instructor over a four year period. The in-class session incorporated audience response for intermittent questioning designed to promote clinical application of material and was structured in a similar way across all academic years. For the 2015 and 2016 academic years, a 20 minute podcast covering introductory material was reviewed prior to class. For the 2013 and 2014 academic years, no specific pre-class learning was incorporated, and the in-class session, though structured as in the 2015 and 2016 years, had a larger didactic component. A retrospective review of student test performance was performed on ten multiple choice imaging-specific questions, comparing students taught with audience response alone ( $n=256$ ) to those taught with audience response in the context of a flipped classroom approach ( $n=274$ ). A test question had to be administered at least once to each group to be included in the analysis. Population test score variance was determined via an F-test, and the Satterthwaite method was used for variance estimation. The mean test scores were compared using a t-test.

**RESULTS:** There was no significant difference in the mean test scores for students taught using audience response in the context of a didactic lecture (mean  $0.9385 \pm 0.005$ ) and those taught with audience response incorporated into the flipped classroom method (mean  $0.9362 \pm 0.004$ ).

**CONCLUSION:** Regarding test performance, the flipped classroom approach may not offer any advantage over other active learning strategies in teaching imaging anatomy to medical students.

### (SS03-04) 2:30–2:40 PM

#### Authentic Performance-based Assessment in a Pre-clinical Medical Student Chest Radiology Curriculum

Thomas P. Sullivan, MD, *Loyola University Medical Center, Maywood, IL*; Jennifer E. Lim-Dunham, MD; David C. Ensminger; Aziz Amany, MD; Khalid Alsabban, MD; Faaiza Mahmoud, MD; et al

**PURPOSE:** To study the impact of authentic performance-based assessment of a medical student radiology curriculum.

**METHOD AND MATERIALS:** 161 second year medical students participated in a predominantly online chest radiology curriculum. At the end of the course, all students took a 31 question multiple choice question (MCQ) exam. Subsequently, in effort to simulate an authentic clinical experience, students were divided into groups of 6 and underwent a performance-based (PB) assessment session administered by a radiology faculty at a PACS workstation. Each student verbally interpreted a chest radiograph showing one of 6 pathologies. Using a standardized rubric, learners were rated on a numerical scale. Performance on PB assessment was compared to MCQ exam response using Pearson point bi-serial correlation. Students completed Likert scale questions in addition to open-ended questions asking what was considered valuable. Open-ended free text responses were coded into qualitative themes by three raters. Frequencies of the highest modes of each theme were tabulated. Reliability of inter-rater coding was measured by calculating an agreement index (AI), ranging from 0-1, with 1 indicating perfect agreement.

**RESULTS:** All point bi-serial Pearson correlation coefficients were below .20, indicating no significant association between correct response on MCQ exam and performance on PBA. 73-90% of respondents indicated a Likert rating of 5 (strongly agree) when asked if the sessions improved understanding of a systematic approach to interpretation of chest radiographs and applied knowledge of specific signs. Inter-rater coding supported these findings. Students reported that a systematic approach (frequency 32%, AI .96) and knowledge of specific radiographic signs (41%, .87) were most valuable. Other themes which increased authenticity (with respective frequencies and AI) were: Manipulating images on PACS (27%, .91); high quality images (23%, 0.87); and relevant activity simulating real life (18%, .82).

**CONCLUSION:** Authentic PB assessment can detect and address gaps in learner knowledge in a way that traditional MCQ exams may not, and provides learners with meaningful reinforcement of skills related to radiographic interpretation.

### (SS03-05) 2:40–2:50 PM

#### Optimizing Medical Student Imaging Education: The Views and Needs of Residency Program Directors

Patrick T. Schiller, BA, *University of Chicago, Chicago, IL*; Andrew W. Phillips, BA; Christopher M. Straus, MD\* (*pschiller@uchicago.edu*)

**PURPOSE:** Though national guidelines exist for teaching imaging in medical undergraduate curricula, there is no mandate or uniformity to their application. Previous study shows that imaging related skills are inconsistently taught, leaving marked differences among interns. However, it is unknown how these disparities in both imaging interpretation and utilization impact non-radiology residency programs.

**METHOD AND MATERIALS:** Nationally, 419 non-radiology residency program directors (PDs) were randomly surveyed from 4 core medical specialties (surgery, medicine, pediatrics, and ob/gyn) in order to assess 1) new intern imaging interpretation and utilization skills, 2) disparities among interns, and 3) program expectations. ACGME medical imaging milestones were used to describe imaging competency.

**RESULTS:** Response rate was 68%. 82% of PDs identified "substantial" to "some" variability in intern skills related to imaging, and this variability caused "quite a bit" or "substantial" problems for 53% of programs. 43% of PDs said their average intern was "unable to identify major anatomical landmarks," and 57% said interns "utilized 'shotgun' image ordering." In contrast, 89% of PDs said their interns

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

should be able to at least “recognize normal from abnormal,” and 87% expected interns to at least be able to “independently utilize evidence-based guidelines.”

**CONCLUSION:** PDs indicated that programs would benefit from incoming trainees with 1) less variability in imaging competency and 2) greater competency in both interpretation and utilization skills, with special emphasis on the latter. Variability among graduating medical students not only forces residency programs to spend curricular resources assessing trainees, but also implies a misuse of healthcare resources stemming from unnecessary and inappropriate image ordering. In an increasingly resource-limited health system, this survey supports the need for a minimum national standard to ensure all interns have a similar fundamental imaging interpretation and utilization ability. Given imaging’s central role in patient care, medical student educators may consider a required radiology shelf exam or radiology-led imaging skill instruction as a core fundamental.

### (SS03-06) 2:50–3:00 PM

#### “Will addition of an audio guide to a learner-oriented radiology teaching file significantly improve knowledge gained?”

Juan M. Olazagasti, MD; Deborah Barry, MD; William Boyd, MS, *University of Virginia, Charlottesville, VA (jo3d@virginia.edu)*

**PURPOSE:** Much of radiology medical education is based on self-directed learning. Our goal is to answer the question, “Will the addition of an audio guide to a radiology teaching file significantly improve the knowledge gained from it?”

**METHOD AND MATERIALS:** We created a thoracic radiology TF for 2nd yr. MS in the pulmonary system. The file covered 40 cases with 136 examples of diseases, normal comparisons, and 27 fully scrollable CTs. 29 students volunteered and completed the project; 14 randomly placed in the control group, and 15 with the audio version of the TF. Prior to accessing the file, a 40 question quiz was given. 10 days after accessing the TF, students retook the test and self-reported their use of the TF, time spent and number of cases completed. We compared students’ formative and summative exam scores among both groups, and compared study participants to the remainder of the class

**RESULTS:** Pre-quiz scores averaged 8.8/40 and 8.9/40 for the control and audio groups respectively. Post-quiz scores improved to 17/40, each ( $p=0.001$ ). Reported time spent on TF varied widely, ranging from 30min-10 hours. There was positive correlation between time spent on the file and improved post quiz score ( $R^2 = 0.6$ ;  $p=0.002$ ). Students using the standard file spent an average of 2min/case. Audio file users spent an average of 5min/case. No significant difference in exam scores was noted; however, study participating students scored significantly higher on their summative exam when compared to the remainder of the class ( $p<0.001$ ).

**CONCLUSION:** Adding an audio component to a radiology teaching file did not provide clear benefit in performance. Data shows using an audio file allowed completing the TF faster. However, students without the audio file did slightly better on their post-quizzes, and spent additional time working with the file. Further research is needed to determine why students with the audio file spend significantly less time studying the material without improving scores. Those students with access to the TF did score significantly higher on their summative exam than the remainder of the class, confirming previous research on the benefit of radiology teaching files.

### (SS03-07) 3:00–3:10 PM

#### The Role of a Radiologist in an Innovative Interprofessional Program for Health Profession Students

Melissa A. Hilmes, MD, *Vanderbilt University, Nashville, TN*; Heather A. Davidson, PhD (*m.hilmes@vanderbilt.edu*)

**PURPOSE:** To describe the role and impact of a radiologist in a medical school’s interprofessional program

**METHOD AND MATERIALS:** The Vanderbilt Program in Interprofessional Learning (VPIL) is a two-year program in which teams of students from medicine, social work, nursing and pharmacy work and learn together in a clinical environment to prepare them for collaborative care. The program recruits faculty from each profession, mostly primary care. The following are highlights of the ways a subspecialist, a pediatric radiologist, has impacted this unique program by applying skills used in work at an academic children’s hospital. 1. Familiarity with clinical groups throughout the children’s hospital system with interprofessional collaboration already in place allowed the radiologist to recruit 3 new clinic sites. 2. Experience in quality improvement allowed coaching for student teams who design and implement their own improvement projects, and then present a formal poster session at the program’s conclusion. 3. Experience mentoring students helped to develop the role of faculty mentor to medical students. A monthly “huddle” was created to support medical students and address their specific concerns regarding their role on the interprofessional teams and their development as physicians. 4. The inherent interdisciplinary and interprofessional practice of academic pediatric radiology is a basis for serving as an interprofessional coach to all four student types at the clinic sites and in the seminar sessions.

**RESULTS:** After active involvement by physician faculty, VPIL course scores improved. The physician mentor role was applauded. Unexpected outcomes: More medical students (10-11 per year) are exposed to radiology as a profession and a potential career path. Nursing, pharmacy and social work students are also exposed to radiology and can demonstrate how a radiologist contributes to the larger clinical team.

**CONCLUSION:** An academic radiologist’s work is interprofessional by nature. This radiologist’s work with an interprofessional program can serve as model for involvement of other faculty members in medical school programs, introducing radiology as a viable career path early in medical school education.

### AUR Memorial Award

### (SS03-08) 3:10–3:20 PM

#### Privacy, Trainee Rights, and Accountability in Radiology Education?

Cory M. Pfeifer, MD, *Phoenix, AZ*

**LEARNING OBJECTIVES:** 1) Identify federal guidelines that pertain to medical trainees. 2) Describe common legal and ethical scenarios in which radiology faculty and learners interact. 3) Emphasize the medical social contract in which radiology educators participate.

**CONTENT DESCRIPTION:** Academic radiologists commonly hold multiple simultaneous roles within the landscape of physician training. This commentary presents three theoretical scenarios describing relationships between medical students, residents, and physician educators in radiology while offering analysis of the depicted events from ethical, regulatory, and legal perspectives. Included in this discussion is the effect of the Family Educational Rights and Privacy Act on medical student education, a review of several landmark judicial proceedings involving graduate medical education, and an assessment of accountability during the transition to the new board certification process. The medical social contract between physicians and the public at large is addressed with attention given to the duty that physician educators have to serve the good of society while ensuring the safe practice of medicine.

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

**(SS03-09) 3:20–3:30 PM**  
**Improving Medical Student Radiology Education through an Interactive Simulator**

Michael V. Friedman, MD, *Washington University School of Medicine, Saint Louis, MO*; Jennifer Demertzis, MD; Jeremiah R. Long, MD; Stephen Currie, MD; David A. Rubin, MD (*mvfriedman@wustl.edu*)

**PURPOSE:** Evaluate the educational impact of an interactive radiology simulator on current medical student curriculum, and effects of the workstation on the students' rotation experience. We hypothesize that transitioning from passive observer to active participant with an interactive workstation improves learning, enhances the rotation experience, and provides students with a better understanding of the radiologists' role.

**METHOD AND MATERIALS:** Institutional Review Board approval was waived. An interactive workstation was created providing diagnostic simulation of 84 cases selected to maximize exposure to important diagnoses in musculoskeletal (MSK) radiology, as suggested by the Alliance of Medical Student Educators in Radiology (AMSER) national medical student curriculum. Clinical vignettes were prepared for each case to develop students' diagnostic skills and noninterpretive radiology knowledge. From February 2015–July 2016, 83 students on the radiology elective rotated through the MSK section, with 40 students in the traditional observational role, and 43 using the simulator. At the end of the elective, all students took a competency exam based on concepts cited in the AMSER curriculum. Students also completed an anonymous survey about their interactive workstation experience.

**RESULTS:** Students in the observational role averaged 51% on the competency exam. Interactive workstation students averaged 71%. 91% of students reported the simulator had at least a moderately (4–5/5) positive impact on their rotation experience. 35% of students felt it was the best experience of the entire elective. All students felt their learning was improved with the interactive experience compared to the observational role on other radiology rotations, and recommended establishing workstations on other clinical services. 94% of students reported improved insight into radiologists' role through the interactive simulation, and 21% reported it had a positive impact on considering a career in radiology.

**CONCLUSION:** Integration of an interactive radiology workstation simulator provides an active learning tool that improves medical student knowledge, perceptions of radiology, and overall experience on the radiology rotation.

**Wednesday, May 10, 2017**  
**2:00–3:30 PM**

**SS04: Leadership and Education**  
**Location: Atlantic Ballroom 3**

**Moderators:** Janet E. Bailey, MD  
Jocelyn D. Chertoff, MD, MS



**(SS04-01) 2:00–2:10 PM**  
**What is the Impact of Collaboration in Radiology Research?**

Ujas N. Parikh, MD, *New York University School of Medicine, New York, NY*; Richard Duszak, Jr, MD; Andrew B. Rosenkrantz, MD (*ujas.parikh@nyumc.org*)

**PURPOSE:** Team science involving multi-specialty and multi-disciplinary collaboration is increasingly recognized as a means of strengthening the quality of scientific research. The aim of this study was to assess for associations between such collaboration and the impact of published radiology research.

**METHOD AND MATERIALS:** 476 original research articles published in Radiology, AJR, Academic Radiology and JACR between January and June 2010 and having at least one radiology-affiliated author were included. Articles were manually reviewed to extract features related to authors' disciplines and institutions. Citations to these articles up through September 2016 were extracted from Web of Science. Associations between articles' citation counts and co-author characteristics were explored using Pearson correlation coefficients and unpaired t-tests.

**RESULTS:** Citation counts showed a moderate correlation with the number of distinct author institutions ( $r=0.40$ ), but only minimal correlation with the number of authors ( $r=0.10$ ). Citation counts were significantly higher for articles with at least one non-clinical collaborator (e.g., basic science, engineering, policy, economics) than for other articles ( $25.4\pm 31.2$  vs.  $20.2\pm 21.4$ ;  $p=0.035$ ). However, citations were not different for articles involving at least one non-radiology clinical collaborator (e.g., medicine, surgery, emergency medicine) ( $22.4\pm 24.4$  vs.  $21.4\pm 26.0$ ;  $p=0.677$ ). Higher citation counts were noted for articles with authors from multiple countries vs. one country, but this was not statistically significant ( $26.5\pm 34.6$  vs.  $21.1\pm 23.1$ ;  $p=0.109$ ). Citation counts showed no associations with the presence of at least one PhD-or-equivalent author or at least one non-university-affiliated author ( $p>0.6$ ).

**CONCLUSION:** Using subsequent journal article citations as a metric, published radiology research involving a non-clinical collaborator has greater scholarly impact. To enhance the quality of their research, radiology investigators are encouraged to pursue multidisciplinary collaboration.

**AUR Joseph E. and Nancy O. Whitley Award**

**(SS04-02) 2:10–2:20 PM**  
**A Leadership Intervention to Further the Training of Female Faculty (LIFT-OFF) in Radiology**

Lucy Spalluto, MD, *Vanderbilt University, Nashville, TN*; Stephanie E. Spottswood, MD; Lori A. Deitte, MD; Alexander Chern; Charlene Dewey, MD, MEd (*lucy.b.spalluto@vanderbilt.edu*)

**PURPOSE:** Women are underrepresented in the field of radiology, occupy a minority of leadership positions, and at our institution, have not achieved the same level of academic success as their male counterparts. Consequently, the authors designed, implemented and evaluated the Leadership Intervention to Further the Training of Female Faculty (LIFT-OFF) Program to: 1) improve access to opportunities for female

faculty development and advancement, and 2) improve clarification of expectations about the role and path of advancement.

**METHOD AND MATERIALS:** LIFT-OFF was developed based on results of a needs assessment survey. Results generated fourteen priority topics which served as the basis for educational modules conducted by expert speakers. Module effectiveness was assessed with pre/post-surveys to elicit participant knowledge about the targeted subject matter. A formative program evaluation was performed at the completion of Year 1 of 2 to assess outcomes and impacts to-date.

**RESULTS:** Seventeen of 55 (31%) educational module post-survey questions demonstrated a statistically significant ( $p < 0.05$ ) increase in "YES" responses, indicating improved understanding of targeted information. At Year 1, 75% of participants indicated that the program improved access to faculty development opportunities and 62% reported improved access to career advancement opportunities. Satisfaction with pace of professional advancement increased from 25% to 46% for junior female faculty ( $p = 0.046$ ).

**CONCLUSION:** Faculty development programs such as LIFT-OFF can provide career development opportunities and executive skills necessary for women to achieve academic career success and assume leadership positions.

### (SS04-03) 2:20–2:30 PM

#### Global Outreach in Radiology: Improvement and Teaching of Radiation Safety in a Low-Income, Resource-Limited Hospital

Teodora Bochnakova, MD, *University Hospitals, Case Western Reserve University, Cleveland, OH*; Neda Sedora-Roman; David W. Jordan, PhD; Matthew Palmer; Alexander Brook (*teodora.bochnakova@uhhospitals.org*)

**PURPOSE:** While radiology is an indispensable aspect of medicine, limited availability of medical imaging in developing countries hinders diagnosis and management of disease contributing to global health care disparities and inadequate patient care. To fill this large deficit in technology many low-income countries acquire equipment that is often outdated with limited training on maintenance and safety, which is detrimental to patients and health care workers. A manifestation of such concerns was encountered in a resource-limited developing country by visiting radiology residents who focused on improvement of radiology services in underserved regions. Assessment of technologists in an Orthopedic Surgery Department, who operated an outdated C-arm fluoroscopy machine, revealed lack of knowledge regarding radiation risks, patient positioning and adequate control of patient and staff radiation exposure. The purpose of this project was to provide education on radiation safety and adequate use of fluoroscopy in a resource-limited setting.

**METHOD AND MATERIALS:** An educational session was tailored to non-radiology trained medical workers with review of radiation safety and a demonstration of techniques for controlling dose. A survey was administered prior to and one week after the presentation to assess the efficacy of the teaching conference.

**RESULTS:** There was a statistically significant improvement in the overall average score prior to and after the teaching conference ( $p = 0.04$ ). Participants demonstrated particular improvement in questions that focused on dose reduction techniques. Efforts were also made to mediate issues with the C-arm settings and to build shelving for appropriate storage of the personal protective equipment.

**CONCLUSION:** Radiation safety standards are often lagging in developing countries due to many inconsistencies in equipment and training. The findings in this brief study emphasize how education in the fundamentals of radiation safety can contribute to the establishment of safer medical imaging practices in developing countries. Furthermore, this presentation can serve as an additional tool for international outreach organizations when optimizing radiological services abroad.

### (SS04-04) 2:30–2:40 PM

#### Resident perceptions of the radiology fellowship application and selection process

Stephen Currie, MD, *Mallinckrodt Institute of Radiology, Saint Louis, MO*; Jonathan C. Baker, MD; Michael V. Friedman, MD; Jennifer Demertzis, MD

**PURPOSE:** The radiology fellowship application process is not standardized. Past attempts to sustain a uniform selection process have been unsuccessful. Our experience suggests that the application process has moved earlier each year to the detriment of applicants and training programs. Our objective is to assess current radiology resident, musculoskeletal (MSK) fellow, and MSK fellowship director perceptions of the fellowship application process.

**METHOD AND MATERIALS:** Institutional review board waiver of consent was obtained. Online anonymous surveys were distributed to PGY4 and PGY5 residents, MSK fellows and MSK fellowship directors in September 2016 to assess respondents' experiences with the current fellowship application process and ideas for improvement, and gauge support for a uniform process.

**RESULTS:** 147 residents, 73 MSK fellows and 43 MSK fellowship directors completed surveys. All resident respondents planned to pursue fellowship training and 82% applied for fellowship outside of their residency institution. For residents whose fellowship uses a match (40%), 19% applied to 1 program and 51% to >10 programs. 25% completed only 1 interview, and 25% completed >10 interviews. For residents whose fellowship does not use a match (60%), 18% applied to 1 program and 30% to >10 programs. Over 90% of non-match residents completed  $\leq 6$  interviews. A small majority of trainees favor a match, and largely agree that it is fair to applicants (>85%) and training programs (>87%). More than 70% think that a non-match system limits the exploration of fellowship options and ability to interview at all programs of interest. Most MSK fellowship directors believe the application process is too early and >80% agree moving the process later would benefit applicants and training programs. Only 51% support a match despite recognizing it is fair to applicants (84%) and programs (72%).

**CONCLUSION:** Radiology resident, MSK fellow and MSK fellowship director survey results show agreement regarding the benefits and detriments of the fellowship selection process. While there is less consensus on how to improve the process, there is strong support for a common application and accord on core issues implying the need to reevaluate the current system.

### (SS04-05) 2:40–2:50 PM

#### Developing and Implementing the Distinguishing Radiology Resident Educator Tract (DiRRect)

Kenny Q. Sam, DO, *Baylor College of Medicine, Houston, TX*; Pedro J. Diaz-Marchan, MD (*kenny.sam2@bcm.edu*)

**PURPOSE:** To promote the growth of radiology residents as clinician-educators by creating an integrated residency curriculum which will encourage direct instruction, educational leadership and professional development.

**METHOD AND MATERIALS:** A clinical-educator track will be offered at the start of the diagnostic residency program (PGY2) at the Baylor College of Medicine. The resident will be required to complete 85 credit hours of education and development in four distinct domains: direct teaching, personal development, educational leadership, and educational research. This curriculum will be integrated into the residency program over four-years without interruption or extension of the standard residency timeline. Additionally, the Radiology Leadership Institute (RLI) Certification program modules will be incorporated into the course to promote leadership and ethics endorsed by the American College of Radiology.

**RESULTS:** Upon completion, the resident will be recognized as a Distinguished Radiology Resident Educator and concurrently earn Level I Radiology Leadership Institute Certification.

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

**CONCLUSION:** Implementation of an optional integrated resident-educator training pathway into a standard 4 year diagnostic radiology residency program will promote development of clinical-educators, expose residents to scholarship within medical education, and promote the field of radiology through effective and interactive educators. This pathway will serve as a model to promote similar resident educator tracks at Baylor College of Medicine.

#### (SS04-06) 2:50–3:00 PM

##### Case Based Simulation in MRI: Effects on Radiologist Confidence

Hansel J. Otero, MD, *Tufts Medical Center, Boston, MA*; Crystal C. Wang (*hanselotero@gmail.com*)

**PURPOSE:** Clinical exposure to new MRI technologies and applications in pediatric radiology are at times insufficient. The uneven distribution of case load amongst radiologists results in a knowledge and experience gap. We seek to establish the effect on perceived diagnostic confidence of a simulation-based curriculum, in which radiologists re-interpret anonymized MRI cases as if they were diagnosing first-hand, with a “read out” session for trainees that replicates on-the-job learning.

**METHOD AND MATERIALS:** In this IRB approved prospective study, we analyzed diagnostic performance and self-reported confidence levels on interpreting MRI for suspected appendicitis of 18 radiology trainees and faculty at a single pediatric hospital. All participants completed pre-test surveys rating confidence on a five-point Likert scale and underwent a simulation test of 10 unknown MRI cases following a suspected appendicitis protocol. After reviewing their reports, a post-test survey was administered.

**RESULTS:** 18 radiologists (4 faculty, 5 fellows, and 9 residents) completed the exercise and diagnosed correctly an average of 7.44 cases out of 10 (range 5-9). Self-described confidence regarding technique and image interpretation increased from an average of 2.0 (SD+- 0.77) and 2.33 (SD 0.69) to 2.83 (SD +- 0.71) and 2.94 (SD 0.73), respectively. Self-described confidence regarding clinical knowledge increased from an average of 2.89 (SD 0.83) to 3.33 (SD 0.91). Participants assigned a score of 4.39 (SD 0.50) for the format’s capability to address areas needing improvement, 4.06 (SD 0.64) for its ease of navigation, 4.39 (SD 0.50) for preparing them to interpret similar studies in future practice, and 3.94 (SD 0.73) for inducing a change in how they report these studies in the future.

**CONCLUSION:** Simulation-based training for MRI interpretation of suspected appendicitis is effective. Moreover, a similar format can be used to facilitate adoption of new technologies and applications by increasing confidence of interpreting radiologists. Reinterpreting cases might also allow departments with a lower volume of cases or uneven case-load distribution to disseminate knowledge and improve training within the department.

#### (SS04-07) 3:00–3:10 PM

##### Experts and novices engage in different cognitive processing when correlating anatomy and imaging

Lonie R. Salkowski, MD, *University of Wisconsin Madison, Madison, WI* (*lsalkowski@uwhealth.org*)

**PURPOSE:** The ability to correlate anatomical knowledge and medical imaging is foundational to radiology. Experts do this well, but we have little understanding about how this occurs. Even more problematic, we don’t know how novices assimilate this understanding. It is difficult to teach concepts of anatomy and imaging correlation when we don’t know the degree of understanding of our novices.

**METHOD AND MATERIALS:** Ten radiologist experts and 11 senior medical student novices performed a simulation localizing axial and sagittal CT images within a human simulation torso. Data was collected on image orientation, time, and correctness of localization. Participants were encouraged to do think alouds. The transcripts were coded and assessed for emerging themes. The simulation data was assessed with

one-way and two-way ANOVAs. Chi-square analysis was performed on the qualitative action codes. Significance assessed at  $p < 0.05$ .

**RESULTS:** In support of the literature, experts are significantly faster at making decisions on medical imaging than novices ( $p < 0.001$ ). Quickness is only one factor. When localizing an image in the body, experts rely on organ substructures ( $p < 0.0001$ ) whereas novices weigh heavily on size or amount of an organ in the image ( $p < 0.001$ ). Experts are more likely to use the correct terminology ( $p < 0.001$ ), whereas novices are more likely to misinterpret the anatomy ( $p = 0.002$ ) and use non-anatomic descriptive cues (color, blobs, patterns) to describe what they are viewing ( $p = 0.004$ ). Experts notice patterns on medical imaging not common to novices. When fine tuning a localization, experts isolate a structure with a narrow band of change ( $p < 0.001$ ), compared to novices who use the shape or size of an organ ( $p < 0.001$ ) or trial and error methods ( $p < 0.001$ ) when performing the same tasks.

**CONCLUSION:** There are differences in the cognitive processing of experts and novices with respect to meaningful patterns, organized content knowledge and the flexibility of retrieval. Presented are some novice-expert differences in image processing. This study investigated extremes, opening an opportunity to investigate the sequential knowledge of residents, and where educators can help intervene in this learning process.

#### (SS04-08) 3:10–3:20 PM

##### Contrast reactions: Does having a reference card improve a radiologist’s knowledge and comfort in treating a contrast reaction?

Ramanujam Prativadi, BS, MD, *University of Rochester, Rochester, NY*; Neil Thayil, MD; Brian Tischler, MD; Susan K. Hobbs, MD, PhD; Sara Meibom, MD; Christina A. LeBedis, MD (*rgprativadi@gmail.com*)

**PURPOSE:** To determine if an easily accessible contrast reaction reference card improves the level of knowledge about current ACR guidelines for treating a contrast reaction and if a contrast reaction card will increase a radiologist’s comfort in handling a reaction.

**METHOD AND MATERIALS:** A 15 question test was created from the ACR Manual on Contrast Media (V. 9) and emailed to adult radiology staff at the university hospital, community hospital affiliate and outpatient center. Participants were given one month to respond, in one sitting without using resources (pretest). Level of training and a “yes/no” question of “comfort handling a contrast reaction if had reference card?” was also assessed. Subsequently a contrast reaction reference card that can fit behind the ID badge was supplied. The same 15 question test (post-test) was again emailed and instructed to complete only using the reference card. The level of training and same “yes/no” question was again assessed (post-test).

**RESULTS:** A total of 63 radiology staff responded to both the pre and post-test, from which the data was gathered. A total of 40 residents, 3 fellows, 3 physician assistants, and 20 attendings participated. On the pretest, out of a score of 15, residents scored 7.39, fellows 6, physician assistants 8.67, and attendings 9.85. On the post-test, out of a score of 15, residents scored 13.56, fellows 14.33, physician assistants 13.33, and attendings 14.3. Residents improved by 83.49%, fellows by 138.83%, physician assistants by 53.75%, and attendings by 45.18%. 98.41% responded “yes” to feeling more comfortable dealing with contrast reaction if had a contrast reaction card and 96.8% of participants responded “yes” to feeling more comfortable dealing with a contrast reaction having a contrast reaction card.

**CONCLUSION:** There is a need for a contrast reaction reference card with over 96% of respondents reporting greater comfort in dealing with contrast reactions with a card. There is also a deficit in knowledge of current guidelines with an average pretest score of 7.97/15 with improvement in results with a reference card with average score of 13.88/15 (74% improvement).

## AUR Trainee Prize: 1st Place

(SS04-09) 3:20–3:30 PM

### Twenty Major University Hospitals Provide Radiology Online Patient Education Materials Not Conforming to NIH and AMA Guidelines

Arpan V. Prabhu, BS, *University of Pittsburgh Medical Center, Pittsburgh, PA*; Tudor Crihalmeanu, BA; David R. Hansberry, MD, PhD; Nitin Agarwal, MD; Hrishikesh Kale, MD; Matthew T. Heller, MD\* (*prabhuav2@upmc.edu*)

**PURPOSE:** The Internet creates opportunities for Americans to access medical information about imaging tests and modalities to guide them in their medical decision-making. Due to health literacy variations in the general population, the American Medical Association (AMA) and National Institutes of Health (NIH) recommend for patient education resources to be written between the third and seventh grade levels. Our purpose was to quantitatively assess the readability levels of online radiology educational materials, written for the public, in 20 major university hospitals.

**METHOD AND MATERIALS:** In September and October 2016, we identified 20 major university hospitals with radiology residency-affiliated hospital systems. On each hospital's website, we downloaded all radiology-related articles written for patient use. A total of 375 articles were analyzed for readability level using 9 quantitative readability scales that are well validated in the medical literature.

**RESULTS:** The 375 articles from 20 hospital systems were collectively written at an  $11.4 \pm 3.0$  grade level (range 8.4–17.1). Only 11 (2.9%) articles were written at the recommended 3rd to 7th grade levels. Overall, 126 (33.6%) were written above a full high school reading level. University of Washington Medical Center's articles were the most readable with a reading level corresponding to  $7.9 \pm 0.9$ .

**CONCLUSION:** The vast majority of websites at major academic hospitals with radiology residencies designed to provide patients with information about imaging were written above the nationally recommended health literacy guidelines to meet the needs of the average American. This may limit the benefit that patients can derive from these educational materials.

Wednesday, May 10, 2017

2:00–3:30 PM

### SS05: Clinical Subspecialties

Location: Atlantic Ballroom 1

Moderators: Jay A. Harolds, MD

Mark E. Mullins, MD, PhD

BR CA MK NR CT NM ER PD SQ

(SS05-01) 2:00–2:10 PM

### Impact of Coronary CTA for patients with Chest Pain on Patient Flow and Overall Performance in the Emergency Department – a System Dynamics Analysis

Alexander Goehler, MD, PhD, *Yale University, New Haven, CT*; Steffen Huber; Udo Hoffmann\* (*alexander.goehler@yale.edu*)

**PURPOSE:** Coronary computed tomographic angiography (CCTA) improves triage efficiency of patients with acute chest pain; however its impact on the Emergency Department (ED) performance for non-cardiac patients is unknown.

**METHOD AND MATERIALS:** We reviewed two consecutive years of ED visits at MGH to identify visits for chest pain suspicious for ACS but without known CAD who were suitable for CCTA. To determine the impact of CCTA on the ED, we identified our comparator group to be all non-cardiac patients who were placed in observation status. We developed a System Dynamics model to simulate patient flow through the ED, incorporating patient characteristics, imaging use, and daily/hourly trends in ED visit volumes. The model considered two strategies (1) Standard of care as observed and (2) CCTA triage after a 1st negative Troponin and discharge of patients without CAD on CCTA. Different CCTA availabilities were considered.

**RESULTS:** Among 9,400 patients who received serial troponin measurements to assess chest pain in the ED, we identified 3,594 visits (38%) eligible for CCTA (age:  $56 \pm 15$  years, 52% male), accounting for 24% of all observation admissions. 3% of the patients were ultimately diagnosed with ACS. 52% of the patients with negative serial troponins had further CAD workup, among which 16% had obstructive CAD. The comparator cohort included 8,848 ED visits (age:  $55 \pm 19$  years, 47% male). 23% required cross-sectional CT imaging including head (37%), abdominal/pelvis (21%), and CTA-PE (8%). The model predicted well the length of stay (LOS) (model vs. observed in hours) for the current standard of care (target: 21 vs. 19, comparator: 22 vs. 25). The LOS was reduced to 14.8 hours (29%) when CCTA was available 24/7 and 10.8 (48%) when it was available M-F from 7AM–4PM. Additionally, observation unit capacity for non-cardiac patients was increased by 7% and 11%, respectively.

**CONCLUSION:** About one third of all ED visits for chest pain could benefit from a CCTA work up. This would not only reduce the length of stay for cardiac patients but also increase capacity for non-cardiac patients, improving overall ED performance.

(SS05-02) 2:10–2:20 PM

### Establishing Reference Values and Reliability of Four-Dimensional Computed Tomography Measurements of the Scapholunate and Lunotriquetral Intervals

Nima Hafezi Nejad, MD, MPH, *Johns Hopkins University School of Medicine, Baltimore, MD*; John N. Morelli, MD; Uma J. Thakur, BA; John Eng, MD; Shadpour Demehri, MD\* (*sdemehr@jhmi.edu*)

**PURPOSE:** To establish: The normal range of scapholunate (SL) and lunotriquetral (LT) interval measurements during active wrist motion, using 4DCT in asymptomatic wrists. The inter-observer reliability of submillimeter SL and LT interval measurements using 4DCT.

**METHOD AND MATERIALS:** Ten asymptomatic wrists were investigated using 4DCT during three active wrist motions including relaxed to clenched fist(1), flexion to extension(2), and radial to ulnar deviation(3).

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

The studied wrists were asymptomatic contralateral wrists of subjects who were referred for further evaluation of chronic wrist pain and instability. All wrists were examined by board-certified hand surgeons. 4DCT examinations were performed by a 320-row-detector CT scanner in 11 consecutive volumes tracking the carpal bones during each of the three active wrist motions (0-5 seconds; temporal resolution:0.5 seconds). Interval measurements were performed using a double oblique Multi-Planar Reconstruction technique. The measurements were performed by two independent musculoskeletal radiologists.

**RESULTS:** Average SL interval measurements (ranging 0.61–0.93mm) showed minimal insignificant changes during active wrist motions (0.84–0.78mm from relaxed to clenched P value=0.19; 0.84–0.73mm from flexion to extension P value:0.18; 0.66–0.64mm from radial to ulnar deviation P value:0.82). Likewise, Average LT interval measurements (ranging from 0.49–0.56mm) showed minimal insignificant changes during active wrist motions (0.49–0.50mm from relaxed to clenched P value:0.73; 0.55–0.55mm from flexion to extension P value:1.00; 0.53–0.56mm from radial to ulnar deviation P value:0.62). Interclass correlation coefficients (ICCs) showed strong consistency and absolute agreement for SL and LT interval measurements among the two observers (all ICCs>0.800 P values<0.05; except SL interval measurements in relaxed wrists, ICC:0.693 P value=0.071).

**CONCLUSION:** SL and LT interval measurements using 4DCT are associated with minimal variations during active wrist motion among the asymptomatic wrists. This study provides expected range of SL and LT intervals in asymptomatic wrists. 4DCT with MPR technique provides reliable assessments of SL and LT intervals during active wrist motions.

#### (SS05-03) 2:20–2:30 PM

##### The role of Dual Energy CT (DECT) in improving the detection of bone metastases using color-coded bone marrow maps: a pilot study

Ghada Issa, MD, *University of Maryland Medical Center, Baltimore, MD*; Michael E. Mulligan, MD; Derik Davis, MD (*ghada.issa87@gmail.com*)

**PURPOSE:** The purpose of this study is to determine the ability of DECT scanning in improving the diagnostic confidence in detecting bone metastasis. Conventional CT has limited sensitivity in detecting bone metastases confined to marrow space. DECT may be able to overcome this limitation through creation of virtual bone marrow (BM) color maps.

**METHOD AND MATERIALS:** Institutional review board approved this retrospective review of a consecutive series of patients with metastatic cancers. Age and gender matched patients were used as controls. Clinical diagnosis, disease status, all imaging studies, BM stimulant medications and hemoglobin were reviewed for each patient. 2 radiologists evaluated each CT study on a conventional Picture Archiving and Communication System and recorded the number of bone lesions suspicious for metastases. The readers were blinded to the clinical information and the other imaging results. They reported their confidence level for each lesion and the Hounsfield Unit (HU) of the lesion and of the corresponding normal bone. After 1 week, the studies were reviewed with DECT bone marrow color maps, same parameters were reported. Manual image post processing was performed with Syngo.via software (Seimens, Germany) using the preset color-coded BM maps setting. The sensitivity and specificity of CT and DECT were calculated using the combination of clinical status and other imaging studies as the gold standard. Confidence levels and HU values were compared for each lesion on both modalities.

**RESULTS:** 9 patients were included and 505 bones were reviewed. Overall, there were 58 true metastatic lesions per the reference image modality and clinical status. The sensitivity of CT significantly increased from 68% to 86%, and from 73% to 84% for the 2 observers, respectively, after using the color-coded bone marrow maps. The specificity also increased from 97% to 99% for both. Image post processing increased the confidence level for medium lesions. HU measurement analysis yielded significant variability and no reproducible cutoff value.

**CONCLUSION:** DECT analysis of bone lesions in patients with metastatic cancers improves the sensitivity, specificity, and confidence level for the detection of BM metastases.

#### (SS05-04) 2:30–2:40 PM

##### Elastofibroma Dorsi (ED): Cross Sectional imaging findings and Follow up

Bilal Mujtaba, MD, *Bellaire, TX*; Mohamed Elshikh, MD; Peter T. Wei, MD; Jesse C. Rayan, MD; Naveen Garg, MD\*

**PURPOSE:** Our objective was to document typical imaging features of ED and evolution over follow up

**METHOD AND MATERIALS:** From April 1997 to April 2015, 52 ED patients presented to our institution. Demographic, clinical, radiological, and pathological data were collected. 17 patients were pathologically proven and 35 were diagnosed radiologically. Clinical and radiological documents were not available for 3 patients from pathologically proven group and were excluded.

**RESULTS:** 55.1% of our population were women and 44.9% were men. Average age of presentation was 65.7 year-old. Affected anatomical locations were periscapular area (93.9%), GIT (4.1%), and shoulder (2%). Radiographically, Computed tomography (CT), positron emission tomography (PET)-CT, and magnetic resonance imaging (MR) were used in 37, 27, and 14 patients respectively. On CT, ED appeared as isodense mass interspersed with hypodense fatty areas. On MRI, all ED except in one patient were isointense to muscle interspersed with hyperintense fatty areas and showed heterogeneous pattern of enhancement. In the remaining patient, ED was hyperintense on T2 weighted images. On PET-CT, 92.6% of ED were FDG avid and 7.4% were non-avid. In one patient, ED became non-FDG avid after 3 years of follow up, this was associated with fatty degeneration on CT. Follow up imaging was available for 30 patients over 75.5 months on average. ED was stable in 22 patients, increased in size in 5 patients with no aggressive features. In one patient, ED decreased in size over 5 months.

**CONCLUSION:** ED is a purely benign lesion that does not carry any risk of malignant transformation. ED with the typical radiological appearance in the periscapular area should not be biopsied. Surgical removal is indicated only for symptomatic cases.

#### (SS05-05) 2:40–2:50 PM

##### Aerobic fitness is associated with younger-appearing brains in older adults

Shinjini Kundu, PhD, *University of Pittsburgh, Pittsburgh, PA*; Kirk I. Erickson, PhD; Edward McAuley, PhD; Arthur F. Kramer, PhD; Gustavo K. Rohde, PhD (*shk71@pitt.edu*)

**PURPOSE:** Higher fitness levels have been associated with larger cortical and subcortical volumes in older adults. Yet, little is known about the tissue characteristics that underlie these differences in total volume. In this cross-sectional study, we were able to examine for the first time whether higher aerobic fitness was associated with differences in gray matter (GM) and white matter (WM) tissue distribution using the novel Transport-Based Morphometry (TBM) technique.

**METHOD AND MATERIALS:** Cardiorespiratory fitness (VO<sub>2</sub> max) was assessed in 172 older adults aged 58–81 (66.5 ± 5.7). High-resolution T1-weighted images were obtained on all participants. White matter and gray matter tissue maps were segmented and analyzed separately. The Transport-Based Morphometry (TBM) technique was used to compute the direction and magnitude of shifts in WM and GM tissue distribution that were maximally correlated with VO<sub>2</sub> max mL/kg, after correcting for covariates of age, gender, and years of education. Statistical significance of the computed shifts in tissue distribution as a function of fitness level was established using permutation testing. Visualizations of the changes in tissue distribution were generated through inverse TBM transformation.

**RESULTS:** The computed changes in white matter and gray matter distribution were significantly correlated with VO<sub>2</sub> max mL/kg, r =

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

0.30,  $p = 0.004$  (WM);  $r = 0.40$ ,  $p < 0.00001$  (GM), after correcting for covariates. TBM shows that brain tissue distribution in older adults with higher VO<sub>2</sub> appears similar to those of younger adults, especially in the frontal and temporal regions (Figure), suggesting that cardiorespiratory fitness may be a potentially important neuroprotective mechanism for maintaining brain health later in life.

**CONCLUSION:** The new TBM technique enables the first assessment of how brain tissue distribution in older adults changes as a function of aerobic fitness. Our study helps elucidate the role of cardiorespiratory fitness on the underlying brain tissue morphology, suggesting that exercise may help protect brain health in aging adults.

### (SS05-06) 2:50–3:00 PM Emergent Large Vessel Occlusion Stroke Patients May Benefit from Thrombectomy After MR Selection Regardless of Time From Symptom Onset

Brian C. Cristiano, MD, *Loma Linda University Hospital, Loma Linda, CA*; Matthew Pond, MD; Paggie Kim, MD\*; Udo Oyoyo; J. Paul Jacobson, MD\*

**PURPOSE:** Time from symptom onset to thrombectomy is considered important for emergent large vessel occlusion (LVO) stroke. However, a paucity of data exists beyond 6–8 hours of symptom onset. Patients with small core infarct on admission MRI may benefit from intervention beyond commonly accepted time thresholds due to superior collateral circulation. Here we present experience with MR-selected LVO patients, many treated at extended time-points, in an effort to shed light on this important knowledge gap.

**METHOD AND MATERIALS:** IRB approved, retrospective analysis of prospectively collected acute stroke intervention database representing 41 consecutive acute stroke interventions between 12/01/14 and 3/31/2016, 33 with MR screening prior to intervention. 90-day modified Rankin score, the primary outcome, assessed by telephone, was available for 27/33 MR screened patients. Comparisons were made between good ( $mRS \leq 2$ ) and poor outcome groups.

**RESULTS:** Of the 33 MR-selected LVO patients, 5 had good outcome at 90d ( $mRS \leq 2$ ) versus 22 with poor outcome. Patients achieving 90d  $mRS \leq 2$  showed: increased likelihood of TIC1 $\geq$ 2B recanalization (OR 1.29 [95CI 1.03 – 1.62]); were less likely to have any hemorrhagic conversion (OR 0.82 [95 CI: 0.67 – 0.99]); had smaller completed infarct volume (median 5 mL v. 27 mL,  $p = 0.048$ ); and lower 24h NIHSS (median 2.5 versus 12.5,  $p = 0.047$ ). Neither time from LSW (441 v. 430 min,  $p = 0.840$ ) nor time from arrival to femoral access (183 v. 188 min,  $p = 0.643$ ) was significantly different. In four of five good outcomes, time LSW to access was greater than 6 hours.

**CONCLUSION:** A significant number of MR screened patients has good clinical outcome despite extended time from LSW. In fact, neither time LSW nor time from arrival to access was significantly different among patients with good or bad clinical outcome suggesting that MR screened patients may be less time sensitive than previously assumed.

### (SS05-07) 3:00–3:10 PM Whole Body FDG-PET and FDG-PET/CT in Patients with Suspected Paraneoplastic Syndrome: A Systematic review and Meta-analysis of Diagnostic Accuracy

Sara Sheikhabaei, *Johns Hopkins Medical Institutions, Baltimore, MD*; Charles Marcus, MD; Roberto S. Fragomeni; Steven P. Rowe, MD, PhD; Mehrbod S. Javadi; Lilja B. Solnes ([ssheikh6@jhmi.edu](mailto:ssheikh6@jhmi.edu))

**PURPOSE:** The purpose of this study was to assess the diagnostic performance of whole body FDG-PET or FDG-PET/CT for detection of underlying malignancy in patients with clinically suspected neurological and non-neurological paraneoplastic syndromes.

**METHOD AND MATERIALS:** A systematic search was performed in PubMed, Embase, Scopus and conference proceedings (last updated July 2016) to identify relevant published studies reporting the

performance of FDG-PET or FDG-PET/CT in patients with suspected paraneoplastic syndrome. Histopathologic confirmation or clinical follow-up was considered as the reference standard. Pooled estimates of sensitivity, specificity and diagnostic odds ratio (DOR) with their 95% confidence intervals were calculated. A summary receiver-operating-characteristics curve was constructed, and the area under the curve (AUC) was determined along with the Q\* index.

**RESULTS:** Fifteen studies including a total of 951 individual patients suspected of having a para-neoplastic syndrome and who underwent FDG-PET or FDG-PET/CT examinations met our inclusion criteria. There was moderate to high heterogeneity among the included studies. The pooled sensitivity, specificity and DOR of FDG-PET or FDG-PET/CT for the detection of underlying malignancy were 0.78 (0.71 to 0.84), 0.86 (0.84 to 0.89), and 23.75 (13.26 to 42.54), respectively. The AUC and the Q\* index were 0.891 and 0.822, indicating good diagnostic accuracy. Secondary analysis on patients with exclusively neurologic paraneoplastic symptoms (10 studies,  $n = 439$ ) yielded sensitivity and specificity of 0.87 (0.79 to 0.92) and 0.82 (0.78 to 0.86) with AUC and Q\* index of 0.903 and 0.834. The subgroup analysis by imaging modality showed significantly higher specificity for FDG-PET/CT compared with FDG-PET alone [0.89 (0.86 to 0.91) versus 0.79 (0.73 to 0.85)] with no significant difference in the pooled sensitivities.

**CONCLUSION:** This meta-analysis of available studies demonstrates that whole body FDG-PET or FDG-PET/CT has good diagnostic accuracy, and moderate to high sensitivity and specificity for detection of underlying malignancy in patients suspected of having a paraneoplastic syndrome.

### A<sup>3</sup>CR<sup>2</sup> Research Award

### (SS05-08) 3:10–3:20 PM Implementation of Category Selection Protocols Software (Featherlight) Reduces Radiation Exposure in Pediatric Patients

Andrew Lee, MD, *Loma Linda University Medical Center, Loma Linda, CA*; Paggie Kim, MD\*; Jaspreet Singh, MD; Geoffrey Delizo, RT ([anwlee@llu.edu](mailto:anwlee@llu.edu))

**PURPOSE:** In an initiative to help decrease CT dose in the pediatric population, the Image Gently campaign had developed a standardized CT protocol approach system, such as Featherlight, that would be able to enter kV and mA values automatically for each patient based on weight and type of CT encounter. Before Featherlight, these kV and mA values were manually entered by technicians for each examination depending on the weight and type of encounter. The purpose of our study is to demonstrate that implementing the category selection protocol software in CT practice helps to better follow kV and mA protocol values in pediatric patients who underwent CT abdomen and pelvic examination, consequently reducing radiation exposure.

**METHOD AND MATERIALS:** Retrospective review of total of 200 pediatric patients who undergoing CT abdomen and pelvis examinations before and after implementation of category selection protocol software were performed. Data included age, sex, weight, and CT dosage parameters of kV and mA were recorded for each group (before and after the implementation). The kV and mA values of each patient were compared between the two groups using Wilcoxon rank-sum test with significance level at 0.05.

**RESULTS:** In the “before Featherlight” cohort, 3 out of 94 patients had received appropriate kV and mA values. In the “after Featherlight” cohort, 74 out of 99 patients had received appropriate kV and mA values ( $p < 0.001$ ). Twenty-five out of 94 “before Featherlight” patients had received kV values over 120, compared to 0 of the 99 “after Featherlight” patients ( $p < 0.001$ ). Additionally, 17 out of 94 “before Featherlight” patients had received mA values over 190 compared to 7 “after Featherlight” patients ( $p < 0.04$ ).

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

**CONCLUSION:** The implementation of automatic input of kV and mA values through category selection protocol (Featherlight software) improved frequency of appropriate usage of kV and mA in pediatric patients who undergoing CT abdominal and pelvic examination, and thus decreases radiation exposure.

**(SS05-09) 3:20–3:30 PM**

**A Deceptive Name: Invasive Micropapillary Carcinoma of the Breast - Single Institution Clinicopathologic and Radiologic Findings in 60 Patients**

Joanna Schneider, BA, *University of North Carolina School of Medicine, Chapel Hill, NC*; Sheryl G. Jordan, MD; Thomas Lawton, MD (*joanna\_schneider@med.unc.edu*)

**PURPOSE:** Despite an innocuous name and favorable immunohistochemistry, invasive micropapillary carcinoma of the breast (IMPC) has an unfavorable profile. We reviewed the clinicopathologic and radiologic features of women with IMPC to a) identify distinguishing clinical or imaging features, b) assess the prognostic value of IMPC immunohistochemistry, and c) examine patient outcomes.

**METHOD AND MATERIALS:** The study was approved by our IRB. 70 patients with histologic diagnosis of IMPC were identified, with complete records available in 60, representing 61 tumors. These patients, seen at the NC Cancer Hospital between 2003 and 2013, were retrospectively analyzed. 33 relevant PubMed articles were reviewed concurrently.

**RESULTS:** 61 tumors in 60 patients were included, with age mean of 55. Immunohistochemistry showed 82% ER positive, 67% PR positive, and 23% HER2 positive. IMPC histopathologic grade was 2% grade 1, 51% grade 2, 46% grade 3. 84% presented as a mass on mammography, 61% showed calcifications, and 69% showed both. Regarding the mass, tumor size mean was 2.8 cm (range 0.5 cm to 9 cm). 34% of tumors were T1, 47% T2, 14% T3, and 5% T4. The majority (55%) underwent only mammography and ultrasound, with 13% receiving a breast MRI, 13% receiving a CT, 8% receiving a PET scan, and 30% receiving a bone scan. The surgical treatments included 44% requiring mastectomy, 36% requiring lumpectomy, and 10% receiving both. Observations currently being further analyzed include the propensity for even T1 tumors to metastasize to LNs, the near-pathognomonic appearance of associated DCIS, and the atypically high percentage of patients requiring mastectomy.

**CONCLUSION:** We report the largest single institution case series of IMPC in the North American imaging literature. Our data indicate high percentages of grade 2 and 3 tumors with mixed molecular subtyping and unusually high lymph node involvement. Understanding that IMPC has high lymph node involvement should guide imagers to target axillary LN for percutaneous biopsy. Identifying LN involvement in this manner obviates the need for the patient to undergo two separate axillary operative procedures, i.e. sentinel node biopsy followed by subsequent axillary node dissection.

**Wednesday, May 10, 2017**

**2:00–3:30 PM**

**SS06: RAHSR Scientific Session (Health Services Research)**

**Location: Diplomat Ballroom 2**

**Moderators: Richard Duszak, Jr, MD  
Stella K. Kang, MD, MSc**



**(SS06-01) 2:00–2:10 PM**

**Evidence Based Reporting: A Method to Optimize Prostate MRI Communications with Referring Physicians**

Michael J. Magnetta, MD, MS, *UPMC, Pittsburgh, PA*; Ashley L. Donovan, BS; Benjamin Davies, MD; Bruce Jacobs, MD; Alessandro Furlan, MD\*

**PURPOSE:** An evidence based method to optimize prostate MRI reports was developed with Urologists and Radiologists using the Knowledge-to-Action framework and Prostate Imaging – Reporting and Data System (PI-RADS™) guidelines to improve communication.

**METHOD AND MATERIALS:** This was an approved QI initiative. Urologists and Radiologists at a single center were surveyed to determine essential components of reports based on local practice norms and PI-RADS™ guidelines. A structured report was developed that contained these components (intervention). 200 pre/100 post-intervention reports with nodules were reviewed. Post intervention compliance was defined as using the new report. Essential components were compared between pre-intervention (pre), post-intervention non-compliant (post-NC) and post intervention compliant (post-C) reports. A sample of 40 pre/40 post intervention reports were evaluated by a urologist and were graded on a 5-point scale of 6C's: consistency, completeness, conciseness, clarity, likelihood to contact radiologist and clinical impact. Statistics were performed in SPSS. Variables were compared with ANOVA or Chi-squared test.

**RESULTS:** Essential components of report: PI-RADS™, findings by lesion, pertinent positive/negative findings (extracapsular extension, SV and NVB invasion) and low word count. Radiologist compliance (post-C) was 36%. PI-RADS™ (pre: 54%, post-NC: 75%, post-C: 100%,  $\chi^2 < 0.001$ ). Findings by lesion (pre: 56.5%, post-NC: 62.5%, post-C: 97.2%,  $\chi^2 < 0.001$ ). All pertinent findings reported (pre: 58.0%, post-NC: 67.2%, post-C: 100%,  $\chi^2 < 0.001$ ). Mean word content/report (pre: 321.0, post-NC: 317.5, post-C: 339.7,  $p=0.55$ ). Radiologists were receptive to the report. No perceived change in reporting speed and no barriers to use were identified. The Urologist indicated improved consistency (pre: 2.7, post: 3.5,  $\chi^2 < 0.001$ ), completeness (pre: 2.8, post: 3.3,  $\chi^2 < 0.001$ ), clarity (pre: 2.9, post: 3.3,  $\chi^2 < 0.05$ ) and clinical impact (pre: 2.8, post: 3.8,  $\chi^2 < 0.001$ ) with reduced need to contact (pre: 3.2, post: 2.1,  $\chi^2 < 0.001$ ).

**CONCLUSION:** Improved communication with evidence-based reporting requires engagement of referring physicians and radiologists to define practice norms in addition to national guidelines.

**(SS06-02) 2:10–2:20 PM**

**Effects of Interpersonal Skills Training on MRI Operations: A Randomized Trial**

Xuan V. Nguyen, MD, PhD, *Ohio State University Wexner Medical Center, Columbus, OH*; Amna A. Ajam, MD, MBBS; Ronda Kelly, BS, RT(R); Elvira V. Lang, MD\* (*Xuan.Nguyen@osumc.edu*)

**PURPOSE:** To assess the effect of team training on operational efficiency during outpatient MRI.

**METHOD AND MATERIALS:** In this IRB-approved HIPAA-compliant study, 6 MRI outpatient satellite sites of a Midwestern hospital system were randomized to either serve as controls or have their teams trained in advanced communication skills. The trial baseline coincided with a

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

peak in system-wide volumes in the 4th quarter of fiscal year 2015 (Q4FY15). The trial ended Q3FY16. The study included 27,425 MRI examinations. Equipment utilization (completed scans/available slots), hourly scan rates (total orders completed per machine per hour of operation), and no-show rates stratified by time were analyzed using the Cochran-Mantel-Haenszel chi square method, with individual pairwise comparisons performed with Bonferroni correction.

**RESULTS:** There were significant overall effects of training, stratified by time, on equipment utilization ( $\chi^2_{MH}=858.2$ ;  $p<0.0001$ ) and no-show rates ( $\chi^2_{MH}=28.7$ ;  $p<0.0001$ ). Compared to baseline, untrained sites experienced significant drops in equipment utilization ( $p<0.01$  for Q1FY16 and  $p<0.0001$  for Q2 FY16 and Q3FY16), decreasing from 77% to 65% over the study period, corresponding to a decrease from 1.15 to 0.97 in hourly scan rates. For trained sites, pairwise comparisons at each FY2016 time point yielded no significant difference from baseline, with maintenance of hourly scan rates of 1.23 and 1.27 and equipment utilization rates of 83% and 85% between baseline and Q3FY16. No-show rates remained stable at trained sites but increased at untrained sites in the last two quarters ( $p<0.05$ ).

**CONCLUSION:** MRI outpatient facilities trained in advanced communication techniques may have more favorable operational efficiency than untrained sites.

### (SS06-03) 2:20–2:30 PM

#### Comparing the Productivity of Teaching and Non-Teaching Workflow Models in a University Hospital Academic Radiology Department

Christopher G. Roth, MD, *Thomas Jefferson University, Philadelphia, PA*; Yakup Akyol, MD; Haresh Naringrekar, MD; Jaydev Dave, PhD, MS; Sandeep Deshmukh, MD (*Christopher.Roth@jefferson.edu*)

**PURPOSE:** The purpose of this research is to compare the productivity and efficiency of 2 different workflow models in an academic radiology department: teaching/trainee-driven (traditional faculty-supervised) workflow and non-teaching/faculty-driven (working independently) workflow.

**METHOD AND MATERIALS:** 2 abdominal imaging fellows compiled RVU data for 6 faculty members from the abdominal imaging division assigned to each of the workflow models over a 6-month period (July–December 2015) using analytics software (Radmetrix, Primordial) processing data from the radiology information system. The relative RVU productivity for faculty members was compared individually and the composite data for the workflow models were compared; on-call days were excluded from the analysis. RVUs per day in the range of 10 to 100 were included in the analysis; data points outside this range were excluded. The relative RVU productivity for each faculty member was compared individually and in aggregate to study the effect of the workflow models on RVUs using factorial ANOVA.

**RESULTS:** RVU data per day from 402 instances was obtained from which data corresponding to 387 instances was analyzed after eliminating values outside the 10 to 100 RVU/day range. RVUs per day for the faculty members ranged from  $23.5 \pm 2.3$  (mean  $\pm$  standard error) to  $46.2 \pm 2.4$  with faculty-driven workflow and from  $29.8 \pm 2.2$  to  $54.4 \pm 2.7$  with trainee-driven workflow, respectively. There was a significant main effect of the workflow model on the RVU productivity ( $p < 0.05$ ). Overall, a significant increase of 27.8% in RVUs was noted with the trainee-driven workflow ( $42.8 \pm 0.9$ ) relative to the faculty-driven workflow ( $33.5 \pm 1.7$ ;  $p < 0.05$ ). There was no significant interaction effect between the workflow model and the independent faculty members ( $p = 0.72$ ). This indicates that the workflow model affected each faculty member in a similar manner i.e., an increase in RVUs with the trainee-driven workflow.

**CONCLUSION:** Trainee-driven workflow enhances the productivity of attending radiologists and additional work is necessary to determine the impact on performance measures, such as turnaround times, communication of findings and operational functions (i.e., protocoling cases, etc.).

### AUR Trainee Prize: 2nd Place

### (SS06-04) 2:30–2:40 PM

#### Screening Mammography and Downstream Diagnostic Breast Imaging in Patients with Advanced Cancer: A Population-Based Study

Gelareh Sadigh, MD, *Emory University, Atlanta, GA*; Ruth C. Carlos, MD, MS; Kevin Ward, PhD, MPH; Jeffrey Switchenko, PhD; Renjian Jiang, MPH; Kimberly E. Applegate, MD, MS; et al (*gsadigh@emory.edu*)

**PURPOSE:** Screening tests are generally not recommended in patients with advanced cancer given their short-term life expectancy. The purpose of this study was to assess rates of screening mammography and downstream diagnostic breast imaging in Medicare beneficiaries with advanced colorectal or lung cancer.

**METHOD AND MATERIALS:** Female fee-for-service Medicare beneficiaries aged  $\geq 65$  years with advanced colorectal (stage IV) or lung (stage IIIB–IV) cancer between 2000 and 2011 who reported to a Surveillance, Epidemiology, and End Results (SEER) registry were included. Patients were required to be continuously enrolled in Medicare Part A and B from diagnosis until death or 12/31/2013. Utilization of screening mammography and downstream breast imaging (diagnostic mammography, breast ultrasound, and breast MRI) was assessed. Logistic regression models were used to explore independent predictors of utilization of each downstream test following screening events while controlling for cancer type, patient sociodemographic and regional characteristics and accounting for within-patient correlation using generalized estimating equation methodology. Analyses were conducted at the screening event level.

**RESULTS:** Overall 34,127 women with advanced colorectal or lung cancer were included (7,843 [23%] colorectal; 26,284 [77%] lung cancer; mean age at diagnosis 75 yrs; 84% White). 9% ( $n=3,159$ ) of these women underwent 5,750 screening mammograms. 11% ( $n=639$ ) of these screening mammograms resulted in at least one subsequent downstream diagnostic breast imaging exam within 9 months, in 356 women. Diagnostic mammography was the most common (9%;  $n=532$ ), followed by ultrasound (6%;  $n=334$ ), and MRI (0.2%;  $n=14$ ). Diagnostic mammography rates were higher in Whites than African Americans (OR, 1.6;  $p < 0.05$ ) and lower in the Midwest (OR, 0.67) and West (OR, 0.65) than the Northeast ( $p < 0.05$ ). Higher ultrasound rates were associated with more favorable economic status (OR, 1.8;  $p < 0.05$ ).

**CONCLUSION:** Of women with advanced colorectal or lung cancer, 9% still undergo screening mammography, and 11% of these screening mammograms resulted in at least one additional downstream diagnostic breast imaging examination, resulting in costs without any meaningful likelihood of benefit.

### (SS06-05) 2:40–2:50 PM

#### Bridging the Gap: Identifying Global Trends in Gender Disparity among the Radiology Physician Workforce

Sarah W. Cater, MD, *Duke University Hospital, Durham, NC*; Sora C. Yoon, MD; Dorothy A. Lowell, MD; James Campbell; Gary Sulioti; Rosie Qin, MD; et al (*sarah.cater@dm.duke.edu*)

**PURPOSE:** Though women make up approximately half of all American medical school graduates, they represent only a quarter of the radiology physician workforce. The purpose of this study is to identify whether similar gender disparities exist in other countries, and to identify any country-level predictors for gender inequality.

**METHOD AND MATERIALS:** Ninety-five professional radiology organizations in 75 countries were contacted via email and asked to provide membership statistics, including total number of female members, female members under age 36, and women in society leadership positions. Country-specific metrics were collected using public sources, including gross domestic product, female medical school enrollment, and the United Nations Gender Development Index (GDI), a validated metric of gender equality.

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

**RESULTS:** Data on 151,648 radiologists representing 27 countries in Europe, North America, Central/South America, Oceania, Africa, and Asia were obtained. Globally, 36.6% of radiologists are female. Women make up a higher proportion (47.5%) of radiologists under age 36. The United States has the lowest female representation of all countries at 27%. Asian countries have the highest overall representation of female radiologists (mean: 50.9%, range: 27.7-85%), with Thailand boasting an 85% female workforce. Europe has the greatest variability (mean: 39.8%, range: 28.8-68.9%). Central/South America has female representation close to average (range: 36.0-44.0%), and Oceania is below average (range: 27.5-34.5%). Having more than one third female representation among a country's radiology physician workforce was significantly associated with higher GDI ( $p=0.002$ ), greater number of women enrolled in medical school ( $p=0.03$ ), and lower length of training ( $p=0.04$ ).

**CONCLUSION:** Women are underrepresented in radiology globally, and especially in the United States. Female physicians make up a higher proportion of the younger workforce, suggesting the trend is improving. Countries with a higher representation of women in radiology scored higher on metrics of gender equality, had higher female medical school enrollment, and lower duration of training, suggesting these factors may play a role in the gender gap.

### (SS06-06) 2:50-3:00 PM

#### A pilot study of Clinical Decision Support for Pulmonary Embolism Studies in the Emergency Department: Feasibility, Diagnostic Accuracy and Provider Perspective

Alexander Goehler, MD, PhD, *Yale University, New Haven, CT*; Howard P. Forman, MD ([alexander.goehler@yale.edu](mailto:alexander.goehler@yale.edu))

**PURPOSE:** In the context of a commercial EMR, we implemented a clinical decision support (CDS) intervention for CTA for pulmonary embolism (CTA-PE) in the Emergency Department (ED). We then quantified the impact of CDS on ordering practices for this indication and sought to determine its perception among providers.

**METHOD AND MATERIALS:** In a survey of 231 radiologists and clinicians in the ED, 78% identified CTA-PE as "overutilized." An interdisciplinary group developed an algorithm that combined established risk scores and local practice patterns to risk stratify patients for PE work-up. We integrated a mandated questionnaire for every CTA-PE study requested within the Epic RIS ordering system (Epic Radiant, 2014). If answers were concordant with the clinical pathway, the study order was placed, but if answers were discordant, alternative scenarios were recommended. We developed an automated querying system in the underlying Epic warehouse Clarity to assess outcomes and performance and to provide direct end-user feedback.

**RESULTS:** Among the 853 studies conducted, 8.2% were positive for PE. The algorithm was highly accurate, with 10.4% and 10.0% positivity among studies that were recommended to proceed with CT or pursue D-dimer, respectively. In cases where cancellation was recommended, 2.6% of studies were positive, and one of these showed a clinically significant PE. Among the 879 studies requested, 479 (55%) received a recommendation to change their order: 6 (1.3%) studies were subsequently cancelled; 13 (2.7%) changed to a D-dimer, 460 (51%) proceeded with CTA despite the recommendation. Among providers who ordered more than 10 studies, concordance with the CDS recommendation ranged from 12 - 68% (mean 45%) with little (0.10) correlation between compliance and positivity rates. The most common reasons for deviation from the recommendation were clinical concern and turnaround time.

**CONCLUSION:** While the CDS algorithm for PE was accurate, it had only a modest impact on ordering practices in the ED, in part due to substantial heterogeneity in physician adherence to the CDS intervention.

### (SS06-07) 3:00-3:10 PM

#### Racial Disparities in Radiographic Features of Knee Osteoarthritis, Patients' Symptoms, and Utilization of Knee Replacement: An Observational Study of the Osteoarthritis Initiative Cohort 2006 - 2016

Nima Hafezi Nejad, MD, MPH, *Johns Hopkins University School of Medicine, Baltimore, MD*; Ali Guermazi, MD, PhD\*; Frank Roemer, MD\*; Kent Kwoh; Elena Losina; Shadpour Demehri, MD\* ([sdemehr@jhmi.edu](mailto:sdemehr@jhmi.edu))

**PURPOSE:** To compare the radiographic incidence and progression of osteoarthritis (OA), patients' symptoms, and knee replacement among African Americans (AAs) and White Americans (WHs) using the Osteoarthritis Initiative Cohort (2006 - 2016).

**METHOD AND MATERIALS:** A total of 4564 subjects (AA/WH=874/3790) were included in our analysis. Plain radiographs (up to 8th year) were used to evaluate the incidence (Kellgren and Lawrence (KL) grade  $\geq 2$  was used as the definition of OA incidence) and progression (Osteoarthritis Research Society International [OARS] Joint Space Narrowing [JSN] whole grade increase was used as the definition of progression) of OA. Western Ontario and McMaster (WOMAC) OA index for pain and disability (up to 9th year) were used to evaluate patients' symptoms and Non-Acceptable Symptomatic State (NASS). Normalized WOMAC pain and disability of greater than 80 (out of 200) was used as the definition of NASS. Knee replacements were evaluated up to the 9th year of study. Baseline variables including age, gender, BMI, Physical Activity Scale for the Elderly (PASE), and socioeconomic variables (annual income, attained education, and employment status) were adjusted in multivariable models.

**RESULTS:** In the adjusted models, AAs (compared to WHs) had similar risk of radiographic incidence (adjusted Hazard Ratio [aHR]: 0.99 [0.79 - 1.24]) and progression of OA (aHR: 0.99 [0.84 - 1.16]), higher risk of having NASS (aHR: 1.99 [1.67 - 2.37]), and lower rates of KR (aHR: 0.61 [0.45 - 0.83]). The racial disparity was persistent after adjustment for baseline characteristics including age, gender, BMI, level of physical activity, and socioeconomic variables. Similar results were obtained after considering patients perception of pain and disability after knee replacement.

**CONCLUSION:** Despite similar rates of radiographic incidence and progression of OA and a higher risk of patient reported non-acceptable symptomatic states, African Americans have significantly lower utilization of knee replacement, when compared to White Americans.

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

## RAHSR Harvey L. Neiman Award

(SS06-08) 3:10–3:20 PM

### Location, Location, Location: The Association Between Imaging Setting and Follow Up of Findings of Indeterminate Malignant Potential

Geraldine Liao, MD, *Hospital of the University of Pennsylvania, Philadelphia, PA*; Joshua M. Liao, MD; Darco Lalevic; Hanna M. Zafar, MD; Tessa S. Cook, MD, PhD ([geraldine.liao@uphs.upenn.edu](mailto:geraldine.liao@uphs.upenn.edu))

**PURPOSE:** Incomplete follow-up of findings with indeterminate malignant potential can lead to missed or delayed cancer diagnoses.

Although follow-up may vary based on patient location at the time of imaging, there is little empirical evidence for the association between patient location—emergency department (ED), outpatient or inpatient—and follow-up of these findings. To address this knowledge gap, we evaluated the association between patient location and completion of relevant outpatient follow-up imaging evaluating findings of indeterminate malignant potential.

**METHOD AND MATERIALS:** Using a standardized institutional coding scheme, we identified 1,055 cross-sectional exams with hepatic, adrenal, renal and pancreatic masses of indeterminate malignant potential performed in the ED, outpatient, and inpatient settings between July 1, 2013 and January 30, 2014. Logistic regression, adjusted for interpreting radiologist-, ordering provider- and imaging modality-related characteristics, was used to estimate the likelihood of completing relevant follow-up imaging within 13 months with respect to patient location.

**RESULTS:** The majority of exams occurred in the outpatient setting (70%), with 14% and 16% occurring in the inpatient and ED settings, respectively. Findings on 49% of exams were followed up within 13 months. In multivariable analysis, findings on exams performed in the ED [OR 0.07, 95% CI (0.03, 0.16)] and inpatient [OR 0.12, 95% CI (0.08, 0.20)] settings were less likely to be followed up compared to those obtained in the outpatient setting. Findings on exams ordered by surgical providers were also less likely to be followed up [OR 0.61, 95% CI (0.45, 0.82)] compared to those ordered by non-surgical providers. Imaging modality, radiologist characteristics, and ordering provider type (physician vs non-physician) did not affect the likelihood of completing relevant follow-up imaging.

**CONCLUSION:** Patient location is correlated with the likelihood of completing relevant follow-up imaging for lesions with indeterminate malignant potential. Future work should evaluate delivery processes, care continuity, and other systems-level factors related to patient location, as well as their effect on follow-up of these findings.

(SS06-09) 3:20–3:30 PM

### Body Mass Index in Association with Radiographic Incidence and Progression of Knee Osteoarthritis, Patient Reported Outcome, and Knee Replacement: Data from the Osteoarthritis Initiative

Nima Hafezi Nejad, MD, MPH, *Johns Hopkins University School of Medicine, Baltimore, MD*; Delaram Shakoor; Frank Roemer, MD\*; Ali Guermazi, MD, PhD\*; Shadpour Demehri, MD\* ([sdemehr1@jhmi.edu](mailto:sdemehr1@jhmi.edu))

**PURPOSE:** To evaluate the association between the baseline and follow-up Body Mass Index (BMI) and incidence of Knee Osteoarthritis (KOA), radiographic progression of KOA [Joint Space Narrowing (JSN) score], patient reported outcome and rate of Knee Replacement (KR)

**METHOD AND MATERIALS:** Data obtained from Osteoarthritis Initiative (OAI) database (n=4796) were assessed to determine four outcomes of interest: 1. Incidence of KOA characterized by Kellgren and Lawrence grade  $\geq 2$  with or without JSN 2. Radiographic progression of KOA employing the Osteoarthritis Research Society International (OARSI) JSN score 3. Non acceptable symptom state (NASS) as a measure of patient reported outcome 4. Rate of KR performed in the nine year follow-up. The first two outcomes were assessed in eight year follow-up period. Cox regression analysis utilizing baseline and follow-up variable exposure was performed. Two sets of adjustment were applied. In model one, (AdjustedHR-1), subjects were adjusted for age, gender and race and in model two, (Adjusted HR-2), further adjustment was performed for Western Ontario and McMaster University osteoarthritis index score (WOMAC), Physical Activity Scale for the Elderly (PASE), and radiographic KL grade.

**RESULTS:** Each unit increase in baseline BMI was significantly associated with higher incidence of KOA (Adjusted HR-2: 1.07 (1.05-1.08); P value<0.001), greater risk of JSN progression (Adjusted HR-2: 1.02 (1.01-1.03); P value<0.001) and higher NASS (Adjusted HR-2: 1.03(1.02-1.04); P value<0.001). In the follow-up period, each additional year of excess BMI was strongly associated with higher incidence of KOA (Adjusted HR-2: 1.08 (1.01-1.17); P value<0.05), greater risk of JSN progression (Adjusted HR-2: 1.07 (1-1.15); P value<0.05) and higher NASS (Adjusted HR-2: 1.21(1.11-1.32); P value<0.001). The relationship between BMI either at baseline or follow-up and rate of KR didn't reach statistical significance

**CONCLUSION:** Excess BMI at baseline and during follow-up period were significantly associated with higher incidence of knee osteoarthritis, greater risk of progression of JSN score and patient NASS, however, they didn't result in higher risk of knee replacement.

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

# AUR 2017 Research Poster Abstracts

Research posters are located in the Grand Ballroom East. Each poster will be presented by its author during one of the *AMA PRA Category 1 Credit™* poster sessions scheduled for 7:00–8:15 AM, Tuesday (Session 201) and Wednesday (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 **green**.

## Abdominal Radiology

### (R-06) Wednesday • 7:00–8:15 AM • Hard-copy poster Optimizing Liver CT Examinations with a Tiered, Weight-Based Protocol

William L. Stafford, MD, *University of Kentucky, Lexington, KY*; James T. Lee, MD; Candice Adams

**PURPOSE:** Comparing diagnostic quality of CT liver protocol studies obtained before and after institution of a three-tiered, weight based contrast dosing protocol.

**METHOD AND MATERIALS:** All CT liver protocol studies obtained over a one month time period, during which contrast dosage was standardized, independent of patient weight, were independently scored by a resident and attending radiologist on a three point scale (0,1,2 poor, diagnostic, optimal) in each phase (arterial, venous, delayed), for a possible score ranging from 0-6. A three-tiered, weight-based contrast dosage protocol was then instituted, and these studies were blindly scored by the same radiologists using a similar system. The average scores before and after implementation of the contrast dosing protocol were then compared.

**RESULTS:** Weight-based dosing protocol significantly improved subjectively scored image quality, most notably in heavy patients. Average score (0-6) in patients weighing >100kg prior to the change was 2.7. This score increased to 4.8 after implementation of weight based dosing protocol.

**CONCLUSION:** Results illustrate dosage changes are effective, with relative ease of implementation. These changes will improve the diagnostic quality of arterial and portal venous phase CT imaging of the liver in larger patients.

### (R-07) Tuesday • 7:00–8:15 AM • Hard-copy poster Hepatic steatosis: detection by low dose CT lung cancer screening

Zhenteng Li, MD, *Thomas Jefferson University, Philadelphia, PA*; David R. Hansberry, MD, PhD; Moughnyan Cox, MD; Donald G. Mitchell, MD\*; Sandeep Deshmukh, MD

**PURPOSE:** Fatty liver disease, an important cause of liver failure and death from malignancy, can be diagnosed by noncontrast CT. It is thus potentially an added benefit of low dose CT (LDCT) lung cancer screening, although data on using LDCT to diagnose hepatic steatosis is lacking. By comparing LDCT of the chest and standard dose CT of the abdomen (SDCT), the authors attempt to validate LDCT as a tool to detect fatty liver disease.

**METHOD AND MATERIALS:** A retrospective search for patients who had both LDCT for lung cancer screening and SDCT within 6 months at a single academic center from August 2014 to August 2016 identified 28 patients (9 men and 19 women; mean age, 66 years; mean BMI, 28; mean time interval 3.2 months). The mean CTDIvol was 2.3 mGy for LDCT and 12.3 mGy for SDCT, using a 32 cm body phantom ( $p < 0.001$ ). Mean liver attenuation (L), spleen attenuation (S), liver-to-spleen attenuation ratio (L/S) and liver-to-spleen attenuation difference (L-S) were computed from multiple regions-of-interest (ROIs) on LDCT and SDCT for each patient. The cutoff values of  $L < 48$  HU and  $L/S < 1.1$  on SDCT were used to diagnose fatty liver. Statistical analysis was performed using IBM SPSS 21.0.

**RESULTS:** In paired samples analysis, there was no significant difference in L, S and L/S between LDCT and SDCT ( $p = 0.984$ , 0.136 and 0.065, respectively) while the difference was significant for L-S ( $p = 0.032$ ). In Bland-Altman analysis, there was least bias in L compared to L/S or L-S (L, -2.3%; L/S, -6.3% and L-S, 5.0%) between LDCT and SDCT. However, the limit of agreement was smallest for L/S (L,  $\pm 37.5\%$ ; L/S,  $\pm 28.5\%$  and L-S, 174.6%). Regression analysis of the differences in L and S between LDCT and SDCT demonstrated an upward trend of proportional bias, which was eliminated in the ratio of liver-to-spleen attenuation (L/S). LDCT using L and L/S achieved 82% to 93% accuracy and an area under the curve of 0.817 to 0.947 in ROC analysis using SDCT as a reference standard.

**CONCLUSION:** LDCT in patients undergoing lung screening can be used to diagnose and/or follow up hepatic steatosis. Liver-to-spleen attenuation ratio (L/S) in LDCT appears to be more consistent in quantifying the degree of steatosis compared to SDCT.

### (R-137) Tuesday • 7:00–7:20 AM • E-poster, computer #7

#### Computed Tomography Urography (CTU) for Evaluation of asymptomatic Micro-hematuria. One more time: Is intravenous contrast administration (urogram phase) warranted for all patients?

L. Alexandre Frigini, MD, *Houston, TX*; Aaron Thomas, MD; Vincenzo K. Wong; Veronica V. Lenge de Rosen, MD; Rony Kampalath, MD (*lfrigini@bcm.edu*)

**PURPOSE:** CT Urography has been used in the evaluation of microhematuria and is very sensitive in identifying an etiology, however, a large number of cases are either negative or positive for a finding which could be diagnosed without intravenous contrast (i.e. urolithiasis). Many patients are pre-menopausal females and/or younger than 40 years of age. We aimed to evaluate claims that CT Urography may not be warranted in specific patient cohorts, in particular these young individuals without risk factors for urinary tract malignancy.

**METHOD AND MATERIALS:** We retrospectively reviewed 367 CT Urography (without and with contrast) exams performed between August 2013 and August 2014. Patients were classified according to age, sex (female patients were further categorized as pre or post-menopausal), and results of CT urography. Exams were classified as either negative or positive. Positive studies were categorized as benign or malignant etiologies.

**RESULTS:** Negative CTU: 266 Positive CT: 101 (97 benign and 4 malignant etiologies): Benign: 20 Bosniak type 1 or 2 cysts 4 Angiomyelolipomas 3 Nonspecific Bladder wall thickening/UTI/Cystitis 3 BPH 58 Nephrolithiasis Additional benign etiology (Benign bladder masses, stricture): 9 Malignant: 4 RCC: 3 Hodgkin's Lymphoma: 1 The majority of cases were negative 72.48%. 27.52% were positive (26.43% benign and 1.09% malignant). The patient age for the malignant etiologies ranged from 44 to 62 years old. Nephrolithiasis (15.8%) was the most common benign

**CONCLUSION:** The majority of CT urogram examinations were negative (almost 3/4). Of the positive studies, only 4 exams (1.09%) revealed a malignant etiology, none of which was an urotelial lesion, and the youngest patient was 44 years old. Of the benign etiologies, the majority of cases was due to urolithiasis which were diagnosed with the non-contrast portion of the CTU. We conclude that it is reasonable to evaluate microhematuria initially with a CT without IV contrast and if urolithiasis diagnosed, post contrast scans are felt to be unwarranted particularly in patients younger than 40 years of age.

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

(R-138) Wednesday • 7:50–8:10 AM •

E-poster, computer #2

### Structured R1 training program for learning abdominal CT protocols: A quality improvement project

Rosan Patel, MD, *University of Michigan, Ann Arbor, MI*; Janet E. Bailey, MD; Katherine E. Maturen, MD

**PURPOSE:** CT protocols in abdominal imaging have become increasingly complex and detailed, posing challenges to new residents. This important task has been identified as one of the ACGME milestones in diagnostic radiology. The goal of this quality improvement project was to create and evaluate a structured training method for first year radiology residents (R1's) learning to assign body CT protocols.

**METHOD AND MATERIALS:** 11 new R1's took a pre-test consisting of 10 questions: 4 regarding resident confidence and 6 knowledge-based questions. After a case-based interactive conference outlining the most common abdominal CT protocols, the same R1's were given an identical post-test one week later. 11 R2's, who were never given this lecture but had learned CT protocols on the job, also took the post-test.

**RESULTS:** After the intervention, R1's had increased confidence regarding protocoling on all four questions ( $p < .0005$ ). The number of residents correctly answering questions about where to find protocols ( $p = .0002$ ), steroid preps ( $p = .08$ ), oral contrast ( $p = .09$ ), bladder injury ( $p = .63$ ), and appendicitis ( $p = .67$ ) protocols increased on the post-test. Compared with R2's, post-test R1's had similar confidence and protocol knowledge.

**CONCLUSION:** A dedicated abdominal CT protocol training system improves the confidence of R1's. There were evident knowledge gains in several domains, though many were marginally significant or non-significant statistically, likely due to small number of participants. Protocol knowledge of these very early R1's was similar to R2's. These findings support the development of focused educational programming for CT protocoling.

## Cardiopulmonary Radiology

(R-139) Tuesday • 7:50–8:10 AM •

E-poster, computer #3

### The Subjectivity of the Wells' Criteria for Pulmonary Embolism

John Garrett, MD, MS, *Louisiana State University Health Science Center-Shreveport, Shreveport, LA*; Simon K. Long, MD; Aaron M. Bogart, DO; Jared Garrett, MD, MS; Guillermo Sangster, MD; Carlos Previgliano, MD; et al

**PURPOSE:** To determine whether an alternative or combination of clinical prediction rules to the 3-Tier Wells' Criteria (3TWC) can decrease unnecessarily irradiating patients deemed less-likely/low risk for pulmonary embolism (PE).

**METHOD AND MATERIALS:** This is a retrospective cohort study detailing the use of the 3TWC and resulting number of CT Pulmonary Angiograms (CTPA) performed with comparison made to the number of actual PEs diagnosed by CTPA. The cohort of 54 patients was obtained at a Level 1 Trauma Center who were risk stratified according to the 3TWC and underwent CTPA for suspected PE. Additionally, the cohort was theoretically analyzed with alternative clinical prediction rules, including the 2-Tier Wells' Criteria (2TWC), and the 2TWC combined with PE rule-out criteria (PERC), and results compared to the 3TWC results.

**RESULTS:** The Wells' score was provided for the 54 patients undergoing CTPA. Of these 54 patients, 39 had Wells' scores which utilized the subjective "PE is #1 diagnosis or equally likely" criteria in calculating the scores. In many of these patients, the d-dimer was deferred as the patient was deemed intermediate risk and the referring clinicians opted for CTPA. Four out of the 54 CTPA studies were positive for PE, while the remaining 50 studies were negative for PE, which yielded a detection rate of PE by CTPA below the national average. When the 2TWC model was applied to the cohort, 33 of the 50 negative patients would have been categorized as "PE Unlikely." Of these 33 patients, 24 had D-dimer ordered, of which 16 were negative. When a combination of the 2TWC model and PERC was applied to the cohort, 33 of the 50 negative patients were considered "low probability for PE". Of these 33 patients, 24 could have been ruled-out for PE as they satisfied the PERC.

**CONCLUSION:** For the study cohort, the percentage of CTPA detecting PE is below the national average. The subjective component of the 3TWC was shown to prominently influence the pursuance of additional imaging in PE workup. Employing either the 2TWC, or a combination of the 2TWC and PERC may decrease unnecessarily irradiating patients deemed low-risk/less-likely to have PE.

## Education of Medical Students, Residents, and Other

### Medical Students

#### (R-21) Tuesday • 7:00–8:15 AM • Hard-copy poster Early Radiology Exposure in the PreClinical Curriculum: Does It Increase Interest?

Michele Retrouvey, MD, *Eastern Virginia Medical School, Norfolk, VA*;  
Anthony P. Trace, MD, PhD; Craig Goodmurphy; Sarah Shaves, MD  
(*retroum@evms.edu*)

**PURPOSE:** With the significant decrease in the number of American medical students applying to Radiology in the last few years, recruitment into our field has become critical. Research has shown that early exposure to the field of Radiology increases interest in the field as a career. We developed an undergraduate medical radiology curriculum with the help of an RSNA Education Scholar grant and implemented it at our institution. We then surveyed our students to see if this exposure was accompanied by increased interest in pursuing a career in Radiology.

**METHOD AND MATERIALS:** The video lectures were integrated into the Anatomy curriculum during the fall of 2015 and were made available to 115 first year medical students at our institution. Before and after implementing the curriculum, the students were asked if they were considering pursuing a career in Radiology and the results were compared.

**RESULTS:** Before the implementation of the curriculum, 88% of medical students stated that they were not considering or unlikely to be considering a career in Radiology, while 3% were most likely going to pursue Radiology or were definitely going to pursue Radiology. After the implementation of the curriculum, 84% of medical students stated that they were not considering or unlikely to be considering a career in Radiology, while 7% were most likely going to pursue Radiology or were definitely going to pursue Radiology.

**CONCLUSION:** There was an increased interest in pursuing Radiology after the implementation of our curriculum; the percentage of students reporting that they were likely/definitely pursuing a career in Radiology more than doubled. Increased exposure to the field of Radiology early in the preclinical years also helped medical students decide whether or not a career as an imager was a good choice for them. Indeed, there was a significant curve deviation to the extremes, indicating that students who were unsure were more likely to make a decision after viewing the videos. Therefore, exposing students at an early stage in their medical education not only increases their interest in pursuing a career in Radiology, it also helps students solidify their career choice.

#### (R-22) Wednesday • 7:00–8:15 AM • Hard-copy poster Do Interventions Intended to Increase Female Medical Student Interest in Radiology Work?: Preliminary Findings

Elizabeth D. Yuan, BS, *University of Massachusetts Medical School, Worcester, MA*;  
Joseph Makris, MD;Carolynn M. DeBenedictis, MD  
(*cmdebene@gmail.com*)

**PURPOSE:** The purpose of this study is to share the preliminary findings after initiation of interventions at the medical school level to increase female interest in radiology at one institution and provide discussion to better future interventions.

**METHOD AND MATERIALS:** Interventions to increase medical student exposure to radiology were implemented at the University of Massachusetts Medical School in 2012. Radiology was incorporated into the preclinical curriculum; flexible clinical experiences stressing patient contact were created for early exposure to radiology during 3rd year clerkships; and faculty radiologists took on a greater role in medical student mentorship.

**RESULTS:** Our results suggest that these interventions may increase overall student interest in radiology but only minimally increase female interest. Since the start of the intervention, more male students have matched into radiology and chosen to take clinical radiology electives

compared to females. The greatest impact occurred when students had exposure to radiology in their first preclinical year. Overall enrollment of male medical students in clinical radiology electives was greater compared to than that of females (58% vs. 42%, respectively). Examination of current UMass faculty radiologists by gender demonstrates that the majority of faculty are male (72% vs. 25%). Female faculty radiologists are less likely to be of junior appointment than of senior appointment (11% vs.17%, respectively). Additionally, only 4% of full-time (i.e. 40 or more hours per week) female faculty are of junior appointment.

**CONCLUSION:** This article may be informative for radiology departments looking to increase female medical student interest. Our preliminary findings support integration of radiology topics into preclinical education. Additionally, radiology electives stressing patient contact are important for addressing medical students' misconception of lack of patient contact. Our data demonstrates that existence of electives alone is not enough. Required visibility of female radiologists and active publicity of female radiologists from the first preclinical year are likely to have the biggest impact in increasing female medical student interest.

#### (R-23) Tuesday • 7:00–8:15 AM • Hard-copy poster “Simulated Interpretation to Enhance Medical Student Radiology Clerkship”

Rebecca Schickman; Daniel Strauchler, MD; Jessica Rosenblum, MD;  
Mark Guelfguat, DO, *Jacobi Medical Center/Albert Einstein College of  
Medicine, Bronx, NY*

**PURPOSE:** The medical student radiology clerkship often involves attending lectures and passively observing radiologists. These rotations tend to lack active learning and student responsibility. This study is based on modifications of an earlier study that sought to enhance medical student radiology education by employing a simulation educational technique. The study also aimed to increase students' subjective confidence in their abilities to interpret chest radiographs and increase their interest in radiology.

**METHOD AND MATERIALS:** In the re-implemented study, all students received instruction on composing systematic reports of chest radiographs. Subsequently, the experimental group utilized the simulator to independently interpret radiographs, with feedback provided. Students' knowledge was measured using an audience response image based quiz, which was administered at the beginning and end of the rotation. Students' subjective experiences with the rotation were evaluated by online surveys administered prior to and at the end of the rotation. We modified the earlier study with the hope of increasing student participation and enhancing the educational value of the simulator. The quizzes were shortened and administered via an audience response system, rather than the students completing an online quiz during their free time. Labelled images were added to the feedback, which previously consisted only of a report describing the findings.

**RESULTS:** The preliminary objective test results were not statistically significantly different between the experimental (n=34) and control (n=21) groups (p=0.849). Additionally, subjective measures between the simulation and control groups were not statistically significant. Nevertheless, students provided positive free form feedback.

**CONCLUSION:** The simulation based training did not significantly improve results on an objective test or lead to higher scores on subjective measures. Nevertheless, students reported that they enjoyed the active learning aspect of the simulation exercise and audience response quizzes. As the study continues, accumulated data may provide more information regarding the effects of education effects of simulated educational techniques.

**(R-140) Tuesday • 7:25–7:45 AM •  
E-poster, computer #1  
UAB Medical Student Education in Radiology: A Retrospective Curriculum Evaluation**

Samuel J. Galgano, MD, *University of Alabama at Birmingham, Birmingham, AL*; Rachel Z. Bass, MD; Jessica G. Zarzour, MD; Michelle M. McNamara, MD (*samuelgalgano@uabmc.edu*)

**PURPOSE:** UAB medical student lecture content was revised in 2014 to increase AMSER and ACR content. The purpose of this study was to evaluate the effectiveness of UAB radiology medical student education through analysis of AMSER's Radiology ExamWeb pre-test and post-test scores.

**METHOD AND MATERIALS:** Retrospective review of pre-test and post-test scores on the Radiology ExamWeb test compiled from June 2011 to July 2016. Students missing pre-test or post-test scores were excluded from the analysis. Statistical analysis was performed utilizing an unpaired t test.

**RESULTS:** 268 students were included. 42 pursued a radiology residency while the remainder entered other residencies. The overall average pre-test score was 61.8% and post-test score was 85.8% ( $p < 0.0001$ ). After curriculum revision in 2014, there was an average improvement in pre-test to post-test scores of 28.2%, while the time period prior to this had an average score increase of 21.2% ( $p = 0.0014$ ). Students who pursued a residency in radiology demonstrated an average pre-test score of 70.0% and an average post-test score of 90.6%, compared to an average pre-test score of 60.3% and average post-test score of 84.9% in those students entering other fields ( $p < 0.0001$  and  $p = 0.010$ , respectively). However, the average increase in score did not demonstrate a statistically significant difference between future radiologists and non-radiologists (20.6% vs. 24.6%,  $p = 0.179$ ).

**CONCLUSION:** The analysis demonstrates statistical significance between pre-test and post-test scores, indicating that medical students show progressive learning on the rotation. Since 2014, there is a significant improvement for all students between the pre-test and post-test scores, supporting that recent curriculum changes have benefitted medical student education. While medical students pursuing a future residency in radiology demonstrated significantly higher pre-test and post-test scores, their average increase in score was not significantly different from those entering residencies in other fields. This is evidence that the radiology medical student rotation not only benefits the small subset of students pursuing a future in radiology, but all students who take the course.

**(R-141) Wednesday • 7:25–7:45 AM •  
E-poster, computer #3  
Introduction to the Profession: Lessons learned from an innovative introduction to Radiology**

Sarah L. Steenberg, MD; Mahan Mathur, MD, *Yale University School of Medicine, New Haven, CT* (*mahan.mathur@yale.edu*)

**PURPOSE:** As part of a new curriculum, 1st year Yale medical students start with a course entitled "Introduction to the Profession" which includes hospital immersion experiences. We aim to assess which educational tools implemented in the Radiology component of the new course are perceived by students as most effective.

**METHOD AND MATERIALS:** A total of 104 students, split into 4 groups, completed the course. The first 2 groups either listened to a lecture or visited reading rooms. Students then convened for an interventional radiology (IR) session, which included a video, case presentation, hands-on time with devices and a lecture on the future of IR. We concluded with a radiology panel. Students evaluated each session on a 5-point Likert Scale ranging from 1 (extremely poor) to 5 (excellent) and answered open-ended questions about the utility of these sessions. The remaining 2 groups either visited reading rooms or participated in an ultrasound (US) scanning workshop and participated in a radiology game show session. Students convened for an IR session and ended the day with a radiology panel. Evaluation forms were again completed.

**RESULTS:** Pooled data from the first 2 sessions demonstrated a response rate of 75%. The average score for the sessions ranged from 3.9-4.9. The lecture, reading room and radiology panel were the most useful sessions, while the IR cases and future of IR lecture was least useful. Students who attended the lecture wished to visit reading rooms. They also felt the future of IR session was rushed, above their level of training, and requested fewer lectures in the IR case lecture. Pooled data from the next 2 sessions demonstrated a response rate of 83%. The average score ranged from 4.0-4.9. The radiology panel, US scanning and the gameshow were rated as the most useful sessions. The IR video was perceived as least useful. Suggestions for improvement focused on allocating more time to each session.

**CONCLUSION:** In our evaluation of the radiology immersion experience for 1st year medical students, lectures, reading room time and a physician panel were most highly rated. These findings may influence future efforts to teach medical students about various specialties in their pre-clinical years.

**(R-155) Wednesday • 7:25–7:45 AM •  
E-poster, computer #2  
Integration of ACR Appropriateness Criteria into traditional medical student radiology education**

Chad Wilcox, MD, MA, *Columbia University Medical Center, New York, NY*; Pallavi S. Utukuri, MD; Dana J. Lin, MD (*chw9089@nyp.org*)

**PURPOSE:** With increasing implementation of Clinical Decision Support systems to improve proper utilization of imaging, it is important to increase awareness of the American College of Radiology (ACR) Appropriateness Criteria. Integrating educational approaches to the Criteria and emphasizing the collaborative nature of image ordering, interpretation, and reporting may contribute to career-long efforts to reduce unnecessary imaging. The purpose of this study is to determine whether didactic and interactive lectures based on ACR Appropriateness Criteria presented during a month-long radiology elective improve medical students' knowledge of appropriate radiology orders.

**METHOD AND MATERIALS:** During six 1-month radiology elective blocks, medical students participated in a multiple choice pre-test consisting of 25 clinical scenario questions based on the ACR Appropriateness Criteria. Within one week of the pre-test, students were given a formal lecture about ACR Appropriateness Criteria in various clinical scenarios. Following completion of an elective consisting of didactic lectures by radiology attendings and residents, workstation teaching, and interactive case presentations, students were administered the same multiple choice test. The average scores of the students at the beginning and end of the elective were recorded. The results were analyzed using a paired t-test.

**RESULTS:** A total of 41 medical students were enrolled in the elective, with 39 students completing the pre-test and post-test. The mean pre-test score was 43.6% and the mean post-test score was 65.7%, representing an improvement of 22 percentage points ( $p < .0005$ ).

**CONCLUSION:** Didactic material addressing the ACR Appropriateness Criteria is effective in improving students' knowledge of appropriate radiology orders in various clinical settings when provided alongside traditional didactic and case-based radiology education. Criteria-based lectures not only supplement traditional radiologic teaching, but also provide context that is useful for clinicians-in-training. By introducing the Criteria in medical school curricula, radiology education may become more relevant to the clinician and both awareness and utilization of the Criteria may increase.

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

## Residents

### (R-41) Tuesday • 7:00–8:15 AM • Hard-copy poster Fellowship Lecture Series by Current Fellowship Directors: A Pilot Study

Junjian Huang, *Pennsylvania Hospital, Philadelphia, PA*; Jeffrey Schneider, MD; Richard Scruggs; Dayna Levin, MD (*Junjian.Huang@uphs.upenn.edu*)

**PURPOSE:** The purpose of this paper is to assess current resident perceptions of the importance of certain fellowship selection factors as well as assess the value of a didactic lecture series on the fellowship selection process delivered by current fellowship directors.

**METHOD AND MATERIALS:** A pilot study was conducted in August 2016 at an urban hospital based residency program with no fellows. A 5-part questionnaire was administered to the current residents (n=20) prior to the start of the lecture series to gauge fellowship interest, comfort with current knowledge about the fellowship process, perceived trustworthiness of sources, and weighting of fellowship selection factors. Fellowship directors from the affiliated university program were asked to deliver fellowship oriented didactic lectures. The fellowship directors were all given a survey to assign weighting for the same fellowship selection factors. A post-lecture survey was given to the residents to evaluate the effect of the lecture series and gauge the overall satisfaction with the lecture series. Survey construction, data collection, and data analysis were performed utilizing QUALTRICS (Qualtrics, Provo, Utah).

**RESULTS:** There were a total of 15 respondents (75%) for the initial survey and 4 respondents (100%) for the fellowship director survey. Residents felt that fellowship directors in their field of interest were the most trustworthy source of information. Based on the surveys, residents overvalue the influence of having a connection and regional bias while underestimating the importance of scholarly activity, medical school performance and reputation. There was total of 16 respondents (80%) for the post-lecture survey. Overall, residents demonstrated increased confidence in their knowledge regarding the fellowship selection process and were mostly satisfied with the lecture series. Most indicated they would like for it to continue on a yearly basis.

**CONCLUSION:** A didactic lecture series bringing fellowship directors to give lectures to residents who otherwise would not have access to such opportunities is feasible and the results of this pilot study suggests that it is worthwhile and well received. A national survey assessing interest is underway.

### (R-42) Wednesday • 7:00–8:15 AM • Hard-copy poster Fellowship Director Lecture Series: Results from a National Survey of US Trainees

Junjian Huang, *Pennsylvania Hospital, Philadelphia, PA*; Jeffrey Schneider, MD; Richard Scruggs; Dayna Levin, MD (*Junjian.huang@uphs.upenn.edu*)

**PURPOSE:** To evaluate current radiology trainee perceptions regarding the fellowship selection process, survey their perceived level of preparedness and desire for a fellowship oriented lecture series.

**METHOD AND MATERIALS:** A 14 question survey designed in September of 2016 to query trainees on their perceptions of the fellowship selection process. Demographic information, gauge fellowship interest, comfort with current knowledge about the fellowship process, perceived trustworthiness of sources, weighting of fellowship selection factors, and interest in a didactic lecture series focused on fellowship selection. Survey construction, data collection, and data analysis were performed utilizing QUALTRICS (Qualtrics, Provo, Utah). The survey was approved and distributed by APCR on 9/15/16 to all APCR members (n=198) for distribution to their residents.

**RESULTS:** As of 10/1/16 there have been 338 respondents which accounts for roughly 5-10% of all US trainees. Actual respondent rate may be higher due to heterogeneous redistribution of surveys. Respondent demographics included 25% R1 (n=81), 27% R2 (n=89), 24% R3

(n=80) and 24% R4 (n=78). 98.8% are considering fellowship training (n=248) with 2 unsure and 1 not. All R4 respondents are going into fellowship (n= 78). The most popular fellowships are Body, IR, MSK, and Neuro (n=88, 86, 85, 77). The most reliable source is a fellowship director in the field of interest followed by fellows. The least reliable are online sources (journal articles, websites). The most important perceived factors were Performance during the interview, during residency, personal connection, and residency reputation while ABR inservice scores and undergraduate reputation were considered least important. 90.9% of R4 and 79% of R1-3 residents would be somewhat or extremely likely to attend a didactic lecture series with direct interaction with a Fellowship Director in their field of interest.

**CONCLUSION:** Almost all trainees are pursuant of fellowship training. Information about fellowship programs are ubiquitous but not created equal. There is high interest in a lecture series that can bring fellowship directors and interested residents together and should be pursued.

### (R-43) Tuesday • 7:00–8:15 AM • Hard-copy poster Utilizing Mobile Spaced Education to Enhance Radiology Resident Education

Meaghan A. Magarik, MD, *Vanderbilt University Medical Center, Nashville, TN*; Lori A. Deitte, MD; Asma Ahmad, MD (*Meaghan.magarik@vanderbilt.edu*)

**PURPOSE:** The purpose of this study was to implement a novel, web-based smartphone application to deliver case-based, spaced education to radiology residents. We hypothesize that the utilization of an institutionally developed web-based smartphone application to deliver short case-based multiple choice questions over time, will enhance radiology resident education and that residents will be highly satisfied with this modality for learning.

**METHOD AND MATERIALS:** We developed a pilot case-based spaced education course addressing diagnoses in radiology that are essential to resident education. This course was offered over three weeks. Most questions were image-based. Questions were developed and reviewed by subspecialty faculty members for accuracy. Each participant was given the option of receiving the questions by text message or email. We assessed learner participation and satisfaction by reviewing the question completion rate and a post-course survey.

**RESULTS:** The pilot course was offered to 32 radiology residents and involved the administration of 14 questions over a three-week time period. Thirteen of 32 residents preferred to receive questions via email, the remainder received questions via text message. The overall resident response rate for opening the questions was 85.5%. Of the 85.5% of residents who opened the questions, 15.1% viewed the question but did not answer the question. 70.4% of residents provided an answer to the questions. Overall, 80.6% of the questions were answered correctly and 19.4% were answered incorrectly. A post-course survey was administered to assess resident satisfaction, with a response rate of 56.3%. The majority of survey respondents (83%) reported feeling comfortable or very comfortable with the user interface.

**CONCLUSION:** A web-based smartphone application was used to pilot a case-based spaced education course in our radiology residency training program. Overall, residents were satisfied with the spaced education and the user interface. The resident participation rate was excellent.

### (R-44) Wednesday • 7:00–8:15 AM • Hard-copy poster Use of a multiplatform, web-based program for pre-call resident competency assessment

Nima Golchin, MD, *Medical University of South Carolina, Charleston, SC*; Caroline C. Swift, MD; Madelene C. Lewis, MD; Leonie Gordon, MBChB; Douglas H. Sheafor, MD\* (*sheafor@muscc.edu*)

**PURPOSE:** The purpose of this study was to evaluate the utility of an online interactive polling platform adapted for multiple choice pre-call testing of lower and upper level radiology residents.

**METHOD AND MATERIALS:** Using integrated features of a web-based polling program (PollEverywhere, San Francisco, USA), an image-based

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

multiple choice testing module was created including normal and abnormal emergency department cases corresponding to upper level (e.g., body CT and advanced neuroimaging) and lower level (e.g., plain film and ultrasound) resident call work distributions. The online system permitted simultaneous testing of registered radiology residents using individual laptop computers, tablet devices or smart phones. At test completion, scores were automatically generated with access to multiple online report formats. Data was exportable for detailed offline analysis. After grading, group and individual feedback was provided to all residents.

**RESULTS:** Upper level testing included the following case distribution: Body (14), Cardiac (3), Chest (3), Neuro (9), Nucs (3), MSK (1), Peds (5). Lower level testing included the following case distribution: Body (4), Chest (5), Neuro (16), MSK (16), Peds (11), US (8). On a 40 question exam, 8 PGY 3 residents scored an average of 81% (range 70-88%). For individual test questions, PGY 3 group average scores ranged from 0-100% correct (mean 81.13, standard deviation 21.46). On a 60 question exam, 8 PGY 2 residents scored an average of 77% (range 68-85%). For individual test questions, average PGY2 group average scores also ranged from 0-100% correct (mean 77.25, standard deviation 27.07). While automated grading required a paid user account, individual resident registration was free. Immediate score assessments readily allowed for general group-wide as well as individualized remediation.

**CONCLUSION:** Adaptation of an online interactive polling software platform to resident pre-call testing is feasible, and allows both automated grading and more advanced offline data analysis useful for individual and group remediation.

### AUR Trainee Prize: 2nd Place

#### (R-45) Tuesday • 7:00–8:15 AM • Hard-copy poster Gamification alters resident behavior more than didactic teaching alone

Karthik M. Sundaram, MD, PhD, *Vanderbilt University Medical Center, Nashville, TN*; Patrick M. Couture, MD; Meaghan A. Magarik, MD; Reed A. Omary, MD, MS; Edwin F. Donnelly, MD, PhD (*karthik.m.sundaram@vanderbilt.edu*)

**PURPOSE:** Successful learning requires the incorporation and the sustained application of the new information. To teach our residents on methods to increase professional engagement, we introduced competition through gaming, an educational method proven to increase motivation and engagement. Professional networking platforms (PNPs) with wide audiences such as Twitter offer new tools for healthcare providers to engage and exchange information with colleagues, trainees, patients, and communities. We tested the hypothesis that gamification of Twitter would increase resident networking and information exchange compared to didactic instruction alone.

**METHOD AND MATERIALS:** Radiology faculty provided didactic instruction to 2 different classes of DR residents (n=9 per class) on creating a professional Twitter account. One class later underwent a competition intervention where the number of followers, tweets, favorited tweets, and accounts followed were assigned point values. The winning resident would receive a cash prize. As a direct measure of engagement, we calculated each class's mean number of de novo tweets, impressions (# of times users saw each tweet), and engagements (# of times a user interacted with the tweet). Two-tailed, paired or 2-sample t-tests were performed,  $\alpha=0.05$ .

**RESULTS:** The workshop increased professional Twitter accounts from 0 at baseline to 18 total. Prior to the gamification intervention, the two classes had similar mean number of de novo tweets, impressions, and engagements. Three weeks after intervention, these values for the gamified class increased from 1.6 to 13.4 (p=0.028), 490 to 1518 (p=0.062), and 33.9 to 80.2 (p=0.077), respectively, while remaining relatively stable for the non-gamified class. Differences between classes were statistically significant (p < 0.05).

**CONCLUSION:** Gamification increases the professional engagement of DR residents with the PNP tool Twitter compared to didactic teach-

ing alone. Future studies should verify if gamification can be applied to other aspects of DR training to improve diagnostic acumen and knowledge base. Our study offers a teaching method for academic radiology departments to increase professional engagement of residents and faculty with PNPs.

#### (R-46) Wednesday • 7:00–8:15 AM • Hard-copy poster Gadolinium Contrast Reaction Rates: Using a Simple and Available Administrative tool to Educate a Department

Brenten L. Heeke, MD, *University of Alabama at Birmingham, Birmingham, AL*; Lisa M. Mabry, MD; Samuel J. Galgano, MD; Daniel Casson, MD; Desiree E. Morgan, MD\* (*dmorgan@uabmc.edu*)

**PURPOSE:** The purpose of our study was to educate UAB radiology residents and faculty on adverse reactions to gadolinium enhanced MR contrast media at our institution. We desired to create a simple, online resource to first test then educate residents and faculty about these reactions.

**METHOD AND MATERIALS:** As part of continual practice quality improvement at our institution, the rates of adverse reactions to gadolinium based contrast media (GBCM) are tracked and reviewed monthly. From a quality database of 99,147 patients who underwent GBCM enhanced MRI from July 2007 to April 2015, we summarized reactions according to ACR definitions and determined adverse and allergic-like reaction rates. We used MedHub, the healthcare educational platform already implemented at our institution, first to administer a short a quiz, and then to distribute a five slide presentation containing adverse reaction data to all radiology residents and faculty, followed by a post test. Notifications for each phase were sent via email, with an embedded link to MedHub. We compared the average pre and post test scores to evaluate increased knowledge of the group on the rates of GBCM reactions at our institution.

**RESULTS:** Prospective PQI database review of the 99,147 patients who underwent GBCM MRI from July 2007 to April 2015 showed a 0.47% rate (461 patients) of acute adverse reactions. The 461 reactions included 440 mild (95.4%), 16 moderate (3.5%), and 5 severe (1.1%). The most frequent adverse, nonallergic reaction was nausea with or without vomiting, occurring in 380 patients (82.4%, or 0.39% of the overall population). Treatment for the allergic like reactions was required in 14.4%. A total of 54 radiology residents and faculty completed the pretest, with an average score of 73.0%. Of these, 32 completed the posttest with an average score of 81.3%. The pretest score of these same 32 was 70.6%, a 10.7% increase.

**CONCLUSION:** The adverse reaction rate with GBCM is low but occurs numerous times per year at our institution. Using an online educational platform, we successfully educated the UAB radiology department on the adverse reaction rates at our institution.

#### (R-47) Tuesday • 7:00–8:15 AM • Hard-copy poster The ABR Noninterpretive Skills Guide: Are its Core Concepts Covered by a Popular Introductory Radiology Resident Textbook?

Mary J. Connell, MD; Andrew B. Rosenkrantz, MD\*; Alisha Nanda, *Maricopa Medical Center, Phoenix, AZ*; Scott Penny, MD; Albert Roh; Dane Van Tassel; et al (*Mary\_Connell@dmgaz.org*)

**PURPOSE:** The American Board of Radiology (ABR) Noninterpretive Skills Domain Specification & Resource Guide reflects general topics of importance to practicing radiologists and that residents are expected to know to pass the Noninterpretive Skills Module of the Core and Certifying ABR exams. We evaluated the extent to which the Noninterpretive Skills Guide's content is reflected in a popular introductory radiology resident textbook.

**METHOD AND MATERIALS:** A radiology residency program director selected 315 key terms to be searched, many suggested from the ABR Noninterpretive Skills Guide. The ABR guide and a popular resident textbook ("Fundamentals of Diagnostic Radiology" by Brant & Helms) were electronically searched for each of the selected terms. All identi-

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

fied instances of the searched terms were classified as “descriptive” (providing a definition, explanation, or other background for the term) or “non-descriptive” (mentions term without further commentary).

**RESULTS:** Of the 315 selected terms, 42.5% (134) appear in the ABR guide in both a descriptive and non-descriptive context. The ABR guide contains 28.6% (90) of the 315 terms in a descriptive context. Only 9.8% (31) of the selected key terms appeared at least once in the introductory radiology textbook, including both descriptive and non-descriptive contexts. Only 5.4% (17) of the terms had a descriptive usage. Common themes of terms that had descriptive usage were contrast agents (e.g., “extravasation”, “adverse reaction”) and imaging physics (e.g., “PACS”, “spatial resolution”). Themes of terms that were not identified in the textbook included: other aspects of quality and safety; process improvement; patient-centered care; professionalism and communication; bioethics; compliance, regulatory, and legal issues; health economics; imaging informatics; dose reduction; and biostatistics.

**CONCLUSION:** We have identified a potentially substantial gap in content between ABR-designated important noninterpretive skills for achieving certification vs. a popular introductory radiology residency textbook. Future editions of resident textbooks may expand the inclusion of noninterpretive skills content to ensure coverage of the identified areas of importance.

#### **(R-48) Wednesday • 7:00–8:15 AM • Hard-copy poster An electronic system for submitting and reviewing resident schedule requests increases resident satisfaction and residency program administrative efficiency**

Yashesh Shah, MD, *University of Michigan Hospitals, Ann Arbor, MI*; Tarun Jindal, MD; Janet E. Bailey, MD ([tjindal@med.umich.edu](mailto:tjindal@med.umich.edu))

**PURPOSE:** Submitting and managing schedule requests has historically been completed using a paper-based system containing inherent inefficiencies for both residents and program administrators. The purpose of this quality improvement effort was to improve scheduling efficiency and effectiveness by transitioning to a web-based format to improve ease of submission, reduce storage needs, and improve resident satisfaction.

**METHOD AND MATERIALS:** Through the use of online applications, the existing paper scheduling forms were converted to an electronic Google Form which automatically populated a Google spreadsheet optimized for efficient display of data to chief residents and program administrators to facilitate review, approval, and implementation of schedule requests. To evaluate the effectiveness of this paper-to-electronic change, current residents were administered a pre-implementation form measuring resident convenience and satisfaction with the paper-based system on a 5 point Likert-scale. During a phased roll out, a subset of residents were invited to submit scheduling requests via the new electronic system. This subset of residents were asked to complete a post-implementation form to assess convenience and satisfaction with the new web-based system. Program coordinators also reported their levels of satisfaction and perceived changes in efficiency before and after introduction of the electronic form.

**RESULTS:** Using a 5 point rating system, the convenience rating of request submissions increased from a mean of 3.52 (n=29) with the paper system to a mean of 4.82 (n=11) with the electronic system (p<0.005). Ease of off-site submission increased from 1.83 (n=29) with the paper system to a mean of 4.64 (n=11) with the electronic system (p<0.005). Overall resident satisfaction increased from a mean of 3.17 with the paper system to a mean of 4.64 with the electronic system (p<0.005). Program coordinators and chief residents uniformly self-reported an increase in workflow efficiency.

**CONCLUSION:** The use of electronic tools for resident scheduling requests leads to a significant increase in resident satisfaction and convenience ratings as well as improved workflow efficiency for chief residents and program administrators.

#### **(R-49) Tuesday • 7:00–8:15 AM • Hard-copy poster Cultivating Future Radiology Educators: Development and Implementation of a Clinician-Educator Track for Residents**

Dexter Mendoza, MD, *Emory University Hospital, Atlanta, GA*; David M. Theriot, MD; Ryan B. Peterson, MD, BS; Christopher P. Ho, MD; Deborah A. Baumgarten, MD, MPH; Peter A. Harri, MD; et al ([dmendo3@emory.edu](mailto:dmendo3@emory.edu))

**PURPOSE:** Exceptional clinical care, high-quality research, and transformative teaching are at the crux of academic radiology. Excelling in all three domains can be a demanding if not impossible undertaking for an individual. Highlighting the importance of dedicated and effective radiology educators, faculty clinician-educator (CE) tracks for promotion have become more common, and similar tracks have been described for residents. While our institution has a well-established resident research track, a similar pathway for education had not been instituted. Here, we discuss our experience with developing and implementing a CE track for radiology residents.

**METHOD AND MATERIALS:** We developed a longitudinal curriculum to be completed through the four years of radiology residency. The curriculum has three main components: 1) a small group series (SGS), an instructive forum with topics including learning theory and teaching techniques; 2) a teaching practicum, providing opportunities to teach; and 3) a required capstone project. In the pilot year, we instituted an application process open to interested rising second-year and third-year residents. Each resident was matched with a faculty mentor and was provided with protected academic time to attend the SGS and work on projects. We tracked each resident's progress and scholarly activities.

**RESULTS:** In the pilot year, we recruited seven residents. The residents reported a total of 35 academic activities, comprised of original research, conference presentations, quality improvement projects, curriculum development, and teaching activities. Curriculum development projects included implementation of a first-year radiology resident lecture series and development of a radiology curriculum for nurse practitioners (NPs) and physician assistants (PAs). Teaching activities included lectures provided to NPs and PAs, medical students, junior radiology residents, and residents from other subspecialties. Lectures provided by the residents are consistently rated well by learners.

**CONCLUSION:** Dedicated and effective educators play a critical role in ensuring the future of radiology. Clinician-educator tracks for residents may help inspire and cultivate future radiology educators.

#### **(R-50) Wednesday • 7:00–8:15 AM • Hard-copy poster The Current State of Radiology Call Assistant Triage Programs Among U.S. Radiology Residency Programs**

Jennifer Shaffer Ngo, MD, *Duke University Medical Center, Durham, NC*; Charles M. Maxfield, MD; Gary R. Schooler, MD ([jennifer.shaffer@duke.edu](mailto:jennifer.shaffer@duke.edu))

**PURPOSE:** To understand the prevalence and current state of various radiology call assistant triage programs among U.S. radiology residency programs.

**METHOD AND MATERIALS:** A survey was created using Qualtrics Survey Software and emailed to all members of the Association of Program Directors in Radiology (APDR) listserv. A total of 296 active members belong to this Listserv, including program directors and assistant program directors. The survey included questions regarding the existence of a call triage assistant program, the qualifications of the people who staff the program, reflections on the program's success, the barriers to success, and the responsibilities, hours, compensation, and training of the triage assistant.

**RESULTS:** Data was obtained from 87 active members of the APDR (29% response rate). Of those, 19 programs (21%) have a radiology call assistant triage program in place. Triage assistant staffing is variable and includes non-medical/clerical staff (n=11, 58%), medical students (n=6, 32%), first year radiology residents (n=1, 5%), and technologists (n=1, 5%). A significant majority (n=14, 74%) report that the

program works well and they have no plans to change. The remaining 26% (n= 5) of programs are considering changes such as program expansion and pay increases. No programs have plans to discontinue the triage assistant program. There is no significant difference in program satisfaction dependent on the type of staff hired. Furthermore, among residency programs without triage assistants, none had previously terminated a call assistant triage program. The most common reasons for not having triage assistants include cost, lack of awareness, differing opinions on utility, and the presence of 24/7 attending coverage.

**CONCLUSION:** A significant number of responding members of the APDR report having a call assistant triage program, and of those, all report satisfaction with the program and none plan on terminating the program. Radiology call assistant triage programs may represent an effective measure in limiting interruptions and thereby decreasing the risk of interpretative errors by residents on call.

### (R-51) Tuesday • 7:00–8:15 AM • Hard-copy poster A Model Process to Respond to Proposed Changes to ACGME Program Requirements by a Professional Organization

Syed M. Hussain, MD, MSc, *Monmouth Medical Center, Long Branch, NJ*; Robert Schiff, MD; Richard B. Ruchman, MD; M. Victoria Marx, MD; Martha B. Mainiero, MD; Lawrence P. Davis, MD; et al (*moinhussain@outlook.com*)

**PURPOSE:** The ACGME recently proposed changes to the program requirements for radiology residency which affect nearly all aspects of a radiology residency program. The APDR created a task-force to survey the APDR membership's opinion regarding the proposed changes and responded to the ACGME.

**METHOD AND MATERIALS:** A 27-question online survey soliciting opinion on proposed program requirements was made available to radiology residency program directors by the APDR office of communications. A total of 160 people responded, of which 148 completed the survey. Responses were recorded by a 5-point Likert scale, 3-point Likert scale or free-text responses.

**RESULTS:** A total of six requirements were chosen for the APDR response. The following were based on survey items that demonstrated disagreement with the ACGME proposals: (1) Time away from clinical responsibilities for Core examination preparation (IV.A.6.c) should be at the discretion of the program director. (2) Physics educational content must have an interactive component but not required to be delivered in-person (IV.A.3.e).(4).(b). (3) The provision which allows supervision of pediatric radiology education by a radiologist with a primary appointment elsewhere should be retained within the main program requirements (old (II.B.2.f).(1)). The following items were based on respondents' comments and free-text responses: (1) The 90% pass-rate requirement over the prior 3 years {(V.C.2.c).(1 & 2)} should be changed to 75% over the previous 5 years so as to not disadvantage smaller programs. (2) Program directors need not be full-time faculty; a more lenient stance should be adopted to include part-time faculty. (3) Radiology program directors should not be required to monitor incoming resident's PGY1 year.

**CONCLUSION:** Understanding the APDR membership's opinions was crucial in responding to the ACGME's proposed requirements. This presentation describes the streamlined process employed by the APDR to achieve that goal. The ACGME's reply to the APDR consensus report is still pending and is expected before the implementation of any requirement changes.

### (R-52) Wednesday • 7:00–8:15 AM • Hard-copy poster Use of Social Media Platform Twitter by Radiology Residency Programs and Departments

Edwin F. Donnelly, MD, PhD, *Vanderbilt University Medical Center, Nashville, TN*; Nolan J. Kagetsu, MD\* (*edwin.donnelly@vanderbilt.edu*)

**PURPOSE:** A large majority of applicants to radiology residency programs are from the "Millennial" generation. Because this generation

uses technology and social media much more than prior generations, one possible avenue for connecting with them is through Twitter. We sought to determine the current usage patterns of radiology residency programs on Twitter and to better characterize those patterns that tend to lead to success.

**METHOD AND MATERIALS:** Through Twitter searches it was determined which of the AMA-Frieda-registered diagnostic radiology residency programs had departmental, program or program-director Twitter accounts. For each account we determined the time since last tweet, number of Tweets, and Klout score. One departmental account and one residency program did not have Klout scores and were excluded from that part of the analysis. Klout score of 40 (the national average) was used as the cutoff for "success."

**RESULTS:** 21 radiology departments, 8 DR residency programs and 5 program directors had Twitter accounts. 6 of the top 10 programs (by Doximity rating) were part of a department with a Twitter account. No residency program account achieved a Klout score of 40, while 10 of 20 (50%) departmental accounts did. Residency program accounts had a Klout score range of 10 – 26, while departmental accounts ranged from 19 – 50. The mean Klout score of a department was 36.5 compared to 17.3 for a residency program ( $p < 0.000025$ ). The mean number of days since last tweet was 47.2 days for a departmental account vs. 537 days for a residency program account ( $p < 0.02$ ). 13 accounts had tweeted within the last two days, while all others had not tweeted in at least two weeks. No account that hadn't tweeted in the last two days had achieved a Klout score of 40. All but 2 that had tweeted in the last two days had a Klout score of 40 or more.

**CONCLUSION:** Currently, not many departments or residency programs are using Twitter. Those which would like to begin using Twitter will have the greatest likelihood of success by branding it at the departmental (not program) level and tweeting on a regular basis.

### (R-53) Tuesday • 7:00–8:15 AM • Hard-copy poster Radiology Residents Exam Performance Related to Medical School Attended. Does it Matter?

Hunter T. Christy, MD, *Louisiana State University Health Sciences Center, Shreveport, LA*; Daniel E. Adams, MD; Eugene P. Cicardo III; Angie M. White, BS; Gloria Caldito; Horacio R. D'Agostino, MD

**PURPOSE:** The purpose of our study focus on exam performance of radiology residents within an ACGME accredited residency program related to the medical schools they attended (US graduates, Caribbean Graduates, or International Medical Graduates [IMG]).

**METHOD AND MATERIALS:** This is a single institution ACGME radiology residency program graduates retrospective review of USMLE exam scores and first time board certification pass rates from 2001 to 2015. Inclusion criteria were resident matriculation during the given time period and recorded USMLE and board examination scores. Exclusion criteria were failure of the resident to matriculate and no recorded scores for USMLE and board examinations. Data collection was from the American Board of Radiology. Score distributions were grouped by exam and type of medical school attended (US, Caribbean, or IMG) and compared among the three cohorts. Statistical analysis for STEP scores was performed by one-way ANOVA, while Fisher's Exact Test analysis was used for first time pass rates of board certification exams. P values were set at 0.05 for both raw data sets.

**RESULTS:** A total of 47 residents were included in the study. US, Caribbean, and IMG graduates respectively contributing to the USMLE data were: step I (n=30), II (n=29), and III (n=21); step I, II, and III (n=7); step I and II (n=11), III (n=8). The variance between the USMLE STEP I, II, and III scores had calculated p values of 0.0002, 0.002, and 0.0004 respectively. US, Caribbean, and IMG graduates contributing to the board examination first time pass rates were: (n=33), (n=7), and (n=13) respectively. The variance between the board examination first time pass rate percentages for the three cohorts had the following calculated p values: physics  $p = 1$ , written  $p = .55$ , and oral  $p = 0.564$ .

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

**CONCLUSION:** The Caribbean medical school graduates reported higher average USMLE scores than US and IMG graduates. There was no relationship between pass/fail rates for radiology board certification examinations and where the residents attended medical school.

**(R-54) Wednesday • 7:00–8:15 AM • Hard-copy poster  
PACS-based On-Call ER Simulation: Preparing New  
Residents for Taking Independent Call**

Dzmitry Fursevich, MD, *Florida Hospital Orlando, Orlando, FL*; Kurt F. Scherer, MD; Laura W. Bancroft, MD\* ([dzmitry.fursevich.md@flhosp.org](mailto:dzmitry.fursevich.md@flhosp.org))

**PURPOSE:** Taking independent call for the first time can be challenging for radiology residents, and their reports may contain diagnostic errors, ineffectively communicate imaging findings and lack imaging recommendations. In our presentation we describe a PACS-based ER call simulation implemented at our institution to assess residents' diagnostic acuity, improve communication of imaging findings and improve resident readiness for independent call.

**METHOD AND MATERIALS:** A total of 75 cases representing all radiology subspecialties are selected by the attending radiologists for PACS-based simulation. Faculty select cases of low, average and high complexity that would be realistically seen in the emergency department. Cases are randomized, anonymized and uploaded into PACS. On the day of simulation, the cases are interpreted individually by each of R2 (PGY-3) year residents in our institution as if they were on-call. In addition to reporting the findings and formulating an impression, residents indicate whether findings are non-urgent, urgent or emergent, and make recommendations on follow-up imaging or subspecialty consultations. 2 weeks after completion of the simulation, the cases are discussed with the residents during a quality assurance (QA) conference with focus on the missed findings, quality of the reports and effective communication of the findings to clinicians. Resident and faculty surveys are administered before and after the simulation to assess resident readiness prior to taking independent call.

**RESULTS:** In general, residents at our institution view the PACS-based ER simulation favorably. Data from the surveys administered before and after the simulation will be available at the time of presentation.

**CONCLUSION:** Realistic PACS-based ER call simulation can be a valuable tool in assessing resident performance, improving the quality of resident preliminary reports and increasing resident readiness prior to taking ER call.

**(R-55) Tuesday • 7:00–8:15 AM • Hard-copy poster  
Livestreamed Lectures: A Cost-effective Way to In-  
crease Lecture Attendance**

LeAnn M. Shannon, MD, *Vanderbilt University Medical Center, Mount Juliet, TN*; Edwin F. Donnelly, MD, PhD ([Leann.m.shannon@vanderbilt.edu](mailto:Leann.m.shannon@vanderbilt.edu))

**PURPOSE:** Lectures and case conferences are an integral part of residency education. With residents often spread across various locations, leaving to attend these can cause a disturbance in workflow, leading many residents to forego lecture when on certain rotations and lose out on a key part of the residency experience. The purpose of this study was to assess if livestreaming resident lectures through Periscope, a free phone and tablet application, lead to an increase in lecture viewers.

**METHOD AND MATERIALS:** From September 2015 through September 2016, 276 resident lectures were given for the radiology department at Vanderbilt University, and 90 of those lectures were also live-streamed using the free Periscope application on a dedicated department tablet. All lectures used only de-identified images and cases for streaming. The number of residents who physically attended all lectures was collected via card reader, as well as the number that watched streamed lectures via Periscope. From this data, annual and monthly averages were calculated.

**RESULTS:** On average throughout the year, livestreaming a lecture increased viewership over three-fold. In total, 276 lectures were given

between September 2015 and September 2016. Of those, 90 lectures (32.6%) were streamed. When comparing the annual average in-person attendance of streamed versus non-streamed lectures, it was 11.0 and 11.3 respectively, demonstrating no loss of in-person lecture attendance with streaming. Average in-person lecture attendance for the year was 11.2, with monthly averages ranging from 6.9–18.8. The annual average number of remote viewers per streamed lecture was 29.4, with monthly averages from 7.6 to 89.8. The average combined total audience for streamed lectures throughout the year was 40.5.

**CONCLUSION:** Livestreaming lectures through Periscope lead to a large increase in lecture viewership. Streaming provides an accessible and cost-effective solution to workflow disruptions that may arise when residents are working at remote sites that would require increased travel time to and from lecture. Without the need for large infrastructure investments, lectures can be viewed off-site, using technology with which residents are already familiar.

**(R-142) Tuesday • 7:00–7:20 AM •  
E-poster, computer #1**

**Best Practices in Resident Development: Fourth Year  
Residents Managing Department Multidisciplinary Con-  
ferences as a Part of Their Transition to Independent  
Practice**

Nathan M. Coleman, MD, *Indiana University School of Medicine, Indianapolis, IN*; Vasantha D. Aaron; Nicholas A. Koontz, MD; Lindsey A. Shea, MD; Darel E. Heitkamp, MD; Aaron P. Kamer, MD ([apkamer@iupui.edu](mailto:apkamer@iupui.edu))

**PURPOSE:** This presentation shares our program's experience in transitioning 4th year residents to independent practice by enabling them to manage the radiology component of our institution's multidisciplinary conferences and tumor boards.

**METHOD AND MATERIALS:** Rising 4th year residents were issued a survey to best match them to our institution's various multidisciplinary conferences and tumor boards. They were assigned to the weekly conferences that matched well with their career goals. Each 4th year resident worked closely with the radiology faculty liaison supporting their assigned conference. Each week, they reviewed together the imaging studies of patients being shown at conference and devised imaging plans for each patient moving forward. Faculty liaisons attended all conferences with the 4th year residents to facilitate responses to complex clinical questions and to offer constructive feedback to the resident. Surveys were sent out to the 4th year residents early in the year to get feedback on the conferences and their performances.

**RESULTS:** Survey results of the first year of this program (2015–2016) showed that both residents and faculty believed it was a very worthwhile experience for transitioning to independent practice. Residents felt that the best learning aspects were interacting with subspecialty clinical faculty and better understanding the clinical management of patients. Survey results revealed that 100% of the residents participated in the multidisciplinary conferences throughout the year. The most significant barriers to participating in conferences were commuting to the downtown hospitals when rotating at offsite facilities and missing conferences when on vacation or night float. The most commonly reported difficulty of running the conferences was not receiving an updated patient list to review prior to the conference.

**CONCLUSION:** Enabling 4th year residents to run multidisciplinary conferences has been a key component to ensuring their stepwise transition to independent practice, an important ACGME curricular requirement. It helps the resident to build confidence in interacting with clinical faculty and encourages a multidisciplinary team approach to patient care.

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

**(R-143) Tuesday • 7:00–7:20 AM •  
E-poster, computer #3  
Current Status of Obstetric Ultrasound Education in  
Radiology Residency**

John McKay; Christine Dove, MD, *Nashville, TN*; Lucy Spalluto, MD

**PURPOSE:** The purpose of this study is to evaluate the current state of obstetric (OB) ultrasound education for radiology residents and to assess program director interest in supplemental education tools aimed to improve OB ultrasound education.

**METHOD AND MATERIALS:** Anonymous electronic surveys were sent to all radiology residency program directors (n=189) in the United States using email addresses obtained from the American Medical Association FRIEDA database. Demographic program information was obtained. Survey questions were designed to evaluate resident experience with OB ultrasound, to elicit perceptions of resident competence in OB ultrasound, and to assess interest in supplemental education tools.

**RESULTS:** Fifty-five of 189 recipients completed the survey, for a response rate of 29%. While OB ultrasound experience was variable among institutions, approximately one-half of institutions (52.1%) offered 2–4 weeks of OB ultrasound exposure per year, predominantly within the institution's radiology department (48%) or OB/GYN department (46%). The vast majority (94%) of programs provide exposure to first trimester pregnancy and complications during call/night time coverage. While most program directors feel residents at their program are adequately prepared for the OB ultrasound portion of the American Board of Radiology (ABR) Core Exam (71% agree or strongly agree), there was less agreement on adequacy of preparation for performing screening OB ultrasound beyond training into practice (35% agree or strongly agree). A majority (76%) of program directors felt that online supplemental educational tools, including online video lectures and question banks, would be useful for training radiology residents in OB ultrasound.

**CONCLUSION:** This preliminary research confirms the variability of OB ultrasound experience at radiology residency programs. While program directors indicate the quality and quantity of OB ultrasound experience is currently adequate for the ABR Core Exam, it may not be sufficient for performing screening OB ultrasound in practice. Online supplemental education tools targeted towards 2nd/3rd trimester ultrasound may be helpful to improve resident training in OB ultrasound.

**(R-144) Tuesday • 7:00–7:20 AM •  
E-poster, computer #4  
More than a report: Improving quality and adding value  
via interdisciplinary conferences**

Michael Furman, MD, MA, *Rhode Island Hospital/Alpert Medical School of Brown University, Providence, RI*; Michelle Tsang Mui Chung, Doctor of Medicine; Lillian Xiong, MD; Grayson Baird, MS; David W. Swenson, MD; Ana P. Lourenco, MD (*furman.m@gmail.com*)

**PURPOSE:** To compare perceptions of diagnostic imaging (DI) among internal medicine (IM) colleagues prior to and following introduction of an interdisciplinary conference at a teaching institution.

**METHOD AND MATERIALS:** IRB approved, HIPAA compliant survey of IM residents between 8/2015 and 3/2016. 41 of 90 (46%) completed the pre-survey, a baseline needs assessment; 29 (32%) completed the post-survey, a measure of post-intervention improvement. 3 DI residents met monthly with the IM department at hour long conferences. Cases were submitted by IM inpatient teams, and the imaging was reviewed by the DI residents. On average, 4–6 cases were discussed; part of each conference consisted of an open forum regarding any topics pertaining to imaging. Survey responses were matched using anonymous identifiers. Generalized mixed modeling assuming a binomial distribution was used to evaluate pre/post responses. Significance was .05 and interval estimates were calculated for 95% confidence.

**RESULTS:** Prior to intervention, 83% of residents believed active radiologist input on imaging findings on interesting cases would enhance

the discussion, and 76% reported a presentation on how to best provide clinical history would be helpful. 61% of residents reported they would speak with a radiologist about a patient; this increased to 69% after the intervention,  $p < .06$ . Likelihood of presenting to the reading room improved slightly between pre/post program;  $p > .05$ . These results are expected, however, given that pre-intervention responses were very positive (above 75%); there was little room for improvement (ceiling effect). 29/29 (100%) wanted the program continued. Our pre-intervention survey results outlined the need clinicians feel for improved quantity and quality access to radiologists. Our intervention was a response to that need, and the unanimous request among survey respondents to continue the interdisciplinary conference reflects a measure of its success.

**CONCLUSION:** Radiologists must demonstrate value in healthcare by proving to be vital and accessible consultants. It is critical to teach trainees the value of interdisciplinary conferences. Our method of survey and intervention can be replicated in different teaching institutions.

**AUR Trainee Prize: 3rd Place**

**(R-145) Tuesday • 7:25–7:45 AM •  
E-poster, computer #2  
Keeping pace with the exam of the future: Development  
and benefits of a biweekly low-stakes quiz competition  
for radiology resident learning**

Shanna Matalon, MD, *Brigham and Women's Hospital, Boston, MA*; Oren Johnson, MD; Glenn C. Gaviola, MD (*smatalon@partners.org*)

**PURPOSE:** To better prepare residents for the ABR Core Exam by improving retention of information taught during noon conference with the introduction of a "low-stakes" multiple-choice quiz competition. The quizzes are based on topics taught during noon conference.

**METHOD AND MATERIALS:** Randomly formed teams of residents compete by answering biweekly multiple-choice quizzes. 4th year resident involvement is optional, as they have already completed their boards. Team scores are available on an online dashboard to spark healthy competition and participation. At the completion of the intervention period, a final exam will be given. Quiz and final exam scores will be tallied and the winning team and the 4th year with the most participation will be awarded an extra vacation day. For randomization, only topics taught on odd-calendar days are included in the biweekly quizzes, while topics from even-calendar days will be used as the control, given only in the final exam at the end of the intervention.

**RESULTS:** The primary endpoint is higher scores on the final exam for quizzed topics compared to non-quizzed topics. Secondary endpoints include improved conference attendance and improved attitudes in the utility of noon conference for learning. A qualitative survey will be provided before and after the intervention, including preferred learning styles and attitudes towards the current noon conference system. Conference attendance before and after the intervention will also be reported.

**CONCLUSION:** With the ABR's recent transition to a multiple-choice based exam, the time is ripe to enhance residency curriculum. We believe that "low-stakes" quizzing is a reproducible intervention to conduct within a residency program. Through repetitive quizzing, residents will improve retention of material and be better prepared for the ABR core examination. Secondly, we believe that friendly competition results in better resident engagement and improved conference attendance. Survey results and quiz performance will be presented to determine the validity of our hypotheses. The details of program development and implementation will be presented as a framework that can be emulated.

**(R-146) Tuesday • 7:50–8:10 AM •**

**E-poster, computer #1**

**Interactive Trainee Education: Using MIRC Radiology Teaching File to Facilitate a Flipped Classroom Monthly Conference**

Crystal C. Wang; Hansel J. Otero, MD, *Tufts Medical Center, Boston, MA*; Jason Tsai, MD (*hanselotero@gmail.com*)

**PURPOSE:** To describe the introduction of a flipped classroom conference using RSNA's MIRC teaching file software to store and present conference cases.

**METHOD AND MATERIALS:** We present a curriculum in which radiology residents and fellows are given background reading on a specific pediatric radiology topic each month and are instructed to add 2 teaching cases on the topic to a shared radiology teaching file. Monthly conferences moderated by a faculty member are held in which each trainee presents their teaching file cases to each other, facilitating a flipped classroom setting. The teaching files, compiled in RSNA's MIRC software (or MyPACS), consist of noteworthy images from cases accompanied by patient history, diagnosis, image findings, differential diagnoses, and discussion, authored by trainees.

**RESULTS:** The teaching file flipped classroom conference gives trainees the opportunity to teach others in a more structured format than the traditional "interesting case conference," engaging students in self-study and encouraging peer review and cooperation, while simultaneously generating a sustainable deposit of noteworthy cases that can be referenced for study. It also allows the moderating faculty to teach a topic of preference without the burden of preparing the material him/herself.

**CONCLUSION:** Interactive flipped classrooms supported by a teaching file platform may be an effective supplement to didactic lectures and individual study.

**(R-147) Wednesday • 7:00–7:20 AM •**

**E-poster, computer #2**

**Cloud based learning portfolio utilizing Google Drive: simplifying the way trainee records are maintained**

Eric Royston, DO, MPH, *Tripler Army Medical Center, Honolulu, HI*; Kevin Nakamura, MD; Yang-en Kao, MD

**PURPOSE:** We present a no-cost, cloud-based method of satisfying the ACGME mandated learning portfolio, utilizing Google Drive. Our goal is to compare our electronic method with other well-established practices (traditional paper charts, paid electronic format, etc), and highlight the strengths and weaknesses of our system.

**METHOD AND MATERIALS:** Utilizing a master Google Drive account, our program has set up individual electronic learning portfolios for each resident. By leveraging Drive's organic sharing features, each resident's learning portfolio will be accessible by the program coordinator, program director and the individual trainee. The basic learning portfolio structure is based on the original 6 core competencies, as detailed below: I. Common Files. A. Resident Handbook. B. Life curriculum attendance. C. ACR economics lecture attendance. II. Interpersonal & Communication Skills. A. Individual year end evaluations by peers and faculty. B. Individual evaluations per rotation. III. Medical Knowledge. A. Course certificates: AIRP etc. B. ACR In-training exam results. C. ABR Core result. IV. Patient Care. A. Case Log. B. I-131 therapies: 3 low dose & 3 high dose. C. Mammogram requirement: 240 mammograms within 6 month period during last 2 years. D. Call miss rate data. V. Practice Based Learning and Improvement. A. Individual Learning Plan. B. Annual resident lecture topic. VI. Professionalism. A. HIPAA. B. BLS. C. State license. D. Military training. VII. Systems Based Practice. A. QI Project. VIII. Scholarly Activity. A. Publications. B. Presentations. C. Ongoing research. We will research other institutional learning portfolio implementations and compare them to our Google Drive learning portfolio in terms of cost, accessibility, and attempt to predict feasibility of long term use.

**RESULTS:** Evaluation of other programs being utilized is under review and pending further evaluation for adequate comparison to our Google Drive method.

**CONCLUSION:** A Google Drive learning portfolio not only allows for a simple method for tracking and maintenance by the resident and the program, but also is cost effective (free) and enables the resident to access the learning portfolio at any point in the future.

**(R-148) Wednesday • 7:00–7:20 AM •**

**E-poster, computer #3**

**Taking Back the Night: Impact of Adding Overnight Faculty Coverage**

Roberto R. Galuppo Monticelli, MD, *University of Kentucky, Lexington, KY*; Alfred Ferro; David J. Nickels, MD, MBA (*rga228@uky.edu*)

**PURPOSE:** We have had increasing pressure to have more faculty coverage after hours and 24/7 in-house faculty coverage was implemented since July 2015. Prior to this change, we only had residents in-house after midnight. We wanted to evaluate the impact this change has had. We felt there would likely be positive changes in patient care but we were also interested in evaluating possible negative impacts to resident education.

**METHOD AND MATERIALS:** The study met our Institutional Review Boards exempt criteria as a retrospective review of data. We pulled data for a three month period both before and after our faculty coverage changes. We used the same three month period from each year to help limit seasonal changes we experience with more ER trauma volume during the warmer months. Since our faculty coverage impacted both Emergency patient and Inpatient volumes we looked at both areas. We chose to focus on three main data elements, "call backs", turn around times (TAT) and resident volumes. All this data was processed and analyzed.

**RESULTS:** The data demonstrated a significant improvement in both the number of "call backs" and in the overall final read TAT. We demonstrated a significantly improved TAT with both emergency patient and inpatient exams. Unfortunately, resident volumes decreased during this same time period even though overall radiology volume slightly increased. Several figures are presented with the results.

**CONCLUSION:** Implementing overnight in-house faculty coverage for ER and STAT inpatient exam coverage was a success for improved patient care at our institution, and satisfied requesting physicians in the Emergency Medicine and Surgery Departments with significantly faster final read TAT and reduced number of call backs. Unfortunately, adding faculty coverage, while good for patient care, does impact the valuable independent experience that residents were getting on their after hours rotation. Residents do get better immediate feedback and teaching, but there is a negative impact with reduced volumes. This study will allow us to continue improving our after hours patient care and to look for ways to improve resident education.

**(R-149) Wednesday • 7:25–7:45 AM •**

**E-poster, computer #1**

**Resident Opinions Regarding 24/7 In-house Faculty Coverage: One Academic Radiology Department's Experience**

Frederick G. Joachim III, MD; Jennifer L. Mulkerin, MD; Margaret H. Mulligan, PhD, MS, *Medical College of Wisconsin, Milwaukee, WI*; Melissa M. Wein, MD (*mwein@mcw.edu*)

**PURPOSE:** The purpose of our study is to survey resident attitudes and opinions in advance of the transition to 24/7 in-house faculty coverage.

**METHOD AND MATERIALS:** Our thirty-two Diagnostic Radiology residents were invited by email to respond to an anonymous online survey in advance of changes to overnight call occurring as a result of a new hospital requirement for 24/7 in-house faculty. The survey consisted of eleven single answer questions regarding the resident year of training, opinions on the location of in-house staff working overnight, and questions related to the anticipated effects of the new in-house faculty coverage on resident education and patient care. Two free answer questions allowed for residents to provide any positive or negative effects the new faculty coverage would have on resident education and patient care.

**RESULTS:** The majority of the respondents to the anonymous online survey were in their 2nd and 3rd year of Diagnostic Radiology training with each of these classes having a 100% response rate. The remainder of the surveys were completed by the residents in their first and last years of training with each class having 5 of 8 trainees respond. Overall, 26 of 32 (81%) of residents completed the survey. While the majority of respondents predicted that the overall volume of cases that they would primarily interpret would decrease (85%), they were hopeful that there would be increased one-on-one teaching at the workstation (62%) compared to the current system. The residents were evenly split concerning the effect 24/7 in-house faculty coverage would have on the development of independent and autonomous decision making.

**CONCLUSION:** As more academic radiology programs move to a 24/7 in-house faculty call coverage model, it is vital that we as academic faculty be cognizant of the potential effects on resident education. The initial survey of our residents clarified opinions and predictions related to case volumes, independent case interpretation and teaching at the workstation. Using these survey results, as well as anticipated follow-up surveys, will guide the development of overnight call practices to optimize resident education.

## Other

### (R-29) Tuesday • 7:00–8:15 AM • Hard-copy poster A Critical Evaluation of Radiology Residency Program Websites

David R. Hansberry, MD, PhD, *Thomas Jefferson University Hospitals, Philadelphia, PA*; Jonathan Bornstein; Sandeep Deshmukh, MD; Suzanne S. Long, MD ([david.hansberry@jefferson.edu](mailto:david.hansberry@jefferson.edu))

**PURPOSE:** When prospective radiology residents are deciding where to apply to residency, many will use the Internet as a resource to garner information. Therefore, it is important for residency programs to produce and maintain an informative and comprehensive website. Here, we review 179 radiology residency program websites for 19 criteria including various aspects related to the residency application process, incentives, didactics, research, clinical training, and faculty leadership.

**METHOD AND MATERIALS:** 179 radiology residency program websites were evaluated for the inclusion of 19 different criteria. Criteria for information not available directly on the website and links with no information were considered not present.

**RESULTS:** Only 12 of the 179 (6.7%) program websites had at least 80% of the 19 criteria. 41 programs (23%) had less than 50% of the criteria listed on their websites. Websites ranged from having 16% of the criteria to as much as 95%. Of the 179 programs, the following criteria was present: 89% facility description, 88% contact email, 83% on academic courses such as AIRP or physics, 78% current residents, 69% benefits, 66% information on surrounding area, 65% past research projects, 63% comprehensive faculty listing, 62% rotation schedule, 61% call schedule, 59% research description, 57% link to ERAS, 55% fellowship placement, 51% salary, 46% message from program director, 42% message from chairperson, 40% meal allowance, 37% selection criteria, and 36% parking.

**CONCLUSION:** While previous studies have shown that prospective radiology resident applicants are influenced by intangibles like current resident satisfaction and academic reputation, they have also shown that applicants are influenced by the educational curriculum, clinical training, program resources, research opportunities and quality of faculty. Therefore, it is imperative to provide online resources for prospective candidates in an attempt for residency programs to remain competitive in attracting US medical student graduates; as in more recent years, there has been a decrease in US medical student applications to radiology.

### (R-30) Wednesday • 7:00–8:15 AM • Hard-copy poster High value practice and professional development: Senior resident consultation service for radiology exam selection

Elizabeth Snyder, *Johns Hopkins Hospital, Baltimore, MD*; Elie Portnoy; Karen M. Horton, MD; Pamela T. Johnson, MD\* ([esnyde17@jhmi.edu](mailto:esnyde17@jhmi.edu))

**PURPOSE:** The role of the radiologist as a consultant to the ordering physician has never been more crucial. Given the complexity of diagnostic radiology exams and increasing concern by the public and the profession to reduce unnecessary testing and to decrease radiation exposure, it is now imperative that radiologists ensure appropriate use of diagnostic imaging. In response to these developments, a radiology resident-lead consulting phone service was implemented in our institution.

**METHOD AND MATERIALS:** A fourth year radiology resident (PGY-5) carried a consult phone Monday through Friday from July 2015 to September 2016. Each received call was recorded, and note was made of the caller, the patient's diagnosis, the clinical question and the resident's recommendation. The call log was reviewed to determine whether the interaction resulted in recommending the best exam, advising use of a more appropriate exam, selection of best protocol or avoidance of unnecessary imaging.

**RESULTS:** A total of 219 calls for consults were received during this interval. The resident's consultation resulted in clarification of the most appropriate imaging test for the clinical situation in 54% of cases, followed by selection of the most appropriate imaging protocol in 30%. In 10% of cases after consultation with the radiology resident the conclusion was that no imaging was indicated. The most common clinical scenarios were neurological complaints (9%) and joint pain (5%). Most protocol questions were related to MRI (52%) and CT (33%).

**CONCLUSION:** Given the wide-range of clinical scenarios referring physicians may encounter, direct physician-radiologist consultation is still essential for providing appropriate patient care. A resident-lead consulting telephone service is a feasible endeavor, which has been demonstrated to affect patient management, minimize inappropriate imaging and therefore reduce unnecessary radiation and cost. Furthermore, serving as a consultant to referring clinicians is an important aspect of the radiology resident's professional development.

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

## Health Services for Radiology

### (R-56) Wednesday • 7:00–8:15 AM • Hard-copy poster Build It—But Will They Come?

Amna A. Ajam, MD, MBBS, *Ohio State Medical Center, Columbus, OH*; Xuan V. Nguyen, MD, PhD; Ronda Kelly, BS, RT(R); Elvira V. Lang, MD\*

**PURPOSE:** New expansions of medical centers and associated imaging facilities may lead to concerns that capacity in MRI is starting to exceed demand in some urban centers. This study was undertaken to assess how the addition of new outpatient capacity would affect volume and distribution of patient MRI visits among the MRI imaging sites.

**METHOD AND MATERIALS:** Total MRI visits were tracked in a 10-site university-affiliated hospital system before and after addition of a state-of-the-art cancer center with 3 additional MRI scanners, for a total of 17 scanners. At the time of opening of the new facility, one of the major competitors in town opened a neuroscience center with additional MRI capacity.

**RESULTS:** After an initial increase in system-wide quarterly MRI visits from 9559 to 10,935 visits after opening of the new facility, a system-wide gradual decline ensued over the next 3 quarters to a quarterly volume of 10,338. When comparing sites, visits to the newest site decreased from the peak by 31%, as they did for another modern campus site (71%). Volume increased at the oldest hospital site over the same period by 54%, was stable at 4 satellite imaging sites, and declined by an average of 16% at 3 other outlying sites.

**CONCLUSION:** New MRI capacity may add increased volume. An initial rise in study volume may be due to accommodation of previously accumulated clinical demand in combination with attraction of new associated medical services. A leveling-off may then be expected as changes in clinical demand and external competition negatively impact volume retention. However, when additional capacity is created, patient visits are not necessarily highest at the newest facility.

### (R-57) Tuesday • 7:00–8:15 AM • Hard-copy poster Peer Review in Clinical Radiology Practice and Associated Legal Liability

Karen Clark, MD, *Yale-New Haven Hospital, New Haven, CT*; Howard P. Forman, MD; Jonathan Mezrich, MD

**PURPOSE:** Computerized peer review systems are used in clinical radiology to evaluate physician performance as well as to improve the quality of patient care. Unlike retrospective peer review, prospective peer review systems allow for double interpretation of active cases, which can affect patient care in real-time. The goal of the survey was to collect information regarding familiarity and use of computerized peer review systems and beliefs/concerns regarding the potential legal liability with respect to critical findings made during a prospective peer review.

**METHOD AND MATERIALS:** IRB exemption was obtained. A 10-question survey was distributed to members of the Association of Program Directors in Radiology and collected via SurveyMonkey platform from June 2016 – July 2016. The online survey settings ensured responses remained anonymous.

**RESULTS:** 39 responses were received. 80% of responders only have used retrospective peer review systems and 20% used both retrospective and prospective peer review systems in their career. Most (46%) were familiar with the latest ACR practice guidelines regarding reporting of critical findings and the majority of responders (59%) felt they were entirely responsible for informing referring provider of discrepant findings. 72% of responders did not know if their state's law currently insulates them from peer review liability. Few responders (5%) were very concerned about legal liability for peer review comments. The majority of responders (72%) never or rarely personally contact the treating physician about discrepant findings.

**CONCLUSION:** Although currently peer review is most commonly retrospective, moving towards using prospective peer review systems

(like other countries such as Canada have done) could positively affect the quality of patient care in real-time by identifying discrepant findings before the patient leaves the healthcare setting. Radiologists should be educated on their state's law regarding communication of discrepant findings made during peer review, as it may subject them to increased obligation and potential liability in certain situations.

### (R-58) Tuesday • 7:00–8:15 AM • Hard-copy poster Radiologist Variation in Addenda Rates to Radiology Reports

Ariadne K. DeSimone, MD, MPH, *Atlanta, GA*; Alex Chung, MD; Carson Wick, PhD; Srini Tridandapani, MD, PhD\*; Stephen F. Simoneaux, MD; Kimberly E. Applegate, MD, MS

**PURPOSE:** To evaluate differences in rates of addenda to radiology reports between individual radiologists, and by the time of day and patient location at imaging.

**METHOD AND MATERIALS:** Addenda to all reports from pediatric radiography (CR/DR) services from 1 hospital network between January 2011 and June 2015 were reviewed and used to calculate addenda rates. Individual radiologist, radiologist gender, time of day (normal work hours versus off-hours, defined as 5:00 p.m. to 8:00 a.m. and weekends), and patient location (emergency department versus inpatient versus outpatient) at imaging were recorded for each. The addenda rate was based on addenda frequency relative to the total number of radiographs interpreted. Analyses were performed using the Chi-square test for independence with  $\alpha = 0.05$ .

**RESULTS:** Addenda were made to 762 of 427,847 reports. The mean and median addenda rate of all 14 radiologists was 1.9 and 1.8 per 1,000 studies, respectively. The addenda rate varied significantly between individual radiologists, from 0.7 to 4.5 per 1,000 studies. The addenda rate of female radiologists was greater than that of male radiologists (2.2 versus 1.2 per 1,000 studies,  $p < 0.0001$ ). Addenda rates during normal work hours and off-hours were nearly equal (1.7 versus 1.8 per 1,000 studies) despite the much greater workload for the on-call radiologist. When analyzed by patient location at imaging, most addenda occurred if the patient was in the emergency department (5.0 per 1,000 studies), followed by outpatient setting (1.7 per 1,000 studies) and inpatient setting (1.0 per 1,000 studies), and this was statistically significant ( $p < 0.0001$ ).

**CONCLUSION:** There is significant variation in use of addenda between individual radiologists, and addenda are more common when the patient is in the emergency department. Better understanding of such differences may aid radiology departments in developing benchmarks, protocols, and report templates to standardize the use of addenda in an effort to correct errors, and improve documentation and communication.

### (R-59) Wednesday • 7:00–8:15 AM • Hard-copy poster Computed tomography of the paranasal sinuses should not be routinely performed to screen for occult fever in pediatric cancer patients

Cory M. Pfeifer, MD, *Phoenix Children's Hospital, Phoenix, AZ*

**PURPOSE:** The purpose of this study was to evaluate the role of routinely including CT of the paranasal sinuses in the diagnostic evaluation of fever without source in pediatric cancer patients.

**METHOD AND MATERIALS:** The first 20 consecutive CT scans of the paranasal sinuses among eligible pediatric cancer patients in the calendar year 2016 were evaluated. In order to meet study inclusion criteria, the patient must have initiated therapy for a known cancer, the reason for exam must have included the terms "fever without source" or "fever of unknown origin," and the CT scan of the paranasal sinuses must have been ordered in conjunction with a CT scan of the chest and/or CT scan of the abdomen/pelvis as part of a screening protocol. The results were compared to a control group comprised of the first 20 eligible consecutive pediatric patients of the calendar year 2016 to receive a maxillofacial CT to evaluate a traumatic injury. To meet inclusion criteria for the control group, the patient must not have previously received treatment for sinusitis and

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

must not have had any fracture of the facial bones or calvarium. Lund-Mackay scores were calculated for each patient, and chart reviews were performed to assess outcomes in diagnostic decision making.

**RESULTS:** The average age of the patients in the pediatric cancer group was 10.2 (95% CI: 8.85-11.58). The average Lund-Mackay score in the pediatric cancer group was 4.26 (95% CI: 3.14-5.39). These 20 CT scans comprised 37% of all paranasal sinus CT scans ordered over the timecourse. The average age of the patients in the control group was 7.94 (95% CI: 6.85-9.04). The average Lund-Mackay score in the control group was 5.42 (95% CI: 4.15-6.69). The findings in at least 2 of the cancer patients resulted in otolaryngology consults, both of which recommended no intervention. No sign of invasive fungal disease was uncovered.

**CONCLUSION:** Sinus mucosal thickening is similar in prevalence among the general pediatric population in comparison to pediatric cancer patients exhibiting occult fever. Given the unnecessary cost and radiation, CT scan of the paranasal sinus as a general screening tool should be avoided.

### (R-60) Tuesday • 7:00–8:15 AM • Hard-copy poster The 2015 Amtrak Philadelphia train derailment: a review of Temple University Hospital's emergency radiology response

Anup Bhattacharya, *Temple University School of Medicine, Philadelphia, PA*; Sarah Fenerty; Omer A. Awan, MD; Clifford J. Belden, MD, MS; Padmaja Jonnalagadda; Stephen Ling, MD; et al (*anup.bhattacharya@temple.edu*)

**PURPOSE:** The aim of this review is to assess a 712-bed tertiary care hospital's emergency radiology response following the 2015 Amtrak Philadelphia train derailment, which strained overall medical operations, and to investigate and improve upon the overall emergency radiology response to such a mass casualty event.

**METHOD AND MATERIALS:** A total of 83 patients with 360 ordered imaging tests presenting to Temple University Hospital's emergency department within a 12-hour time frame was included in this study. A retrospective PACS system review of timestamps corresponding to the following time parameters was conducted: exam ordered, scheduled, begun, completed, viewed by radiologist, marked read by radiologist, and finalized. These results will be compared to regular emergency department radiology operations outside of a mass casualty event.

**RESULTS:** A total of 170 injuries, with thoracic injury (41.8%) as the most common, was found on radiologic examination. Injuries were found in a total of 44 (53%) patients, with an average of 3.9 injuries per injured patient. Average time from train derailment to ordering of radiologic examinations in the emergency department was 202 minutes, from ordering to scheduling of exams was 9 minutes, from scheduling to beginning of exams was 54 minutes, from beginning to completion of exams was 72 minutes, from completion to viewing of exams by a radiologist was 185 minutes, from viewing to reading exams was 26 minutes, and from reading to finalization of reports was 89 minutes.

**CONCLUSION:** Mass casualty events like the one described here are known to strain emergency medical resources. The 2015 Amtrak Philadelphia train derailment was no exception, with nearly 3.5 hours passing between first reports of the injury and ordering of radiological examinations and nearly 7.5 hours passing between ordering of examinations and availability of the dictated final reports for clinicians to review and make appropriate recommendations for the care of these patients. The data also suggest that a new departmental plan in the event of a mass casualty event is needed.

### (R-61) Wednesday • 7:00–8:15 AM • Hard-copy poster Decreasing resident reporting errors by differentiating typed, dictated and templated text through the use of high contrast color coded reports

David R. Clifton, BS, *University of Virginia, Charlottesville, VA*; Brandi T. Nicholson, MD; Carrie M. Rochman, MD; William P. McCullough, MD\*; Michael Hanley, MD (*drc8b@virginia.edu*)

**PURPOSE:** A common complaint regarding resident dictations at our institution pertains to typographical mistakes within resident reports including spelling, grammatical and word choice errors. We sought to demonstrate that implementing a high contrast color coding scheme within report dictations, able to visually differentiate typed, dictated and templated text is a simple means of decreasing typographical errors by making the text most at risk for error more conspicuous and errors more easily recognized.

**METHOD AND MATERIALS:** Radiology residents at a large academic institution were split into two groups; one that already utilized color coding within their dictation reports (Control, N=8, 1st - 4th year residents) and one that did not (Experimental, N=14, 1st - 4th year residents). Attending radiologists at the same institution were asked to complete a 1-page online survey ([www.surveymonkey.com](http://www.surveymonkey.com)) made available on an easy to access, frequently used internal information website each time they final signed resident reports for a total of 5 weeks. Residents were instructed to remind the attending to complete the survey at each sign out. Surveys were collected for 2.5 weeks and then the experimental group was switched to color coded dictations with one-on-one education on how to utilize color coding. Surveys were collected for another 2.5 weeks (116 surveys). After 5 weeks all participating residents were surveyed ([www.surveymonkey.com](http://www.surveymonkey.com)) about their experience using color coded reporting dictations (22 surveys).

**RESULTS:** Data collected demonstrates decreased report error rate within the experimental group after implementation of color coded dictation reports for 1st - 4th year residents. Post project surveys demonstrated near universal acceptance of color coding among the sampled residents. Unforeseen benefits were discovered, including improved organization of notes taken during signout leading to more accurate changes prior to final submission and increased dictation speed.

**CONCLUSION:** Implementing high contrast color coding within dictations is a simple means of decreasing typographical and content errors within resident reports while also increasing resident dictation speed and improving the accuracy of report edits.

**(R-62) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Choosing Wisely®: The Importance of Cross-Departmental Collaboration for Reducing Low Value Practice**

Matthew D. Alvin, MD, MBA, *Johns Hopkins Hospital, Baltimore, MD*;  
Douglas T. Reh, MD; Deanna Saylor, MD, MHS; Pamela T. Johnson, MD\*

**PURPOSE:** Healthcare costs have garnered national attention over the past decade. Relative to radiology, between 20–40% of imaging procedures have been deemed unnecessary. Aligned with the ABIM Choosing Wisely® campaign and the ACR Appropriateness Criteria®, the Director of Appropriate Imaging created a Radiology Appropriateness Initiative, designed to reduce unnecessary imaging utilization, radiation risk, and costs. Interventions include tailoring clinical decision support software, leveraging our radiology senior resident consultant service, providing feedback to providers on ordering habits relative to peers, and educating medical students, residents, and faculty through high value curricula and CME. One key part of the initiative is cross-departmental collaboration by residency programs on quality improvement initiatives to create educational campaigns and analyze pre-/post-intervention data.

**METHOD AND MATERIALS:** The radiology department faculty/leadership identified the most overutilized imaging exams in our institution. Our radiology residency program director and chair invited all residency program directors and chairmen at our institution to collaborate on cross-departmental quality improvement initiatives to reduce inappropriate imaging. In collaboration with the otolaryngology and neurology department faculty/residents, lumbar spine MRI for uncomplicated low back pain, brain CT/MRI for chronic headache, non-neurologic syncope imaging, and sinus CT for acute uncomplicated rhinosinusitis were chosen as the initial targets.

**RESULTS:** Cross-departmental resident teams were formed to spearhead each individual diagnosis and to develop the interventions to reduce inappropriate imaging. Baseline data ordering practices have been collected for comparisons post-intervention implementation. The impact of reducing imaging overutilization will be assessed and quantified through imaging volume, radiation exposure, and charge data.

**CONCLUSION:** Reducing overutilization in imaging requires cross-departmental collaboration to ensure appropriate provider buy-in. Residency programs can align high value initiatives to engage residents and fellows in both multidisciplinary collaboration and quality improvement.

## Informatics

**(R-151) Tuesday • 7:50–8:10 AM •**  
**E-poster, computer #2**  
**Automated Suggestion of Descriptive Alternatives for Medical Eponyms in Radiology Reports**

Vishal Patel, MD, PhD, *University of California, Los Angeles, Los Angeles, CA*

**PURPOSE:** Eponyms represent a controversial but enduring component of the medical lexicon. Efforts to catalogue the corpus of medical eponyms have been previously undertaken, but because many such terms have no radiological relevance, we set out to assess the true distribution of eponym usage in reports produced by a modern academic radiology practice. In addition, given recent calls for the eradication of eponyms, we introduce an automated mechanism for suggesting descriptive alternatives.

**METHOD AND MATERIALS:** A list of medical eponyms was compiled by referencing medical dictionaries, anatomy texts, online compendia, and radiology subspecialty-specific review articles. All radiology reports issued at our academic center between July 1, 2015 and June 30, 2016 were searched for the presence of each eponym. The total number of reports containing each eponym was tallied, and each term was classified according to the taxonomy proposed by Aronson. An automated system was developed that queried the SNOMED CT database for each eponym and suggested an alternate descriptive term, if available.

**RESULTS:** The compiled list of eponyms contained 7899 entries, of which only 267 appeared in radiology reports. Of the 20 most frequently appearing eponyms, the most common classification was “anatomical or pathological structures” (8/20), with the remainder distributed amongst the other taxons. Within this group of 20 common eponyms, the automated system identified only 5 terms with descriptive equivalents in the SNOMED CT vocabulary. The 20 least frequently encountered eponyms consisted primarily of “diseases, disorders, or syndromes” (16/20), and within this group, acceptable alternatives were identified for 14 of the terms.

**CONCLUSION:** Alternative terms are rarely available for eponyms appearing frequently in radiology reports, and conversely, descriptive alternatives generally do exist for rarely-appearing eponyms. Global replacement of eponyms in radiology reporting may not be possible and is likely of questionable utility. Rather, targeted substitution of rare eponyms with the assistance of an automated system is likely to yield the greatest value in clarifying communications with referring providers and patients.

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

(R-152) Wednesday • 7:00–7:20 AM •

E-poster, computer #1

### Using Google Maps to Create an Easy-to-use Networking and Recruiting Platform for Trainees and Alumni

Jessica Smith; Hasaan Siddiqui, MD, *Indiana University School of Medicine, Indianapolis, IN*; Henry Chou, MD; Darel E. Heitkamp, MD; Lois A. Shuman; Brandon P. Brown, MD, MA ([brpbrown@iupui.edu](mailto:brpbrown@iupui.edu))

**PURPOSE:** This presentation demonstrates how to create an easy-to-use networking and recruiting tool for radiology trainees and alumni using free web-based resources.

**METHOD AND MATERIALS:** Microsoft Excel spreadsheets (Microsoft, Redmond, WA) were used to organize data regarding the graduates of each of the last six residency classes from our large midwest academic radiology residency program. For each graduate, the following data were collected: 1) first and last names, 2) year of residency graduation, 3) fellowship specialty, 4) name of fellowship institution, 5) name of current radiology group, 6) city and state of current radiology group, 7) website URL of current radiology group, 8) current email address, 9) link to a current online photo. Spreadsheets were then uploaded to Google Maps (Google, Mountain View, CA). Each of the six alumni classes appears as a different color pushpin on a single Google map of the United States, their exact locations on the map reflecting either their current fellowship locations (for fellows) or current job locations (for post-fellowship alumni). The interactive map allows users to select or deselect entire classes for simultaneous viewing on the map. It also allows users to select individuals to see their detailed information. Links to the Google alumni map were sent out to the six classes of alumni included in the map project, numerous alumni radiology recruiters in practice throughout the country, and the current residents and fellows at our institution.

**RESULTS:** In July 2016, the networking map went live. Feedback indicates that the map has been used for many networking and recruiting purposes including: (1) as a networking resource for current residents and fellows searching for potential fellowships and jobs, (2) as a recruiting resource for resident alumni to fill open positions in their radiology groups, (3) as a peer-to-peer resource for seeking specific information, often regarding best practices, (4) as a directory for alumni and current trainees to become acquainted or to stay in touch.

**CONCLUSION:** Sharing alumni information by way of Google Maps provides a no-cost interactive platform for networking and recruiting that any training program can easily employ.

## Interventional Radiology

### (R-69) Wednesday • 7:00–8:15 AM • Hard-copy poster Microwave Ablation of Osteoid Osteoma: Our Experience with a Novel Variation of a Proven Technique

Thomas W. Bowden, MD, *Mayo Clinic, Phoenix, AZ*; Scott W. Young, MD; J. Scott Kriegshauser, MD; Eric Huettl, MD; Rahmi Oklu, MD, PhD; Grace (Martha-Gracia) Knuttinen, MD, PhD ([bowden.thomas@mayo.edu](mailto:bowden.thomas@mayo.edu))

**PURPOSE:** Radiofrequency ablation (RFA) has become the standard treatment approach for osteoid osteomas (OO). However, RFA has limitations, particularly in tissues with poor conductivity (i.e. low water content) such as lung and bone. Microwave technology offers the ability to penetrate deeper and cause less collateral tissue damage, allowing for safer and more efficient thermal ablation of bone tumors such as OO. We retrospectively analyzed the efficacy and safety of this novel variant. Increased safety without decreased efficacy may potentially lead to the widespread use of microwave ablation (MWA) for treatment of OO and other bone tumors.

**METHOD AND MATERIALS:** Four patients (3 men, 1 woman; age range, 17–33 years) with characteristic OO by history and imaging appearance underwent CT fluoroscopy-guided MWA to treat OO between 6/2015 and 8/2016. All lesions were located in long bone cortex, including the femur (2), humerus (1) and tibia (1). Imaging modalities included radiographs, CT, MR, ultrasound and bone scans. Immediate complications related to MWA therapy, as well as efficacy and complications at short-term (1 month) and long-term (3-6 months) follow up were assessed.

**RESULTS:** All four patients successfully underwent CT-guided MWA and experienced no immediate or delayed complication, recurrence of OO or return of symptoms. No collateral tissue damage occurred, regardless of lesion size or depth from skin surface. Intra-procedural CT imaging revealed the electrode probe centered within the OO nidus. Multiple 30 second ablation cycles were performed at 30W: 4 cycles (2) or 6 cycles (1). One ablation was tailored (30 sec at 20W followed by three 30 sec cycles at 30W) and utilized hydrodissection. Patients were seen in IR clinic with resolution of symptoms.

**CONCLUSION:** Percutaneous microwave ablation for osteoid osteoma appears to be both safe and effective. No complications or lasting tissue damage occurred in our experience. MWA offers several advantages over RFA, including deeper and more efficient penetration with less collateral tissue damage. Although further investigation is needed, MWA offers new, improved opportunities in the treatment of bone tumors.

#### AUR Trainee Prize: 1st Place

### (R-70) Tuesday • 7:00–8:15 AM • Hard-copy poster Conventional CT vs. Quick-Check CT Fluoroscopy-Guided Lung Biopsy: A Comparison of Success, Efficiency, Complications, and Radiation Exposure

Maia VanDyke, BS, *University of Texas Southwestern, Dallas, TX*; Anil K. Pillai, MD; Jon A. Anderson, PhD; Yin Xi, MS; Ali Pirasteh, MD ([ali.pirasteh@phhs.org](mailto:ali.pirasteh@phhs.org))

**PURPOSE:** To compare the technical/histopathological success, efficiency, patient radiation exposure, and safety of lung biopsies utilizing quick-check computed tomography fluoroscopy (QCT) to those utilizing conventional computed tomography (CCT).

**METHOD AND MATERIALS:** All 229 CT-guided core lung biopsies in 2014 at two hospitals affiliated with the same academic institution were retrospectively reviewed. Hospital 1 utilized QCT to guide needle placement and Hospital 2 utilized CCT. A single team of nine interventional radiologists performed the biopsies at both hospitals. Hospital 1 was a training site for radiology residents who actively participated in the procedures while biopsies at Hospital 2 were performed by the staff radiologist. Outcomes were defined as success rate (technical and histopathologic), complications requiring hospitalization or intervention,

radiation exposure calculated by dose-length product (DLP), and biopsy duration. 64 patients were excluded due to non-standard protocol or missing information. The included 165 patient records were reviewed for potential confounders: age, gender, body mass index, inpatient procedures, lung disease, lesion size/type/distance from pleura, lesions in technically-challenging locations, coaxial needle size, and type of anesthesia. Data were adjusted for possible confounders by propensity score; p-values < 0.05 were considered significant.

**RESULTS:** Adjusting for different potential confounders, average patient radiation exposure was significantly lower in the QCT group than in the CCT group (respective DLPs of 31.2 vs. 368.4 mGy·cm,  $p < 0.001$ ). There were no differences in biopsy duration, success, or complication rates ( $p > 0.270$ ).

**CONCLUSION:** QCT-guided lung biopsies provide for significantly lower patient radiation exposure without compromising success, efficiency, or patient safety.

**(R-153) Tuesday • 7:00–7:20 AM • E-poster, computer #2  
Safety of Computed Tomographic-Guided Bone Marrow  
Biopsy in Obese Patients: A Retrospective Review of  
1,015 Bone Marrow Biopsies**

Bo Liu, MD, *Florida Hospital Orlando, Orlando, FL*; Joseph M. Limback, MD; Melissa Kendall; Jamil Armaly; Vincent Grekoski; Michael Valente; et al ([bo.liu.md@flhosp.org](mailto:bo.liu.md@flhosp.org))

**PURPOSE:** Bone marrow biopsy performed using physical landmarks can be challenging in patients with an elevated body mass index (BMI), with previous reports suggesting that obesity increases the risk for post-biopsy bleeding complications (1). The purpose of this retrospective review is to evaluate the safety of CT-guided bone marrow biopsy in obese patients, as defined as a body-mass-index (BMI) of 30 or greater.

Reference: 1. Bain BJ. Bone marrow biopsy morbidity and mortality. *Br J Haematol.* 2003;121(6):949-51.

**METHOD AND MATERIALS:** This single-center, institutional review board approved, retrospective study included CT-guided bone marrow biopsies performed between May 1, 2006 and May, 1 2016. The study population included 1,015 patients, mean age 57.7 (+/-15.2) years, 51.6% male, 48.4% female. 348 biopsies were performed in obese patients (BMI  $\geq 30$ ); 667 were performed in patients with BMI < 30. The electronic medical record for each biopsy was reviewed for 48 hours after each biopsy to identify procedural related hemorrhagic complications, SIR complication class C or above. The complication rates in obese patients were compared to patients with a BMI of 30 or lower. A 95% confidence interval was calculated for each group.

**RESULTS:** 0 biopsies resulted in a SIR class C or above complication, no interventions or transfusions were needed for procedural related bleeding. A single patient with BMI of 24.1 required a dressing change because of minimal bleeding at the needle entry site; this was self-limiting and no transfusion or intervention was required. There was no difference of complication rate (0%) based on BMI. For obese patients with a BMI of 30 or greater, the complication rate was 0% (95% CI: 0-1.3%).

**CONCLUSION:** CT-guided bone marrow biopsy in obese patients is safe, with a complication rate < 1.3%. An elevated patient BMI, which may increase the risk for a hemorrhagic complication when guidance is performed using physical landmarks alone, does not impact the safety of bone marrow biopsy performed under CT guidance.

**(R-154) Wednesday • 7:00–7:20 AM •  
E-poster, computer #4  
Preoperative CT-Guided Needle Localization of Benign  
and Malignant Soft Tissue Lesions for Surgical Excision:  
A Novel Synergy Between Radiology and Orthopedic  
Oncology**

Zachary Mikes, *Cooper University Hospital, Camden, NJ*; Jared Meshekow, MD, MPH; Gabriel Meshekow, MPH; Rohan Amin, MD; Jacinto Camarena III, MD; Douglas Tsai, MD; et al

**PURPOSE:** Active surveillance and surgical excision are the standard of treatment for malignant and symptomatic benign lesions involving the superficial and deep soft tissues. However, some lesions are difficult to isolate during dissection. We demonstrate the utility of CT-guided needle localization as an adjuvant to preoperative planning, a method that can obviate the need for wide surgical margins, burdened by preventable complications and postoperative morbidity.

**METHOD AND MATERIALS:** Soft tissue tumors are a large and heterogeneous group of neoplasms, which may arise from fibrous connective tissue, skeletal muscle, adipose tissue, vasculature, lymphatics, and/or the peripheral nervous system. While benign soft tissue lesions are common, malignant neoplasms and metastasis are atypical. Although surveillance is adequate for the majority of cases, surgical resection is sometimes required for malignant or symptomatic benign lesions. Surgery carries the inherent risk of morbidity as well as recurrence. Here, the authors present a series of preoperative CT-guided needle localizations for surgical resection of soft tissue tumors. All patients presented with clinical symptoms of a palpable mass, superficial skin changes, and/or pain. The presence of a soft tissue tumor was established and documented with contrast enhanced CT or MRI.

**RESULTS:** In each case, the soft tissue lesion was localized with CT, and hookwires (X-Reidy type) were sterilely placed within the center of the soft tissue lesion. Patients were subsequently sent to the operating room, and surgical excision was performed in all cases. Correlations to the size of the surgical margin as well as pathologic findings were subsequently reviewed. There were no acute or latent complications as a result of needle localization.

**CONCLUSION:** CT-guided needle localization is an applicable adjuvant for preoperative planning prior to resection of soft tissue tumors in select patients with appropriate anatomy and pathology.

## Musculoskeletal

### (R-80) Tuesday • 7:00–8:15 AM • Hard-copy poster Radiologic pattern of injuries following the 2015 Amtrak Philadelphia train derailment

Anup Bhattacharya, Temple University School of Medicine, Philadelphia, PA; Sarah Fenerty; Omer A. Awan, MD; Clifford J. Belden, MD, MS; Padmaja Jonnalagadda; Stephen Ling, MD; et al (*anup.bhattacharya@temple.edu*)

**PURPOSE:** The aim of this study is to describe the pattern of injuries that was encountered in the radiology department at Temple University Hospital following the 2015 Amtrak Philadelphia train derailment.

**METHOD AND MATERIALS:** A total of 83 patients with 360 ordered imaging tests presenting to a 712-bed tertiary care hospital's emergency department within a 12-hour time frame was included in this study. A retrospective PACS system review of their radiologic findings was evaluated for injuries consistent with trauma following the train derailment.

**RESULTS:** A total of 170 injuries was found on radiologic examination. Injuries were found in a total of 44 (53%) patients, with an average of 3.9 injuries per injured patient. Thoracic injury, much of which involved fractured and displaced ribs, was the most common type of injury suffered and accounted for 71 (41.8%) of the injuries. Next most common were injuries to the extremity (47, 27.7%), particularly lower extremity fractures or hematomas, followed by vertebral injuries (23, 13.5%), mostly to the transverse process. The two least common injuries were head injuries (15, 8.8%), mostly involving the supraorbital regions, and abdominal injuries (14, 8.2%), which involved the abdominal wall, flank, and peritoneal cavities.

**CONCLUSION:** A majority of patients with suspected injuries following the train derailment was found on radiologic imaging to have injury patterns consistent with trauma, with thoracic trauma involving fractured ribs as the most common type of injury suffered.

### (R-156) Tuesday • 7:25–7:45 AM • E-poster, computer #4 Ultrasound-Guided Microwave Ablation for the Management of Inguinal Neuralgia: Preliminary Results



Jessica M. Sin, MD, PhD, University of Wisconsin-Madison, Madison, WI; Priti Patil, MD; Carrie Adamany, RN; Kenneth Lee, MD\*

**PURPOSE:** Inguinal neuralgia is a known complication of inguinal and abdominal hernia repair. Treatment of chronic inguinal neuralgia can be challenging, with variable outcomes following conservative or surgical management. This preliminary study investigates the efficacy of ultrasound (US)-guided microwave ablation (MWA) of peripheral nerves as a new alternative treatment method for refractory inguinal neuralgia.

**METHOD AND MATERIALS:** IRB approval and informed consent were obtained for this study performed between August 2012 and August 2016. Prior to MWA, each patient underwent selective diagnostic US-guided nerve block with 2 ml of corticosteroid and anesthetic. Positive nerve blocks underwent MWA. US-guided MWA of either the ilioinguinal, iliohypogastric, or genitofemoral nerves was performed. Medical records and images from procedures MWA were reviewed. Pain was rated at baseline according to a visual analog scale (VAS) from 0 to 10. After MWA of the targeted nerve, VAS pain response was measured immediately post-ablation and at 1 month, 6 months, and 12 months post-ablation. Summary statistics were computed and a Wilcoxon signed rank test was used to test the null hypothesis that the pain reduction was zero.

**RESULTS:** 12 MWA procedures were performed in 10 patients (8 males and 2 females) with an average age of 41 years (range: 15 to 64 years). Baseline pain scores were compared to post-ablation pain scores at each time interval. Baseline pain scores ranged from 2 to 10, with a mean of 5.7. Pain scores for all 12 procedure sites were recorded im-

mediately after ablation, 11 sites at 1 month, 9 sites at 6 months, and 7 sites at 12 months post-ablation. At 1 month post-ablation, there was pain reduction in 82% of ablated sites (9/11,  $p = 0.0003$ ), and at 6 and 12 months post-ablation, pain was reduced in 78% (7/9,  $p = 0.0004$ ) and 86% (6/7,  $p=0.013$ ), respectively. No complications have been reported in the short or long term.

**CONCLUSION:** US-guided MWA is a new and effective technique for the management of chronic inguinal neuralgia, providing at least 12 months of pain relief in the majority of patients in this initial study. MWA may serve as a useful alternative to surgical neurotomy or radiofrequency ablation.

### (R-157) Wednesday • 7:50–8:10 AM • E-poster, computer #1 Radiographic Evaluation of Meniscal Extrusion

Behrad Golshani, BS, MD, UC Davis Medical Center, Sacramento, CA; Cyrus Bateni, MD; Saraporn Bamrungchart (*bgolshani@ucdavis.edu*)

**PURPOSE:** The meniscus provides increased surface area and allows for more uniform distribution of weight bearing forces. Meniscal injury is known to predispose to the progression of osteoarthritis. Magnetic resonance imaging (MRI) is well established as the preferred noninvasive tool for meniscal evaluation. Meniscal extrusion on MRI has also been described to have significant correlation with root tears. To our knowledge, there has been no study examining the utility of diagnosing meniscal extrusion from radiography alone. We hypothesize that with the appropriate window settings, an extruded meniscus may be identified.

**METHOD AND MATERIALS:** Our institutional review board approved this retrospective health insurance portability and accountability act (HIPAA) compliant study. We collected 190 patients with MRI of the knee performed within three months of knee radiography. Meniscal extrusion by MRI was defined as meniscal tissue extending 3mm or greater beyond the margin of the tibial plateau, excluding osteophytes. Two attending radiologists blindly and independently identified the absence or presence, in millimeters, of medial meniscal extrusion on radiograph. Kappa test was calculated to assess the extent of inter-reader agreement and correlation. Sensitivity and specificity were calculated based on the contingency table for each reader assuming the concurrent MRI served as the gold standard.

**RESULTS:** 96 patients had medial meniscal extrusion and 94 had no medial extrusion by MRI. For the detection of meniscal extrusion by radiograph, reader A had a sensitivity of 0.59 (95% CI 0.49-0.69) and a specificity of 0.88 (95% CI 0.79-0.94); reader B had a sensitivity of 0.61 (95% CI 0.51-0.71) and a specificity of 0.85 (95% CI 0.76-0.91). Kappa test for inter-reader agreement = 0.61.

**CONCLUSION:** There is substantial inter-reader agreement of meniscal extrusion measurement between readers. Our results also demonstrate high specificity for meniscal extrusion by radiograph. Such evaluation can be a quick adjunct to routine interpretation of knee radiographs and a positive finding may highlight meniscal pathology as a source of patient's symptoms, expediting further workup and imaging.

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

## Neuroradiology

### (R-84) Tuesday • 7:00–8:15 AM • Hard-copy poster Microthrombectomy for Recanalization of Distal Intracranial Vasculature: Smaller Tools for Smaller Vessels

Michael S. Achilleos, MD, *Baylor University Medical Center, Dallas, TX*; Kenneth F. Layton, MD (*michael.achilleos@bswhealth.org*)

**PURPOSE:** Mechanical thrombectomy has recently been shown to be an important adjunct in select patients with acute stroke. The first generations of thrombectomy devices require larger microcatheters for deployment, which could limit safe access to emboli in more distal branches, and studies using these devices have restricted their use to the internal carotid and proximal middle cerebral arteries. Newer stent retriever devices are now available which can be deployed through smaller microcatheters and have the potential to allow for intervention in more distal cerebral artery divisions.

**METHOD AND MATERIALS:** We review two patients who presented to our comprehensive stroke center and met eligibility criteria for intra-arterial therapy. The patients were a 72-year-old male and an 83-year-old female who presented with acute neurological deficits with thrombi extending into the M2 divisions of the middle cerebral arteries on CT angiography. The NIH stroke score fluctuated between 6-12 in the first patient and was 19 in the second. The patients were both ineligible for intravenous tPA therapy given other medical comorbidities and were taken to the angiography suite for attempted mechanical thrombectomy. Thrombectomy was attempted within the M2 divisions using a new stent retriever device (Mindframe Capture LP thrombectomy device [ev3 Neurovascular, Irvine, CA, USA]). A single operator performed both procedures.

**RESULTS:** On catheter angiography, thrombus was confirmed to be present within the M2 divisions of the middle cerebral arteries in both patients. These were successfully retrieved using the smaller stent retriever device with subsequent restoration of blood flow to the distal middle cerebral artery branches. Both patients experienced improvement in their neurological deficits and NIH stroke scores, which decreased to 1 and 11 respectively, and were subsequently discharged home after a short hospital stay.

**CONCLUSION:** These cases demonstrate the utility of these newer "microthrombectomy" devices for use in smaller intracranial vessels and highlight the potential for treating more stroke patients with clinically relevant distal emboli.

### (R-85) Wednesday • 7:00–8:15 AM • Hard-copy poster Comparing Imaging Qualities of Gadobutrol and Gadopentetate in the Abdomen

Albert Roh, *Maricopa Medical Center, Phoenix, AZ*; Juliana Liang; Cody R. Larson, MD; Dane Van Tassel; Mary J. Connell, MD; Dan G. Gridley, MD

**PURPOSE:** Different gadolinium-based contrast agents (GBCAs) are available for use in magnetic resonance imaging (MRI). Newer nonionic macrocyclic agents such as gadobutrol are more stable than older ionic linear agents such as gadopentetate, but their imaging qualities, especially in the abdomen, are not well documented.

**METHOD AND MATERIALS:** This study is a retrospective review of prospectively-collected data from 66 subjects who underwent a contrast-enhanced MRI of the abdomen in a 3T system. Randomization of subjects to receive either 1.0 M gadobutrol or 0.5M gadopentetate is performed. Signal-to-noise ratio (SNR) is calculated in arterial, venous, and delayed phases, using multiple regions of interest (ROIs) for both the signal and noise values. Signal ROIs include the suprarenal aorta, aorta at the level of the renal arteries, infrarenal aorta, inferior vena cava, and main portal vein. Noise ROIs include the psoas muscles, anterior abdominal wall subcutaneous fat, posterior abdominal wall subcutaneous fat, and intra-abdominal fat. Data is collected by two observers.

**RESULTS:** Regardless of phase of contrast and regions of interest for both the signal and noise values, there is no statistical difference in

signal-to-noise ratio between 1.0M gadobutrol and 0.5M gadopentetate in the abdomen at 3T field strength. Overall, interobserver agreement is best using the aorta at the level of the renal arteries as the signal ROI and the anterior abdominal wall subcutaneous fat as the noise ROI. Using these regions of interest, delayed phase interobserver agreement is better than those of venous and arterial phases (Pearson correlation coefficients of 0.781, 0.742, and 0.733 respectively).

**CONCLUSION:** Gadobutrol has comparable imaging quality to gadopentetate in the abdomen at 3T.

### (R-86) Tuesday • 7:00–8:15 AM • Hard-copy poster 3D Printed Ventriculostomy Simulator from CT Data to Aid in Training of External Ventricular Drain Placement

Craig Johnson, MD, *University of Utah Health Care, Salt Lake City, UT*; Justin A. Cramer, MD; Edward P. Quigley III, MD, PhD

**PURPOSE:** Our purpose in this study was to create a valuable, cost-effective training tool using realistic tissue characteristics for our neurosurgical colleagues to simulate external ventricular drain placement. This multidisciplinary collaboration was implemented in order to improve the competency and skill level relating to this procedure for our institution's trainees.

**METHOD AND MATERIALS:** Volumetric CT images of a normal brain were obtained and anatomic data was segmented and prepared for 3D printing using commercially available software. A reusable 3D model of the calvarium, brain, and ventricular system was created using local additive manufacturing services. Calvarial models were produced in an osseous like sandstone material, using fused deposition techniques. Brain material was produced using flexible 3D printed material and casting techniques with elastomeric properties to mimic realistic tissue characteristics. Ventricles were 3D printed using a variety of flexible polymeric materials. A dynamic flow pump was created to emulate variable ventricular size and pressure during catheter placement. Trainees are able to utilize these models to drill through the 3D printed calvarium and advance ventriculostomy catheters through tissue-like brain material into the pressure controlled ventricular system. Attending staff evaluated residents and fellows on their technical approach and competency using these anatomic simulators. A pretest and posttest for each scenario was utilized to assess the competence and comfort level prior to and after simulator use.

**RESULTS:** Creating 3D models for ventricular drain placement simulation is a valuable tool for a radiology department to provide neurosurgical trainees. A qualitative analysis showed that creation and implementation of these simulation tools improved both the competency and comfort level for trainees performing this common procedure.

**CONCLUSION:** 3D printed ventriculostomy simulators are a cost-effective means for simulation of external ventricular drain placement. Creating a reproducible 3D blueprint which can be used by other institutions can provide a valuable tool for improvement of the competency and comfort levels of trainees prior to performing this procedure.

(R-158) Tuesday • 7:25–7:45 AM •

E-poster, computer #3

### Clinical Characteristics can Differentiate Peritonsillar from Intratonsillar Abscesses: a Retrospective Imaging Study

William M. Stewart; Marc Rohrbach, MD; John-Paul J. Yu, MD, PhD; Greg D. Avey, MD; Tabassum A. Kennedy, MD, *University of Wisconsin-Madison, Madison, WI (wmstewart@wisc.edu)*

**PURPOSE:** Intratonsillar abscesses are typically treated conservatively whereas peritonsillar abscesses often require incision and drainage. The purpose of this study is to determine the clinical signs and symptoms that can differentiate a peritonsillar from an intratonsillar abscess as validated by contrast-enhanced computed tomography.

**METHOD AND MATERIALS:** This retrospective HIPPA compliant study has been approved by our Institutional Review Board. A 10-year retrospective chart review was performed from 2006 through 2016 to identify patients who (1) presented to our hospital with either a peritonsillar (PTA) or intratonsillar (ITA) abscess and (2) who received imaging at the time of initial presentation; 91 abscesses were identified. Individual patient medical records were then reviewed for the following clinical signs and symptoms: muffled voice, drooling, trismus, tonsillar abnormality, uvular deviation, uvular edema, peritonsillar or soft palate fullness, tonsillar erythema or exudate, and soft palate erythema. The patient's imaging by computed tomography (CT) at their initial encounter was then reviewed by three experienced board-certified neuro-radiologists to establish an imaging diagnosis of either a PTA or ITA; abscesses with imaging findings suggestive of a combined PTA and ITA were excluded from our study. Chi-square analysis was then conducted to determine statistically significant associations between clinical characteristics and an imaging diagnosis of a PTA or ITA.

**RESULTS:** Contrast-enhanced imaging of the neck identified 51 PTAs and 26 ITAs; 14 abscesses possessed imaging characteristics of both PTA and ITA and were excluded from our study. Muffled voice ( $p=0.02$ ), uvular deviation ( $p=0.01$ ), and soft palate or peritonsillar fullness ( $p<0.001$ ) are each independently associated with an imaging diagnosis of PTA.

**CONCLUSION:** Peritonsillar abscess is associated with muffled voice, soft palate or peritonsillar fullness, and deviation of the uvula. These clinical signs can be used to guide clinicians in differentiating between peritonsillar and intratonsillar abscess and to prospectively identify those patients that may substantially benefit from additional imaging.

## Pediatric Radiology

(R-159) Tuesday • 7:50–8:10 AM •

E-poster, computer #4

### Clinical markers of obesity correlate with quantitative liver MRI for non-alcoholic fatty liver disease in pediatric patients



Justin G. Peacock, MD, PhD, *San Antonio Uniformed Services Health Education Consortium, JBSA Fort Sam Houston, TX*; Christian L. Carlson, MD, MS (*justin.g.peacock@gmail.com*)

**PURPOSE:** The childhood obesity epidemic is leading to chronic diseases, previously only seen in adults, including non-alcoholic fatty liver disease (NAFLD). NAFLD can progress to non-alcoholic steatohepatitis (NASH) and cirrhosis. Liver disease is commonly diagnosed by liver biopsy, which is invasive, expensive, and can lead to complications. New MRI techniques and analysis software have recently demonstrated accurate diagnosis of NAFLD in adults, including MR elastography (MRE) and LiverMultiScan™(LMS) software. In this pilot study, we hypothesized that these MRI techniques can similarly be applied in overweight pediatric patients to assess for NAFLD.

**METHOD AND MATERIALS:** We recruited military dependent children ages 10-17 with overweight body mass index (BMI) values (BMI >85%), according to an Institutional Review Board (IRB) approved protocol. We obtained metabolic lab panels and MRI scans with and without elastography for assenting pediatric patients. The LMS software calculates a liver inflammation and fibrosis score (LIF score) based on a corrected T1 relaxation time, which accounts for the bias introduced by elevated iron in the liver.

**RESULTS:** We recruited 14 patients for the pilot study. The median patient age was 13 (range 10–17), with a median BMI of 30.5 (range 21.4–38.8). The median LIF score was 2.0 (normal < 2.0, range 1.2 – 3.2) and the median MRE composite score was 2.0 (normal < 2.5, range 1.7 – 2.8). Multivariate analysis demonstrated strong positive correlation between BMI and LIF average scores ( $r = 0.8226$ ) and MRE composite scores ( $r = 0.3217$ ), independent of the lab variables included in the analysis.

**CONCLUSION:** In this pilot study, we demonstrate that advanced MRI techniques can be used in pediatric patients to quantify liver parameters that correlate with NAFLD, reducing the need to perform costly and potentially dangerous liver biopsies. We find a strong positive correlation between patient BMI and MRI variables associated with NAFLD, independent of other clinical measures.

## Women's Imaging

### (R-91) Wednesday • 7:00–8:15 AM • Hard-copy poster Clinical and Imaging Outcomes of Ultrasound Guided Cryoablation of Fibroadenomas

Emily S. Nia, MD, *University of Arizona Medical Center, Tucson, AZ*;  
Marisa Borders, MD; Kim Fitzpatrick, MD

**PURPOSE:** Fibroadenomas are treated with surgical excision or followed up via serial ultrasounds. Ultrasound guided cryoablation has been introduced as an alternative minimally invasive management option of fibroadenomas and this study describes our experiences with this treatment option.

**METHOD AND MATERIALS:** In this IRB approved study, 16 biopsy proven symptomatic fibroadenomas in 13 patients were treated with ultrasound guided cryoablation technique utilizing the Cryosense treatment system. After completion of treatment, each patient participated in a post-treatment survey focusing on their experiences with cryoablation, symptom relief and overall satisfaction. The patients then completed, or will complete, follow-up imaging approximately 6 months to 1 year post-treatment.

**RESULTS:** Our preliminary results demonstrate an overall decrease in size of 9 out of 10 treated fibroadenomas in patients who have completed follow-up imaging. Follow-up imaging for 6 treated lesions has not yet been completed; however, during post-treatment surveys, all patients who have not yet completed follow-up imaging reported an overall improvement in palpable symptoms. In a post-treatment survey, 88% of patients reported improvement in their symptoms and indicated that they would choose ultrasound-guided cryoablation again to treat their fibroadenoma. All patients chose to treat their fibroadenoma due to bothersome symptoms with pain and palpable lump being the most common reported complaints. Only 40% of patients experienced enough pain to require pain medication for relief, with only 2 patients requiring prescription level analgesics. 60% of patients reported a return to normal daily activity in less than 3 days. All patients who completed the survey answered "no" when asked if cryoablation treatment had impacted the natural appearance of their breast. At our institution, the cost of a partial breast excision is \$6,750 versus \$4,550 for fibroadenoma cryoablation. Partial breast excisions also require additional general anesthesia costs.

**CONCLUSION:** We report positive initial results with ultrasound guided cryoablation treatment of fibroadenomas and recommend such treatment due to excellent patient satisfaction and overall decreased costs.

### (R-92) Tuesday • 7:00–8:15 AM • Hard-copy poster Has the California Breast Density Legislation changed Breast MRI Utilization?

Shruthi Ram, MD, *UC Davis Radiology, Sacramento, CA*; Shadi Aminololama-Shakeri, MD; Nandini Sarma ([thesriram@ucdavis.edu](mailto:thesriram@ucdavis.edu))

**PURPOSE:** To assess the impact of the California Breast Density Law (BDL) on MRI utilization.

**METHOD AND MATERIALS:** We performed an IRB approved retrospective analysis of contrast-enhanced breast MRI studies done for screening in a 30 month period before and after the California breast density law (BDL) went into effect on 4/1/13. Screening breast MRIs were subcategorized into those with breast density mentioned as an exam indication. Patients were further classified into three levels of risk - (1) defined high risk (eg. calculated lifetime risk > 20%, presence of genetic mutation, radiation at young age for lymphoma or presence of syndromes), (2) above average risk, however not quantified or calculated, or (3) completely undefined/ average risk. Chi test statistical analysis was performed, using the 2-tailed Fisher exact test to compare overall MR utilization, use of breast density as an indication, patient demographics and ordering provider characteristics.

**RESULTS:** Screening breast MRI exams with breast density as clinical indication increased from 8.5% (32/376) to 20.9% (136/650,

$p < 0.001$ ) after the BDL went into effect. When patients with known or defined high risk were excluded, the increase was from 7.7% to 16.3% ( $p < 0.001$ ). Patient demographics in the period before and after the BDL went into effect were, by race, White: 71.8% vs. 71.2%; Asian 6.4% vs. 10.5%; Black 3.7% vs. 3.1%; American Indian 0.3% vs. 1.4%; Native Hawaiian/ Pacific Islander 1.6% vs. 1.7%; Mixed 1.6% vs. 0.6; other/ unknown 14.6% vs. 11.0%; by ethnic group: Hispanic or Latino: 10.6% vs. 7.9%.

**CONCLUSION:** Screening breast MRI utilization in non-defined high risk women with breast density as the requested indication for exam has more than doubled since the California BDL went into effect. Although the majority of patients undergoing breast MRI screening before and after the BDL are of white race, a surge after BDL was seen among Asian women and a downward trend in Hispanic/Latino women. Breast density legislation has had an important impact on breast MRI utilization. Its clinical value for changing outcomes with attention to race and ethnicity information deserves further study.

### (R-160) Wednesday • 7:50–8:10 AM • E-poster, computer #3 Introducing iPad Based Multimedia Education During Informed Consent for Image-Guided Breast Procedures: Initial Experience

Andrew S. Taliaferro, BA, *Beth Israel Deaconess Medical Center, Boston, MA*; Evgenia J. Karimova, MD; Michael Fishman, MD; Jordana Phillips, MD; Vandana Dialani; Valerie Fein-Zachary, MD; et al ([andrew\\_taliaferro@hms.harvard.edu](mailto:andrew_taliaferro@hms.harvard.edu))

**PURPOSE:** To determine whether multimedia education during informed consent for image-guided breast procedures improves patient understanding and experience.

**METHOD AND MATERIALS:** 160 women having ultrasound-guided or stereotactic breast biopsy at our institution were included in the study to date (target 240). Each was randomized to one of four study arms (A-D). Arm A consisted of standard paper informed consent. Arm B added informed consent on an iPad. Arm C added real-time review of the patient's imaging during consent. Arm D consisted of an educational video discussing the standard informed consent followed by iPad consent. Objective understanding was assessed for all patients using the MacArthur Competency Assessment Tool for Treatment (MacCAT-T). Subjective patient experience, including anxiety, provider trust, and user experience with multimedia was assessed through pre-consent, peri-consent, and post-procedure surveys. One-way ANOVA was performed to evaluate for a difference between the 4 study arms.

**RESULTS:** To date, the mean age of participants was 53.1 years ( $\pm 12.9$  years) with 63.8% White, 18.8% Black, 5.0% Hispanic, 10.6% Asian, 0.6% Pacific Islander, and 1.3% Other. There was no significant difference between the 4 study arms in pre-consent or post-procedure anxiety, MacCAT-T understanding score, provider trust, or subjective understanding. A significant difference was observed between the study arms in post-procedure subjective experience among non-English-speaking patients ( $P = 0.02$ ). Those in arm C had greater subjective experience ( $9.9 \pm 0.4$  SD) than those in arm B ( $9.1 \pm 0.8$  SD,  $P = 0.03$ ). A significant difference was also observed between study arms in peri-consent anxiety among non-White patients ( $P = 0.04$ ). Those in arm D had lower peri-consent anxiety ( $3.6 \pm 2.2$  SD) than those in arm A ( $6.2 \pm 3.1$  SD,  $P = 0.05$ ). There was otherwise no significant difference between the study arms.

**CONCLUSION:** Viewing a video detailing the benefits, risks, alternatives and steps of the procedure reduces patient anxiety. For non-English-speaking patients, review of imaging as part of the consent process improves subjective experience.

# AUR 2017 Education Poster Abstracts

Instructional education posters are located in the Grand Ballroom East. Each poster will be presented by its author during one of the *AMA PRA Category 1 Credit™* poster sessions scheduled for 7:00–8:15 AM, Tuesday (Session 201) and Wednesday (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 **green**.

## Abdominal Radiology

### (E-01) Tuesday • 7:00–8:15 AM • Hard-copy poster Primary Splenic Tumors: A Pictorial Review

Kalen Riley, MD, *Indiana University School of Medicine, Indianapolis, IN*;  
Bilal Tahir, MD (*riley9@iupui.edu*)

**LEARNING OBJECTIVES:** 1) Discuss the differential diagnosis of primary splenic tumors including benign and malignant etiologies. 2) Recognize imaging findings on CT and MRI associated with these various entities in order to narrow the differential diagnosis. 3) Become familiar with preferred management of various lesions.

**CONTENT DESCRIPTION:** Primary splenic mass lesions are less common than those seen in the other intra-abdominal organs, however they are occasionally found incidentally on cross-sectional imaging, particularly as the use of such modalities has rapidly increased in recent years. While simple cysts are certainly the most common focal mass lesion seen within the spleen, there is a host of other benign and malignant primary splenic tumors that are frequently asymptomatic and are otherwise only found incidentally. Benign splenic tumors include hemangiomas, lymphangiomas, hamartomas, and sclerosing angiomatoid nodular transformation (SANT), among others. Splenic abscess may also resemble a focal primary neoplasm. The most common primary splenic malignant masses include lymphoma and angiosarcoma. In this exhibit we will describe characteristic imaging findings on CT and MRI for several of these lesions and present pathologically proven examples with the ultimate goal of narrowing the differential diagnosis and helping to guide the referring clinician to make the appropriate management decision after one of these tumors is discovered.

### (E-03) Tuesday • 7:00–8:15 AM • Hard-copy poster Turning Up the Heat with Microwave Ablation of Hepatocellular Carcinoma: A Pictorial Review of MR Imaging Features and Potential Pitfalls

Amanda Romesberg, DO, *University of Kentucky, Lexington, KY*; James T. Lee, MD; Steven J. Krohmer, MD (*jtle3@uky.edu*)

**LEARNING OBJECTIVES:** 1) Review the typical MRI appearance of post-microwave ablation of HCC during early and late post-treatment windows. 2) Discuss current recommendations for follow-up imaging in patients undergoing microwave ablation for hepatocellular carcinoma. 3) Discuss potential pitfalls in determining treatment response with magnetic resonance imaging.

**CONTENT DESCRIPTION:** Thermoablation of hepatocellular carcinoma (HCC) has been utilized since the turn of the century. This minimally invasive approach which includes radiofrequency and microwave ablation has seen a recent rise in popularity with indications beyond the treatment of HCC in suboptimal surgical candidates. It is quickly becoming one of the first-line treatment options for patients with hepatocellular carcinoma regardless of their surgical risk. Because of the growing evidence of excellent treatment responses coupled with the relatively low morbidity and mortality, utilization of thermoablative techniques, specifically microwave ablation (MWA), has continued to branch out beyond the large tertiary centers with implementation at smaller community hospitals around the country. This trend has in turn necessitated the diagnostic radiologists' competency in reading and interpreting follow-up imaging studies to assess treatment response and disease recurrence in this select patient population. This presentation aims to familiarize the diagnostic radiologist with the typical MRI features of HCC post-microwave ablation at various stages of healing to differentiate treatment response with disease recurrence. Current recommendations on follow-up imaging with MRI will also be reviewed so that the radiologist can guide the referring clinician to the appropriate surveillance study. Emphasis will be placed on the typical morphologic patterns seen on MR imaging specific to MWA of HCC, as well as, important pitfalls that may be encountered by the interpreting radiologist when assessing for disease recurrence.

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**(E-04) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Review of Abdominal and Pelvic Hernias: A Pictorial Essay**

Marie Tominna, *Beaumont Health, Royal Oak, MI*; Sailaja Yadavalli, MD, PhD

**LEARNING OBJECTIVES:** 1) Review of normal intra-abdominal anatomy with attention to spaces and abdominal and pelvic wall musculature anatomy that may be involved potential hernias. 2) Recognize signs of herniation of bowel by CT and Ultrasound that may be the cause of bowel obstruction.

**CONTENT DESCRIPTION:** Internal hernias and those involving the abdominal or pelvic wall musculature may result in symptoms ranging from minor discomfort or more serious conditions such as strangulation of bowel. The more severe hernias have significant morbidity and mortality and need to be recognized in the emergency setting. Others are equally important as they may cause chronic symptoms and impair a person's well-being and life-style. Radiologists play an important role in diagnosis of these which aids in pre-surgical planning. Important factors that are relevant include a thorough knowledge of normal anatomy including the spaces within the abdomen and pelvis and common sites of potential herniation, as well as a high index of suspicion when findings of bowel obstruction are seen. The exhibit will include a review of normal abdominal anatomy with a focus on intra-abdominal spaces and abdominal and pelvic wall musculature involved in potential bowel herniation. CT and ultrasound imaging are the mainstay for assessing hernias, however, some hernias may be seen even on radiographs. Understanding imaging features of herniated bowel is very important in making a timely diagnosis. Examples of various types of internal hernias and abdominal wall hernias will be presented using different imaging modalities.

**(E-05) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Deciphering the Defecogram: A Resident Primer to Fluoroscopic Defecography**

Nathan Y. Kim, MD, *University of Wisconsin, Madison, WI*; Perry J. Pickhardt\*, David H. Kim, MD\*, Jessica B. Robbins, MD (*nkim3@uwhealth.org*)

**LEARNING OBJECTIVES:** 1) Understand the role of defecography in the evaluation of pelvic floor disorders. 2) Explain the rationale and procedure of a defecogram to a patient in an understandable and reassuring manner. 3) Perform the technical steps of a defecogram and obtain relevant images for a complete examination. 4) Identify normal structural anatomy and basic pathology of the pelvic floor and anorectum.

**CONTENT DESCRIPTION:** A. Description of indications and contraindications for defecography. B. Review of the structural anatomy of the pelvic floor and anorectum as seen on fluoroscopy. C. Overview of phrases and terminology that can assist a resident in allaying patient discomfort and uneasiness with particular focus on avoiding wording that may potentially negatively impact the patient-physician interaction. D. Overview of technical steps in performing barium defecography. E. Discuss the pertinent images that are required for a complete examination. F. Review of normal anatomy, basic pathology, and potential pitfalls during image acquisition.

**(E-101) Tuesday • 7:00–7:20 AM • E-poster, computer #10**  
**Percutaneous Ablation Technologies: Mechanisms of action, specific applications, outcomes and complication**

Andrew S. Niekamp, MD; Derek L. West, MD; Rodrick Zvavanjanja, MD; Aaron Baxter, MD; Anil K. Pillai, MD, *University of Texas Southwestern, Dallas, TX* (*andrew.s.niekamp@uth.tmc.edu*)

**LEARNING OBJECTIVES:** Interventional ablative technologies are becoming an increasingly integral aspect in the treatment of primary and metastatic malignancies. As these ablation techniques continue to become more prevalent, it is imperative to have a basic understanding of these treatment modalities and their effects on patients. A myriad of information regarding the efficacy of these treatments has already been gleaned and we are beginning to understand that one modality may be more effective in certain clinical scenarios than others. These ablation methods may also lead to wider systemic effects than previously realized and also have the potential to cause complications that must be promptly realized and treated before they lead to more significant patient morbidity or mortality. After studying this exhibit, the individual will be able to understand the basic mechanisms of action of various ablation techniques, describe advantages and disadvantages of each technique, identify common associated complications as well as be provided with real life case scenario explanations of each ablation method.

**CONTENT DESCRIPTION:** Multiple ablation techniques will be introduced including more established ablation techniques, such as radiofrequency ablation (RFA) and cryoablation, as well as newer therapy modalities such as microwave ablation (MW) and irreversible electroporation (IRE). The basic underlying mechanisms of action including the equipment utilized, how energy is generated and how these modalities lead to tumor cell death will subsequently be discussed. The advantages for each specific ablation modality will then be presented such as which modality is preferred for certain tumor types, locoregional tumor control, which modalities may be used as a bridge to transplant as well as a brief discussion about the rare abscopal effect. Disadvantages for each modality will then be presented such as contraindications and limitations of ablative therapies. A tabular description of the most relevant outcome studies for each modality will be presented. Finally, the various complications that may arise from each modality will be presented via the form of multiple real life case examples.

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(E-150) Wednesday • 7:50–8:10 AM •

E-poster, computer #4

### MR Imaging Appearance of Hepatocellular Carcinoma after Locoregional Therapy within the Cirrhotic Liver: A Comparative Review

Andrew Zhang, MD, *University of Michigan Health System, Ann Arbor, MI*; Alexandria Jo; Mishal Mendiratta-Lala, MD

**LEARNING OBJECTIVES:** 1) Learn the expected temporal progression of imaging findings after stereotactic body radiotherapy (SBRT) in the treatment of hepatocellular carcinoma (HCC) in the cirrhotic liver. This includes imaging findings of the target lesion and the surrounding hepatic parenchyma in the treatment zone. SBRT is a newer technology recently gaining favor as a locoregional treatment option for HCC. 2) Compare imaging findings of treated HCC after SBRT to that of other locoregional therapies such as radiofrequency ablation (RFA), microwave ablation (MWA), and transarterial chemoembolization (TACE). 3) Identify imaging findings which suggest local recurrence of HCC after treatment with each of the above mentioned modalities.

**CONTENT DESCRIPTION:** The purpose of this exhibit is to illustrate expected imaging findings after various locoregional therapies used to treat HCC in the cirrhotic liver, in order to help guide image interpretation in evaluation of local control versus local progression. This is particularly important in the cirrhotic and transplant cohort of patients. Findings will be illustrated through an image-rich case based review of MR imaging findings in treated HCC after SBRT, RFA, MWA, and TACE. We will focus on the appearance of treated tumor, as well as findings which suggest recurrent disease. Additionally, there will be a summary table of the expected post-treatment imaging findings. This comparison is based on an IRB approved retrospective analysis of MR imaging at multiple time points from 58 subjects with cirrhosis who underwent SBRT for definitive treatment of HCC. In this pilot study, imaging-based response criteria were developed in a cohort of subjects with HCC successfully treated by SBRT using explant and alpha-fetoprotein response as reference standard(s). Our results suggest that post-SBRT imaging findings are in contradistinction to post-treatment imaging findings of other locoregional therapies.

## Cardiopulmonary Radiology

(E-08) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Simplifying cardiac MRI for the residents and fellows - a step-by-step approach

Alexander M. Tassopoulos, MD, *Medical College of Wisconsin, Milwaukee, WI*; Dhiraj Baruah, MD; Kaushik Shahir, MD, MBBS (*atassopo@mcw.edu*)

**LEARNING OBJECTIVES:** Cardiac MRI (magnetic resonance imaging) is perceived to be a complex imaging modality by most residents. Commonly, cardiac MRI is regarded as an advanced modality and residents fail to experience the beauty of it till the end of their training. Aim of our exhibit is to present basics of cardiac MRI in a way that residents in their early years of training understand this modality and are able to apply this knowledge to enhance further experience.

**CONTENT DESCRIPTION:** A. Overview of cardiac anatomy with representative diagrams. B. Describing cardiac segments. C. Basic MRI planes. D. Observing dynamic function of heart in different planes. E. Looking at chambers and valves with MRI. F. Common measurements (with normal ranges) that we need to take. G. Contrast enhancement (dynamic and delayed). H. Examples of some common cardiac diseases. I. Recent advances in cardiac imaging. J. Structured reporting.

(E-09) Tuesday • 7:00–8:15 AM • Hard-copy poster  
Simplified Approach for Thoracic Lymph Node Mapping

Kristin Fay, MD, *Medical College of Wisconsin Affiliated Hospitals, Milwaukee, WI*; Frederick G. Joachim III, MD; Kaushik Shahir, MD, MBBS; Joseph Budovec, MD; Dhiraj Baruah, MD (*kfay@mcw.edu*)

**LEARNING OBJECTIVES:** Mediastinal, hilar and intrapulmonary lymph node evaluation is an important parameter for staging and management of lung cancer. Before 2009, there were different systems used by different working groups leading to discrepancies in accepting a universal nomenclature. In 2009 the International Association for the Study of Lung Cancer (IASLC), proposed a new lymph nodal map to provide precise lymph nodal station anatomy as well as to reconcile the differences among previously used maps. The overall idea for a universally accepted lymph nodal map is to assess outcomes, inter-institutional result comparison, clinical trial planning, and importantly selection of appropriate therapy and predicting prognosis.

**CONTENT DESCRIPTION:** A. Prior lymph node mapping systems. B. International Association for the Study of Lung Cancer (IASLC) lymph node map. C. CT based approach and description to define mediastinal lymph node status with representative images of normal and abnormal lymph nodes.

(E-10) Wednesday • 7:00–8:15 AM • Hard-copy poster  
The Diagnosis Formerly Known as BAC: A Multimodality Review - What the Radiologist Needs to Know

Nicholas F. Lambert, DO, *University of South Florida Health, Tampa, FL*; Dalanda Diallo, MD; Kim T. Truong, MD, MPH; Maria Harvey, MD (*nlamber2@health.usf.edu*)

**LEARNING OBJECTIVES:** 1) Discuss the current classification system and imaging features of lung adenocarcinoma across different imaging modalities. 2) Showcase a pictorial review with radiologic-pathologic correlation illustrating the spectrum of adenocarcinoma subtypes. 3) Discuss the significance of this classification system for the radiologist, as a multidisciplinary team member in determining disease staging and management.

**CONTENT DESCRIPTION:** This educational poster will review the imaging features and classification system of lung adenocarcinoma. The content is geared towards trainees and the practicing radiologist. This exhibit will provide annotated images, multimodality imaging characteristics, rad-path correlation, and discussion of the clinical significance for each diagnosis as it relates to patient management and treatment

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options. We hope that this educational exhibit will raise awareness of the recently adopted classification scheme for lung adenocarcinoma, increase the learners comfort in utilizing the scheme, discourage the use of the now obsolete term bronchioloalveolar carcinoma, and finally provide insight into the significant resultant effect on patient management.

**(E-11) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**What Goes Up Must Be Found: A Pictorial Review of Upper Lobe Predominant Lung Disease**

Kim T. Truong, MD, MPH, *Tampa, FL*; Nicholas F. Lambert, DO; Dalanda Diallo, MD; Maria Harvey, MD (*nlamber2@health.usf.edu*)

**LEARNING OBJECTIVES:** 1) Review the differential diagnosis of upper lobe predominant lung disease. 2) Showcase the distinguishing imaging features of upper lobe predominant lung diseases using chest radiograph and computed tomography. 3) Describe the pathophysiology of upper lobe predominant lung disease.

**CONTENT DESCRIPTION:** This educational poster will explore the differential diagnosis of upper lobe predominant lung disease, geared towards trainees and the practicing radiologist. This exhibit will provide annotated images with a focus on disease specific imaging characteristics utilizing chest radiograph and computed tomography. Underlying pathophysiology of disease distribution will be explained, along with a discussion of the clinical significance for each diagnosis as it relates to management and treatment options. We hope that this educational exhibit will increase familiarity with the differential diagnosis for upper lobe predominant lung disease as well as unique imaging features permitting accurate and timely diagnosis.

**(E-12) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Reducing Resident Tachycardia: An Introduction to Cardiac CTA for Trainees**

Dalanda Diallo, MD, *University of South Florida, Tampa, FL*; Nicholas F. Lambert, DO; Kim T. Truong, MD, MPH; Maria Harvey, MD (*ddiallo@health.usf.edu*)

**LEARNING OBJECTIVES:** 1) Discuss appropriate indications and patient preparation for Cardiac Computed Tomography Angiography (CTA). 2) Discuss imaging techniques for Cardiac CTA, including unique features such as ECG gating. 3) Emphasize the characteristic Cardiac CTA imaging of appearance of normal coronary anatomy with an introduction to coronary pathology.

**CONTENT DESCRIPTION:** This educational poster will provide an introduction to coronary CTA geared towards radiology residents. Our goal is to reduce trainee anxiety when encountering coronary CTA and encourage resident level reading of these examinations. This exhibit will provide detailed information regarding patient selection and preparation, referencing the ACR Appropriateness Criteria and explaining premedication. Unique cardiac scanning concepts will be explained, including ECG cardiac gating. Images will showcase pertinent normal cardiac anatomy and standard cardiac imaging planes. An introduction of coronary pathology will also be illustrated, with emphasis on improving interpretive skills.

**(E-13) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Noncompaction of the Ventricular Myocardium: A Pictorial Review**

Lowell H. Ellerbrook, MD, *Scott & White Healthcare, Temple, TX*; Ryan Elliott, MD; Rodney Hajdik, MD; Whitney Edmister, MD

**LEARNING OBJECTIVES:** 1) Discuss the current understanding of ventricular noncompaction, its pathogenesis and epidemiology, and its relationship to other cardiomyopathies. 2) Understand the diagnostic challenges in identifying ventricular noncompaction, common diagnostic strategies, and common therapeutic standards. 3) Identify the characteristic imaging features of ventricular noncompaction using ultrasound and cardiac magnetic resonance imaging.

**CONTENT DESCRIPTION:** There has been much discussion concerning the diagnosis of ventricular noncompaction of the myocardium, its pathogenesis and epidemiology, and its relationship to other cardiomyopathies. Ventricular noncompaction is generally differentiated from other cardiomyopathies by the presence of prominent ventricular trabeculae, deep intertrabecular recesses, and a thin compacted layer. However, overlap in histologic, radiologic, and genetic findings, has raised questions concerning its differentiation as a separate cardiomyopathy. This is particularly true of the less common right ventricular noncompaction variant. It is generally agreed upon that ultrasound and cardiac magnetic resonance imaging are the optimal tools in assessing the diagnosis and severity of this pathology. Accurate assessment of these variables is important for the radiologist as this distinction is crucial for continuing to expand our understanding of this disease process. An image-rich multimodality presentation will be used to demonstrate the numerous facets of the current conversation surrounding noncompaction of the ventricular myocardium.

**(E-14) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**When a Filling Defect Is Not a PE—Pathologic and Technical Mimics of Acute Pulmonary Embolism**

Divya Kumari, MD, *University Hospitals Case Medical Center, Cleveland, OH*; Kevin Kalisz, MD; Shiraz Rahim, MD; Majid Chalian, MD; Luis A. Landeras, MD; Robert C. Gilkeson, MD\*

**LEARNING OBJECTIVES:** The purpose of this exhibit is to: 1) Review of CT angiography protocol and technique. 2) Diagnosis of true acute pulmonary emboli. 3) Review pathologies that can mimic acute pulmonary emboli (PE). 4) Understand technical pitfalls of pulmonary CT angiography that may mimic PE. 5) Discuss methods of correcting technical artifacts mimicking PE.

**CONTENT DESCRIPTION:** The advent of CT pulmonary angiography (CTPA) has allowed for improved detection of pulmonary embolism (PE) permitting for prompt diagnosis and treatment of a potentially lethal venous thromboembolism disease. However, with the use of CTPA, underlying pathological conditions and technical artifacts can create diagnostic pitfalls resulting in misdiagnosis. In this exhibition, we will examine the CT pulmonary angiography protocol and techniques currently used to achieve optimal image quality for a PE study. Furthermore, a systematic approach to evaluate for acute pulmonary embolism using the diagnostic criteria will be discussed in this exhibit. A pictorial review of various underlying pathologies such as chronic pulmonary embolism, thrombophlebitis, post pneumonectomy in situ thrombosis, pulmonary artery angiosarcoma, metastatic tumor, thrombotic microangiopathy, systemic to pulmonary artery shunt, and post-vertebroplasty cement embolism mimicking acute PE will be provided. Additionally, the diagnostic challenges proposed when faced with technical artifacts imitating pulmonary embolism will be explained. Specifically, images demonstrating motion artifact, flow-related artifact, partial volume averaging, quantum mottle artifact, and catheter/device artifact mimicking acute pulmonary embolism will be reviewed. Finally, tips will be provided for correcting artifacts and differentiating pathologies from acute PE in order to make a correct diagnosis and avoid mismanagement with potential morbidity and mortality.

**(E-15) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**A Change of Heart: Multimodality review on updated guidelines for diagnosis of cardiac amyloidosis**



Nikhil Madhuripan, MD, *UMMS-Baystate, Springfield, MA*; Daniel P. Thut, DO, MD; Oliver Atar, MD; Tina Tian; Alena Kreychman, MD

**LEARNING OBJECTIVES:** 1) Summary of literature on use of Tc99m PYP and cardiac MRI in diagnosing ATTR and AL amyloidosis. 2) Clinical algorithm used at our institution and validated in literature for diagnosis of ATTR amyloidosis. 3) Combining information from MRI

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and scintigraphy for diagnosis. 4) Clinical perspective on how it affects management.

**CONTENT DESCRIPTION:** Cardiac amyloidosis is an infiltrative cardiomyopathy from deposition of abnormal fibrillar protein (amyloid). Cardiac MRI helps distinguish restrictive from other forms of cardiomyopathies but is limited in differentiating amyloidosis from other restrictive conditions (such as Sarcoidosis). Moreover, it cannot differentiate amyloid light-chain (AL) from transthyretin-related amyloidosis (ATTR), the clinical course, management and prognosis of which differ. The use of Tc-99m Pyrophosphate (PYP) for cardiac imaging dates back to the 1970s, when its primary role was for imaging myocardial infarction. It is now resurfacing for cardiac imaging as a highly sensitive and specific tool for differentiating ATTR amyloidosis from other subtypes. Combined with a clinical decision protocol, combined MR and Tc99m PYP scan can be powerful tools to accurately diagnose ATTR and light chain cardiac amyloidosis without the need for an invasive cardiac biopsy. The review aims at sharing the experience at our center in diagnosing ATTR and AL amyloid subtype with a combined clinical and radiology perspective.

**(E-102) Tuesday • 7:00–7:20 AM •  
E-poster, computer #8**

**To illustrate various causes of central airway lesions which may not be readily recognized on conventional axial images but are easily visualized on the volume rendered 3D bronchograms**

Santosh K. Selvarajan, MD, *Thomas Jefferson University, Philadelphia, PA*; Rashmi Balasubramanya, MD; Babitha Asha, MD (*santosh.rad@gmail.com*)

**LEARNING OBJECTIVES:** 1) To review various causes of central airway lesions and illustrate the incremental information gained from volume rendered 3D bronchograms. 2) To review the clinical significance of these lesions, particularly those that would need surgical treatment. 3) To illustrate utility of 3D bronchograms in preoperative planning for central airway lesions.

**CONTENT DESCRIPTION:** A. Congenital: Tracheal bronchus, diverticulum, Bronchus Suis, Bronchial Arteria, Tracheobronchomegaly. B. Tracheobronchomalacia. C. Saber Sheath Trachea. D. Iatrogenic injury. E. Airway Dehiscence. F. Bronchial fractures. G. Infectious: Aspergillosis, tracheobronchitis and necrotization. H. Tracheopathia Osteoplastica. I. Relapsing polychondritis. J. Non-malignant tracheal fistulas. K. Wegener granulomatosis. L. Amyloidosis. M. Extrinsic tracheal narrowing. N. Neoplasms.

**(E-103) Tuesday • 7:25–7:45 AM •  
E-poster, computer #10**

**Learning from the Side - Why the lateral chest xray is your forgotten friend**

Varun Mehta; Nikhil Goyal, MD, *Emory University Hospital, Atlanta, GA*

**LEARNING OBJECTIVES:** 1) Learn the basic anatomy of the lateral chest film. No frontal films will be provided. 2) Review abnormal cases which specifically highlight anatomy on the lateral film. 3) Show correlations with sagittal CT images to reinforce understanding.

**CONTENT DESCRIPTION:** 1. First a lateral film will be shown with highlighted structures and accompanying memorization aids (example -- the large candy cane is the aorta and the small candy cane is the left pulmonary artery). 2. Specific cases will show anatomy - Pulmonary hypertension, pulmonic stenosis, posterior pneumonia, sarcoid, pulmonary sling, thickened bronchus intermedius.

## Education of Medical Students, Residents, and Other

### Medical Students

**(E-16) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**Spread the word: Incorporating interventional radiology into the third year surgical clerkship**

Adam J. DeFoe, MD, *University of Nebraska Medical Center, Omaha, NE*; Christopher J. Vargo, MD

**LEARNING OBJECTIVES:** 1) Recognize the need for greater and earlier awareness of Interventional Radiology (IR) as a specialty among medical students now that IR is recognized as a primary specialty. 2) Identify ways to incorporate IR and radiology teaching into the medical school curriculum, specifically the surgical clerkships.

**CONTENT DESCRIPTION:** Interventional Radiology (IR) became available as a primary specialty for the 2016 match, with 150 applicants for just 15 positions. There will be many more positions available for the 2017 match as 61 institutions currently have accredited Interventional Radiology residency programs. To continue the competitive applicant to available positions ratio, it is imperative that medical students gain exposure to interventional radiology early on. Our strategy for this includes incorporation of IR into the required third year surgical clerkship. This exposes all medical students to interventional radiology during a time when many decide on their future specialty choice. We accomplish this instruction with both didactic lectures and hands-on education. So far we lecture on chest radiographs, abdominal CT, and ultrasound. The ultrasound lecture takes place immediately before a hands-on skills session with ultrasound-guided procedures. This skills session engages students with ultrasound-guided central venous access and biopsy. They are able to practice on phantoms simulating blood vessels and practice biopsy techniques on both cow liver and biopsy phantoms with simulated masses. This is accomplished with hands-on instruction by either a staff radiologist or resident. We have had positive responses both during the sessions and through formal course evaluations. We aim to continue this method of spreading the word about IR and encourage others to follow suit so that we may sustain a large number of applicants in the future.

**(E-17) Tuesday • 7:00–8:15 AM • Hard-copy poster  
Engaging Future Radiologists: A simple, reproducible process to put medical students in the driver's seat and introduce them to cross sectional imaging**

Michael Lucin, *University of Iowa Hospitals and Clinics, Iowa City, IA*; T. Shawn Sato, MD (*michael-lucin@uiowa.edu*)

**LEARNING OBJECTIVES:** 1) Review several simple tools that can be used to create interactive education content with minimal training. 2) Describe a reproducible cross-platform distribution method for case-based medical student education using current, widely-available technologies. 3) Discuss medical student benefit to using cases for blended self-directed and guided learning.

**CONTENT DESCRIPTION:** In developing future radiologists, it is essential to engage medical students from an early point in their educational training. While this may be simple with a single static image such as a plain film, cross sectional imaging provided more of a challenge to allow for independent review. With the steep learning curve and finite availability of PACS stations, it can often be difficult for medical students to experience independently scrolling through an imaging study. We have created an easily reproducible system for allowing medical students to review imaging studies (including cross sectional imaging) independently. A USB flash drive loaded with pictures and videos in common formats created with open-source software and a web-based index file is fully functional on most platforms. Combining the structure of the USB flash drive with web hosting may allow medical students to

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view cases from any device with web access. At our institution, after the medical students have time to view cases in a self-directed manner and note findings, an educator reviews cases with the students. A post-activity survey collects information regarding the perceived efficacy and utility of this teaching activity. The way students learn has changed dramatically in the last 20 years, and it is important to evolve educational tools that take advantage of these changes. This presentation will demonstrate how to incorporate newer tools to develop more interactive and engaging teaching content.

**(E-18) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**Teaching Radiology to Medical Students: we are doing better! Spot light on utilization trends of CORE, Case-based Online Radiology Education**

Timothy R. Diestelkamp, BS, *Sewell, NJ*; Evan Rochlis, BS; Jeffery Hogg, MD; Pauline Germaine, DO

**LEARNING OBJECTIVES:** Learner interacting with this poster will become familiar with a novel approach to teach radiology which is gaining popularity among medical student educators. Current trends in the use of CORE throughout the country will be highlighted.

**CONTENT DESCRIPTION:** Radiology is a vital part of clinical decision making. Its role in patient management is fluid, reflecting evolution in current medical knowledge, integration of guidelines for clinical decision support, and new technologies. Medical students must master some basics of radiological imaging so they can knowledgeably incorporate radiological imaging and procedures in their future patients' care, and to perform on high stakes examinations that include this content. MedU is a non-profit consortium of medical educators that strives to enhance and revolutionize education of the next generation of healthcare providers by leveraging online technology to host peer-reviewed, updated virtual patient cases in several clinical disciplines, including radiology. MedU's CORE (Case-based Online Radiology Education) fills an important gap for a structured education in radiology, because the majority of US medical schools do not have a clearly articulated requirement for radiology education in their curricula. CORE is based on the AMSER (Alliance of Medical Student Educators in Radiology) National Medical Student Curriculum. The 19 CORE Cases teach a patient-centered approach to imaging, foster self-directed and independent study, build clinical problem-solving skills, and instruct students about ACR Appropriateness Criteria, widely accepted as best practice clinical decision support for imaging. At the present time MedU has 670 course subscriptions from 202 institutions. 84 of these 202 institutions (41%) subscribe to CORE. There has been steady growth in CORE subscriptions, as educators learn how MedU CORE offers a clear path to high quality instruction that students value and that fills an important curricular gap.

**(E-19) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Supplementation of Online Radiology Modules in Medical School Curriculum**

Shingo Kihira, BS, *Icahn School of Medicine at Mount Sinai, New York, NY*; Nolan J. Kagetsu, MD\* (*shingo.kihira@icahn.mssm.edu*)

**LEARNING OBJECTIVES:** 1) Understand the benefit and disadvantages of integrating online-based Radiology modules throughout clerkship year in medical school. 2) Discussing potential concerns for the online Radiology Curriculum. 3) Suggestions for enhancing curriculum experience.

**CONTENT DESCRIPTION:** Exposure of medical students to academic radiology is typically brief. Most institutions in the US do not require radiology courses in their curriculum; however, there is growing interest to integrate modules within the medical school curriculum during third and fourth year. Several institutions have started to implement required online modules to educate students on understanding the mechanism behind various imaging modalities and how to interpret fundamental radiological findings by requiring completion of the online radiology module as recommended by the Alliance of Medical Student

Educators in Radiology in 2011. At Icahn School of Medicine at Mount Sinai, students are required to take the Case Oriented Radiology Education (CORE) that is integrated within the third year clerkship alongside the core rotations: medicine, surgery, obstetrics and gynecology, and neurology. 17 modules comprehensively cover chest imaging, pediatric radiology, abdominal imaging, neuroradiology, and musculoskeletal imaging. Although the knowledge gained from modules is essential, there is concern that having solely online-based modules may unintentionally give a skewed view the field. Students may not take further initiative to participate in radiology electives where they can observe attendings and residents at work and gain actual field exposure. Many of these students may not realize how interaction with other fields is integral to radiology. Furthermore, relying solely on the online modules may lead to decreased interest of those who may have initially been interested in the field. Preliminary data from a survey sent to the class after course completion showed that 67% (n=35) of the class felt that it did not garner further interest in the field and 62% (n=35) found that they had enough exposure to the field after completion. Additional surveys to assess for change in interest will be sent out.

**(E-20) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**CORE Utilization Parallels Current Trends in Radiology Education: Do Statistics Help Define Opportunity Space to Improve Medical Student Education in Radiology?**

Timothy R. Diestelkamp, BS, *Sewell, NJ*; Evan Rochlis, BS; Jefferson F. Benites; Jeffery Hogg, MD; Pauline Germaine, DO (*germaine-pauline@CooperHealth.edu*)

**LEARNING OBJECTIVES:** 1) Describe how CORE usage and case completions statistics reflect and align with content delivered. 2) Analyze their instructional practice with respect to the evenness of coverage of topics and reflect on educational gaps. 4) Create alternative instructional strategy to deliver more fully the AMSER national curriculum in radiology.

**CONTENT DESCRIPTION:** We digest statistics for MedU CORE Case completions with a novel analysis geared to identify our present successes and identify direction for further progress. CORE Case completion statistics serve as a useful lens through which we see "success" in delivery of radiology instruction. Conversely, analysis can help us focus effort where those statistics indicate educators deliver less of the essential content to our learners. CORE Cases are used/completed in an uneven manner, for example: Case 1 (dealing with signs and diagnosis of pneumonia) registered more than 2,200 completions in one time frame. While Case 19 (dealing with the role of radiology in oncologic disease) registered fewer than 600 completions during the same time frame. This uneven case completion pattern reflects uneven emphasis and teaching of radiology to our learners. Inclusion of all CORE Cases in instruction (thus evening out the usage statistics) ensures inclusion of the essential instruction students require to become entrustable residents who can knowledgeably incorporate radiological diagnostic and therapeutic procedures in their future patients' care. We present organized tabulated data with similar comparisons made at several time points over several academic cycles, reflecting instruction in all sites using CORE (currently 84), providing a novel broad look at trends in content delivery by topic and time frame. Conclusion: Case completion data serve as one useful surrogate for the completeness of educators' delivery of the AMSER National Medical Student Curriculum in Radiology more broadly than is possible by analysis in a single institution.

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

**(E-104) Tuesday • 7:50–8:10 AM •**

**E-poster, computer #8**

**Types of Learner Assessment in Medical Student Radiology Education**

Matthew R. Vickery, MD; Ann Helms, MD, MS; Dhiraj Baruah, MD; Joseph Budovec, MD, *Medical College of Wisconsin, Milwaukee, WI* ([jbudovec@mcw.edu](mailto:jbudovec@mcw.edu))

**LEARNING OBJECTIVES:** 1) Explain the purpose and role of assessment in medical student radiology education. 2) Compare the advantages and disadvantages of the various assessment types and methods in regards to medical student education in radiology. 3) Select effective assessment tools for evaluation of medical students in a diagnostic radiology elective.

**CONTENT DESCRIPTION:** I. Why do we care? A. 21st century learners expect to be taught HOW to apply clinical information, not simply be presented with facts. B. Thus, evaluation of these learners should assess clinical reasoning and application skills. II. What are the different forms of assessments? A. Norm referenced – as utilized by national organizations like the USMLE or ABR. B. Criterion based – more typical of departmental or institutionally based exams. C. Formative. D. Summative. III. What are the different methods of assessment? An explanation of the types and associated advantages and disadvantages of assessment methods as they relate to clinical reasoning and application of acquired knowledge and skills. A. Multiple choice, matching, and extending matching. B. Short answer and short essay. C. Clinical evaluation exercise – case interpretation. D. OSCE – Objective Standardized Clinical Examination. E. Case based discussion. IV. How should we integrate the different forms and methods of assessment into our medical student rotations? A. According to current pedagogical theories, frequent assessment improves knowledge and cognitive skills. B. Our assessment tools and techniques should focus on higher order clinical decision making and thinking. C. Assessment methods should vary to provide a more ‘holistic’ evaluation. V. Conclusion. VI. References.

**(E-105) Wednesday • 7:50–8:10 AM •**

**E-poster, computer #10**

**An Innovative Approach of Instructing Medical Students in Ultrasound - Comprehensive short exposure**

Manickam Kumaravel, MD, *University of Texas Houston, Houston, TX*

**LEARNING OBJECTIVES:** The intention of the ultrasound education program was to: 1) Create an intensive ultrasound curriculum by designing a program “Ultrasound Immersion Week” aimed specifically at second year medical students. 2) Devise a method for measuring effectiveness of the program. 3) Assess the feasibility of teaching this methodology for various audiences in different institutions.

**CONTENT DESCRIPTION: Methods:** • Analyze existing ultrasound training for medical students. • Evaluate current status and gaps in instruction of ultrasound education. • A curriculum for 2nd year medical students in ultrasound education at our institution including instrumentation, anatomy, and ultrasound guided interventional procedures using phantoms was created • Pre- and post- Immersion Week assessments of skills and knowledge was performed with standardized questionnaire and hands on competition • Program overview of Ultrasound Immersion Week included o Hands on education of various systems using multiple ultrasound units and students divided into small groups. Radiology resident educators to guide o Ultrasound guided intervention using home made phantoms o Medical student ultrasound skills competition o Medical student standardized questionnaire – pre and post week evaluation o Medical student & resident satisfaction surveys Creation of low-cost homemade phantom models to demonstrate ultrasound guided interventional procedures **Results:** Evaluation of the ultrasound exposure week was performed by • Standardized questionnaire administered to all second year medical students – 245 students. Results of this is included in the table (two tailed P value < 0.0001) • Satisfaction survey using survey monkey was administered anonymously **Conclusions:** • Short focused ultrasound education programs

are useful and effective in educating second year medical students • Standardized questionnaire demonstrates that it is possible to have a significant impact in the knowledge obtained by the medical students by the week of ultrasound education • Using homemade phantoms it is possible to educate Second year medical students effectively and keep them engaged. • It is possible to propagate this method of education to other centers using videos and the pictures

**Residents**

**(E-31) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Designing and Implementing a Senior Focused Elective in Quality Improvement and Patient Safety**

Jeffrey Kempf, MD, *Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ*; Martha Ksepka, MD; Vyacheslav Gendel, MD ([JKempf@Univrad.com](mailto:JKempf@Univrad.com))

**LEARNING OBJECTIVES:** 1) The purpose of this presentation is to aid Radiology Residency programs in creating a Senior Focused Elective (SFE) in Quality Improvement (QI) and Patient Safety through a structured curriculum such as the one we recently implemented for our residency, designed for the radiology resident interested in becoming a future leader and teacher in Quality Improvement. 2) We will review our QI elective goals and objectives which include an in-depth training and understanding in Quality Improvement concepts, with instruction from varied QI resources including on line modules, quality certificates, recent papers with review of the literature, as well as to learn best practices techniques, along with the challenges and common pitfalls in quality improvement implementation. 3) We will present how our SFE QI and Patient Safety elective incorporates the senior resident as leader and mentor in the design and implementation of a QI project for junior residents, along with leading and participating in a Mock Root Cause Analysis to the residency and faculty at the completion of the elective.

**CONTENT DESCRIPTION:** Quality Improvement (QI) training has only relatively recently become an integral part of graduate medical education in the United States. This originated from concerns of patient safety in the delivery of medical care in the US. The goal of this education is to provide trainees with the skills and tools to participate in quality improvement and safety initiatives when they enter practice, to continuously improve patient care, reduce errors, and improve patient safety. The ACGME Diagnostic Radiology Milestones competencies include the implementation of evaluation of radiology residents in QI activities including the completion of a systems-based QI project. However, there are some residents who complete their QI projects in the second or third year of residency and have requested further training in QI to help develop future leadership skills in this area. We describe our recent experience in creating a senior focused elective in Quality Improvement, the curriculum we have developed for the elective, as well as future directions.

**(E-32) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**Let’s Talk: Teaching Provider to Provider Communication**

Alison L. Chetlen, DO\*; Barry Amos; Lindsay Stratchko, *Penn State Health, Milton S. Hershey Medical Center, Hershey, PA*; Jeanine Beatty-Chadha, MEd; Sosamma T. Methratta, MD

**LEARNING OBJECTIVES:** 1) Compare and contrast effective versus non-effective communication techniques between health care providers in the observed simulation scenarios. 2) Describe the components of the Situation, Background, Assessment, and Recommendation (SBAR) communication technique. 3) Implement a curriculum for teaching provider-to-provider communication.

**CONTENT DESCRIPTION: Introduction:** Failures in effective communication among the health care team is a common cause of errors that lead to patient harm. Interpersonal and communication skills are one of six general competencies identified by the ACGME and ABMS of

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

a competent physician. During this interactive electronic module, participants will observe and critique effective provider-to-provider communication skills and practice methods used improve communication between colleagues using the SBAR framework (Institute for Healthcare Improvement). Simulated scenarios will feature communication between two physicians in a typical clinical setting. Participants will learn to standardize both nomenclature and communication processes when communicating information so that patient care is optimized. This session will provide educators with practical tools to use and teach effective provider to provider communication. **Module:** During this interactive module, each learner will complete an anticipation guide and poll questions related to teaching and implementing effective provider-to-provider communication. Participants will observe and critique a flawed provider-to-provider communication scenario. Next the critical elements of a verbal report using the SBAR communication technique will be taught. The participants will next observe a simulated verbal discussion between two physicians demonstrating improved, clear and concise communication, comparing and contrasting communication techniques to the earlier demonstration. **Expected Outcomes:** After participating in this interactive electronic module, participants will have learned how to create and implement this curriculum in order to improve provider-to-provider communication and improve patient safety across the continuum of care.

**(E-33) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Online Radiology Procedure Manual: a new approach to standardizing resident education on procedures in radiology**

Nnamdi Udeh, *University of Virginia, Charlottesville, VA*; Jason W. DeBerry, MD; Rachel McEachern, MD; Jason N. Itri, MD, PhD; Michael Hanley, MD; Adam B. Winick, MD; et al ([ndu2vt@virginia.edu](mailto:ndu2vt@virginia.edu))

**LEARNING OBJECTIVES:** How to Establish a Dynamic Online Radiology Procedure Manual: 1. Collate the information regarding the most effective methods for individual procedures. 2. Create instructional images and videos to the website with corresponding written instructions. 3. Add accessibility for radiologists to continually modify and improve the comprehensive procedure manual.

**CONTENT DESCRIPTION:** Our novel approach to supplementing radiology resident education is with the use of an online instructional manual that contains both a step-by-step guide to commonly performed procedures in radiology and a description of the tools used to perform them. An advantage of creating this online guide is the ability to condense a large volume of knowledge and experience into an electronic format easily accessible to radiologists in all parts of their training. This format also allows the addition of image rich articles and videos demonstrating key elements such as appropriate technique and image-guided procedure fundamentals. By maintaining the manual on an open-edit platform, both residents and attendings will be able to modify the information contained within it. Over time, the methods most utilized will be updated and new techniques and procedures added to this continually evolving, dynamic resource. One of the greatest advantages of creating this comprehensive and user-friendly procedure manual is ease of accessibility by radiologists at all levels of training while embracing our affinity for technology, quality improvement, and collaboration.

**(E-34) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**The Electronic Reading Room: A unique and highly evolved method to conduct high volume, accurate multi-specialty resident training in a hybrid academic-private residency program**

Ankit H. Shah, BA, MD, *Baylor University Medical Center, Dallas, TX*; Umesh D. Oza, MD ([Ankit.Shah@bswhealth.org](mailto:Ankit.Shah@bswhealth.org))

**LEARNING OBJECTIVES:** 1) Demonstrate the ability to teach subspecialty radiology in the electronic reading room. 2) Provide infrastructure for radiology. 3) To show proficiency and efficiency in resident interpretation of exams in a hybrid practice setting. 4) Develop a means to provide quaternary type radiologic patient care to more remote and rural communities.

**CONTENT DESCRIPTION:** Realizing the importance of both volume and variety in facilitating learning, we created a unique rotation that utilized teleradiology, a robust PACS, and one on one attending radiologist/resident interaction to manage the imaging and provider communication for many imaging centers across the state of Texas and even abroad. The presence of a centralized reading room, operator driven phone system, and instant messaging was implemented to prevent interruptions. The presence of the real-time text functionality allows attending physicians to show particular key images and provide insight into resident reports while residents gain access to a wide variety of cases. The reading room is divided into separate sections for neuroradiology, body imaging, musculoskeletal, and molecular imaging with dedicated subspecialty trained attendings in each section. The residents are provided their own reading rooms with ergonomic layouts and high-powered work stations. The residents have full access to multiple worklists and large volumes of cases that are associated with robust clinical histories built into the PACS from remote uploading of data and real-time communication with technologists. We have provided residents with unparalleled diversity in cases and experiences with teleradiology to provide them a unique balance of private practice experience for simulation prior to their graduation and appropriate interruption-free dedicated subspecialty learning throughout the day.

**(E-35) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**“Boot Camp” for first-year radiology residents: a training program to prepare for the rigors of diagnostic radiology call**

Alan M. Chen, MD, *University of South Florida College of Medicine, Tampa, FL*; John C. Feldman, MD; Douglas P. Ivancsits, MD; Robert A. Zamore, MD; Ryan D. Murtagh, MD, MBA ([amchen2107@gmail.com](mailto:amchen2107@gmail.com))

**LEARNING OBJECTIVES:** 1) Outline the workflow design of the “Boot Camp” in preparation for diagnostic radiology call for first-year residents. 2) Discuss the educational benefits of the program. 3) Describe the future plans for additional uses in other aspects of radiology education.

**CONTENT DESCRIPTION:** Taking call as a diagnostic radiology resident requires the application of a comprehensive array of clinical knowledge in a high-stress, fast-paced environment. This is especially intimidating for the first-year resident who only has a few months of formal radiology training. We have developed a unique teaching program to facilitate readiness in a controlled hands-on environment. This program begins approximately one month prior to the start of the first-year resident call cycle. The primary objective is to be accustomed to common emergency cases and situations. Approximately fifteen cases are presented in each of two evening sessions. Negative examinations are included in the pool of cases. Residents have five minutes to complete each case. Additionally, volunteer actors, posing as technologists, clinicians, or nurses, present common distracting scenarios, while the resident worked through the case. For each case, the resident would form his or her own impression and answer other questions about the case. The attending facilitators review the answers and give personal feedback. As a quality measure, we obtained feedback from our first-

year residents following completion of the program. In the future, we would like to extend this program to the upper-level residents with more complex cases to further increase the comfort level of taking diagnostic radiology resident call. This exercise also has implications as an evaluation tool of resident performance.

**(E-36) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**Interpretative Differences Between Neuroradiology Trainee and Faculty in Cerebrovascular Stroke Evaluation: Case Illustration and Analysis**

Manav Bhalla, MD, *Medical College of Wisconsin, Milwaukee, WI*; John Ulmer, MD\*; Andrew P. Klein, MD; Stephen A. Quinet, MD; Leighton P. Mark, MD; Namrata Bhalla, MD

**LEARNING OBJECTIVES:** 1) Review of altered brain physiology in stroke and relevant interpretative features on CT and MR imaging. 2) Spatiotemporal correlation of stroke evolution on radiologic imaging and some common pitfalls in interpretation among Radiology trainees, fellows and faculty members. 3) Evaluation of impact of level of training on the predictive indices of stroke imaging. 4) Discussing ACGME core competencies required of radiology residency trainees (Patient care, medical knowledge, practice based learning/improvement and systems based practice) that may be enhanced by identifying and discussing trainee-faculty interpretative differences. 5) Optimizing teaching modules for stroke imaging to improve trainee skill. 6) Validating clinician reliance on preliminary readouts by trainees in the triage of ED stroke patients.

**CONTENT DESCRIPTION:** 1. Diagnostic imaging requirements at designated stroke centers. 2. Constituents of Neuroradiology core rotations for Radiology trainees in preparation for stroke imaging interpretations. 3. Diagnostic dilemmas that can lead to discrepancies in trainee wet reads, with case examples. 4. Does the trainee level of experience impact concurrence with final read? 5. Clinical outcome in patients who had discrepant wet reads. 6. Optimizing patient care and radiology resident training in stroke imaging.

**(E-37) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Giants in Radiology From Head to Toe: A Pictorial Review**

Lori Schoenbrun, MD, *Winthrop-University Hospital, Mineola, NY*; Douglas S. Katz, MD; Michael K. Brooks, MD, MPH; Joseph P. Mазzie, DO; Orlando Ortiz, MD, MBA; Galina Levin, MD (*lschoenbrun@winthrop.org*)

**LEARNING OBJECTIVES:** Case-based review of “giant” entities in radiology. The term “giant” is frequently encountered in medical literature in association with multiple conditions in the head, neck, chest, abdomen, pelvis and extremities. Sometimes the term “giant” is used to describe a finding that meets a certain size criteria. Other entities carry the word “giant” in their terminology because of their unique appearance under the microscope rather than their actual size. In our exhibit we revisit the commonly and not so commonly encountered “giant” entities in radiology. Familiarity with clinical and radiological findings of these “giant” conditions is important for accurate diagnosis and patient management.

**CONTENT DESCRIPTION:** This educational exhibit will be an image rich, case-based review which will also include an in-depth literature review (diagnostic radiology, interventional radiology and surgery) regarding diagnosis and management. Pearls and pitfalls in diagnosis of these entities will be emphasized. Some examples of entities that will be covered: A. Giant hemangioma. B. Giant brain aneurysm. C. Giant bulla. D. Giant bone island. E. Giant myelolipoma. F. Giant cell bone tumor. G. Giant cell tumor of the tendon sheath. H. Giant cell arteritis. Topics include, but are not limited to: A. Etiology. B. Prevalence. C. Pathophysiology. D. Presentation. E. Imaging appearance (Ultrasound, CT, MRI, Nuclear Medicine, and Angiography). F. Differential Diagnosis. G. Pearls and pitfalls in diagnosis. H. Management. I. The role of biopsy of these lesions.

**(E-38) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**Development of a dedicated Quality Improvement Training Track for Radiology Residents**

Jeannie K. Kwon, MD, *University of Texas Southwestern, Dallas, TX*; Ankaj Khosla, MD; Travis Browning, MD; Daniel S. Moore, MD; Jessica Porembka; Michael C. Morriss, MD (*Jeannie.Kwon@childrens.com*)

**LEARNING OBJECTIVES:** 1) Demonstrate a basis for a Radiology Residency Quality Improvement curriculum. 2) Describe a model for residents to become involved with quality improvement initiatives. 3) Develop an avenue for residents with a deep interest and potential in healthcare quality leadership to develop a career in radiology and quality improvement.

**CONTENT DESCRIPTION:** Our institution has developed a quality resident yearlong track for select radiology residents with a self-identified interest in quality improvement. Focusing on a small group of residents has multiple advantages, including direct mentorship, easier access to system-wide meetings, and more focused small-group learning discussions. Track residents first undergo a basic quality curriculum, consisting of on-line courses being offered by the Institute of Healthcare Improvement. Residents and faculty leaders in quality improvement discuss the principles covered in each course. Concurrently, residents attend various quality committee meetings to observe team dynamics, leadership styles, and quality improvement project cycles. Upon completion of the curriculum and a few months of observation, residents develop their own quality improvement project and present the project plan to the faculty. After giving feedback on each project, a faculty mentor is assigned. The project is executed during the latter half of the year, and includes team formation, gaining buy-in from stakeholders, data collection, and interventions designed to create positive sustainable change. Residents regularly present updates on the project and continue to meet regularly to review scholarly articles and other literature on the topics of quality and leadership. At the end of the academic year, residents present their project to the entire residency and faculty and are awarded a certificate. Graduating residents are given the opportunity to continue in the track in a mentorship role for the next cohort.

**(E-39) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Radiologists on the wards and in the lab? The added value of “rounds” with our referring doctors**

Nikhil Goyal, MD, *Emory University Hospital, Atlanta, GA*; Varun Mehta

**LEARNING OBJECTIVES:** To understand the needs of our referring doctors by witnessing their daily activities on wards and in labs.

**CONTENT DESCRIPTION:** Radiology resident will witness several common clinical scenarios or procedures which require image guidance. Through watching procedures or understanding routine clinical care in specific patient populations, high-yield tips will be presented which will help other fellow imagers learn what is most important information we can provide. For example, in the post lung transplant patient, routine biopsies are done to help search for acute rejection. Knowledge of these biopsy schedules may help narrow the differential when viewing post lung transplant CT exams. Similar things can be said for knowledge on the steps in a TAVR procedure so that the resident can understand why certain pre-procedure measurements are provided by CT imaging prior to the procedure.

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

**(E-40) Wednesday • 7:00–8:15 AM •****Hard-copy poster  
What Every Radiology Resident Should Know About Biostatistics**

Viet H. Vu, MD; James Vu; Theodore A. Brown, MPH, BS; Scott L. Beech, MD, *Tulane University School of Medicine, New Orleans, LA*; Jeremy B. Nguyen, MD, MS

**LEARNING OBJECTIVES:** 1) Describe the basic role of biostatistics in medical research study. 2) Describe descriptive statistics, including basic statistical calculations, central limit theorem, normal distribution and t-distribution. 3) Describe inferential statistics, including hypothesis testing, Type I and Type II errors, alpha, beta and power. 4) Describe analysis of variance (ANOVA), correlation and regression. 5) Illustrate the usefulness of electronic spreadsheet in the teaching of biostatistics.

**CONTENT DESCRIPTION:** Research study design with biostatistics is traditionally taught in the second year of medical school curriculum. This subject is usually taught in a highly theoretical manner with little practical applications. Radiology residency traditionally places emphasis on learning diagnostic imaging during the training period. The new milestones of diagnostic radiology re-emphasize teaching the skills of critical thinking and research design. Research studies ultimately involve the collection and analysis of data to arrive at a conclusion. Therefore, a firm understanding of statistical analysis is a prerequisite. The educational poster attempts to presents the basic ingredients of biostatistics that is necessary for the undertaking of a research design. There are two broad categories of statistics: descriptive and inferential statistics, which play important roles in research data analysis. Descriptive statistics involves collecting, analyzing, summarizing and presenting the data. It does not involve generalizing the data at hand. On the other hand, inferential statistics encompasses estimating confidence interval, hypothesis testing, relationship determination and making predictions. Type I and Type II errors as well as the p-value, alpha, beta and power are all important concepts in hypothesis testing. Advanced concepts of ANOVA, correlation and regression extend the data analysis to multivariate process. Electronic spreadsheet can be useful to illustrate some practical applications of statistical calculation and inferences in research design.

**(E-110) Tuesday • 7:25–7:45 AM •****E-poster, computer #6  
Simulation OSTE (Objective Standardized Teaching Exercise) as part of a radiology residency's "resident as teacher" curriculum**

Maria C. Shiau, MD, MA, *NYU Langone Medical Center, New York, NY*; Lindsay M. Griffin, MD; Nancy R. Fefferman, MD; Cecilia L. Mercado, MD; Anne Dembitzer, MD; Sondra R. Zabar (*Maria.Shiou@nyumc.org*)

**LEARNING OBJECTIVES:** By the end of this educational exercise, the learner should be able to: 1) Apply the principles of active learning to their resident educator curriculum. 2) Design a 4-5 station Objective Structured Teaching Exercise (OSTE) for resident education training. 3) Evaluate the effectiveness of a simulation-based training program.

**CONTENT DESCRIPTION:** This poster exercise will guide educators through the steps required for a successful simulation focused trainee educator workshop. Steps include a myriad of tasks that, once listed, become less daunting. Examples of goals, learning objectives, case scenarios, and evaluation forms will be shared. A sample of the objective structured teaching exercise (OSTE) workflow in tabular form and an estimated budget will also be provided. Following a literature review and a needs assessment of our radiology residency program, a proposed resident as teacher curriculum was drafted. The proposed framework for curriculum delivery includes a combination of learner-centric teaching encounters with emphasis on reflection and feedback. Curriculum Goal: The goal of the Teach The Teacher (T3) curriculum is to motivate residents to teach and improve the quality of their teaching. The OSTE exercise addresses the following three learning objectives: Objective 1: Discuss personal

learner type and role as resident teacher, with an emphasis on the learner-centered approach and adult learning theory. Objective 2: Demonstrate 5 micro-skills for teaching at the workstation: Focus, What, Why, Whenever, Feedback, based on the one-minute preceptor model. Objective 3 Feedback: Demonstrate the skills of delivering feedback as well as reflect on individual, generational, and cultural differences in giving and receiving feedback. Assessment of the T3 curriculum will be composed of (1) evaluations of the workshop by participants and facilitators, (2) novel retrospective pre- and post-self-assessment by participants which will include confidence level rating of teaching skills, and (3) review of resident evaluations by medical students pre- and post-workshop.

**(E-111) Wednesday • 7:00–7:20 AM •****E-poster, computer #6  
Keeping Ultrasound in our Hands - Graduating Confident and Competent Diagnostic Radiology Residents**

Ryan J. Smith, MD, *Albert Einstein Medical Center, Philadelphia, PA*; Josh McCambridge; Mindy M. Horrow, MD\*; Cheryl Kirby; Shuchi K. Rodgers, MD

**LEARNING OBJECTIVES:** 1) Establish a learning environment that requires residents to be hands on and fosters resident training in performing ultrasounds. 2) Identify specific goals at each level of training that will allow a resident to progressively learn and become confident in performing and interpreting ultrasounds. 3) Create a Milestones based system of evaluations to monitor resident progress.

**CONTENT DESCRIPTION: Overview:** A major educational component of our residency program for almost 25 years has been achieving competency in interpretation and performance of real time ultrasound. Our residents acquire the skill set to perform their own ultrasounds and confidently interpret all studies. To achieve these goals, we have created a comprehensive Ultrasound curriculum that focuses on manual ultrasound skill development, a graded progression of daily and on-call responsibility, and formal Ultrasound conferences. We strongly believe that all radiologists should be able to take up a transducer in their own hands and perform ultrasounds with confidence. **Culture:** In our department, every study is reviewed before a patient leaves, allowing the Radiologist an opportunity to talk to the patient and personally re-scan if necessary to make a diagnosis. The residents are exposed to this culture, providing the framework for their education and a daily mentorship by our "ultrasound dedicated" staff radiologists. **Early Education:** First year residents begin by working with a technologist to learn the basics of scanning. After residents build confidence with the machine and basic imaging, they go to our ER with a senior resident to perform urgent cases. We will discuss our methods for evaluating residents. Competency in these areas prepares them for night call in the second year. **Call Experience:** Our residents perform their own ultrasounds at night. We will discuss why we feel this is such a critical part of resident education. **Future:** We will continue to teach our residents how to perform their own ultrasounds including early morning or after hours scanning sessions, hands on practicums (MSK), simulations to gain skill with ultrasound guided procedures and use of ultrasound contrast.

**(E-112) Wednesday • 7:00–7:20 AM •****E-poster, computer #7  
Implementation of a Departmental Resident Web-based Database**

Stephanie P. Yen, MD, *Dartmouth-Hitchcock Medical Center, Lebanon, NH*; Petra J. Lewis, MD\* (*stephanie.p.yen@hitchcock.org*)

**LEARNING OBJECTIVES:** 1) Recognize the ease and flexibility in developing a resident web-based database. 2) Discuss the advantages of a resident web-based database.

**CONTENT DESCRIPTION: Purpose:** Evaluating resident performance throughout residency is essential to satisfy ACGME and departmental requirements. The myriad of parameters used for resident evaluation makes collecting and tracking of these data challenging and time

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consuming and institutional databases have limited functionality. We decided to develop a web-based database for data entry and tracking. **Materials and Methods:** Commercial, customizable and affordable software (Knack™) was used to develop a user friendly password protected, multiplatform database that would track case logs, procedure logs, procedural competencies, exam scores, scholarly activities, QI projects, learning plans, self-assessments, teaching/leadership/administration activities/positions, biannual Milestone evaluations and faculty lecture evaluations. Specific reports are automatically generated for CCC committee and Program Director reviews and ACGME annual reporting (e.g. % procedural competencies). Residents can review their own performance but specific report 'pages' are only visible to designated faculty/administration. **Results:** Since January 2015, over 8000 entries have been made into the database. User acceptability has been high and CCC/ACGME reporting markedly facilitated. **Conclusion:** The central online repository of data has enabled faster and more efficient documentation and reporting of required resident performance areas for reviews and ACGME reporting. The template is exportable for other Knack™ users.

**(E-113) Wednesday • 7:00–7:20 AM •**

**E-poster, computer #8**

### **Web-based PACS in Radiology Residency Education**

Hsiang-Jer Tseng, MD, MA, *Emory University, Atlanta, GA*; Nabile M. Safdar, MD; Christopher P. Ho, MD; Matthew E. Zygmunt, MD; Brent P. Little, MD (*htseng3@emory.edu*)

**LEARNING OBJECTIVES:** The goal of this exhibit is to discuss novel and cost-effective ways to enrich Radiology resident education through incorporation of web-based teaching PACS in training. 1) Demonstrate a versatile and HIPPA compliant way to share interesting cases. 2) Demonstrate the use of web-based PACS for educational quizzes and exams. 3) Demonstrate how to incorporate scrollable cross sectional imaging data sets in resident teaching conferences.

**CONTENT DESCRIPTION:** Web-based PACS systems can make radiology education more portable and flexible, allowing users to access radiology exams outside the reading room through the Internet at anytime. Users can interact with full DICOM data sets with scrolling and windowing. In this educational exhibit, we provide our own examples of how Web-based PACS can be used to enrich radiology resident training: 1. Interesting cases can be shared via email or mobile texting in a HIPPA compliant format. 2. Web-based PACS can be embedded or linked within other online form services to create quizzes for a variety of purposes, such as pre and post-rotation exams or pre-call competency exams. Feedback can be given to users instantaneously. User performance can be recorded and possibly become part of a learning profile. We present examples, including a coronary CTA quiz for residents and fellows. 3. Web-based PACS can be shared on computer screens in real time, which can enrich resident educational conferences. The audience can access the images in real time on any computer or mobile device.

**(E-114) Wednesday • 7:25–7:45 AM •**

**E-poster, computer #4**

### **Establishing an Early Specialization in Interventional Radiology Program at a Community Based Hospital**

Varun Chowdhary, MD, *Staten Island University Hospital, Staten Island, NY*; David S. Sarkany, MD

**PURPOSE:** This exhibit demonstrates the experience of a community hospital residency in obtaining an Early Specialization in Interventional Radiology (ESIR) certification and planning for and IR/DR residency program.

**METHOD AND MATERIALS:** Interventional Radiology (IR) is becoming an increasingly competitive area as a larger portion of residents applying to Diagnostic Radiology (DR) show a strong interest in IR. In order for a community based program to continue attracting top applicants, these residents need to be provided with a robust curriculum

geared towards a career in IR. In this exhibit, we outline our program's experience in obtaining ESIR certification.

**RESULTS:** The community hospital is an 800 bed, trauma level 1 center with 4 residents per year and no IR fellows. We have 4 full-time IR attendings. Our first step was to establish an IR Program/Educational Director. The IR program director coordinated with the DR program director to analyze the current curriculum and institute new requirements for an IR focused curriculum. We created a block schedule for potential ESIR residents, allowing a maximum of 3 residents that are selected by the end of the R2 year through a newly created internal application process. In addition, we created tools to analyze the potential ESIR residents' procedural experience over 4 years to confirm sufficient volume and procedural experience for the ESIR curriculum. Given the unique advantages of a small hospital, we were able to utilize already well established relationships with other departments to create IR related rotations with the ICU, Vascular Surgery and Gastroenterology. Additionally, an IR clinic was established. Finally, in order to obtain final approval by the hospital designated institutional officer, we presented our objectives of the new ESIR curriculum (and future IR/DR plans) to the hospital GME committee.

**CONCLUSION:** Our experiences at a community based hospital in applying for ESIR certification can serve as a model for many similarly sized residencies nationwide. We strongly feel a resident interested in IR from our program will develop an excellent foundation with the ultimate goal of training physicians who will be successful clinicians in the field of IR.

**(E-115) Wednesday • 7:25–7:45 AM •**

**E-poster, computer #10**

### **Lessons from ACGME Self-Study Process, Pilot Visit, & Preparation for Site Visit**

Margaret H. Mulligan, PhD, MS, *Medical College of Wisconsin, Milwaukee, WI*; Mark D. Hohenwalter, MD; Guillermo F. Carrera, MD; Frederick G. Joachim III, MD; Jennifer L. Mulkerin, MD; Kristin Fay, MD; et al

**LEARNING OBJECTIVES:** Related to ACGME Self-Study (SS) Process, learners will be able to: 1) Pinpoint stakeholders of program and plan for their input. 2) Identify key steps of SS process. 3) Optimize time and preparation for ACGME reporting. 4) Pinpoint areas for program improvement. 5) Plan for period between SS process and Site Visit.

**CONTENT DESCRIPTION:** Description of areas to be covered in poster. **Stakeholder Input:** Information will be given on this essential part of Radiology residency SS process-obtaining input on program from those who have an interest in the success/failure of your program. Discussion included on ACGME expectations on input sources and processes. ACGME's value and role as stakeholder discussed. **SS Process:** Detailed description of our residency's SS process correlated with ACGME SS Summary Reporting and Site Visit expectations. **Optimizing Time & Reporting Preparation:** Tips based on experience will be provided to strategically use participants' time and effort in all phases of the SS process. Strategies for designing process to prepare for ACGME reporting. **Ways to identify program improvement:** ACGME expectations regarding improvement and radiology residency's approach to meet expectations will be described. Strategies for success include viewing the ACGME as overlooked stakeholder in program.

**Plans for Site Visit:** Experienced based tips for preparing for Site Visit and new expectations discussed. ACGME has expectations regarding program action between SS process and Site Visit. Our Program's suggestions for actions between SS process and Site Visit; record keeping and reporting accomplishments prior to ACGME arrival.

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

**(E-116) Wednesday • 7:50–8:10 AM •****E-poster, computer #9****Development and Implementation of a Resident-Led Introductory Lecture Series for First-Year Radiology Residents**

David M. Theriot, MD, *Emory University, Atlanta, GA*; Dexter Mendoza, MD; Brent P. Little, MD; Ryan B. Peterson, MD, BS (*David.M.Theriot@emory.edu*)

**LEARNING OBJECTIVES:** After viewing our exhibit, participants will be able to: 1) Discuss training models for transitioning first-year residents into radiology. 2) Discuss potential challenges and benefits of developing a resident-led lecture series for first-year radiology residents. 3) Outline important components for an effective lecture series. 4) Assess opportunities for a resident-led lecture series for first-year radiology residents at their respective institutions.

**CONTENT DESCRIPTION: Introduction:** First-year residents enter residency with varying knowledge of radiology, depending on prior exposure during medical school and internship. Several training models, including introductory lecture series, have been used to facilitate the transition of residents into clinical radiology. In our institution, first-year level education is intermixed in didactic lectures during noon conferences, alongside upper-level residents of all years. Often, the content of these lectures exceeds the knowledge of first-year residents, particularly in the first months of residency. Previous studies demonstrated senior residents are effective teachers of junior residents due to a close proximity in experience. In this exhibit, we will discuss the development and implementation of an introductory lecture series for first-year radiology residents created and taught by senior residents under faculty supervision. **Curriculum Development:** The course was developed to ensure first year residents are exposed to basic radiology concepts and cases at the level of a graduating medical student. By reviewing anatomy, physics and fundamental cases, the lecture series hopes to smoothly transition interns into radiology. As an additional goal of training the upper-level residents as teachers, each lecture was designed and presented by a senior resident with faculty guidance and feedback. The course includes instruction on interpretative and non-interpretative skills with a mixture of didactic and case conferences. **Initial Outcomes/Future Direction:** We will discuss our experience during the first year of the lecture series including the challenges, opportunities, and initial feedback, as well as future direction.

**Other****(E-25) Tuesday • 7:00–8:15 AM • Hard-copy poster  
Creating a Culture of Continuous, Constructive Feedback—Modeling Excellence for our Learners around Diagnostic Errors**

Andrew Olson, MD; Elizabeth Cohen, MS; Jeffery Hogg, MD, *West Virginia University School of Medicine/Robert C. Byrd Health Sciences Center, Morgantown, WV* (*also5714@umn.edu*)

**LEARNING OBJECTIVES:** 1) Improve the diagnostic process by constructive engagement in feedback between radiology and clinical colleagues about errors. 2) Identify best practices for communication about errors discovered during imaging examinations and/or in imaging interpretations. 3) Apply novel tools to foster collaborative constructive discussions around diagnostic error.

**CONTENT DESCRIPTION:** Diagnostic error is common and costly. Up to 15% of inpatient and 5% of outpatient diagnoses may be in error. Opportunities for teamwork and improved patient safety may be lost if radiologists lack skills for discussing error. We describe engagement of radiologists and referring physicians with collaboration and constructive feedback in the diagnostic process. Radiologists are poised both to find and also to make diagnostic errors. Educators should equip learners for effective and empathetic conversations about diagnostic error. Physicians – not just patients and families – may suffer as a result of diagnostic errors. We describe this “second victim” effect. Skills of

error disclosure and communication among referring physicians and radiologists are important. Well-developed skills support and nurture ongoing collegial, positive, and effective relationships. The opposite results if these discussions go poorly. Such discussions about error are so fundamental that the ABR addresses these in their non-interpretive skills domain. We present tools to teach feedback and discussion about diagnostic error for radiology educators, including communication simulation, online virtual patient cases, and discussions in interdisciplinary conferences. We reference evidence supporting that effective feedback should be timely, collaborative, emotionally safe, specific, and with limited scope. We offer learners approaches, language, and suggestions on dealing with errors in diagnosis that involve the radiologist’s work, the referring physicians’ work or both. We engage learners to examine their own practice, reflect on clinical and educational examples, and approach discussion of errors in a positive and mutually satisfying manner for improved practice, and better patient outcomes.

**(E-26) Wednesday • 7:00–8:15 AM •****Hard-copy poster****Parallel selection processes for medical school students and future radiologists**

Shingo Kihira, BS, *Icahn School of Medicine at Mount Sinai, New York, NY*; Thuy-My Le; Nolan J. Kagetsu, MD\* (*shingo.kihira@icahn.mssm.edu*)

**LEARNING OBJECTIVES:** 1) To address how behavioral style interviews used in medical school admissions may affect future applicants going into radiology. 2) To discuss possible trends seen in future radiology applicants and its alignment with trending admissions process for resident selection.

**CONTENT DESCRIPTION:** Through ongoing efforts to select successful future clinicians, there is rising trend in using behavioral style interviews to select for medical students. New methods such as the Multiple Many Interview (MMI), CASPER (Computer-based Assessment for Sampling Personal Characteristics), and many other behavioral style interviews are being employed increasingly commonly in screening applicants on their ability to be articulate and tactful while handling complex social situations. These tests are standardized screening tools designed to assess personal and professional characteristics. Although these tools may help to screen applicants that are articulate and with broad experiences, it may inadvertently select for a student body that is predisposed towards humanities and careers that are centered around patient interaction. Many of the questions target scenarios based on close patient interaction and ethical decision-making. We believe that this may have potential effect on future radiology applicants. Namely, this trend may decrease the number of applicants for fields that may not be centered on patient interaction such as radiology. However, in the recent years, the trend in radiology has been a push to integrate more patient involvement and to recruit students that are interested in direct patient care to broaden the scope of the field. Interestingly, this new trend in radiology resident selection may align with the screening process for upcoming generation of students. We must keep in mind that interaction with other fields is integral to radiology, as we often function as consultants and coordinate with clinicians. Thus, such elements such as effective physician-to-physician communication should be assessed in selecting residents. We hope to further explore how this trending interview style will affect both the medical student and resident body in the field of radiology.

**(E-27) Tuesday • 7:00–8:15 AM • Hard-copy poster  
An Introduction to Ophthalmic Ultrasound: Anatomy, Indication, and Pathology in Clinical Practice**

Frederic J. Bertino, MD, *Emory University, Atlanta, GA*; Steven Tucker, MD; Ryan B. Peterson, MD, BS (*fbertin@emory.edu*)

**LEARNING OBJECTIVES:** 1) Review ocular anatomy as it pertains to ophthalmic ultrasound, with a focus on the clinically relevant normal anatomic landmarks. 2) Discuss clinical indication and utility of

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ophthalmic ultrasound, image acquisition technique, and interpretation. 3) Experience a variety of pathologies as detected by ophthalmic ultrasound, including: retinal detachment, vitritis, vitreous hemorrhage, endophthalmitis, intraocular foreign body, lens dislocation, and choroidal pathology.

**CONTENT DESCRIPTION:** *Introduction:* Ultrasonography is rapidly gaining clinical appreciation across the spectrum of subspecialized fields, including emergency medicine. Ophthalmologists have adapted the use of a clinical ultrasound examination (called amplitude (A) and brightness (B) scans) for the rapid diagnosis of acute ocular pathology, especially for vitreoretinal disease and post-surgical evaluation when there is inadequate view through the pupil. Diagnostic radiologists are not often exposed to these types of images despite their routine use at the bedside by clinicians. In our exhibit, we aim to introduce the ophthalmologic ultrasound examination to radiologists to 1) expand the diagnostician's clinical acumen, 2) review clinically relevant anatomy and 3) discuss important pathology of an infrequently encountered anatomic region. *Methods:* We reviewed patient cases that have undergone ultrasound examination within our outpatient centers and emergency departments, including our pediatric hospital. We will depict the normal ocular anatomy in ultrasound imaging. We will then illustrate common and uncommon pathologies and review the technique, interpretation, clinical indication and utility to provide further insight into the necessity of the modality and to aid in the interpretation of our image collection. *Conclusion:* Ophthalmic ultrasound, though uncommonly encountered by diagnostic radiologists, remains an important component to an ophthalmologist's clinical examination. Our survey of ultrasound ocular anatomy and pathology exposes the diagnostic radiologist to an unfamiliar modality in clinical imaging.

**(E-28) Wednesday • 7:00–8:15 AM •  
Hard-copy poster  
Contrast Media: Myths and Facts**

Ami Gokli, MD, *Staten Island University Hospital, Staten Island, NY;*  
David S. Sarkany, MD

**LEARNING OBJECTIVES:** 1). Review and address common questions about the use of contrast media by clinicians, patients and radiologists. 2) Dispell myths that are still commonly believed to be true regarding contrast media with regard to CT and MRI. 3) Emphasize the importance of accurate knowledge by radiologists and clinicians when discussing contrast media, its risks, and appropriate protocoling.

**CONTENT DESCRIPTION:** Although used on an every day basis, contrast media is still a subject that many clinicians and radiologists are not comfortable with. There are many myths regarding contrast media that are still believed to be true, and which we plan to address in this educational poster. We will discuss topics such as: shellfish allergies and if they have been associated with contrast allergies; whether pregnant patients can and should receive IV contrast; prior contrast reactions and the impact on future use of contrast; the proven safety of emergent premedication protocols; breastfeeding and its impact on wither a patient should receive IV contrast; and others. In addition we will include a quiz to reinforce the take home points of the exhibit.

**(E-107) Tuesday • 7:25–7:45 AM •  
E-poster, computer #7  
Contrast Reaction Simulation: An Interdisciplinary  
Teaching Tool for Radiology Residents, Fellows, Attend-  
ings, Nurses and Technologists**

Alisa Sumkin, DO, *University of Pittsburgh, Pittsburgh, PA;* Michael  
J. Magnetta, MD, MS; Marion A. Hughes, MD\*; Philip Orons, DO  
(sumkina3@upmc.edu)

**LEARNING OBJECTIVES:** Participants should be able to promptly recognize and treat contrast reactions utilizing an interdisciplinary approach amongst various healthcare workers. They should also understand contraindications and appropriate use of IV contrast.

**CONTENT DESCRIPTION:** Our goal was to develop a recurring training course to increase familiarity of types of contrast reactions and teach ACR based treatment algorithms to all members of the healthcare team involved in a contrast reaction including technologists, nurses, residents, fellows and attending physicians. Teaching was performed using a combination of standard didactic methods and simulation. Participant baseline contrast reaction knowledge was assessed with a 17 question multiple-choice pre-test. Participants then viewed an interactive online module containing information regarding properties of IV contrast material, contraindications to administration of contrast agents and management of a variety of contrast reactions. Following the module participants completed a two-hour simulation on 5 life-like simulation dummies designed to mimic life-threatening contrast reactions. Since participants included technologists, nurses and all levels of physicians, simulations were designed to reflect the actual roles of each healthcare provider's position as part of the healthcare team. Following each simulation, participants were debriefed individually and then as a large group. They then completed the same 17 question post-quiz. A total of 70 healthcare members (32 residents, 13 attendings, 13 fellows, 4 nurses, 1 physician assistant, 1 radiology assistant student, 6 technologists) participated in the course. The average score of the baseline knowledge quiz was 65% with a standard deviation of 13%. The average post quiz score was 74% with a standard deviation of 12%,  $p < 0.001$ . We created an innovative, effective program, which emphasizes an integrative approach to teaching members of the healthcare team to recognize and treat contrast reactions using traditional didactic methods and simulation.

**(E-108) Wednesday • 7:50–8:10 AM •  
E-poster, computer #5  
Teaching Radiology in Malawi, Africa: Lessons Learned  
by a Diagnostic Radiology Resident**

Gary G. Tse, MD, *UC Davis Medical Center, Sacramento, CA;* Rebecca  
Stein-Wexler, MD\* (ggtse@ucdavis.edu)

**LEARNING OBJECTIVES:** 1) Discuss the goals of the global health initiative in Malawi, Africa. 2) Describe the Diagnostic Radiology Resident's role in the international outreach effort at Kamazu Central Hospital, Lilongwe, Malawi Africa. 3) Address what could have been done differently to improve the resident experience and participation on international electives. 4) Examine the challenges faced by the Kamazu Central Hospital Radiology Department and other similar underserved hospitals and review potential solutions or future directions that may help resolve these challenges.

**CONTENT DESCRIPTION:** Kamazu Central Hospital (KCH) is a tertiary referral hospital located in Lilongwe, Malawi's capitol city. At this hospital serving approximately 1 million people, there is only 1 part time diagnostic radiologist, 1 CT scanner, 4 radiographic units, and 3 ultrasound machines, most of which are donated used and function suboptimally. Therefore, the primary challenge is that the radiology service cannot meet the patient care demand. The primary goal of the RAD-AID global health initiative at KCH is to promote sustainable radiologic advances to improve patient outcomes and clinical education. Both a pediatric radiologist and senior resident from a U.S. university hospital spent one week at KCH collaborating with the attending radiologist, teaching radiology to prospective radiology resident applicants, and rounding with the clinical pediatric and medicine teams on the wards. They also observed and reviewed what educational and resource disparities existed to make recommendations to the RAD-AID International Group which would help guide future radiological objectives and educational endeavors. While there were positive achievements that resulted from their clinical and educational efforts, there were also unexpected challenges and mishaps which could have been mitigated. In this abstract, we hope to report on the RAD-AID global health initiative goals in Malawi, Africa and the current strategy for aid intervention. Moreover, we hope to describe our inefficiencies and make recommendations on how they may be avoided in future aid efforts.

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**(E-109) Wednesday • 7:50–8:10 AM •  
E-poster, computer #7  
Drawing the Eye and Keeping it: Tips and Tricks to Keep  
Your Learners Engaged**

Susanna C. Spence, MD, *University of Texas, Houston, TX*  
([susanna.c.spence@uth.tmc.edu](mailto:susanna.c.spence@uth.tmc.edu))

**LEARNING OBJECTIVES:** 1) Learn the basics of using dynamic presentations inside powerpoint. 2) Free tools for building audience response into your presentations.

**CONTENT DESCRIPTION:** This is not the basics of how to make text appear in powerpoint. It's about: 1. Motion paths: Want to show how rigid spine puts the upper and lower ends of the fusion block at risk? Show how the spine moves! 2. Magnifying key parts of the image for emphasis. 3. Adding gifs and scrollable image stacks in the middle of your presentation: show how that liver hemangioma enhances over time. 4. Create your own uncopyrighted drawings by tracing an object. 5. Show how a fracture line moves across the pelvis with serial images. Combine this with what we know about today's learner: the average attention span is now approximately 8 seconds. What if you can take advantage of the need for change, by subtly changing your slide as you move through the explanation, just enough to keep the viewer's eye on the screen? No annoying flashy graphics, just subtle movements and changes that draw attention. Use it to make them follow your line of thought as you move through your differential or search pattern. Learn about free online tools that can embed audience response into your images. Are they checking their phone during your presentation? Make them use it to answer your questions and stay engaged!

## Health Services for Radiology

**(E-117) Tuesday • 7:00–7:20 AM •  
E-poster, computer #5  
Landing Safely: Reducing Diagnostic Error On-Call  
Through Education, Workflow and Cognitive Engineering  
for Radiology Residents**

Andrew J. Degnan, MD, *University of Pittsburgh Medical Center, Pittsburgh, PA*; Carinna M. Scotti-Degnan, PhD ([DegnanAJ@upmc.edu](mailto:DegnanAJ@upmc.edu))

**LEARNING OBJECTIVES:** 1) Define concerns related to diagnostic error in on-call radiology. 2) Examine interventions to reduce cognitive biases and workflow protocols to optimize study interpretation. 3) Model strategies including checklists and teamwork approaches to improve radiology resident performance.

**CONTENT DESCRIPTION:** Radiology plays a central role in diagnosis including many conditions requiring prompt medical or surgical intervention overnight. The on-call radiologist, often a trainee, is confronted with challenging cases that require knowledge, expertise and awareness. While the practice of radiology residents rendering independent preliminary interpretations on-call has decreased in recent years, early independent decision-making experience remains an essential component of training with implications for patient care at academic medical centers. Diagnostic imaging safety is affected by the interplay of human factors including cognitive psychology, workflow processes, imaging technology and institutional culture. An intricate appreciation of these factors can be engaged to optimize radiology resident performance on-call. Resident education prior to call can be leveraged to advantage residents in increasing awareness of cognitive biases, improving meta-cognition and avoiding common pitfalls through reflection and simulation exercises. Workflow designs to reduce reading room interruptions, streamline communication with referring clinicians, and establish a "sterile cockpit" through delegation of non-essential duties may mitigate errors by focusing resident attention during image interpretation tasks and allowing uninterrupted communication of critical findings. A standardized approach to interpreting high-risk studies using checklists, akin to those used by the aviation industry, also serves to enhance the diagnostic performance of on-call radiologists. Responsible scheduling

practices that incorporate teamwork amongst on-call residents establish optimal conditions for safe resident performance in minimizing eye strain, reducing perceptual errors and incorporating redundancy. These approaches have the potential to increase detection of critical findings and improve learning while on-call.

**(E-118) Tuesday • 7:25–7:45 AM •  
E-poster, computer #5  
Accident Investigation: Lessons from Cognitive Psychology and Aviation for Understanding and Avoiding Diagnostic Error by Radiology Residents On-Call**

Andrew J. Degnan, MD, *University of Pittsburgh Medical Center, Pittsburgh, PA*; Carinna M. Scotti-Degnan, PhD; Mitchell Rees, MD; Anish Ghodadra, MD\* ([DegnanAJ@upmc.edu](mailto:DegnanAJ@upmc.edu))

**LEARNING OBJECTIVES:** 1) Highlight common sources of error in diagnostic radiology residents on-call. 2) Outline standardized approaches to error investigation through root cause analysis. 3) Discuss approaches to collective learning from errors.

**CONTENT DESCRIPTION:** Diagnostic error in medicine including misinterpretation of imaging studies comprises the largest component of medical error in general, contributing to inappropriate treatment with resultant morbidity and mortality. While diagnostic error in perceptual specialties including radiology is less than that of clinical specialties in general, deficiencies in missing or overcalling findings on imaging studies have a clear clinical impact that is presently underappreciated. Radiology residents on-call perform valuable clinical service in providing prompt interpretation of complex imaging studies in critically-ill patients with low discrepancy rates, but error occurs despite appropriate training. Creating a culture of safety requires residents on-call to learn from past mistakes and take steps to minimize future errors. Diverse approaches to diagnostic error exist that seek to understand predisposing factors that increase the risk of error, discern whether error resulted from individual or systems-related deficiencies, and develop appropriate responses to address mistakes. Understanding the complex, multifactorial nature of error on-call necessitates a standardized approach that takes advantage of lessons from safety science including prospective failure mode and effects analysis in addition to retrospective root cause analysis. Individual human factors including cognitive errors related to heuristics, unsafe organizational psychology and suboptimal workflow practices all contribute to mistakes. Evaluation of diagnostic error should not be limited to only significant errors, but should also examine near-miss events that highlight vulnerable patterns. Residency programs can benefit from interactive diagnostic error conferences that outline causes of error, promote collective learning and minimize individual blame.

## Informatics

**(E-63) Wednesday • 7:00–8:15 AM •  
Hard-copy poster  
Case Files 101: Best Practices for Building a Personal  
Library of Teaching Cases**

Andrew B. Ross, MD, MPH, *University of Wisconsin School of Medicine and Public Health, Madison, WI*

**LEARNING OBJECTIVES:** 1) Describe the important characteristics of a personal teaching case file system. 2) Identify multiple software options for the storage, organization, manipulation, back up, and presentation of teaching case files. 3) Select a software platform and implement a robust and "future-proof" system for maintaining personal teaching cases.

**CONTENT DESCRIPTION:** A robust personal teaching case file offers many advantages to the radiologist, providing a ready source of images and cases for the teaching of residents and for use in educational presentations or manuscripts. Although a variety of options exist for maintaining a library of teaching cases, many of these are created for

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enterprise and department-wide use and lack the portability and flexibility desired by the individual radiologist. Multiple software solutions exist to fill this gap but must be implemented in a way that fulfill the key criteria of an effective teaching file system: HIPAA compliance, portability, redundancy, searchability, ease of presentation, and format compatibility ("future proofing"). Part I of this exhibit describes each of the components of an effective teaching file system in detail providing the background that the reader may then use to evaluate the pros and cons of existing software options and storage systems. Part II discusses existing cross-platform software options including their advantages and disadvantages and specific tips for their implementation. Multiple examples are provided to illustrate ways to optimize storage and redundancy, searchability, and ease of image annotation and presentation. Strategies and potential pitfalls for maintaining HIPAA compliance are discussed in detail. Part III illustrates important habits for the ongoing maintenance and upkeep of an effective teaching file system over time and provides tips for successful implementation.

## Interventional Radiology

### (E-64) Tuesday • 7:00–8:15 AM • Hard-copy poster Teaching Interventional Radiology Technical Skills and Concepts for Radiology Residents Through a Hands-On Practicum: How We Do It

Kumar Shah, MD; Jeffrey Kempf, MD; Vyacheslav Gendel, MD; Issam F. Moubarak, MD, MS; Omar Hasan, *Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ (kumar.shah@univrad.com)*

**LEARNING OBJECTIVES:** 1) Discuss current challenges Radiology residents face on a busy Interventional Radiology (IR) rotation. 2) To present our IR Practicum including the four simulation stations we use to teach: ultrasound (US) guided vascular access, US-guided biopsy techniques using gel-based phantoms, IR tools of the trade, as well as a comprehensive review of the code cart and contrast reactions. 3) To review our trainees feedback regarding the success of this program.

**CONTENT DESCRIPTION:** IR concepts and hands-on techniques are essential to Diagnostic Radiology training, but can be difficult to teach during a busy IR workday. We have developed an annual hands-on resident IR practicum in a supervised simulation setting which fosters procedural skills development and knowledge of IR tools. We hold a full day training session during the beginning of each academic year for all our radiology residents where they rotate through four different stations, each of which we will present in detail in this exhibit. The first focuses on simulated US-guided access using a gel-based phantom to learn the technical aspects of US directed vascular access. The second station focuses on US-guided biopsy of artificially placed targets in a gelatin medium, suitable for US use with adequate visualization of the biopsy needle and target. The third station consists of a comprehensive hands-on display of commonly used tools in IR such as wires, catheters, balloons, stents, filters, and embolics along with a discussion of their physical characteristics, optimal selection and use. The fourth station consists of a code cart with review of emergency code interventions, commonly used IR drugs, and treatment of contrast reactions. In our most recent post-practicum survey, 100% of residents agreed or strongly agreed with feeling more confident with US-guided vascular access and biopsies; 71% agreed or strongly agreed to feeling more comfortable with the code cart, running codes and handling contrast reactions, and 93% agreed or strongly agreed to feeling better prepared for their IR rotation. All residents recommended our hands-on practicum be continued for future trainees.

### (E-65) Wednesday • 7:00–8:15 AM • Hard-copy poster

#### Use of Simulation in Interventional Radiology Training

Umairullah Lodhi, MD, *North Shore University Hospital and Long Island Jewish Medical Center, Manhasset, NY*; Saadullah Khan; Muhammad S. Amjad, MD

**LEARNING OBJECTIVES:** 1) To understand and appreciate the value of simulation in interventional radiology training and how it can improve resident training as well as patient care. 2) The online simulator will enable users to navigate through as many 130 case scenarios using various techniques currently employed in interventional radiology. 3) Through accurate speech recognition software, users will be able to dictate cases using bluetooth technology.

**CONTENT DESCRIPTION:** 1. Simulation is a proven strategy to mimic real life experiences while ensuring safety, and has been validated in the military, aviation, and increasingly in medicine. 2. Similarly, simulation has surfaced in diagnostic radiology training programs for various purposes such as call preparation. 3. Our online radiology simulator incorporates several key components required for realistic simulation. It enables realistic visualization of anatomy and instrument activity with active real-time feedback. It also features entire scrollable cross-sectional studies in multiple planes, thereby closely approximating the experience of the picture archiving and communication system (PACS) used at most institutions. 4. The stimulator also features accurate speech recognition technology powered by leading medical dictation software. 5. Lastly, the simulator has an ever-expanding database of case scenarios thereby providing most up-to-date information to its users.

### (E-66) Tuesday • 7:00–8:15 AM • Hard-copy poster Urology 101: Review of surgical techniques for native and transplant ureters and their post-surgical appearance

Adam J. DeFoe, MD, *University of Nebraska Medical Center, Omaha, NE*; Christopher J. Vargo, MD; Andrew Heckman; Dick Slater, MD; Joseph J. McBride, MD

**LEARNING OBJECTIVES:** 1) Review the surgical options available for ureteral diversion following cystectomy and identify their post-surgical imaging appearance. 2) Review the surgical options available for treatment of transplant ureteral stricture and identify their post-surgical imaging appearance.

**CONTENT DESCRIPTION:** Percutaneous renal interventions are common in interventional radiology. As many of these patients will have undergone ureteral surgery, it is important to be familiar with the surgical options and their imaging appearances. Following cystectomy ureteral diversion is achieved with either an ileal conduit or orthotopic neobladder creation. Multiple techniques are available for both. An ileal conduit nephrostogram will opacify the ureter anastomosed to a loop of ileum. An orthotopic neobladder's appearance depends on the particular technique used, though will be located in the pelvis, attached to the urethra. Transplant ureter strictures have an incidence of 2-6%. Ureteroneocystostomy is the most common surgical procedure, whereby the non-stenosed portion of the allograft ureter is reimplanted into the bladder. Other options include a ureteroureterostomy or ureteropyelostomy that connect the recipient native ureter to the donor ureter or donor renal pelvis, respectively. Additional techniques include use of the contralateral ureter, direct anastomosis of the renal pelvis to the bladder, small bowel interposition, and mobilization of the bladder (Boari flap, psoas hitch). For ureteroneocystostomy, the basic approach is to tunnel the transplant ureter through the bladder wall to prevent reflux. Post-surgical nephrostogram will demonstrate the new ureter location. With ureteroureterostomy and ureteropyelostomy it is important to note that the allograft ureter remains intact, with visualization of two ureters on a post-surgical nephrostogram common. Bladder-mobilization techniques will show distortion of the bladder commensurate with the procedure used.

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(E-67) Wednesday • 7:00–8:15 AM •

Hard-copy poster

Is it real or not? That's the question! Imaging of arterial dissection and its mimics

Melkamu Adeb, Yale New Haven Health, Bridgeport Hospital, Bridgeport, CT; Salil Sharma; Yogesh Kumar, MD (*melkamu.adeb@bpthosp.org*)

**LEARNING OBJECTIVES:** 1) Discuss imaging findings of commonly encountered arterial dissections. 2) Describe common mimics of arterial dissection on CT and MR angiography arterial imaging for evaluation of dissections. 3) Describe protocol optimization of CT and MR angiography to minimize possible pitfalls in imaging of arterial dissection.

**CONTENT DESCRIPTION:** I. Carotid dissections: A. CTA/ MRA findings: 1. Pearls and pitfall. 2. Imaging examples. B. Mimics. 1. Imaging examples. C. Protocol optimization to avoid pitfalls. II. Vertebral artery dissections: A. CTA/ MRA findings: 1. Pearls and pitfall. 2. Imaging examples. B. Mimics. 1. Imaging examples. C. Protocol optimization to avoid pitfalls. III. Aortic dissections: A. CTA/ MRA findings: 1. Pearls and pitfall. 2. Imaging examples. B. Mimics. 1. Imaging examples. C. Protocol optimization to avoid pitfalls. IV. Mesenteric artery dissections: A. CTA/ MRA findings: 1. Pearls and pitfall. 2. Imaging examples. B. Mimics. 1. Imaging examples. C. Protocol optimization to avoid pitfalls.

(E-68) Tuesday • 7:00–8:15 AM • Hard-copy poster  
The weakest link: A quiz on CT angiography of the extremities

Nikhil Madhuripan, MD, UMMS-Baystate, Springfield, MA; Andrew Moon; Njogu Njuguna, MD

**LEARNING OBJECTIVES:** 1) Learn upper and lower extremity anatomy on CTA. 2) Learn protocol for acquiring CTA of the extremities. 3) Review common pathologies with focus on findings related to trauma.

**CONTENT DESCRIPTION:** CT angiography of the extremities is an extremely valuable tool for non invasively imaging the arterial tree. It has found a permanent place in being the first line tool in cases presenting to the ED with suspected vessel injury. Extremity vasculature emergencies presenting to the ED have different management and outcomes depending on the cause and nature of injury. They range from symptoms of chronic claudication to critical limb ischemia at risk for loss of limb and life. Characterizing them prior to the decision for intervention and planning the technique of intervention is of prime importance to the interventional radiologist/vascular surgeon taking on the case. This quiz based approach provides a structured approach to evaluating the vessels with review of common pathologies. Conditions discussed include active arterial bleeding, occlusion/transection, pseudoaneurysms, traumatic AV fistula, dissection, takayasu arteritis, giant cell arteritis, buerger disease, raynaud phenomenon, hypothernar hammer syndrome, and thoracic outlet obstruction.

## Musculoskeletal

(E-71) Wednesday • 7:00–8:15 AM •

Hard-copy poster

Medial Plica Syndrome: A Forgotten Cause of Knee Pain

Meagan Uzee, MD, Baylor Scott & White Health, Temple, TX; Brandon Ashton, MD; Richard Auzenne, MD; Connie C. So, MD; Ricardo D. Garza-Gongora, MD; Linda Parman, MD

**LEARNING OBJECTIVES:** 1) Review the three most common knee plicae and their relevant anatomy. 2) Demonstrate how to classify a medial plica via the Sakakibara Classification system and examine how each type correlates with the development of medial plica syndrome. 3) Discuss medial plica syndrome to include understanding both the surgical and nonsurgical treatment approaches.

**CONTENT DESCRIPTION:** Knee plicae are normal anatomic structures that can become symptomatic and result in painful, limited knee mobility. If a radiologist does not know to specifically look for this cause of knee pain on MRI, it can be easy to overlook. There are three knee plicae that are seen most commonly: the suprapatellar plica, the infrapatellar plica, and the medial plica. Although the infrapatellar plica is the most common of these three types of plicae, the medial plica is, by far, the most likely to become symptomatic. Medial plica syndrome is usually seen in people who are involved in an athletic activity requiring repetitive flexion-extension and/or will follow an episode of trauma, sometimes even months to years later. The resultant inflammation of the plica itself can cause pain; however, the secondary effects on the synovium and articular cartilage are usually the reason why the patient presents with pain. The Sakakibara Classification System separates medial plicae morphologically into four categories, which can predict their likelihood of being symptomatic. Both clinical presentation and evaluation for a plica on MRI, generally with gradient-echo T2 weighted and fat-suppressed T2 or proton density weighted images, will help guide this diagnosis. Therefore, it is important that the radiologist be aware of knee plicae and specifically look for them, particularly when a knee MRI does not have other significant findings that suggest an alternate diagnosis. Both diagrams and complementary MRI images depicting the normal anatomy of knee plicae will be reviewed. Correlative arthroscopic images will also be provided to further delineate the anatomy/pathology.

(E-72) Tuesday • 7:00–8:15 AM • Hard-copy poster  
MRI Characteristics of Adhesive Capsulitis

Marcelo D. Ribeiro, MD, RN, Temple, TX; Preston Spindle, MD; Ricardo D. Garza-Gongora, MD

**LEARNING OBJECTIVES:** 1) Review anatomy of the shoulder pertaining to adhesive capsulitis. 2) Briefly explain the pathophysiology and clinical stages of adhesive capsulitis. 3) Discuss findings seen on MRI in the setting of adhesive capsulitis.

**CONTENT DESCRIPTION:** Adhesive capsulitis, commonly known as frozen shoulder, is characterized by thickening, inflammation and contraction of the shoulder joint capsule with involvement of the adjacent synovium. This is more often seen in women in the 5th and 6th decades of life with diabetes being an additional significant risk factor. Three distinct clinical stages are described as: a painful "freezing" stage, traditional "frozen" stage and an improving "thawing" stage. Anatomy primarily involved and normally seen on MRI includes the axillary recess of the joint capsule as well as the coracohumeral ligament and superior glenohumeral ligament, which are located in the rotator interval. Other structures include the subcoracoid triangle, long head of the biceps tendon, rotator cuff and inferior glenohumeral ligament. When evaluating the rotator interval in the setting of adhesive capsulitis, you can expect to see thickening and increased signal of the coracohumeral ligament in addition to a thickened capsule. The axillary recess of the joint will demonstrate decreased volume, also due to thickening and edema of the capsule. Other findings would include

complete loss of the fat in the subcoracoid triangle, thickening and edema of the inferior glenohumeral ligament and pericapsular edema in the rotator cuff.

**(E-73) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Facing-off with Lacrosse Injuries: The Fastest Game on Two Feet**

Corey Ho, MD, BA, *State University of New York-Stony Brook, Stony Brook, NY*; Ezemonye Madu, DO; Matthew Teng, MD; Mingqian Huang, MD (*corey.ho@stonybrookmedicine.edu*)

**LEARNING OBJECTIVES:** 1) Discuss the common injuries suffered by the lacrosse player, which is one of the fastest growing sports across the nation. 2) Describe imaging findings and explain the mechanisms behind common lacrosse injuries across both genders.

**CONTENT DESCRIPTION:** This exhibit will demonstrate the wide variety of injuries that a lacrosse player often sustains. Understanding types of injuries that are commonly suffered can help to tailor our protocols and search patterns. I. Background: Lacrosse was one of the most popular games that Native Americans historically played. In recent years its popularity has soared with increased youth participation and formation of a professional league. As participation grows, musculoskeletal imagers should familiarize themselves with the constellation of injuries commonly sustained by the lacrosse player. II. Rules and Common Injuries: As lacrosse is a full contact sport, injury patterns involve the entire body varying from rotator cuff pathology to lower extremity stress fractures. Given the different rules between the men's and women's versions of the sport, injury patterns also vary. III. Case Presentations: Selected cases will illustrate common examples of lacrosse injuries suffered across both genders. IV. Conclusion: Lacrosse is a high impact sport that is demanding on both the upper and lower body. Understanding the most prevalent injuries that can occur will aid in proper diagnosis in a growing population of athletes.

**(E-74) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Hamstring Injuries; how the radiologist's report can help guide treatment course and return to activity**

Casey Reed, MD, *University of Cincinnati Department of Radiology, Cincinnati, OH*; Kaushal Mehta, MD; Eric B. England, MD

**LEARNING OBJECTIVES:** 1) Identify patterns of imaging findings in hamstring injuries and how they apply to current grading systems. 2) Explain how associated imaging findings, in addition to the conventional grading of injury, relate to length of recovery and return to physical activity.

**CONTENT DESCRIPTION:** The Semimembranosus, Semitendinosus, and Biceps Femoris, collectively known as the hamstrings, are three of a small number of muscles in the body that cross and act upon two joints. As such, they play an important role in many daily activities by providing extension at the hip as well as flexing the knee joint. While crossing two major joints allows for unique biomechanical functions, it also creates a greater predisposition to injury. In addition to conventional injury grading, associated imaging findings such as intramuscular hematoma or disruption of the central tendon can be used to help determine an appropriate treatment course and anticipated duration of recovery.

**(E-75) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Myositis Ossificans: A Potentially Dangerous Tumor Like Lesion of the Soft Tissues**

Stephen Ling, MD, *Temple University Hospital, Philadelphia, PA*; Omer A. Awan, MD; Sarah Fenerty; Padmaja Jonnalagadda; Sayed Ali, MD (*stephen.ling@tuhs.temple.edu*)

**LEARNING OBJECTIVES:** 1) Describe the epidemiology, causes, and pathophysiology of myositis ossificans. 2) Identify the imaging characteristics of myositis ossificans in its different stages, as well as the radiologic appearance of certain osteoid forming tumors originating from the surface of bone or deriving from the extraosseous soft tissues that may be mistaken for myositis ossificans. 3) Discuss multimodality imaging workup, pitfalls in imaging interpretation, and the critical role of the radiologist in correctly making the diagnosis of myositis ossificans.

**CONTENT DESCRIPTION:** Myositis ossificans is a benign, self-limited, focal bone forming process occurring within muscle. It presents as a mass in the musculature, and the entity may clinically be inaccurately diagnosed as a soft tissue tumor. Several osteoid and chondroid producing neoplasms are known to arise in the soft tissues or at the surface of bone. In the case of some of these neoplasms, myositis ossificans may appear similar to and can be mistaken for a "true" tumor on imaging. As a result, there is potential for unnecessary biopsies, and more importantly the possibility of tissue sampling that is histologically erroneous due to the presence of immature osteoid in the central portion of the mineralization early on in the process. Confident differentiation of myositis ossificans from these tumors by the radiologist with imaging is of paramount importance. We will discuss the epidemiology, common causes and pathophysiology of myositis ossificans. Imaging examples that demonstrate findings corresponding with the various stages of the entity will be provided. Imaging characteristics of osteoid and cartilage forming tumors originating from the surface of bone or deriving from the extraosseous soft tissues, including parosteal and extraskeletal subtypes of osteosarcoma, will also be highlighted. This will overall present a spectrum of both tumor and tumor like lesions. Furthermore, we will discuss multimodality radiologic workup and pitfalls in imaging interpretation related to this soft tissue pseudotumor.

**(E-76) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**How Did We Get Here? A review of the progression from early osteochondral injury to frank osteochondral defect utilizing multimodality grading systems**

Jed Hollingsworth, DO, *University of Massachusetts Medical School-Baystate Medical Center, Springfield, MA*; Amy M. Oliveira, MD; Parthiv N. Mehta, MBBS, MD

**LEARNING OBJECTIVES:** 1) Review the most common locations for developing osteochondral defects. 2) Develop a systematic approach in assessing for osteochondral injury. 3) Review the injury grading systems for radiographs, computed tomography, and magnetic resonance as well as the surgical grading system correlate. 4) Cover the limitations of each modality during each phase of injury. 5) Address potential mimickers and pitfalls.

**CONTENT DESCRIPTION:** Osteochondral defect, previously described as osteochondritis dissecans (OCD), is a process in which there is aseptic osteochondral fragmentation and is most often seen in the knee, elbow, and ankle; although termed osteochondral lesion of the talus (OLT) when involving the talus. Manifestation typically occurs in adolescence to mid adulthood and is often associated with a traumatic event, repetitive microtrauma, or decreased perfusion. Symptomatically speaking, the patients can be clinically silent for an extended period of time, but once fragmentation has occurred and a loose body is present, pain and locking symptoms can occur. Although an osteochondral defect is the late stage of osteochondral injury, it is important to recognize the progression of this injury, which may be demonstrated on radiographs, computed tomography, and magnetic resonance. Fortunately, grading systems for each modality have been developed based on the imaging characteristics and further help to

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standardize reporting. As is the case with so many musculoskeletal processes, correlation with the surgical grading system will be made as will a brief overview of surgical intervention. Multimodality imaging, primarily MR, of the later stages of injury involving the knee, elbow, and ankle are included as are radiographic and CT correlates when applicable. A short three to five question quiz will be included at the end of the presentation.

**(E-77) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**Talar Injuries: A Pictorial Review**

Richard Auzenne, MD, *Baylor Scott and White Memorial Hospital, Temple, TX*; Jeffrey D. Stevens, MD; Ricardo D. Garza-Gongora, MD; Linda Parman, MD; Connie C. So, MD (*Richard.Auzenne@bswhealth.org*)

**LEARNING OBJECTIVES:** 1) Detail the unusual skeletal anatomy and vulnerable vascular supply of the talus, which predisposes it to long-term complications, such as avascular necrosis. 2) Describe relevant imaging features of various talar injury patterns and further detail associated classification systems, most notably the Hawkins-Canale and Sneppen systems.

**CONTENT DESCRIPTION:** While talar fractures commonly result from high-energy trauma, radiographic findings may be subtle and even radiographically occult. Given the talus's tenuous blood supply, these fractures are at increased risk for long term morbidity, such as avascular necrosis and post-traumatic arthritis; therefore, accurate detection and prompt management is essential to avoid these devastating complications. This educational exhibit will give a detailed pictorial depiction of the skeletal anatomy of the talus, to include articulations with the tibia, fibula, calcaneus, and navicular bones. Additionally, the atypical vascular anatomy will be discussed in detail. The radiologic evaluation begins with foot and ankle radiographs, which may include a Canale view and a Harris view to evaluate the talar neck and talocalcaneal articulations, respectively. Given the complex anatomy of the talus, a CT scan is often necessary to evaluate fracture extension, comminution, displacement, and associated injuries. In evaluating talar fractures, the talus is separated into three parts, the head, neck, and body—each of which has its own management. Talar head fractures can often be treated conservatively, though CT is frequently required to evaluate for extension into the neck. Talar neck fractures are commonly classified according to the Hawkins-Canale system, which evaluates displacement of the body of the talus, and carries a strong correlation with risk of avascular necrosis. Talar body fractures are further divided into fractures of the talar dome, lateral, and posterior processes and shear and crush injuries which are detailed using the Sneppen classification system. Talar dislocations will also be discussed, as they often accompany these fractures and carry a high incidence of post-traumatic arthritis when present.

**(E-78) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Friday Night Football, Monday Morning MRI: A Review of High School Football Knee Injuries**

Fara Shikoh, MD, *University of Kentucky, Lexington, KY*; David Mehr; Paul Spicer, MD

**LEARNING OBJECTIVES:** The learning objectives of this educational exhibit is to review various knee injuries encountered during high school football due to both contact and non-contact injuries. After reviewing this exhibit the learner will be able to describe and apply: 1. Bone marrow edema patterns correlating with specific injuries. 2. Common ligamentous and tendon injuries, meniscal pathology and dislocations. 3. Mechanism of injury associated with the various injuries.

**CONTENT DESCRIPTION:** Topics to be covered would include: A. Bone marrow edema patterns associated with various injuries such as pivot shift contusion patterns in ACL tears, kissing contusions of hyperextension injuries and transient lateral patellar dislocations. B. Ligamentous injuries including ACL and collateral ligament tears as well as posterior lateral corner injuries. C. Meniscal injuries including radial tears and

bucket-handle tears. D. Dislocations including transient lateral patellar dislocation and knee dislocation. E. Brief overview of the mechanism of injury associated with each injury.

**(E-79) Wednesday • 7:00–8:15 AM •**

**Hard-copy poster**

**Tumoral Calcinosis: Uncommon Masses In End Stage Renal Disease**

Juan S. Gomez, MD; Jeremy B. Nguyen, MD, MS; Enrique Palacios, MD; Michael Serou, MD; Cynthia W. Hanemann, MD; Mandy C. Weidenhaft, MD, *River Ridge, LA*

**LEARNING OBJECTIVES:** 1) Discuss the medical entity known as Tumoral Calcinosis (TC) and its association with end stage renal disease (ERSD). 2) Identify the characteristic features of TC in imaging studies and histopathology slides. 3) Describe the most common differential diagnosis of TC and its symptomatic manifestations. 4) Provide a literature review of the treatment and management of TC.

**CONTENT DESCRIPTION:** Tumoral Calcinosis (TC) is an uncommon familial disease, characterized by dense, lobular calcified benign masses in soft tissue of the extensor surface of a bursa. The characteristic imaging features typically include amorphous, multilobulated cystic calcifications in the periarticular distribution. Tumoral Calcinosis is secondary to a mutation in FGF23 (Fibroblast Growth Factor 23), KL (Klotho) gene and the N-acetylgalactosaminyltransferase 3 (GALNT3) gene. TC is most frequently seen in African Americans without gender predominance and usually appears in childhood or young adulthood in the first and second decade of life. Tumoral Calcinosis may be classified into three types: 1. Primary normophosphatemic TC; in this type, patients have normal serum calcium and phosphate levels. 2. Primary hyperphosphatemic TC characterized by a defect in phosphate resorption. 3. Secondary TC: these patients have a concurrent disease that causes soft tissue calcification, such as chronic renal failure with a secondary hypervitaminosis D, hyperparathyroidism and bone destruction. Imaging and biopsy may confirm the diagnosis revealing yellow material containing calcium hydroxyapatite. In this presentation, the imaging and histopathology findings of TC in three patients with ESRD are presented. Computer Tomography and radiography are performed to illustrate the imaging findings of this disease process.

**(E-119) Tuesday • 7:00–7:20 AM •**

**E-poster, computer #6**

**Spectrum of MRI Bone Marrow Contusion Patterns in the Traumatic Knee**

Omer A. Awan, MD, *Temple University Hospital, Philadelphia, PA*; Sarah Fenerty; Padmaja Jonnalagadda; Stephen Ling, MD; Sayed Ali, MD (*omer.awan@tuhs.temple.edu*)

**LEARNING OBJECTIVES:** 1) Recognize the five most common MRI bone marrow contusion patterns encountered in the traumatic knee. 2) Identify the associated soft tissue injury/injuries that corresponds with each of the five most common MRI bone marrow contusion patterns. 3) Explain the different treatment implications for the five most common MRI bone marrow contusion patterns.

**CONTENT DESCRIPTION:** In the setting of trauma, radiographically occult marrow contusions are often assessed with MRI, and show areas of hyperintense signal on T2 and STIR weighted MRI images secondary to edema, hemorrhage, or hyperemia. These injuries usually result from a direct blow, compression forces from adjacent osseous structures, or traction forces from avulsive injuries. Recognition of the specific bone marrow contusion patterns about the knee remains extremely important for the radiologist because the contusion pattern will often predict the associated soft tissue injury that will be present, which then will dictate management. Five different contusions patterns have been described in the literature, all of which with different mechanisms of injury, as well as different associated soft tissue injuries; and these include pivot shift injury, acute lateral patellar dislocation/relocation, clip injury, hyperextension injury, and dashboard injury. This presentation

will highlight the five different contusion patterns within the knee. The mechanism of injury, pathophysiology, MRI imaging appearance, associated soft tissue injuries, and treatment implications will be discussed for all five edema patterns. We will provide examples of each entity to show the spectrum of findings.

**(E-120) Tuesday • 7:25–7:45 AM •**

**E-poster, computer #9**

**Learning the Labrum: An Approach to the Acetabular Labrum on MRI**

Nathaniel G. Gray, MD, *Wake Forest School of Medicine, Winston-Salem, NC*; Scott D. Wuertzer, MD; Bahram Kiani, MD, MHA; Leon Lenchik, MD

**LEARNING OBJECTIVES:** 1. Review MRI anatomy of the acetabular labrum, including normal variants. 2) Describe a systematic approach to evaluating the labrum. 3) Apply this approach to case examples of arthroscopically proven hip joint pathology.

**CONTENT DESCRIPTION:** Acetabular labral pathology is a common source of hip pain that can lead to premature osteoarthritis in young patients. The diagnosis of labral pathology can be difficult due to the varied appearance of the normal and abnormal labrum. The labrum is not oriented in a standard orthogonal plane, which makes the evaluation more difficult. In this exhibit, we review the normal anatomy of the labrum on MRI, including normal variants that can commonly be mistaken for tears. We provide a systematic approach that can be used to diagnose labral tears, describe their appearance, including location and extent, and avoid common pitfalls. We apply our approach to various case examples of arthroscopically proven tears.

**(E-121) Tuesday • 7:50–8:10 AM •**

**E-poster, computer #5**

**Osteochondroses, Differential Considerations and Recent Developments**

Vanja Varenika, MD, *University of California-San Francisco, San Francisco, CA*; Lynne S. Steinbach, MD ([vanja.varenika@ucsf.edu](mailto:vanja.varenika@ucsf.edu))

**LEARNING OBJECTIVES:** Osteochondroses present challenges for radiologists at all levels of training. The proposed presentation aims to achieve the following three learning objectives: 1) Provide a basic overview of the most common osteochondroses for junior radiology residents. 2) Explore differential diagnostic considerations of the most common osteochondroses for senior radiology residents. 3) Summarize recent developments in the literature related to the most common osteochondroses for practicing radiologists.

**CONTENT DESCRIPTION:** Osteochondrosis is a term applied to more than fifty different disorders affecting the epiphysis, apophysis, and epiphyseal bones, with a predilection for the immature skeleton. The proposed education exhibit seeks to provide an overview of the most common osteochondroses. In addition to the usual discussion of etiologies, imaging findings, staging, and treatments, the exhibit will focus in particular on differential diagnoses. For example, the presentation will describe the most useful imaging findings used in distinguishing Panjer's disease from osteochondritis dissecans of the humeral capitellum, an important differential consideration. The exhibit will also summarize the new concepts. Examples of interesting discussions in recent publications include: utility of diffusion weighted imaging in staging of Legg-Calve-Perthes, prevalence of radiographically incidental Kienboeck disease, comparison of radiological versus functional outcomes of surgically treated Scheuermann patients, proposed etiology of Van Neck disease, relationship between clinical and radiologic severity of Osgood-Schlatter disease, ultrasound diagnosis of Sinding-Larsen-Johansson syndrome, and comparison of radiographic and clinical sagittal alignment in Blount's disease. The ultimate goal of the presentation is to provide a practical overview of the most common osteochondroses and to summarize recent literature on the subject.

**(E-122) Wednesday • 7:00–7:20 AM •**

**E-poster, computer #9**

**MR Evaluation of Lower Extremity Neuromuscular Complications of Diabetes Mellitus**

Ali Alian, MD, *University of Texas Southwestern Medical Center, Dallas, TX*; Parham Pezeshk; Anish A. Patel; Michael Vanpelt; Avneesh Chhabra, MD\*; George Liu

**LEARNING OBJECTIVES:** 1) Learn pathophysiology of neuromuscular complications of Diabetes Mellitus. 2) Review optimal MR imaging techniques for the evaluation of Diabetic amyotrophy (lumbosacral plexopathy) and lower extremity myopathy and neuropathy, including DWI and MR neurography. 3) Illustrate the MR imaging findings of neuromuscular effects of diabetes mellitus, including myopathy, myonecrosis, infectious myositis, mono- and poly-neuropathies, amyotrophy, Charcot foot and secondary soft tissue and bone infections.

**CONTENT DESCRIPTION:** The MR findings of various neuromuscular complications of diabetes mellitus will be reviewed, with emphasis on features that facilitate lesion detection, differential diagnosis, and management. We will discuss imaging techniques for muscles and nerves complicated by diabetes, including: 1. Routine MR imaging. 2. MR neurography of the lumbosacral plexus. 3. DWI. A spectrum of neuromuscular abnormalities will be presented, including: 1. myopathy, myonecrosis, infectious myositis with or without abscess. 2. mono- and polyneuropathies in the lower limb including superimposed nerve entrapment. 3. diabetic amyotrophy with/without femoral/sciatic neuropathy. 4. late manifestations of denervation including Charcot joint and secondary soft tissue and bone infections. The role of advanced imaging will be discussed in this domain.

**(E-123) Wednesday • 7:00–7:20 AM •**

**E-poster, computer #10**

**Sarcopenia: The Time is Now**

Leon Lenchik, MD, *Wake Forest University School of Medicine, Winston-Salem, NC*; Robert D. Boutin ([llechik@wakehealth.edu](mailto:llechik@wakehealth.edu))

**LEARNING OBJECTIVES:** 1) Describe various approaches to the diagnosis of sarcopenia. 2) Discuss the new ICD-10 code for sarcopenia and its implications. 3) Provide practical advice on including sarcopenia in CT reports.

**CONTENT DESCRIPTION:** Analogous to osteopenia, sarcopenia is progressive loss of skeletal muscle, most commonly related to aging. Unlike osteopenia that has one major clinical consequence - fractures, sarcopenia has a wide range of clinical consequences. Sarcopenia has been associated with decreased physical function, frailty, fractures, falls, diabetes, weight gain, loss of independence, and increased mortality. For many years sarcopenia has been the linchpin in the studies of aging, and yet the term is unknown to many radiologists and it is rarely used in radiology reports. It is time to change that. On October 1st, 2016 a new ICD-10 code for sarcopenia (M62.84) was made available. This is an important milestone not only for researchers and clinicians working with the elderly but also for radiologists. Radiologists can now contribute to the diagnosis of sarcopenia. In particular, in CT reports of the chest, abdomen, pelvis or extremities, we can suggest the diagnosis of sarcopenia based on the qualitative assessment of muscle: decrease in muscle volume or increase in muscle fatty infiltration. Alternatively, we can provide a quantitative measurement of muscle cross-sectional area or attenuation. For example, these measurements of the psoas muscle on a single axial image can be an effective proxy for systemic muscle health and may help predict outcomes for a wide array of patients (e.g., undergoing surgery for cancer, organ transplantation, and aortic aneurysm repair). For now, the approach to quantitative measurements of sarcopenia on CT has not been standardized. But that should not be a deterrent. Osteopenia was included in radiology reports long before quantitative diagnostic thresholds were established and standardized. This is where the sarcopenia field is today. It is up to us in the radiology community to help move it forward and thereby help promote physical function and quality of life in our older patients.

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

(E-124) Wednesday • 7:25–7:45 AM •

E-poster, computer #6

### Femoral Acetabular Impingement: A Review of Diagnostic Imaging, Surgical Treatments and Postoperative Imaging

Henry Chen, MD, *University Hospitals Cleveland Medical Center, Cleveland, OH*; Mark R. Robbin, MD; Christos Kosmas, MD

**LEARNING OBJECTIVES:** 1) Review the clinical significance of femoral acetabular impingement and preoperative diagnostic image findings. 2) Discuss surgical treatments, indications, and procedures. 3) Review postoperative images including femoral osteoplasty and periacetabular osteotomy.

**CONTENT DESCRIPTION:** Understanding the radiologist's role with emphasis of preoperative and postoperative findings will be the objective of this educational poster. Femoral acetabular impingement is becoming more frequently diagnosed and surgical treatments are becoming more commonly performed in the United States. Femoral acetabular impingement is a structural hip disorder that results from the abnormal abutment of the anterolateral femoral head-neck against the acetabular rim-lateral complex. Recurrent impingement leads to pathology including labrum degeneration and delamination of the articular cartilage. Studies have shown an association between anatomic pathology and the development of secondary osteoarthritis. Preoperative imaging assessment for FAI is performed with radiographs, CT (computed tomography) and MRI (magnetic resonance imaging). Radiographs can review osseous excess of the femoral head or neck and on the acetabular rim. MRI can evaluate the labrum and cartilage. CT can assist in the preoperative planning. The surgical treatment for FAI is constantly evolving and indications and algorithms likely vary per institution. We will review a series of cases demonstrating expected postoperative findings with surgical treatments.

(E-125) Wednesday • 7:25–7:45 AM •

E-poster, computer #9

### Soft Tissue Abnormalities Missed on Musculoskeletal Radiography: A Pictorial Essay



Dana Feraco, *Beaumont Hospital, Royal Oak, MI*; Sailaja Yadavalli, MD, PhD

**LEARNING OBJECTIVES:** 1) Understand the importance of evaluation of soft tissues on musculoskeletal radiographs and develop a pattern that includes assessment of these. 2) Recognize common soft tissue abnormalities that may be easily overlooked on musculoskeletal radiographs.

**CONTENT DESCRIPTION:** Soft tissue abnormalities are often overlooked on musculoskeletal radiographs as we focus our search on the osseous structures in question. These soft tissue abnormalities may be directly related to the adjacent osseous structures and be the primary cause of the patient's symptoms. Often they may serve as subtle indicators of underlying occult osseous pathology. However, some soft tissues abnormalities may be the sole cause of the patient's presentation without involvement of the adjacent osseous structures. Other soft tissues abnormalities may cause chronic problems or result in symptoms over time and are therefore equally important to recognize. Radiologists have to avoid the problem of 'satisfaction of search' when an osseous abnormality is present and have a pattern of search that includes thorough evaluation of all the soft tissues included on the radiographs. This poster will present a pictorial review of commonly missed soft tissue abnormalities on radiographs, including a focus on 'soft tissue signs' in the setting of osseous injury. Other examples will include abnormalities that may be congenital, vascular, infectious, inflammatory, or related to neoplasm. In addition, false positives will be also be discussed. Where relevant, CT, MR or Ultrasound images will be presented as supporting evidence. It is imperative for the radiologist to recognize these subtle findings during a thorough soft tissue evaluation as part of a comprehensive approach to musculoskeletal radiographs.

(E-126) Wednesday • 7:50–8:10 AM •

E-poster, computer #8

### Changing Residents' Perspective on Bone Tumors: From Intimidating to Inviting

Brandon Roller, MD, PhD\*, *Wake Forest Baptist Medical Center, Winston-Salem, NC*; Jason Powell, MD; Scott D. Wuertzer, MD; Leon Lenchik, MD; Maha Torabi, MD; Bahram Kiani, MD, MHA

**LEARNING OBJECTIVES:** 1) Describe a systematic approach to bone tumors that makes them less intimidating. 2) Learn to differentiate aggressive from non-aggressive lesions. 3. Discuss common pitfalls in the radiographic evaluation of bone tumors.

**CONTENT DESCRIPTION:** Bone tumors can be intimidating for residents because they occur infrequently, can be classified into many different types, and often have similar sounding names. To make the radiographic diagnosis of tumors less intimidating, we advocate a systematic approach. We first show residents multiple case examples to emphasize the importance of patient age, tumor location, and radiographic appearance when learning about bone tumors. We then practice a methodical description of various bone lesions that includes: pattern of bone destruction, margins (zone of transition), periosteal reaction, matrix, cortical destruction, and soft tissue component. With practice and sufficient case material, most residents become comfortable differentiating aggressive from non-aggressive bone lesions. By combining this knowledge of radiographic appearance with the age and location of tumors, a diagnosis can often be made. When a precise diagnosis is not possible, we teach residents to develop a differential diagnosis that is most clinically relevant. As bone tumors become more inviting for residents, the final step in our systematic approach emphasizes the recognition of diagnostic pitfalls. Residents must be aware of two potential pitfalls: osteomyelitis, which can mimic a tumor, and benign conditions, where malignant lesions may arise.

## Neuroradiology

(E-81) Wednesday • 7:00–8:15 AM •

Hard-copy poster

### What Every Radiologist Should Know About Intracranial Hypotension: A Misdiagnosis and Mismanagement

Nancy N. Emelifé; Mandy C. Weidenhaft, MD, *River Ridge, LA*; Howayda Mourad, MD; Enrique Palacios, MD; Cynthia W. Hanemann, MD; Jeremy B. Nguyen, MD, MS (*jnguye2@tulane.edu*)

**LEARNING OBJECTIVES:** 1) Illustrate multimodal imaging findings of intracranial hypotension syndrome. 2) Illustrate imaging features of cranial and spinal CSF leak as it relates to Intracranial Hypotension. 3) Discuss the correlation of MRI features with clinical manifestations. 4) Discuss MRI findings and its pitfalls to avoid inappropriate or delayed management.

**CONTENT DESCRIPTION:** References to intracranial hypotension syndrome date back to more than six decades. However, it continues to remain underdiagnosed both clinically and by imaging. There is significant lack of identification of the subtle imaging findings that have resulted in significant patient morbidity. In intracranial hypotension syndrome, various clinical and neuroradiologic signs and symptoms can be confused with other neurologic diseases. In the literature, studies demonstrate misdiagnosis of intracranial hypotension syndrome, including as described by 18 cases of intracranial hypotension syndrome, where 17 of them received an incorrect diagnosis. Imaging role is vital as it can refine intracranial hypotension syndrome management by early and accurate diagnosis leading to appropriate early treatment. Review of MRI findings of multiple cases of intracranial hypotension syndrome reveal important findings: Enhancement of the pachymeninges, brainstem slumping, subdural hygroma or hematoma, slit-like ventricles, dural venous sinus engorgement. Illustration of the MRI findings and its pitfalls will be discussed according to clinical manifestation. Neuroimaging is a crucial part of the evaluation of intracranial hypotension syndrome. So

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far, there are limited studies about its current use in the initial evaluation and its yield during the initial diagnosis of intracranial hypotension. The aim of this exhibit is to demonstrate and describe multimodal imaging findings of intracranial hypotension syndrome as to yield a deeper understanding of the syndrome and to avoid exposing patients to inappropriate treatment.

**(E-82) Tuesday • 7:00–8:15 AM • Hard-copy poster**  
**Remember the Limbic System?: MR Anatomy and Pathology Review of Structures Involved in Emotion and Memory Formation**

Jane Ball, *Tulane University School of Medicine, Metairie, LA*; David Sawyer; Krystle Barhaghi, MD; Adam Blanchard; Enrique Palacios, MD

**LEARNING OBJECTIVES:** 1) To describe and provide examples of MR imaging findings of pathological processes involving the Limbic System. 2) To review the normal anatomy and functions of Limbic System structures.

**CONTENT DESCRIPTION:** The major sections of this poster include, 1. Functional review of Limbic System (LS) structures. 2. Anatomical review of LS structures labeled on normal MR images. 3. Clinical presentations and MR imaging findings of pathological processes affecting the LS, including Limbic Encephalitis, Hippocampal Sclerosis, Alzheimer's Disease, and Schizophrenia.

**(E-83) Wednesday • 7:00–8:15 AM •**  
**Hard-copy poster**  
**Diagnostic Discrepancies between MRI and Clinical Diagnoses in Stroke Imaging**

Manav Bhalla, MD, *Medical College of Wisconsin, Milwaukee, WI*; Andrew P. Klein, MD; John Ulmer, MD\*; Leighton P. Mark, MD; Stephen A. Quinet, MD; Namrata Bhalla, MD

**LEARNING OBJECTIVES:** 1) Presence / absence of signal alteration on DWI/ADC do not always indicate presence / absence of ischemia. 2) Differences can potentially occur between clinical findings and DWI/ADC findings. 3) Detecting an imaging finding depends on time course in histopathologic cascade of ischemia. 4) Certain conditions can mimic stroke on MRI. 5) Hypoperfusion without restricted diffusion may produce clinical symptoms. 6) Follow up imaging may be useful in "Stroke in evolution" and TIA. 7) DWI abnormalities in TIA could be small, and may resolve / atrophy on follow up. 8) Location and size of signal abnormality may influence detection by MRI.

**CONTENT DESCRIPTION:** 1. Basis of application of restricted diffusion in diagnosing stroke. 2. Histological requirements to produce restricted diffusion in MRI. 3. Stroke mimics causing restricted diffusion. 4. Potential causes of false positive MR in stroke. 5. Potential causes of false negative MR in stroke. 6. Reversibility of DWI signal abnormality.

**(E-129) Tuesday • 7:25–7:45 AM •**  
**E-poster, computer #8**  
**Spectrum of imaging findings in spinal infections and associated complications: what the radiologist should know!**

Salil Sharma, *Yale New Haven Health, Bridgeport Hospital, Bridgeport, CT*; Melkamu Adeb; Yogesh Kumar, MD (*melkamu.adeb@bpthosp.org*)

**LEARNING OBJECTIVES:** 1) Discuss the role of CT and MRI in evaluation of spinal infections and associated complications. 2) Describe spectrum of imaging findings in spinal infections and associated complications. 3) Describe important anatomic structures to evaluate during imaging of a suspected spinal infection.

**CONTENT DESCRIPTION:** I. Spinal infections: A. Epidemiology, B. Pathophysiology; modes of infection. C. Clinical presentation and diagnostic workup. II. Role of imaging: A. CT. B. MRI. 1. Protocol. 2. Important sequences. C. Nuclear medicine. 1. Gallium scan. 2. Three phase bone scan. D. Comparison of the different imaging modalities. III. Types of spinal infections: with imaging examples: A. Spondylodiscitis: 1. Bac-

terial spondylodiscitis. 2. Tuberculous spondylodiscitis. B. Septic facet arthritis. C. Fungal infections. D. Epidural infection/ abscess. E. Subdural infection/abscess. F. Spinal meningitis. IV. Complications: with different imaging examples: A. Ascending infection to brain. 1. Ascending bacterial meningitis, ascending tuberculous meningitis. B. Spinal cord abscess. C. Cord compression. D. Nerve root impingement. E. Paraspinal abscesses. F. Psoas abscess.

**(E-130) Wednesday • 7:25–7:45 AM •**  
**E-poster, computer #5**

**Post Cranial Surgery Complications: Imaging Review**

Mohamad H. Gharavi, MD, *Aultman Hospital NEOMED, Canton, OH*; Michael Markovich; Shankar Ganapathy (*mgharavi@neomed.edu*)

**LEARNING OBJECTIVES:** 1) Describe the normal imaging appearances of post operative cranium. 2) Discuss the most common complications associated with cranial surgery. 3) Describe the CT and MR imaging appearances of common complications of cranial surgery.

**CONTENT DESCRIPTION:** This poster will first review the normal cranial anatomy and some of the most common standard surgical techniques, such as burr holes, craniotomy, craniectomy, and cranioplasty. Then, several interesting cases of post operative complications including but not limited to infection (brain abscess, extra-axial empyema and meningitis), hemorrhage, CSF leakage, tension pneumocephalus, encephalocele and Trefhine syndrome (sinking skin flap) will be presented and briefly reviewed.

**(E-131) Wednesday • 7:25–7:45 AM •**  
**E-poster, computer #7**

**Nasopharyngeal Cancers and Mimics: Staging and Spectrum of Imaging Findings**

Partha Mandal, DO, *University of Texas Health Science Center at San Antonio, San Antonio, TX*; Bundhit Tantiwongkosi, MD

**LEARNING OBJECTIVES:** 1) Understand the clinical presentations, epidemiology and association with Epstein-Bar virus (EBV) and Human Papilloma virus (HPV) of nasopharyngeal carcinomas. 2) Illustrate cross sectional anatomy of the nasopharynx. 3) Discuss roles of imaging, imaging techniques, unique radiologic findings and pitfalls in both pretreatment and post treatment phases.

**CONTENT DESCRIPTION:** Nasopharyngeal cancers (NPC) are rare malignancy of the head and neck in North America with a unique clinical presentations and imaging findings. The disease may presents as an incidental finding, cervical lymphadenopathy, conductive hearing loss due to obstruction of eustachian tube, nasal obstruction or cranial nerve palsy due to skull base invasion. EBV and HPV have been found to associate with the entity. The radiologist need to be familiar with specific patterns of cancer spread and appropriately stage the disease utilizing the new 8th Edition of American Joint Committee of Cancers (AJCC). Computed tomography (CT) and Magnetic resonance imaging (MRI) are complementary for detection and staging. Positron emission tomography (PET)/CT is helpful in post treatment evaluation. Retrospective review of the cancers in the tertiary care university-based institute from 2009 reveals 13 cases of nasopharyngeal cancers: 11 squamous cell carcinomas, 1 undifferentiated carcinomas/squamous cell carcinomas, 2 lymphomas, 1 case out of 4 is associated with EBV or HPV. Entities that may mimic NPC include adenoid hyperplasia, Thornwadt cyst, juvenile nasopharyngeal carcinoma (JNA), and polyps that potentially mimic the NPC. Post treatment changes are challenging due to anatomic distortion and overlap between inflammation, residual and recurrent tumors.

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

## Nuclear Medicine

(E-87) Wednesday • 7:00–8:15 AM •

Hard-copy poster

### Amyloid Plaque PET Brain Imaging: What The Radiologist and Radiology Resident Needs to Know

Rahul Garg, MD, *Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ*; Jeffrey Kempf, MD (*JKempf@Univrad.com*)

**LEARNING OBJECTIVES:** 1) To understand the importance and heterogeneous nature of Mild Cognitive Impairment (MCI). 2) To review the amyloid hypothesis in Alzheimer's Disease (AD), and to understand the association of B-amyloid with AD through its interactions with the tau protein. 3) To learn how to acquire and interpret amyloid brain PET scans, and to review the implications of a positive scan in patients with MCI, including the risk of subsequent conversion to frank AD.

**CONTENT DESCRIPTION:** In this educational exhibit we will review the preclinical criteria and stages in the assessment of Alzheimer's Disease (AD). We will examine the role of amyloid deposition in AD, additional neurodegenerative diseases, as well as in patients with normal cognition. We will review the currently available amyloid PET ligands and how to interpret a positive and negative amyloid PET scan. Appropriate use criteria as well as the current national IDEAS study will be discussed. The significance of a positive versus negative amyloid PET scan in patients with Mild Cognitive Impairment (MCI) will be presented along with the potential conversion rates to AD. We will cover the associated cognitive changes and neuronal loss in AD and the association with tau pathology. Finally, potential disease modifying therapeutic targets for AD will be presented.

(E-88) Tuesday • 7:00–8:15 AM • Hard-copy poster  
NaF PET Bone Imaging: From Acquisition and Interpretation to Current Applications and Future Directions

Silvano Samartine, MD, *Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ*; Jeffrey Kempf, MD; Vyacheslav Gendel, MD; Levi Sokol

**LEARNING OBJECTIVES:** 1) To learn current indications for and applications of 18F-Sodium Fluoride (NaF) PET/CT bone scan in oncologic imaging. 2) To describe how to acquire and interpret normal and abnormal 18F-NaF PET/CT imaging studies, and to describe its advantages in comparison to MDP bone scans. 3) To learn additional applications of 18F-NaF PET bone scans in Musculoskeletal imaging as well as future directions.

**CONTENT DESCRIPTION:** 18F-Sodium Fluoride (NaF) PET/CT Bone imaging has only recently been approved in 2011 for Medicare beneficiaries through the Coverage with Evidence Development/National Oncologic PET Registry Program (NOPR). 18F-NaF PET bone imaging has emerged as an important tool for detecting and evaluating malignant osseous lesions in oncologic imaging, and has been shown to have a developing role in imaging of various other musculoskeletal disorders. NaF PET/CT offers a number of advantages over conventional bone scintigraphy utilizing Tc-99m MDP including improved sensitivity and specificity, improved spatial resolution, more accurate anatomical localization of tracer uptake using CT, and faster study times. Clinical use of NaF PET/CT predominantly involves diagnostic evaluation of osseous metastatic disease, however the role of NaF PET/CT also includes further characterization of primary osseous neoplasms as well as evaluation of benign diseases of the skeletal system. In this educational exhibit we will present how to acquire and interpret NaF PET/CT bone scans, as well as current and potential future indications for oncologic as well as benign bone imaging including emerging musculoskeletal applications.

(E-127) Tuesday • 7:50–8:10 AM •

E-poster, computer #6

### Thinking Outside the Thorax: Perfusion Scanning for Pulmonary Hernia

Matthew B. O'Brien, MD, *Henry Ford Hospital, Detroit, MI*; Xiaoni Hong, MD; Kastytis C. Karvelis, MD

**LEARNING OBJECTIVES:** Largely used in context of ventilation perfusion scanning for evaluation of acute and chronic pulmonary embolus and emphysema, pulmonary perfusion scanning is performed with a microembolic shower of radiolabeled MAA to the pulmonary precapillary arterioles. As such, it can thus be used to evaluate lung perfusion in other settings where poor or absent lung perfusion is of concern. In our case report, we performed lung perfusion scanning to confirm non-viability of lung tissue in the context of possibly long-standing, post-surgical pulmonary hernia.

**CONTENT DESCRIPTION:** Lung herniation is a rare event in both traumatic and non-traumatic circumstances, but is most commonly seen as a consequence of either severe thoracic trauma, or of thoracic / mediastinal surgery. Acute, traumatic lung herniation is most often managed surgically, but it can be managed conservatively in certain settings. Postsurgical lung herniation is often managed conservatively, and has even been reported to spontaneously resolve. It is often difficult to differentiate viable tissue which could be managed conservatively, from ischemic or infarcted tissue which demands prompt operative management. We successfully used Tc-99m MAA perfusion SPECT CT to confirm ischemia in a traumatically herniated lung segment, a finding which guided surgical management. Use of perfusion only scanning early in lung herniation cases could allow prompt evaluation for non-perfused herniated lung in questionable clinical settings, possibly decreasing time to definitive management. This could also mitigate complications such as secondary infection or abscess, such as may occur from delayed resection and defect closure.

(E-128) Tuesday • 7:50–8:10 AM •

E-poster, computer #10

### Molecular Imaging of Neurodegenerative Disorders with an Emphasis on 18F-florbetapir PET: What the Radiology Resident Needs to Know

Michael S. Achilleos, MD, *Baylor University Medical Center, Dallas, TX*; Umesh D. Oza, MD (*michael.achilleos@BSWHealth.org*)

**LEARNING OBJECTIVES:** 1) Discuss the indications for <sup>18</sup>F-florbetapir PET, mechanism of localization, and technical aspects of image acquisition. 2) Demonstrate normal and abnormal findings found on <sup>18</sup>F-florbetapir PET. 3) Compare and contrast <sup>18</sup>F-florbetapir PET findings with MRI and <sup>18</sup>F-FDG-PET findings.

**CONTENT DESCRIPTION:** Alzheimer disease is the most common primary neurodegenerative disorder, accounting for a reported 50–60% of dementias in the elderly. The gold standard for diagnosis of Alzheimer disease is made by post-mortem detection of amyloid plaques and neurofibrillary tangles within the brain, with pre-mortem diagnosis being presumed based on clinical findings and evaluation with MRI and <sup>18</sup>F-FDG-PET. The significant overlap of symptoms and imaging findings with the various dementia syndromes has led to the incorrect or missed diagnosis of Alzheimer disease in many patients. This limits effective clinical treatment and research as the currently available Alzheimer therapies have little effect for patients with other dementia syndromes. Several amyloid plaque imaging agents have been recently approved by the FDA for use in the detection of amyloid deposition within the brain. The high sensitivity of these tests for amyloid detection may allow improved clinical differentiation amongst patients with cognitive impairment and may be of utility in selecting patients for future research. In this poster we will review the mechanism of action of <sup>18</sup>F-florbetapir uptake along with the technical parameters for study performance. We will then show normal and abnormal findings with comparison to MRI and more conventional <sup>18</sup>F-FDG PET findings.

## Pediatric Radiology

(E-89) Wednesday • 7:00–8:15 AM •

### Hard-copy poster Spectrum of Complications in Meconium Ileus - A Case Series with Prenatal, Neonatal, and Surgical Imaging

Lindsey A. Shea, MD, *Indiana University, Indianapolis, IN*; Brandon P. Brown, MD, MA; Brian W. Gray, MD (*brpbrown@iu.edu*)

**LEARNING OBJECTIVES:** By reviewing this presentation, the learner should be able to: 1) Understand fetal imaging findings in complicated meconium ileus, including concurrent ileal atresia, volvulus, and meconium peritonitis. 2) Identify how combining postnatal imaging with findings from fetal imaging can facilitate identification of surgical candidates. 3) Better appreciate the radiologic-surgical correlation through the spectrum of presentations of meconium ileus.

**CONTENT DESCRIPTION:** In this case series presentation, we will examine the spectrum of complications of meconium ileus - including concurrent intestinal atresia, volvulus, and meconium peritonitis - through prenatal and postnatal imaging, as well as surgical pathology correlates. We review multiple cases of complicated meconium ileus which were followed in our patient population over the last year; the clinical course will be summarized, as well as the salient fetal and neonatal imaging features and the eventual surgical findings and outcomes. Finally, we demonstrate the additional diagnostic value of adding fetal MRI to the more traditional postnatal imaging practice patterns, in order to influence surgical management. This includes a case in which fetal MRI contributed to expedited surgical management of a patient with complicated meconium ileus - resulting in salvaged bowel and reduced morbidity for the patient.

(E-106) Tuesday • 7:00–7:20 AM •

### E-poster, computer #9 An Overview of Pediatric Biliary Interventions

Umairullah Lodhi, MD, *North Shore University Hospital and Long Island Jewish Medical Center, Manhasset, NY*; Saadullah Khan; Peter Assaad, MD

**LEARNING OBJECTIVES:** 1) To understand the role of various pediatric biliary interventions in diagnosing and treating conditions such as biliary atresia, benign biliary strictures, infantile sclerosing cholangitis, biliary rhabdomyosarcoma, choledocholithiasis, and biliary trauma. 2) To understand the risks and benefits associated with various interventional techniques/modalities commonly used to diagnose/manage these conditions. Learners will be able to gauge their understanding of pediatric biliary interventions through an optional pre-post questionnaire provided to them.

**CONTENT DESCRIPTION:** Interventional radiology plays a central role in diagnosing and treating biliary diseases such as choledocholithiasis, benign biliary strictures seen in the setting of liver transplant, infantile sclerosing cholangitis, biliary rhabdomyosarcoma, and biliary trauma. Understanding the utility of various contemporary biliary interventions for the purposes of diagnosing and treating the above mentioned entities is of paramount importance for radiologists and other clinicians. The goal of this educational poster is to present a pictorial review of commonly used diagnostic and therapeutic biliary interventions. Additionally, classic radiologic findings of various pediatric biliary pathologies on magnetic resonance and percutaneous biliary cholangiography will also be discussed. A pre-post questionnaire exercise will also be conducted that will enable learners to gauge their understanding of common biliary interventions before and after the information provided to them.

(E-132) Wednesday • 7:00–7:20 AM •

### E-poster, computer #5 Fetal Urogenital Abnormalities on MRI: Imaging Review

Armaghan Faghimehr, MD; Mohamad H. Gharavi, MD, *Aultman Hospital NEOMED, Canton, OH*

**LEARNING OBJECTIVES:** 1) To describe the normal and abnormal embryological development of the urogenital system. 2) To discuss the imaging presentation of common urogenital abnormalities on fetal MRI.

**CONTENT DESCRIPTION:** This poster will first review the normal and abnormal fetal urogenital development. Then, several cases of commonly seen fetal urogenital malformations such as hydronephrosis, renal genesis, duplication, horseshoe kidney, autosomal recessive polycystic kidney, multicystic dysplastic kidney, posterior urethral valve and cloacal abnormality will be presented and their presentations on fetal MRI will be reviewed.

## Women's Imaging

(E-133) Tuesday • 7:50–8:10 AM •

### E-poster, computer #7 Your First Rotation in Breast Imaging - The Whos, Whats, Whens, and Hows of imaging each patient

Sarah LaFond, MD, *University of Virginia Hospital, Charlottesville, VA*; Carrie M. Rochman, MD; Brandi T. Nicholson, MD; Jennifer A. Harvey, MD\*; Jonathan Nguyen, MD (*sel8q@virginia.edu*)

**LEARNING OBJECTIVES:** 1) Become familiar with the spectrum of imaging modalities most commonly used in breast imaging and recognize images of each. 2) Learn indications, strengths, and weaknesses of each modality as well as specific populations in which they are most helpful and most often used. 3) Practice basic cases, guiding work-up of patients in different clinical scenarios to reinforce understanding of the above concepts.

**CONTENT DESCRIPTION:** We will describe breast imaging modalities including 2D mammography, tomosynthesis, diagnostic and screening ultrasound, MRI, and contrast enhanced mammography and include examples of each. We will specifically describe certain patient populations and clinical scenarios in which each modality is commonly used highlighting strengths and weaknesses of each. We will describe how the exams are performed including how patients are positioned, the level of patient cooperation required, and what patient limitations or medical conditions may be relative or absolute contraindications for the different modalities. We will supply several basic cases with multi-step management questions to reinforce learning.

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

**(E-134) Tuesday • 7:50–8:10 AM •  
E-poster, computer #9  
Developing and Implementing a Mammography Screening  
Case Set for Radiology Trainees**

Anika L. McGrath, MD, *University of Washington, Seattle, WA*; Diana L. Lam, MD; Habib Rahbar, MD\*; Janie M. Lee, MD, MS\* (*mcratha@uw.edu*)

**LEARNING OBJECTIVES:** At the University of Washington, a mammography teaching case set of approximately 300 screening mammograms, enriched with screen-positive interpretations, has been developed. The purpose of the case set is to improve interpretive performance for screening mammography. The objectives of this exhibit are to describe the content and development of this teaching case set, discuss challenges with utilization and implementation by trainees during a busy academic breast imaging practice, and demonstrate the potential for broader use by other breast imaging training programs and community practices.

**CONTENT DESCRIPTION:** The Accreditation Council for Graduate Medical Education (ACGME) requires residents to interpret at least 300 mammograms during the entire residency. The prevalence of breast cancer in a screening population is approximately 5 per 1000 women. Therefore, if a resident were to only read the number of studies required for graduation, they would see very few screen-detected breast cancers. Furthermore, mammography clinical exposure, faculty view-box teaching, and teaching files typically focus on diagnostic mammography images, which are a specialized set of additional images already highlighting an abnormal finding. This educational exhibit will describe how this enriched screening mammography curriculum was developed at our institution, detail the components of this enriched screening-mammography curriculum, primary performance measure to be evaluated (recall rate), and discuss our experience with challenges encountered during implementation and utilization by trainees during our busy clinical workflow.

**(E-135) Wednesday • 7:25–7:45 AM •  
E-poster, computer #8  
Pictorial Review of Biopsy Proven Benign and Malignant  
Male Breast Masses**

Solomon Cherian, MD, *McGaw Medical Center of Northwestern University, Chicago, IL*; Meghan Boros, MD; Jieqi Wang, BA; Julie M. Franz, MD (*jmfranz77@yahoo.com*)

**LEARNING OBJECTIVES:** 1) Describe the radiologic features of benign and malignant masses in the male breast. 2) Describe the imaging features to help differentiate benign and malignant processes in the male breast.

**CONTENT DESCRIPTION:** An institutional review of cases from 2005 - 2016 was performed to investigate biopsy proven benign and malignant masses in the male breast. The review identified 138 total cases with 86 benign and 52 malignant biopsy-proven processes. The radiologic features of benign and malignant masses that involve the male breast, as well as the imaging characteristics that help differentiate between them, will be discussed. These will include, but not be limited to, gynecomastia, spindle cell lipoma, lymphocytic mastitis, angioliopoma, cavernous hemangioma, papillary carcinoma, metastases, invasive ductal carcinoma, eccrine adenocarcinoma, and Hodgkin's lymphoma.

**(E-136) Wednesday • 7:50–8:10 AM •  
E-poster, computer #6  
Emergency imaging in early pregnancy: what can go  
wrong, and what to do about it**

Ramanjot Muhar, MD, *St. Joseph Mercy Oakland, Pontiac, MI*; Andrew Lukaszewicz, MD; Grygori Gerasymchuk, MD (*a.lukaszewicz@utoronto.ca*)

**LEARNING OBJECTIVES:** 1) Review the physiology of early pregnancy, with a special emphasis on the timeline of imaging findings in a normal intrauterine pregnancy. 2) Understand what can go wrong in pregnancy, and how to make an accurate diagnosis with ultrasound. 3) Learn the appropriate follow up recommendations, to better assist clinicians in managing the pregnant patient in the acute care setting.

**CONTENT DESCRIPTION:** Sonographic imaging is essential in assessing the pregnant patient in the emergency setting. After a brief review of normal uterine anatomy, as well as anatomic variants, the timeline of intrauterine development is discussed. Topics include the gestational sac, yolk sac, fetal pole, fetal heart rate and crump rump length. The importance of correlation with beta-hCG is addressed. Various emergencies seen in early pregnancy are presented, primarily through sonographic cases, which include different types of ectopic pregnancies (focusing on location and clinical significance), viability, fetal demise/miscarriage, retained products of conception, cervical incompetence and gestational trophoblastic disease. A discussion of updated recommendations ensues. A summary of important teaching points and conclusions ties the educational exhibit together.