

# AUR 2016 Research Poster Abstracts

Research posters are located in the Seaport Ballroom D-E. Each poster will be presented by its author during one of the *AMA PRA Category 1 Credit™* poster discussion sessions scheduled for 7:00–8:15 AM, Wednesday (Session 201) and Thursday (Session 301). The day and time for each poster presentation follows the presentation number. Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (medical students, residents, or 1st-year fellows) are noted in [blue](#).

## Abdominal Radiology

### AUR Trainee Prize: 1st Place

#### (R-01) Wednesday • 7:00–8:15 AM • Hard-copy poster Multiparametric Prostate MR Imaging with Pathologic Correlation: Performance of Free-Text Reporting in the Age of PI-RADS (v2)

Paul B. Stoddard, MD, *University of Maryland Medical Center, Baltimore, MD*; Melina Pectasides; Zein Farhat, MD; Jade J. Wong You Cheong, MD; Mohummad M. Siddiqui, MD ([paulstoddard@gmail.com](mailto:paulstoddard@gmail.com))

**PURPOSE:** It is standard practice at our institution and many others to issue unstructured reports for multiparametric prostate MRI (mpMRI). Also called free text, unstructured reports convey an index of suspicion for prostate cancer (PCa) but do not itemize findings and lack consistency between readers. In contrast, structured reporting using PI-RADS (v2) contains standardized elements and an algorithmic level of suspicion. The purpose of this retrospective study was to evaluate (1) how often free-text reporting includes all elements of PI-RADS, (2) the correlation of an unstructured reporting index of suspicion to a retrospectively assigned PI-RADS score, and (3) the performance of an index of suspicion in predicting histology.

**METHOD AND MATERIALS:** Local IRB approved this retrospective study. **Inclusion Criteria:** Patients underwent mpMRI between October 2009 and July 2015 and had prostatic histologic specimens available (either prostatectomy or transrectal ultrasound-guided biopsy). Research electronic data capture (REDCap™) was used for data collection. **Statistical Analysis:** Descriptive statistics of the comprehensiveness of unstructured reports, correlation coefficient of index of suspicion to assigned PI-RADS score, and sensitivity and specificity of index of suspicion in predicting histology. “Comprehensive” was defined as characterizing lesion location and signal on T2-weighted, diffusion-weighted, and dynamic contrast-enhanced imaging. Only reports deemed “comprehensive” were assigned PI-RADS score. Due to variability of free text, index of suspicion in unstructured reports was categorized as benign, equivocal, or suspicious for PCa.

**RESULTS:** 504 patients were included. Data analysis confirmed unstructured reports are not reliably comprehensive; approximately 80% contained all vital elements in mpMRI. Extent of correlation of the index of suspicion with PI-RADS (v2) and performance characteristics on pathologic correlation will be revealed.

**CONCLUSION:** Structured reporting should be used to reduce inter-reader variability, adhere to validated interpretation methods, and streamline communication. Standardized inclusion of specific exam elements with algorithmic conclusions should facilitate clinical decision making.

## Education of Medical Students, Residents, Other

#### (R-21) Wednesday • 7:00–8:15 AM • Hard-copy poster Development and Implementation of the Brigham Radiology Medical Student Triage Program: How We Did It

Oren Johnson, MD, *Brigham and Women's Hospital/Harvard Medical School, Boston, MA*; Glenn C. Gaviola, MD; Donald N. Di Salvo, MD ([ggaviola@partners.org](mailto:ggaviola@partners.org))

**PURPOSE:** The purpose was to provide medical students with early exposure to the key role radiology plays in the daily clinical management of hospital inpatients through creation of a “minicall” program and thus assist in future recruitment into the specialty early in medical student training.

**METHOD AND MATERIALS:** Following the example of similar medical student radiology triage programs already in place in two academic institutions, we planned a similar effort at our academic center. Medical students who are not currently engaged in a clinical clerkship are offered the opportunity to assist radiology residents in the routine activities encountered after hours: handling requests for “stat reads,” for add-on exams, and for callbacks to clinicians with exam results. Initially beginning with a small cohort of students, mainly drawn from our local medical student radiology interest group, we provided orientation/training in the rudiments of handling imaging requests to allow students to begin to triage exam appropriateness and acuity. Secondary benefits of this program include sparking an interest in radiology as a career for medical students while also assisting residents in the often chaotic environment of after-hours/on-call duties.

**RESULTS:** The rudiments of setting up this program will be demonstrated, including development of a leadership team including faculty, residents, and medical students; timeline from recruitment and appropriate selection of medical students to implementation; achieving buy-in from medical school, hospital, radiology staff, and residents; creating a self-sustaining training program and call schedule for the students; and budgeting for monetary reimbursement. Pre- and postcall survey results from both students and residents from our initial pilot program will also be presented.

**CONCLUSION:** The creation of a medical student radiology “minicall” triage program, while logistically complex, is nonetheless feasible. We hope this may assist in future recruitment of medical students to a radiology career while allowing medical students to assist residents during a busy on-call rotation.

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

**(R-22) Thursday • 7:00–8:15 AM • Hard-copy poster  
Developing a Pilot Radiology Curriculum for the Yale  
University School of Medicine Primary Care Clerkship**

Mahan Mathur, MD, *Yale University School of Medicine, New Haven, CT*; Peter J. Ellis, MD, MPH; Thomas R. Goodman, MBChir (*mahan.mathur@yale.edu*)

**PURPOSE:** The purpose of this project is to assess the impact of implementing a pilot radiology curriculum, consisting of topics on radiation safety and EBI guidelines, on senior medical students rotating through their primary care clerkship.

**METHOD AND MATERIALS:** Radiation safety and EBI guidelines workshops were created, with pretests given before both workshops. The radiation safety workshop consisted of five test questions and four survey questions. The EBI workshop consisted of 10 case scenarios requiring the students to identify next best imaging step. Four survey questions were also included. Three weeks after the workshops, posttests were given to all students. Responses to the pre- and posttest radiation safety questions, as well as the 10 clinical case scenarios from the EBI workshop, were evaluated via the  $\chi^2$  test.  $\chi^2$  test was also used to assess whether the EBI workshop had a significant impact on the question, "I am aware of the ACR Appropriateness Criteria."

**RESULTS: Pretest Radiation Safety Survey:** 54/70 (77%) of students were either unaware or could not remember if they had a lecture on this topic. 60/70 (86%) of students thought that radiation exposure is either a "very important" or "somewhat important" consideration when ordering radiology studies. Evaluation of the test questions revealed a statistically significant improvement in correct responses in 3/5 questions. Posttest survey demonstrates that 31/32 (97%) of students feel more confident discussing the radiation risk of imaging studies with their patients. **EBI Test Survey:** 42/53 (79%) of students were unaware of the ACR Appropriateness Criteria®, while 38/53 (72%) were either unsure or could not remember if they had a lecture on this topic. Evaluation of the case scenarios demonstrated a statistically significant improvement in correct responses in 5/10 questions. Posttest survey demonstrates that 30/31 (97%) students are aware of the ACR Appropriateness Criteria® and that 27/31 (87%) plan to use this resource in their future career.

**CONCLUSION:** There is a lack of formal education on topics of radiation safety and EBI guidelines during medical school. Implementation of a formal curriculum to address these deficiencies can improve these knowledge gaps.

**(R-23) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Teaching Medical Students Radiology in a Large Classroom  
Using New Technology: Flipped Classroom Method  
and Boot Camp**

Sri Hari Sundararajan, MD, *Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ*; Lily Zou, MD; Puneet Belani, MD; Kevin W. Mennitt, MD; Judith K. Amorosa, MD (*ssundararajan@univrad.com*)

**PURPOSE:** There are several methods to prepare medical students for internship. At our institution, the surgery and medicine departments introduced boot camp, an intense course reinforcing knowledge concepts of clinical medicine prior to graduation. Radiology was invited to participate in this multidisciplinary exercise. We incorporated the flipped classroom style of teaching for the boot camp, rather than traditional lectures given by other participating departments, and surveyed student interest in the radiology section of the boot camp following its completion and gauged interest in flipped-style learning compared to traditional didactics.

**METHOD AND MATERIALS:** An image-rich PowerPoint presentation with the most frequently encountered imaging diagnoses faced by a PGY-1 house officer was created. The presentation was sent to the students enrolled in the boot camp 3 days prior to the scheduled boot camp session, with instructions to review the slides prior to the session. This is accordance to the flipped classroom concept of pre-read-

ing for a class, rather than focusing on postclass homework. Following completion of the boot camp, we surveyed the medical students regarding how much time they spent studying the "flipped" PowerPoint, whether they interacted with other students using the PowerPoint preparing for boot camp, whether the material inspired pre-session questions, and if they felt this method of instruction was useful.

**RESULTS:** The medical students all evaluated the flipped classroom method favorably. By learning ahead of time from the materials in the flipped preview, they were prepared to discuss and ask pertinent questions at the time of the conference. The students looked up references, discussed questions among themselves prior to the conference, and reported better retention of material compared to traditional teaching of other material during the course.

**CONCLUSION:** Using the flipped classroom educational method, students and radiology faculty reported engaging participation in the interdisciplinary boot camp. The endeavor was a success in helping students feel more confident and prepared going into internship. Students reported that participation in the session had better prepared them for a future internship.

**(R-24) Thursday • 7:00–8:15 AM • Hard-copy poster  
Learner Experience Implementing a Case-based Online  
Radiology Education Requirement for 3rd-Year Medical  
Students**

Austin Trinh, *Loma Linda University, Loma Linda, CA*; Smyrna Tuburan, MD; Michael J. Lee (*atrinh@llu.edu*)

**PURPOSE:** At a single institution, the radiology education during the first 2 years of medical school is 3 hours of lecture by radiology faculty, with topics chosen by the anatomy department. This is under the assumption that medical students will experience imaging through radiologic utilization during clinical years. One approach to develop a foundation for radiologic knowledge is through case-based online education such as CORE MedU® (*www.med-u.org*), which is a structured radiology course with modules that can be incorporated into clerkships. We surveyed 169 third-year medical students to identify their self-assessment of ability in radiologic anatomy and knowledge of the ACR Appropriateness Criteria® to support diagnostic decision making before and after their use of CORE modules.

**METHOD AND MATERIALS:** The 18 CORE modules were subdivided into topics and assigned to 3rd-year medical students during clerkships. An initial two-question survey measured the 3rd-year medical students' self-assessment of radiologic knowledge and knowledge of the Appropriateness Criteria® for imaging sufficient for clinical decision making. Response choices ranged from "not at all" to "more than adequate." A follow-up survey was sent at the end of the 3rd year to assess the impact of the CORE modules.

**RESULTS:** The data revealed 97% and 96% perceived their knowledge was less than adequate for radiologic anatomy for clinical decision making and the Appropriateness Criteria®. The follow-up survey revealed that 63% and 58% of 3rd-year medical students felt that their knowledge was "somewhat" to "more than adequate" for clinical decision making and knowledge of the Appropriateness Criteria®. Furthermore, the categories "not at all" decreased by 15% and 21%, "barely" decreased by 16% and 10%, and "somewhat" increased by 21% and 27% for the respective responses.

**CONCLUSION:** Medical student education of radiologic anatomy and of appropriateness for medical imaging at this institution, as self-reported by current 3rd-year medical students, is deficient. With the requirement of the CORE modules, the medical students completed 3rd year with improved self-assessed knowledge of radiologic anatomy and appropriateness to support their clinical decision making.

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

**(R-25) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Integrating Web-based Radiology Imaging into Preclinical  
Problem-based Learning Course**

Alexander Rand, BA, *Boston University School of Medicine, Boston, MA*; Kitt Shaffer, MD, PhD (*aerand@bu.edu*)

**PURPOSE:** Medical schools are increasingly integrating radiology into the preclinical curriculum. We sought to integrate Web-based imaging into the problem-based learning (PBL) course. This study assesses attitudes toward a Web-based preclinical radiology education tool.

**METHOD AND MATERIALS:** PBL students were exposed to a radiologist-designed Web site containing images, test ordering, and gross interpretation pertinent to the course's existing cases. Surveys were administered to students exposed to the Web site and nonexposed controls. Controls assessed imaging needs, while the intervention group assessed Web site quality. Both groups were asked for awareness of and comfort with the addressed American College of Radiology Appropriateness Criteria® (ACR-AC). Multiple question types were utilized, especially a five-level Likert scale. Some data were analyzed using a Student *t* test.

**RESULTS:** Seventy-four students responded to the survey, 37 for each group. Controls gave a weighted five-level Likert score of 3.97 for demand for more radiographic images in the PBL course, overall preclinical curriculum, and desire for a Web-based imaging tutorial format. Comfort with the clinical curriculum based on preclinical imaging exposure was a 2.72. Intervention group reported of the Web site 4.03 for the belief of value to education, 4.00 for desire for greater similar exposure, and 3.97 for suitability to the level of students' education. For awareness of the ACR-AC, weighted averages of 1.95 and 2.08 ( $P = .5$ ) were reported for the control and intervention, respectively. Comfort with the ACR-AC was 1.78 and 2.00 ( $P = .2$ ) for the control and intervention, respectively.

**CONCLUSION:** Medical students agreed that more Web-based radiographic imaging should be integrated into the preclinical curriculum. Students who used the Web site agreed that it contributed to their education but still desired greater imaging exposure. However, students still lacked in awareness of and comfort with ACR-AC. Web site redesign to emphasize ACR-AC is indicated. Due to low response numbers and recall bias with retrospective surveys, further curricular change and prospective surveying are warranted.

**(R-26) Thursday • 7:00–8:15 AM • Hard-copy poster  
Medical Imaging Use by Pediatricians: Identifying Core  
Imaging Concepts and Their Optimal Point of Introduction**

William J. Moser, Jr, BS, *University of Chicago, Chicago, IL*; Andrew W. Phillips, BA; Hunter Eason, BS; Christopher M. Straus, MD\* (*wmoser@uchicago.edu*)

**PURPOSE:** Results from a national survey of medical school and radiology departments indicate that 75% of medical schools have no imaging requirements, and greater than 90% of student imaging education is taught by nonradiologists. These results indicate that training is nonstandardized, leading to a potential variability in intern skills, adding to both the cost of training and variability of these future practicing physicians. Pediatric trainees, in particular, have a higher responsibility, given the potential risks and deleterious effects resulting from radiation exposure. A pediatric topic-specific module was developed, targeting core imaging principles relevant to referring pediatricians, for medical students in their last year, to provide a more uniform imaging experience for those embarking into pediatrics. In this study, we examined when trainees and students would prefer to learn the information included in the module.

**METHOD AND MATERIALS:** The pediatric medical imaging module was compiled by known educational experts in radiology and pediatrics, each identifying key vocabulary, concepts, and cases pertinent to pediatric care. To focus evaluation on the global concepts, key examples were selected for survey purposes to test the level of content.

A Likert item questionnaire was validated and distributed to clinical medical students and pediatric house staff via e-mail or paper survey.

**RESULTS:** We received an overall 21% response rate, without evidence of nonresponse bias. All of the respondents agreed that the content presented in the module was pertinent and of the appropriate level. All but one respondent thought it would be helpful prior to a pediatric internship. The clear majority (37/56) of respondents thought the material should be presented during clinical medical school. Students preferred to be exposed to the material during medical school significantly more than postgraduate trainees (Fisher's  $\chi^2 = 0.002$ ), which demonstrates an anticipated self-selection bias.

**CONCLUSION:** A topic-specific imaging module with content targeting future nonradiologists prior to graduating medical school was identified as relevant and of high value to both students and postgraduate trainees specializing in pediatrics.

**(R-27) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Radiology Residents Teaching 1st-Year Medical Students  
during Anatomy Dissection Labs: The Evaluation of a  
Mutually Beneficial Program**

Samantha Zuckerman, MD, MS, *Hospital of the University of Pennsylvania, Philadelphia, PA*; Austin Pantel, MD; Mary H. Scanlon, MD; Neal Rubinstein, MD, PhD; Arun Nachiappan, MD (*samantha.zuckerman@uphs.upenn.edu*)

**PURPOSE:** Residents play a significant role in medical student teaching during clinical clerkships but have a limited role during the preclinical years. At our institution, 1st-year radiology residents teach 1st-year medical students radiology-anatomy correlates in small groups during anatomy dissection lab time. This project assesses the efficacy of this program in increasing students' knowledge in and improving attitudes about radiology, as well as increasing resident confidence in teaching.

**METHOD AND MATERIALS:** This project is IRB exempt. Prior to the start of teaching sessions, a survey about attitudes toward radiology and an anatomy-radiology knowledge pretest were sent to medical students. A survey about attitudes toward teaching was also sent to 1st-year radiology residents. These three surveys will also be sent at the conclusion of the program. All data are being collected using our institution's REDCap™ software (Vanderbilt University, Nashville, TN).

**RESULTS:** Prior to the start of the program, 80/156 (51.2%) medical students completed the attitudes survey, 71/156 (45.5%) medical students completed the knowledge pretest, and 13/13 (100%) radiology residents completed the attitudes survey. On the preprogram surveys, most students reported that they are not familiar with the field of radiology (66%) but are interested in learning radiology (79%). 18% are considering a career in radiology. The average score on the knowledge pretest was 32% correct (standard deviation, 11.5). Radiology residents report they are interested in teaching medical students during residency (85%) but feel neutral to somewhat unconfident in their radiology knowledge (85%) and believe they are novice or beginner teachers (77%). Most residents believe they can increase their own knowledge by teaching (85%).

**CONCLUSION:** Further data collection is forthcoming and will be completed by the end of the course in December 2015. The results from the postprogram surveys will be compared to the preprogram surveys. The differences between the surveys will illustrate the effect of the teaching program on medical student radiology knowledge and interest in radiology, as well as resident confidence in teaching.

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

## AUR Trainee Prize: 3rd Place

### (R-37) Wednesday • 7:00–8:15 AM • Hard-copy poster Occupational Dose Monitoring: Impact of a Dedicated Educational Learning Module for Radiology Residents

Philip Murillo, MD, *Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ*; Sara Venezia, MD; Jeffrey Kempf, MD; Vyacheslav Gendel, MD; Murray Becker, MD; Lisa Fletcher, MA, RT; et al (*JKempf@Univrad.com*)

**PURPOSE:** Occupational dose monitoring is required for many health care workers in the radiology department but is commonly misunderstood and may not be followed. Our purpose was to evaluate the baseline knowledge and compliance among our radiology residents regarding occupational dose monitoring and to reassess their knowledge and compliance after completion of an educational learning module on this topic.

**METHOD AND MATERIALS:** A 22-question survey regarding radiation personnel dosimeters was administered as a pretest to our radiology residents. The survey was anonymous but did ask current resident year. Questions included different types of dosimeters, what they measure, where they should be worn, monitoring during pregnancy, NRC occupational limits, ALARA limits, and deterministic and stochastic effects of radiation. After obtaining the baseline data, an educational PowerPoint module on this topic was given to the residents. The same pretest survey was later readministered. Compliance with wearing a radiation dosimeter was investigated by a question in the survey about regular badge use.

**RESULTS:** The baseline study average score was 58% across all resident year responses; this increased by resident year from 48%, 56%, 59%, and 78% for PGY-2, PGY-3, PGY-4, and PGY-5 residents, respectively. After studying the educational learning module, the average resident postscore increased to 84%. The learning module postscores were 89%, 76%, 79%, and 93% for the PGY-2, PGY-3, PGY-4, and PGY-5 residents. Through the survey, compliance was self-reported and increased from 53% prior to the module to 69% afterward. There were 19/20 resident responses on the pretest survey and 16/20 responses on the posttest survey.

**CONCLUSION:** The use of a dedicated educational module on occupational monitoring increased our residents' test survey scores from a baseline average of 58% to 84% for all the participants and helped raise awareness about dosimetry monitoring in our department. However, self-reported compliance increased only modestly, from 53% to 69%. Future considerations include evaluating resident badge compliance as part of the residents' milestone professionalism evaluation.

### (R-38) Thursday • 7:00–8:15 AM • Hard-copy poster "Great Call" Web Site: An Effective Teaching Tool

Austin Pantel, MD, *Hospital of the University of Pennsylvania, Philadelphia, PA*; Seetharam C. Chadalavada, MD; Po-Hao Chen, MBA, MD; Tessa S. Cook, MD, PhD (*austin.pantel@uphs.upenn.edu*)

**PURPOSE:** On-call radiology residents provide high-quality interpretations on many interesting and rare cases at our tertiary referral center. Radiology attendings overreading such cases can identify outstanding calls using a "great call" macro. Our goal was to create and test an educational Web site to feature these great calls so other trainees can learn and benefit. No such instrument was otherwise available to publish these cases, which we believe have great educational potential.

**METHOD AND MATERIALS:** A Web site was created with a link from the radiology home page: <https://sites.google.com/site/macrogreatcall/>. Cases were presented as unknowns, with the patient and interpreting trainee deidentified. The Web site was updated for 3 months. Anonymous pre- and postimplementation surveys were sent to all 44 residents in the program, not including this author. The preimplementation survey was constructed to assess the demand for such a teaching tool; the postimplementation survey was constructed to measure the suc-

cess of the Web site. Survey answer options were mostly in the form of a five-point scale from "strongly disagree" to "strongly agree."

**RESULTS:** The survey response rate was 82% and 57% for the pre- and postimplementation surveys, respectively. Prior to the implementation of the Web site, 17% of respondents agreed (rated 4 or 5) that there are effective ways to share interesting cases among residents. After implementation, 44% of respondents answered similarly. In addition, on the postimplementation survey, 88% of respondents agreed (rated 4 or 5) that they were interested in looking at "great call" cases, 92% agreed that they found the Web site educational, and 84% agreed that the Web site was an effective way to share interesting cases. On the postimplementation survey, 84% of respondents indicated that the great call macro was used "too little" or "much too little," and 88% agreed that they remember cases given a "great call" or a "major change" more than those that were not.

**CONCLUSION:** Based on survey responses, there was an unmet need for an instrument to share interesting cases among residents. This Web site appears to fill some of that need, and residents expressed a favorable opinion of the Web site.

### (R-39) Wednesday • 7:00–8:15 AM • Hard-copy poster Quality Assurance and Improvement Conferences in Ra- diology Resident Education: A Survey of U.S. Radiology Program Directors

Philip Wong, MD, *Emory University, Atlanta, GA*; Anne E. Gill, MD; Mark E. Mullins, MD, PhD; Amanda S. Corey, MD\*; Brent P. Little, MD (*pwong2@emory.edu*)

**PURPOSE:** There are few publications discussing characteristics for radiology-focused missed-case or quality improvement conferences. Our goal was to determine the type and frequency of feedback provided to radiology residents with respect to preliminary interpretations of diagnostic imaging studies, evaluate the use of quality assurance and improvement (QA) conferences in radiology residencies, and identify unifying characteristics used in QA conferences as well as feedback mechanisms to further improve education of radiology residents.

**METHOD AND MATERIALS:** A questionnaire containing multiple-choice answers with free-text areas of additional comments was sent via e-mail to all diagnostic radiology program directors using a mailing list compiled from the Association of Program Directors in Radiology in 2012–2013, supplemented by residency program Web sites and the FREIDA Online® database. The online survey settings rendered all responses anonymous.

**RESULTS:** We sent 188 e-mails to program directors and representatives, receiving 45 survey responses, a 24% response rate. Most respondents were from programs with 17–40 residents (71.1%) and university-based practices (62.2%). Almost all respondents reported that residents provide preliminary readings for either all or some diagnostic modalities (95.5%). Resident feedback on missed cases included QA case conferences (81.4%), discussion during readout at the end of shift (69.8%), faculty-resident meetings (67.4%), verbal discussions other than at the end of shifts (65.1%), e-mail notices (46.5%), and computerized review (27.9%). In regard to QA conferences, faculty radiologists (31.0%) or program directors (19.0%) were most often the moderators. Common formats of QA conferences were informal discussion (40.5%), formal presentation (28.6%), or case conference (28.6%). The majority of programs chose to have the resident who missed the case remain anonymous (77.1%).

**CONCLUSION:** While the prevalence and structure of QA conferences are routinely discussed with other medical disciplines, it is not a common topic with radiology. Our study gives further insight into the current structure of feedback mechanisms for trainees in a specialty where feedback is critically important.

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

**(R-40) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Novel Software-based Method for Monitoring and Reporting Discrepant Resident–Attending Read Rates for Trauma-related Imaging in a Level 1 Trauma Center: Our Experience**

Bhargavi Guddanti, MBBS, *CHI Health Creighton University Medical Center, Omaha, NE*; Gopi Sirineni, MBBS, MD; Shawn Stone, MD; Adam Stibbe, MD; Megan Hora, MD; Johanna Schubert, MD (*bhargaviguddanti@creighton.edu*)

**PURPOSE:** Monitoring discrepancies between resident-attending reads by institution's PIPS (patient improvement/patient safety) system is an important requirement for maintaining Level 1 trauma center designation. We propose a novel software-driven PIPS system for assessing and reporting resident-attending discrepant read rates.

**METHOD AND MATERIALS:** We developed and implemented a custom software-based, continually updating, monthly monitoring system for resident (R2–R4)-attending discrepant reads using RADPEER™ criteria since June 2012. Custom software created by our residents automatically extracts all of the preliminary resident and final attending reads and calculates the percentage of change in the report with respect to the word count and words changed, added, or deleted. Each month, 50 reads with maximum discrepancy percentages are reviewed manually and scored by two attending radiologists and an R4 resident using RADPEER™ criteria by consensus. Patient details, study type, discrepant finding, interpreting resident/attending name, and RADPEER™ score are documented in Excel spreadsheet, along with reasoning for the assigned score. Missed findings are discussed individually with the interpreting resident and are presented at the monthly trauma committee meeting and intradepartmental QI meeting.

**RESULTS:** Overall monthly resident-attending read discrepancy rate (RADPEER™ based) was 1.4%. Most were of low clinical significance level RADPEER 2a category (72%). Others were 2b (4%), 3a (12%), 3b (8%), 4a (4%), and 4b (0%). Error rate by resident year was R2 (40%), R3 (56%), and R4 (4%). Imaging study-wise read discrepancies were CT of head (32%), CT of abdomen/pelvis (24%), plain films (16%), and CT chest (12%). Our data compared favorably to published data from other institutions.

**CONCLUSION:** R2–R4 residents were able to provide relevant provisional reports without significant adverse effect on patient care. We successfully validated a novel software-driven solution for meeting PIPS requirements for Level 1 trauma certification. This also satisfies the ACGME practice improvement requirement for residents to evaluate their personal practice, utilizing scientific evidence, “best practice,” and self-assessment programs.

**(R-116) Wednesday • 7:50–8:10 AM •**  
**E-poster, computer #3**  
**Where Are the Women? Addressing the Gender Gap in Radiology with an Interactive Seminar**

Alixandra S. Purakal, MD, *University of Chicago, Chicago, IL*; Ashley Altman, MD; Anil Baron; Zheng Feng Lu, PhD; Maryellen L. Giger, PhD\*; Carina W. Yang, MD (*zflu@uchicago.edu*)

**PURPOSE:** Despite years of efforts to close the gender gap, women still make up a small proportion of radiologists. The cause is complex, including perceived and real concerns held by medical students prior to choosing a specialty. We hypothesized that providing intervention with informative sessions early in training and access to appropriate mentors may help dispel these myths and increase interest among potential female applicants.

**METHOD AND MATERIALS:** We presented a 13-question 5-point Likert scale survey to 32 M1/M2 female medical students before and after an informational seminar. The session also included a case presentation to highlight the multifaceted aspects of a career in radiology, followed by a faculty- and resident-led dialogue.

**RESULTS:** Prior to the seminar, women were concerned with lack of patient interaction, boredom, and being in a darkroom, among other factors. All of the discussed concerns were alleviated, most with statistical significance, when using a one-sided *t* test. Every woman in attendance not only felt that the seminar provided an adequate introduction to radiology but left interested in learning more. The most significant changes were regarding interaction with patients and boredom (mean difference > 1.0; *P* < .00005), concerns that were explicitly addressed with demonstration of a clinical case. Interestingly, there was no change in perception of radiation exposure at session's end, the one issue not addressed, thus highlighting the importance of positive change in opinion to topics discussed.

**CONCLUSION:** This survey is the first step in addressing why women are hesitant about a career in radiology, what interventions could remedy the situation, and how to assist students in making an informed decision about their career. Despite a small sample size, we identify the top concerns women have and found that an informational seminar increases understanding of radiology and alleviates concerns. In response to these results, we plan to implement more unique interventions to alleviate this issue, including developing recruitment recommendations for the upcoming admission cycle, as well as a program to match female students who are interested in radiology with appropriate mentors.

**(R-117) Thursday • 7:00–7:20 AM •**  
**E-poster, computer #3**  
**Nobody Cares about This but Radiologists: Evaluating Medical Student Impressions of Radiation Dose before and after Educational Intervention**

Jordan Swensson, MD, *Indiana University, Indianapolis, IN* (*jswensso@iupui.edu*)

**PURPOSE:** Radiation dose and radiation safety are hot-button topics within the medical profession and the lay population and lay press. Real-world events like medical dosing errors and nuclear accidents may be sensationalized, leading to patients receiving alarming information about radiation. Despite this, there is little formal education in radiation dose and safety of medical professionals. This poster evaluates medical student impressions about radiation dose from common radiology exams, before and after didactic intervention.

**METHOD AND MATERIALS:** Over a 9-month period, a total of 132 medical students were asked to provide estimates for the approximate number of two-view (AP and lateral) chest radiographs it would take to equal the radiation dose given to patients in other radiologic exams. Then the students attended a 1-hour didactic conference about radiation safety that included information about relative radiation doses in radiologic exams, radiation carcinogenesis, and dose-reduction strategies. Three months after this lecture, the students were again asked to submit estimates of radiation dose for the same types of exams.

**RESULTS:** A majority (61%) of medical students reported no education on radiation dose prior to the study. The medical students' initial responses underestimated radiation dose for radiographs, while overestimating radiation dose for CT exams. Didactic intervention provided statistically significant improvement in dose estimations for KUB (3.5 chest radiographs vs 4.0; *P* = .01), chest CT (154 vs 59; *P* = .01), chest CT PE protocol (316 vs 90; *P* = .01), and abdomen/pelvis CT (413 vs 103; *P* = .03). No statistically significant improvement was noted in lumbar spine radiographs (*P* = .3), head CT (*P* = .22), RUQ ultrasound (*P* = .68), MRI brain (*P* = .6), or average yearly background radiation (*P* = .13).

**CONCLUSION:** At baseline, medical students appear to underestimate radiation dose from radiographs and overestimate dose from CT exams, although their estimates demonstrate a wide range of thought on how much radiation comes from radiology studies. Focused didactic intervention can be beneficial in improving knowledge of radiation dose for certain radiology exams.

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

(R-118) Thursday • 7:25–7:45 AM •

E-poster, computer #3

### Adding Value and Improving Inpatient Care Quality by Preemptively Addressing Common Clinical Questions regarding Inpatient Imaging

Emily Ambinder, *Johns Hopkins Medical Institutions, Baltimore, MD*; Krystyna Jones; Javad Azadi; Jeff Jensen; Blake Jones; Matthew Kruse; et al ([kportel14@jhmi.edu](mailto:kportel14@jhmi.edu))

**PURPOSE:** Quality metrics and reimbursements are transitioning from a volume-based model to a value-based system. In response, radiology departments are striving to optimize the imaging experience for both the patient and ordering clinician. To this end, we solicited radiologist and ordering clinician input about common inpatient imaging questions and misconceptions and created an informational Web site for clinicians to address these issues.

**METHOD AND MATERIALS:** Radiology residents and faculty were asked to identify common questions they receive from clinicians about inpatient imaging or to describe what they perceive to be misconceptions among ordering clinicians. From these suggestions, an online questionnaire was created and distributed to the medical and surgical house staff at our institution to assess areas of concern or misunderstanding. From the survey responses, we identified the most common questions and points of frustration among ordering clinicians. We then created a readily accessible informational Web site addressing these frequent questions and concerns.

**RESULTS:** Thirty-five ordering clinicians provided feedback. Universal questions and areas of concern included identifying the radiologist performing or interpreting their patient's study (76% of respondents), contacting specific locations within the radiology department (67% of respondents), ordering premedication for iodinated contrast (58% of respondents), and selecting the correct imaging exam within a specific modality (52% of respondents).

**CONCLUSION:** Utilizing feedback from the providers ordering imaging studies, radiologists can add value and improve care quality by preemptively addressing ordering clinician concerns through an informative online resource.

(R-119) Thursday • 7:50–8:10 AM •

E-poster, computer #2

### Getting a Head Start: The Role of Rotation Orientation in Improving Resident Experience and Clinical Productivity

Donald J. Perry, MD, *University of Washington, Seattle, WA*; Nupur Verma, MD; Aaron Rutman; Bruce E. Lehnert, MD\*

**PURPOSE:** Orientation is greatly emphasized in any business, because it hastens effective contribution. Initial residency orientation emphasizes various software, GME, and department policies. However, orientation for each subsequent radiology rotation can vary dramatically and is often underemphasized. The broad multisystem scope of radiology can make the 1st day of each new rotation feel overwhelming, disorienting, or even unsafe. We examined how important structured orientation is to residents and propose a method to streamline the process.

**METHOD AND MATERIALS:** We polled radiology residents and radiology faculty at a major academic hospital using an anonymized online survey. We compared satisfaction with provided orientations and their impact on resident education and clinical service, as well as differences between rotations that had structured "onboarding" and those that did not. Residents were also evaluated 1 year later to see if there was significant improvement and evaluate potential barriers to implementation.

**RESULTS:** Initial results showed residents felt that 47% of rotations were not performing adequate orientations greater than 50% of the time. A prior survey had identified that residents and faculty felt that structured orientation was important but agreed it was often over-

looked or inadequate. Rotations with a checklist-based orientation helped residents acclimate, reduced anxiety, and clarified expectations. When a brief, structured, and dedicated orientation existed, residents contributed earlier, found solutions faster, reported better education, and improved patient care. One year later, 19/37 evaluated rotations had increased onboarding.

**CONCLUSION:** Structured onboarding is implemented across many other customer service fields to orient employees to expectations and tasks and has demonstrated a high return on initial investment. Radiology rotations can benefit from adopting brief and structured orientation conducted on each 1st day to reduce anxiety, provide early answers to common questions, and establish expectations. We are implementing structured orientation templates to foster onboarding for each rotation, to improve resident education, performance, and, ultimately, patient care.

## Health Services for Radiology

### (R-52) Thursday • 7:00–8:15 AM • Hard-copy poster Improving Time-to-Acquisition Performance via Multidisciplinary Guidelines for Oral Contrast-enhanced CT Scans in the Emergency Department

Jessica Spivey, MD, *New York-Presbyterian Hospital/Weill Cornell Medical Center, New York, NY*; Grafe Lyons, MD; Ian R. Drexler, MD; Yeang H. Chng, MD, PhD; Molly Parsons, MD; Ashley Giambone, PhD; et al ([grl9017@nyp.org](mailto:grl9017@nyp.org))

**PURPOSE:** Prompt and proficient radiology services are required for efficient care delivery in the emergency department (ED). Based on feedback from referring providers at our institution, we identified the timeliness of oral contrast-enhanced CT scans as an area for potential improvement. We assembled a multidisciplinary team of radiologists, emergency physicians, technologists, and nurses to develop new guidelines for CT scans, including a CT acquisition time goal of 90 minutes after the patient begins oral contrast administration. This study aims to assess the effectiveness of this intervention in safely improving the timeliness of CT scans requiring oral contrast.

**METHOD AND MATERIALS:** A retrospective review was conducted to analyze the effectiveness of an education program designed to improve timeliness of CT exams with oral contrast in our ED. We evaluated all patients undergoing oral contrast-enhanced CT scans in the ED in October 2013 and October 2014 (10 months prior to and 2 months after the intervention, respectively). The time to scan was computed by subtracting the acquisition time (documented by the technologist) from the PO contrast administration time (documented by the ED nurse). Images were individually assessed by a radiologist for location of oral contrast.

**RESULTS:** For the sample prior to the intervention, the mean time to scan acquisition was 211.5 minutes ( $n = 149$ ; 95% CI, 199.8–223.4). For the sample following the intervention, the mean time to scan acquisition was significantly reduced to 169.4 minutes ( $n = 163$ ; 95% CI, 160.2–178.6;  $P < .01$ ). Analysis of oral contrast location at the time of scan revealed similar distribution of contrast location, with 83% of preintervention scans and 71% of postintervention scans containing contrast at or beyond the appendix.

**CONCLUSION:** Time-to-acquisition performance was improved via multidisciplinary guidelines for contrast-enhanced CT in the ED. This study demonstrates the effectiveness of a goal-oriented educational intervention for improving time to acquisition of CT scans without compromising the utility of enteric contrast. Future directions will focus on improving scan quality by optimizing oral contrast location at the time of acquisition.

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

**(R-55) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**“Patient-centered” Reporting: Utilization of Crowdsourcing to Quantify Perceptions of Radiologists’ Competence and Empathy in Written Communication**

Tina D. Taylor, MD, *Duke University Medical Center, Durham, NC*; Daniel Hippe\*, Lauren K. Toney, MS, MD; Carolyn Chen; Eric J. Stern, MD; Gautham P. Reddy, MD

**PURPOSE:** Our purpose was to use crowdsourcing to evaluate the perception of radiologists’ competence and empathy. We also evaluated if including a “patient-centered one-liner” in a radiology report, defined as a sentence stating the patient’s name and relevant medical history, changes the perception of radiologists’ competency and empathy. Online crowdsourcing is an efficient means to recruit a large crowd to perform a well-defined task. Amazon Mechanical Turk (AMT) is one such crowdsourcing platform. As a survey tool, crowdsourcing offers low-cost, expeditious, and large-volume data collection from respondents across a national or worldwide population.

**METHOD AND MATERIALS:** AMT was used to collect responses. All participants were ≥18 years old and U.S. residents. There were a total of 291 respondents ( $n = 167$  experimental;  $n = 124$  control). Each participant received a survey consisting of five fictional radiology reports. The experimental and control surveys were identical with the exception that reports in the experimental survey contained a “patient-centered one-liner.” Each report was followed by six questions to assess the radiologist’s empathy and competence. Each question was answered on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Analysis was done with linear regression models based on generalized estimating equations.

**RESULTS:** All responses were gathered in less than 55 minutes. Both groups perceived radiologists as accurate effective communicators and competent (average, 4.0–4.2). For one report, the experimental group perceived radiologists to have higher accuracy (4.2 vs 4.0;  $P = .009$ ) and better communication (4.0 vs 3.7;  $P = .003$ ) compared to control. Regarding measures of empathy, which included ratings of compassion, concern, and understanding, there was only modest agreement in both groups that radiologists possessed these traits (average, 3.1–3.8).

**CONCLUSION:** With the rising need for radiologists to provide increased value, the need for improved radiologic communication is paramount. Crowdsourcing offers a low-cost, expeditious, and potentially effective method to quantify the effectiveness of radiology reporting.

**(R-126) Wednesday • 7:50–8:10 AM • E-poster, computer #7**

**Nature of Phone Call Interruptions in a Neuroradiology Reading Room during a Typical Workday: An Observational Study**

Steven M. Sogge, MD, *Penn State Hershey Medical Center, Hershey, PA*; Neil Mannering, BS; Shyam Sabat, MD

**PURPOSE:** Phone calls are a known and loathed distraction in radiology reading rooms. The phone calls disrupt the train of thought of the involved radiologist and others in the room and are a potential patient safety issue. This can lead to errors and substantial time to get back on task. The intent of the study was to understand the origin of and the reason for the phone calls and quantify the duration of the individual and aggregate calls. Understanding the nature of the phone calls might eventually lead to a solution to reduce the distraction caused by them.

**METHOD AND MATERIALS:** A 4th-year medical student sat in the reading room for the entire duration of the work hours to collect data. Data were collected for 3 nonconsecutive days to remove bias of a single day or particular day of the week. The call details were recorded, and the person who received the phone call was noted as a trainee (resident/fellow) or an attending. All incoming phone calls were included. Outgoing calls were excluded.

**RESULTS:** The average total number of minutes spent on the phone each day was 64 minutes for a 9-hour workday. The total number of phone calls per day was 39, with 4.4 phone calls per hour on average. The trainees (residents/fellows) answered 71% of the phone calls, with an attending’s intervention needed in 13% of those calls. The attendings received phone calls in 29%. The average duration of phone calls was 1 minute 39 seconds. The average duration of resident-received calls was 1 minute 26 seconds and that by an attending was 2 minutes 2 seconds. Approximately 57% of phone calls received originated from MR/CT technologists. Less than a quarter of the calls originated from providers.

**CONCLUSION:** Phone calls are a source of substantial disruption in the radiology reading room. Any efforts to reduce the number of incoming calls to the reading room should be welcomed. Provider-originated phone calls make up a minority of the phone calls. There may be interventions available to decrease the number of interruptions in the reading room, which would allow radiologists to stay on track, potentially reduce errors and stress, and lead to decreased turnaround time.

**(R-127) Thursday • 7:00–7:20 AM • E-poster, computer #4**

**The Ongoing Gap between the Availability of Imaging Services at Teaching versus Nonteaching Hospitals**

Andrew B. Rosenkrantz, MD, *New York University School of Medicine, New York, NY*; Wenyi Wang, MA; Richard Duszak, Jr, MD (*Andrew.Rosenkrantz@nyumc.org*)

**PURPOSE:** While greater complexity of care at teaching hospitals serves, in part, as a basis for Medicare’s substantial funding of those institutions, the extent of this greater complexity has been questioned. To help inform policy amid calls to cut such funding, we studied relationships between imaging services availability and teaching intensity among U.S. hospitals.

**METHOD AND MATERIALS:** Using the AHA Annual Survey Database™, we studied facility self-reported information about imaging services availability at general hospitals nationwide in years 2007 (4102 hospitals) and 2012 (3876 hospitals). Teaching intensity was categorized into Council of Teaching Hospitals and Health Systems (COTH) member, non-COTH teaching hospital (non-COTH member with affiliated medical school and/or residency), and nonteaching hospital. Hospitals’ availability of reported basic and advanced imaging modalities, as well as beds and number of physicians, was analyzed. Overall trends were assessed.

**RESULTS:** All 15 assessed imaging modalities showed significant increases in availability as hospital teaching intensity increased ( $P < .001$ ). Modalities showing the largest differences between COTH and nonteaching hospitals in 2012 were image-guided radiation therapy (78% vs 14%), PET/CT (74% vs 17%), SPECT (88% vs 35%), 64-slice CT (94% vs 41%), PET (60% vs 12%), and virtual colonoscopy (61% vs 13%). The gap between COTH and nonteaching hospitals was generally similar between 2007 and 2012, although it increased from 43% in 2007 to 57% in 2012 for PET/CT and from 34% to 48% for virtual colonoscopy. At multivariable analysis using 2012 data, COTH status was a significant predictor, independent of numbers of beds and physicians, for six modalities (Bonferroni-corrected  $P < .001$ –.015).

**CONCLUSION:** The availability of both basic and advanced imaging modalities increased with greater hospital teaching intensity. Differences were most pronounced and sustained over time for more-advanced modalities. Our findings reflect the greater imaging resources necessary to support the complexity of care rendered at teaching hospitals. This differential must be considered when exploring proposed cuts to teaching hospitals’ funding levels.

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

## Informatics

(R-128) Thursday • 7:25–7:45 AM •  
E-poster, computer #7

### Optimizing Radiologist Staffing through Analysis of PACS-generated Relative Value Unit Data

Robert K. Bour, MD; Lynn S. Broderick, MD, *University of Wisconsin-Madison, Madison, WI*; Frank J. Thornton, MD (*rbour@uwhealth.org*)

**PURPOSE:** The purpose was to develop an objective data-supported solution to radiologist reading room staffing through analysis of PACS data.

**METHOD AND MATERIALS:** PACS (picture archiving and communication system) data were exported into a spreadsheet (Microsoft Excel) with one row for each study performed at seven sites in the prior 15 months, with data fields including study date, time, description, procedure code, reporting radiologist, location, etc. A lookup table matching unique PACS procedure codes with CPT codes was then developed. The publicly available Centers for Medicare & Medicaid Services Physician Fee Schedule (CMS PFS) was then imported and automatically linked to the CPT codes, yielding professional component work RVUs (wRVUs) for each study performed. Study information and associated wRVUs were then analyzed in an Excel PivotTable, allowing wRVUs to be instantly aggregated in a variety of ways: quantity of work done by day of week, month of year, or hour of day, by radiologist, by modality, by site, and by any combination of these variables. Work performed per FTE was assessed to estimate our average productivity as a group (RVUs/FTE/hr) and then multiplied by our current staffing (FTE/hr) to estimate our average reading capacity by hour of the day. This was compared graphically with the incoming work per hour of the day to assess opportunities to improve our staffing model.

**RESULTS:** The analysis showed that from 0800–1100 on weekdays, the reading room was understaffed by 25%. From 1100–1700, the reading room was overstaffed by 20% as volume dropped and staffing increased. Evening and overnight staffing proved to be appropriate. The greatest mismatch in staffing was on Saturday from 1300–1800, during which the reading room was understaffed by 50%. This caused the radiologists to experience difficulty in achieving the expected 1-hour turnaround time for dictations.

**CONCLUSION:** Subjective impressions of work volume and staffing adequacy are prone to individual bias and can be deceiving, often leading to anecdote-based solutions. We have developed a robust tool that uses data analysis to manipulate staffing in an objective and efficient manner. These data were helpful in explaining the need for staffing changes on impacted physicians.

(R-129) Thursday • 7:50–8:10 AM •  
E-poster, computer #7

### Incremental Resource Utilization Adopting Two-Step Feeding Tube Placement: A Single Hospital's Perspective

Philipose G. Mulugeta, MD, *Hospital of the University of Pennsylvania, Philadelphia, PA*; Saurabh Jha, MBBS\*

**PURPOSE:** Nasoenteral tubes used for nutrition in critically ill patients are a relatively safe procedure, but tracheobronchial placement is a feared complication. Our institute considers this a zero-event complication. Thus the institute mandated two-step verification of all feeding tubes in January 2011. The first step is radiographic confirmation that the feeding tube is below the carina and, therefore, in the esophagus before advancement. Final location is also confirmed by radiograph. The study investigates the incremental resource utilization of the mandated two-step method.

**METHOD AND MATERIALS:** This is an IRB-approved retrospective study. Patients referred for radiographs to confirm feeding tube placement were selected randomly from radiology RIS/PACS database.

Group A ( $n = 59$ ) included patients with feeding tubes 6 months prior to two-step verification policy. Group B ( $n = 32$ ) included patients 6 months after two-step verification policy implementation. The number of radiographs required to confirm appropriate positioning of enteric tube, time (minutes) between index radiograph and last radiograph confirming positioning (radiographic interval), and radiologist report confirming positioning (reporting interval) were compared between the two groups. Analysis was performed using a two-tailed Student  $t$  test.

**RESULTS:** The average number of radiographs utilized per patient rose after the two-step method was mandated ( $3 \pm 2.7$  vs  $1 \pm 0.5$ ;  $P < .005$ ). The minimum time to feed increased from  $19 \pm 8$  minutes before the mandate to  $47 \pm 49$  minutes after the mandate ( $P = .01$ ). The two-step technique did not alter turnaround time for portable radiograph performance ( $38$  vs  $55$  minutes;  $P = .32$ ) or the radiographic report ( $17$  vs  $13$  minutes;  $P = .87$ ) in a statistically significant manner.

**CONCLUSION:** Mandating two-step feeding tube verification increases resource utilization and minimum time to feed. The latter finding is an important unintended complication of pursuing a zero-event policy. Our data of incremental resource utilization of two-step verification can be used to determine what hospitals would be willing to pay for the more-expensive magnetic-guided feeding tubes that do not have tracheobronchial placement risks.

## Interventional

### (R-64) Thursday • 7:00–8:15 AM • Hard-copy poster Bigger Is Not Always Better: Small-Bore Pleural Catheter Insertion for Iatrogenic Pneumothorax after Cardiac Implantable Electronic Device Placement

Travis McKenzie, DO, *University of Kansas-Wichita, Derby, KS*; Patrick Craig, DO; Kamran Ali, MD; Charles W. McGuire, MD (*travismckenzie33@hotmail.com*)

**PURPOSE:** Iatrogenic pneumothorax is an uncommon complication after placement of a cardiac implantable electronic device (CIED). There is very little literature regarding the management of these patients. At our institution, large-bore chest tubes were traditionally placed to treat large or persistent iatrogenic pneumothoraces. Larger-caliber catheters can cause significant trauma during insertion, cause pain, prevent full lung expansion, and worsen pulmonary outcomes. We present our experiences and data for managing pneumothoraces with small-bore catheters over a 4-year period.

**METHOD AND MATERIALS:** This is a retrospective study which reviewed all small-bore pleural catheters that were placed by radiology for pneumothorax after placement of CIED. The duration of chest tube placement, length of hospital stay, periprocedural complications, and need for further procedure were evaluated.

**RESULTS:** Over a 4-year course from 2009 to 2014, there were 13 patients who developed a pneumothorax after placement of CIED. These were managed with a small-bore catheter placed by the radiologist. Patient age ranged from 65 to 92 years old. Eleven of the 13 patients were female. All catheters were 8 French with Heimlich valves and placed under fluoroscopic guidance, utilizing an anterior approach. One patient had a stable pneumothorax for 10 days and catheter removal without need for further treatment. All other pneumothoraces resolved without complications or need for a large-bore catheter. The time to chest tube removal ranged from 1 to 10 days and averaged 2.85 days. Three patients had small pleural effusions and still had resolution of pneumothorax in 1–3 days.

**CONCLUSION:** Our experience suggests that small-bore pleural catheters can successfully treat iatrogenic pneumothorax after CIED placement. The smaller size is tolerated better by patients and can be used rapidly in the radiology department. Trends in our experience suggest that there is also likely a positive effect on decreased time to chest tube removal and, consequently, shorter hospital stay when compared to larger chest tube placement.

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

**(R-66) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Clinical Utility of Calf Vein Assessment in Stat Lower Extremity Duplex US Protocols**

Michael S. Kuwabara, MD, *St. Joseph's Hospital and Medical Center, Phoenix, AZ*; Courtney L. Mitchell, MD

**PURPOSE:** Duplex ultrasound is a well-established and highly accurate modality for detecting lower extremity deep vein thrombosis (DVT) in patients. However, the full extent to which lower extremity veins should be assessed has yet to be fully delineated, and protocols vary widely. Proximal (common femoral through popliteal) vein thrombosis is usually readily visualized during examination and is recognized to have greater clinical significance, resulting in well-defined management guidelines. Distal (calf) veins, on the other hand, are often poorly visualized, and optimal management of thrombosis in this region remains equivocal. Thus, the analysis of the clinical utility of calf vein assessment in stat lower extremity ultrasound protocols presents opportunities for improvements in health care utilization and radiology department work flow.

**METHOD AND MATERIALS:** This study involved retrospective analysis of 1422 stat lower extremity venous duplex ultrasound examinations during a 6-month period at a single hospital. All patients underwent both proximal and calf vein assessment. Officially dictated radiologist reports and sonographer worksheets were analyzed for rates of calf vein visualization and lower extremity DVT detection. Patient charts were reviewed (Cerner; North Kansas City, MO) to assess treatment status.

**RESULTS:** Among the ultrasound examinations performed, 57.5% (817/1422) had fully visualized calf veins, while 4.1% (58/1422) had nonvisualized calf veins. Isolated calf vein DVT was detected in 3.0% (42/1422) of the examinations. Of the positive examinations, 36 patients were eligible for anticoagulation, and 83% (30/36) received treatment for their DVT.

**CONCLUSION:** Assessment of calf veins on lower extremity venous duplex ultrasounds yields nonideal visualization rates. However, even with poor visualization, ultrasound examinations of the lower extremity detected isolated calf vein DVTs for treatment in a cohort of patients, suggesting calf vein assessment may still have an important role in stat ultrasound protocols.

## Neuroradiology

**(R-79) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Maternal-Fetal MR Imaging for Confirmation of CNS Abnormalities Detected at Prenatal US: Case Series**

Simon Onderi, MD, MA, *Winthrop-University Hospital, Mineola, NY*; Tarnima Ahamed, MD; Jean Murphy; Martin Chavez, MD; Orlando Ortiz, MBA, MD

**PURPOSE:** Prenatal ultrasound is optimal for identification of fetal abnormalities, as it is readily available, radiation free, cost-effective, and accurate. Its limitations include operator dependence, unfavorable maternal body habitus, and advanced fetal age, among others. MRI is a useful diagnostic adjunct when confirmation of suspected abnormalities on ultrasound is required. With regard to central nervous system (CNS) abnormalities, MRI provides excellent soft-tissue contrast, facilitating the identification of CNS pathology, including hemorrhage, abnormalities in neuronal migration, sulcation, myelination, ventriculomegaly, and others. Despite literature demonstrating the added value of MRI in confirming and identifying additional CNS abnormalities, controversy still exists. Our objective is to assess the diagnostic accuracy of fetal-maternal MRI by comparing MRI findings with prenatal ultrasound.

**METHOD AND MATERIALS:** From January 2013 to July 2015, women primarily in their second trimester of pregnancy visiting our institution's prenatal clinic whose fetuses were suspected of having CNS

abnormalities on ultrasound were referred to MRI for further evaluation. The MRI findings were compared to the initial prompting prenatal ultrasound for diagnostic congruence.

**RESULTS:** A total of 38 women with identified sonographic fetal CNS abnormalities were referred to MRI for further evaluation. Thirteen patients who had ventriculomegaly on ultrasound had findings confirmed on MRI. Of six patients identified with absent cavum septum pellucidum or agenesis of the corpus callosum, two had findings confirmed on MRI. Two patients diagnosed with holoprosencephaly spectrum had findings seen on follow-up MRI. An additional case of holoprosencephaly not previously identified on ultrasound was diagnosed on MRI. Three inter-hemispheric cysts were identified on ultrasound but not seen on MRI. A sacrococcygeal teratoma was noted on both ultrasound and MRI. Additional findings seen on ultrasound were confirmed on MRI.

**CONCLUSION:** MRI is a useful adjunct to prenatal ultrasound when confirmation of abnormalities is needed. There was poor ultrasound-MRI correlation for diagnosis of abnormalities of the corpus callosum and intracranial cysts.

**(R-148) Wednesday • 7:00–7:20 AM • E-poster, computer #9**  
**Concurrent Use of Maxillofacial CT with Head CT in Cases of Acute Head Trauma: Added Diagnostic Value or Unnecessary Radiation Exposure?**

Andrew Lukaszewicz, MD; Zacharias Zitterkopf, *St. Joseph Mercy Oakland, Pontiac, MI*; Sundeep Patel, MD; Grygori Gerasymchuk, MD ([a.lukaszewicz@utoronto.ca](mailto:a.lukaszewicz@utoronto.ca))

**PURPOSE:** Head trauma is a frequently encountered reason for emergency department (ED) visits. Although a computed tomography (CT) scan of the head is the most commonly ordered study, in our ED a maxillofacial CT is often ordered concurrently. The purpose of this study is to examine whether the addition of maxillofacial CT adds any diagnostic value to cases of head trauma.

**METHOD AND MATERIALS:** A retrospective analysis of patients presenting to our ED with head trauma during the period from July 1, 2014, to July 31, 2015, was performed. Inclusion criteria were having both head and maxillofacial CT scans ordered concurrently. Each study was reviewed, and in positive scans, the determination was made as to whether or not findings were seen on head CT alone. In cases where pathology was not apparent on head CT, scan length and location of pathology were noted.

**RESULTS:** Two hundred seventy-seven (277) patients met the inclusion criteria; of these, 137 (49.5%) had negative studies. On positive examinations, findings were seen on head CT in 86.4% of cases. Where the finding was not seen on head CT, 10 patients had nasal bone fractures, five had soft-tissue swelling, one had foreign bodies in the cheek, and three had mandibular bone fractures. In the patients with a mandibular fracture, clinical suspicion would have required a maxillofacial scan. In all remaining cases, having the scan length extended to include the inferior maxillary sinuses would have allowed for visualization of pathology on head CT.

**CONCLUSION:** Head CT is the preferred initial imaging modality in cases of head trauma. Based on the results of this study, concomitant maxillofacial CT does not provide additional diagnostic value unless there is clinical suspicion of inferior (eg, mandibular) injury. To further increase sensitivity, the field of view for head CT should be extended inferiorly to the base of the maxillary sinuses, allowing better evaluation for secondary signs of injury, such as blood in the paranasal sinuses. When head CT hints at injury, maxillofacial CT may be requested by the interpreting radiologist, thereby eliminating unnecessary patient radiation exposure, as well as saving costs.

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

## Nuclear Medicine

### (R-77) Wednesday • 7:00–8:15 AM • Hard-copy poster Comparing Two <sup>123</sup>I-Ioflupane SPECT Processing Methods for Determination of Basal Ganglia Volumes in Patients with Parkinsonian-like Features

Karl Echiverri, BA, *University of Kentucky College of Medicine, Lexington, KY*; Partha Sinha, MD, MBA; Elizabeth Cheatham, AAS, CNMT; George Quintero; Craig van Horne, MD, PhD; M. Elizabeth Oates, MD ([karl.echiverri@uky.edu](mailto:karl.echiverri@uky.edu))

**PURPOSE:** In combination with clinical assessment, SPECT imaging with <sup>123</sup>I-ioflupane injection (DaTscan; GE Healthcare, Little Chalfont, UK) is a powerful tool for differentiating parkinsonian syndromes from essential tremor. This radiopharmaceutical localizes symmetrically in healthy basal ganglia (BG) but is asymmetric, decreased, or absent in diseased BG. The purpose of this study was to compare the BG volumes measured by commercially available image processing software (GE Healthcare) versus that developed in house (University of Kentucky [UK]). Quantifying such differences will aid in assessing the quality and usefulness of these methods and may guide improvements in <sup>123</sup>I-ioflupane image processing.

**METHOD AND MATERIALS:** <sup>123</sup>I-ioflupane SPECT images from 17 patients (12 males, 5 females; 53–81 years) with parkinsonian-like features were processed by GE and UK methods. By using stereotactic planning software (iPlan 3.0 Stereotaxy; Brainlab, Westchester, IL), three analyses were performed on each patient's images. First, a band threshold was applied to each gray-valued image to define a three-dimensional BG region of interest for analysis. Images were manually edited to further remove signals outside the BG. Volumes of the left, right, and total BG were calculated for each method. Next, BG volumes were determined from settings that were 90% and 110% of the original band threshold. For all three analyses, differences in BG volumes between the GE and UK methods were calculated for each patient and compared using a two-tailed paired *t* test.

**RESULTS:** Fifty-one pairs of <sup>123</sup>I-ioflupane images were analyzed and average left, right, and total BG volumes compared. A statistically significant difference was found between the average BG volume generated by GE versus UK methods ( $P < .05$ ). Comparing the volumes generated for the left BG and the right BG showed significantly different volumes ( $P < .05$  and  $P < .05$ , respectively).

**CONCLUSION:** The clinical usefulness of <sup>123</sup>I-ioflupane injection is enhanced by accurately measured volumes, underscoring the importance of robust processing parameters. We demonstrated statistically significant differences between two acceptable methods. Future studies can attempt to account for these differences and determine how they might impact diagnostic decision making.

## Women's Imaging

### (R-92) Thursday • 7:00–8:15 AM • Hard-copy poster Assessing Tumor Size Extent on Contrast-enhanced Digital Mammography versus Full-Field Digital Mam- mography and US

Sarah Eversman, *Mayo Clinic Arizona, Scottsdale, AZ*; Victor Pizzitola, MD; Marina Giurescu; Roxanne Lorans; Bhavika K. Patel, MD ([patel.bhavika@mayo.edu](mailto:patel.bhavika@mayo.edu))

**PURPOSE:** Contrast-enhanced digital mammography (CEDM) is a novel breast imaging modality that has demonstrated increased sensitivity and specificity compared to full-field digital mammography (FFDM) or FFDM combined with ultrasound. In cases of malignancy, our radiologists find it easier to delineate extent of disease using the subtracted contrast-enhanced image rather than the standard FFDM, especially in the case of dense breasts. We aimed to evaluate correlation and agreement of tumor size measurements using CEDM compared to FFDM and ultrasound.

**METHOD AND MATERIALS:** Between October 2014 and August 2015, a total of 239 cases have been performed for varied indications. Of these, 83

had biopsy-proven cancer at the time of CEDM or within 4 weeks of having CEDM. Exclusion criteria included 23 patients undergoing neoadjuvant therapy due to lack of gold standard pathology size, one patient who was deceased prior to surgery, 10 patients with surgery pending, and one patient lost to follow-up. The remaining 48 cases were collected, and data on maximum tumor size measurements were obtained by three radiologists with 9–25 years of experience. In 43 cases, tumor size measurements were available for breast FFDM, 40 for US, and 44 for CEDM. Histopathologic results of the surgical specimen served as gold standard in all cases.

**RESULTS:** The Pearson's correlation coefficients of FFDM, US, and CEDM versus histopathology were 0.867, 0.851, and 0.889, respectively ( $P < .001$ ). For the agreement between measurements, the mean difference between FFDM and histopathology was 0.12 mm, for US and histopathology was  $-0.05$  mm, and for CEDM and histopathology was 0.14 mm. Limits of agreement were  $-0.88$  to 1.11 mm for FFDM,  $-0.89$  to 0.99 mm for US, and  $-0.77$  to 1.05 mm for CEDM. In dense breasts, correlations between CEDM and FFDM with histopathology were similar (0.867 vs 0.840;  $P = NS$ ).

**CONCLUSION:** Accuracy of tumor size measurement using CEDM appears to be noninferior and matches the quality of measurements obtained from breast FFDM and US. Specifically, in cases of dense breasts, where the extent of disease can be difficult to delineate, CEDM shows promise as an alternative tool of measurement.

### AUR Trainee Prize: 2nd Place

### (R-93) Wednesday • 7:00–8:15 AM • Hard-copy poster Benefit Analysis of BRCA Testing in Women at High Risk for Breast Cancer

Mariam Hamid, BA, *University of Michigan Medical School, Ann Arbor, MI*; Kelli Hall; Giselle Kolenic; Jessica Dozier; Vanessa Dalton; Ruth C. Carlos, MD, MS

**PURPOSE:** The Affordable Care Act (ACA) requires insurance plans in the individual market to provide full coverage with no cost share for preventive services with a grade "B" from the U.S. Preventive Services Task Force, including BRCA genetic screening for women with a family history of breast cancer. This study aims to determine if coverage information for this preventive service provided by insurance representatives of companies offering plans in the 2015 health insurance marketplaces is concordant with legislation.

**METHOD AND MATERIALS:** In each state, all insurers offering coverage through the state (Connecticut) and federal health exchanges were identified by customer service telephone numbers. A total of 165 unique numbers were contacted between June 1 and July 10, 2015, to elicit information about insurance coverage for BRCA genetic screening among women with a family history of breast cancer. A single researcher posed as a secret shopper using a standardized patient biography. Information provided by call center representatives was assessed for concordance with federal legislation, the primary outcome; and additional call information was recorded. Descriptive statistics were obtained for the primary outcome.

**RESULTS:** For BRCA testing coverage, 17% ( $n = 28$ ) of insurer representatives provided information that was concordant with the ACA, and 58% ( $n = 95$ ) were nonconcordant. In 25% ( $n = 42$ ) of calls, coverage information could not be obtained. The average duration of the phone calls was  $12.0 \pm 9.3$  minutes, and the average duration on hold per call was  $3.3 \pm 6.3$  minutes. The average number of times transferred was  $0.6 \pm 0.8$  times per call. There was no association between concordance rate and call duration, duration on hold, or times transferred.

**CONCLUSION:** Customer service representatives of insurers offering plans in state and federal health exchanges delivered coverage information that is heterogeneous and often not concordant with current federal legislation. Providing inaccurate information regarding insurance coverage of BRCA testing in high-risk women limits fully informed choice of insurer. More broadly, misinformation may prevent women who are cost sensitive and at high risk of developing breast cancer from pursuing appropriate genetic testing.

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

# AUR 2016 Education Poster Abstracts

Instructional education posters are located in the Seaport Ballroom D–E. Each poster will be presented by its author during one of the *AMA PRA Category 1 Credit™* poster discussion sessions scheduled for 7:00–8:15 AM, Wednesday (Session 201) and Thursday (Session 301). The day and time of each poster presentation follows the presentation number. Presenting author is identified by institution name, city, and state (or country if not United States or Canada). Presentations by trainees (medical students, residents, or 1st-year fellows) are noted in blue.

## Abdominal Radiology

### (E-02) Thursday • 7:00–8:15 AM • Hard-copy poster Radiologic Evaluation of Retained Surgical Instruments (Chest and Abdomen): A Self-learning Module in Two Parts

Jacob M. Yousef, BS, *Penn State Hershey College of Medicine, Hershey, PA*; Janet A. Neutze, MD; Rekha Cherian, MD (*jneutze@psu.edu*)

**LEARNING OBJECTIVES:** 1) Explain the significance, risk factors, and outcomes of retained surgical instruments (RSIs). 2) Discuss one institution's procedures for review, communication, and documentation of intraprocedural imaging. 3) After review of unknown cases, describe a standardized diagnostic approach to imaging of RSIs, improve perception of RSIs, recognize limitations of intraprocedural imaging, learn adequate communication of results, and practice standardization of documentation of findings in the radiology report.

**CONTENT DESCRIPTION:** Retained surgical instruments (RSIs) are not uncommon. Estimates suggest one in 1500 open abdominal and chest surgeries (approximately one a year in a typical large hospital), resulting in approximately 1500 per year in the United States. This poster will illustrate the major sections of this two-part teaching module, prepared for MedEdPORTAL submission. Sections include the incidence, risk factors, types and sites of RSIs, and outcomes, as well as technologist procedure, resident/radiologist role, and sources of interpretation error in intraprocedural imaging. The poster will comment on and demonstrate several unknown cases with various RSIs, teaching points for detection, and examples of proper communication and documentation of findings.

### (E-03) Wednesday • 7:00–8:15 AM • Hard-copy poster Pancreatic Transplantation: What Radiologists Need to Know

Lorena Garza Garcia, MD; Anil Paramesh, MD\*; Nhan Nguyen, MD; Jeremy B. Nguyen, MD, MS; Cynthia W. Hanemann, MD; Mandy C. Weidenhaft, MD, *Tulane University School of Medicine, Healthcare Medical Center, New Orleans, LA*

**LEARNING OBJECTIVES:** 1) Describe the surgical technical procedures of pancreas transplantation. 2) Recognize the surgical anatomy, specifically the vascular anastomoses and the exocrine secretion drainage. 3) Describe the normal imaging findings of a pancreatic transplant through common imaging modalities such as ultrasound, computed tomography, and magnetic resonance imaging. 4) Discuss the most common posttransplantation complications.

**CONTENT DESCRIPTION:** Pancreatic transplantation was introduced more than 40 years ago, and it is currently the treatment of choice for diabetic patients with end-stage renal failure. Therefore, it is often performed in conjunction with kidney transplantation. Multiple efforts have been made to improve pancreatic graft survival, so it is imperative for radiologists to familiarize themselves with the surgical technique, normal graft imaging, and postoperative complications. Since pancreatic transplantation poses a great imaging

challenge due to the specialized surgical technique, a multimodality imaging approach is often employed that utilizes sonography, computed tomography, and magnetic resonance imaging. Complications immediately after surgery may include graft thrombosis, pancreatitis, infection, bleeding, anastomotic leak, and rejection. However, rejection may occur immediately or at any time during the patient's life. A pictorial review of pancreas transplantation is presented, including surgical anatomy, expected normal findings, and posttransplantation complications.

### (E-04) Thursday • 7:00–8:15 AM • Hard-copy poster What Every Radiologist Should Know about Endoscopic Retrograde Cholangiopancreatography: A Pictorial Review

Logan Bisset, MD, *Tulane University School of Medicine, New Orleans, LA*; James Vu; Jeremy B. Nguyen, MD, MS; Mandy C. Weidenhaft, MD; Cynthia W. Hanemann, MD; Henry Hefler, MD; et al

**LEARNING OBJECTIVES:** 1) Explain the role and technical aspect of endoscopic retrograde cholangiopancreatography (ERCP). 2) Identify the diagnostic and therapeutic indications for ERCP. 3) Describe the common risks and complications associated with ERCP. 4) Identify the radiology modalities used to diagnose complications of ERCP. 5) Discuss how to interpret radiologic findings of ERCP and its pitfalls.

**CONTENT DESCRIPTION:** Endoscopic retrograde cholangiopancreatography (ERCP) is a procedure that uses endoscopy and fluoroscopy to primarily treat and also to diagnose disease processes associated with the biliary and pancreatic ductal system. Therefore, it is important that radiologists be aware of the technique, its indications, and complications of ERCP, which will be discussed. ERCP is a technique that involves passing a side-viewing upper endoscope to the second portion of the duodenum (via the esophagus and stomach) and subsequently cannulating the ampulla of Vater. Radiopaque contrast material can be injected to opacify the biliary and pancreatic ducts, and therapeutic interventions can be performed. Illustrations of the current ERCP equipment and techniques will be provided. Reviews of multiple modalities that radiologists have at their disposal for optimal evaluation of the risks and complications of ERCP (ie, pancreatitis, hemorrhage, perforation, and infection) will be provided. Illustrations of the radiologic findings of ERCP and its pitfalls will be discussed. Correlation of ERCP imaging sensitivity and specificity with those of MRCP will also be reviewed.

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

**(E-05) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Diffusion-weighted Imaging of the Liver: A Pictorial Review**

Scott L. Beech, MD, *Tulane University School of Medicine, New Orleans, LA*; Andrew Marshall, MD; James Vu; Jeremy B. Nguyen, MD, MS; Cynthia W. Hanemann, MD; Krystle Barhaghi, MD; et al

**LEARNING OBJECTIVES:** 1) Describe the physical principle and mathematics of diffusion-weighted imaging (DWI) of the liver. 2) Describe the utilization of DWI data in imaging of the liver. 3) Discuss the clinical applications of DWI in characterizing disease processes in the liver.

**CONTENT DESCRIPTION:** Diffusion-weighted imaging (DWI) is a form of magnetic resonance imaging (MRI) that can be applied in liver imaging, with improved image quality compared to T2-weighted MRI and with potential additional values to contrast-enhanced sequences. It is a viable alternative to gadolinium-enhanced MRI, particularly in patients with severe renal disease who are at risk for nephrogenic systemic fibrosis. DWI uses an imaging sequence that sensitizes to the diffusivity of the inherent random motion of the water molecules (brownian motion), to enable the qualitative and quantitative assessment of liver tissue diffusivity. Illustration of imaging physics, techniques, postprocessing, and quantification methods applicable to liver DWI will be discussed. MR images of the liver, based on DWI, will be displayed to illustrate the clinical applications of DWI in characterizing disease processes in the liver. Strategies to improve DWI limitations in the liver (spatial image quality and ADC reproducibility) will also be discussed. Correlation with other imaging modalities will also be provided to illustrate the teaching points.

**(E-07) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Welcome to the Peritoneum: A Primer for Radiology Trainees**

Samira Rathnayake, MD, *Yale University School of Medicine, New Haven, CT*; Michael Spektor; Steffen Huber; Jay K. Pahade, MD; Patricia Balcacer, MD; Mahan Mathur, MD (*mahan.mathur@yale.edu*)

**LEARNING OBJECTIVES:** 1) Describe the ligaments, mesenteries, omenta, and organs that delineate and reside within the peritoneal cavity. 2) Recognize the imaging appearance of nonneoplastic conditions of the peritoneal cavity. 3) Describe how to develop an organized approach to classifying peritoneal neoplasms.

**CONTENT DESCRIPTION:** **Anatomy:** Schematic diagrams with radiology correlation will be used to describe the anatomy of the peritoneal cavity. The following will be covered: subphrenic space, falciform ligament, hepatorenal recess/Morrison's pouch, gastrohepatic ligament, splenorenal ligament, lesser omentum, greater omentum, paracolic gutters, small bowel mesentery, transverse mesocolon, sigmoid mesocolon, pouch of Douglas, and greater and lesser sacs. **Nonneoplastic Conditions:** Relevant clinical/epidemiologic data will be provided alongside the imaging appearances of the following: omental infarct, epiploic appendicitis, mesenteric panniculitis spectrum, TB, encapsulating peritoneal sclerosis, peritoneal inclusion cyst, splenosis, endometriosis, gastric perforation, and bladder rupture. **Neoplastic Conditions:** Relevant clinical/epidemiologic data will be provided alongside the imaging appearances. Secondary neoplastic conditions include carcinomatosis, desmoid, carcinoid, pseudomyxoma peritonei, peritoneal lymphomatosis, and GIST. Primary neoplastic conditions include lymphangioma, primary effusion lymphoma, malignant mesothelioma, benign cystic mesothelioma, well-differentiated papillary mesothelioma, adenomatoid, primary peritoneal serous carcinoma, primary peritoneal serous borderline carcinoma, leiomyomatosis peritonealis disseminata, desmoplastic small round blue cell tumor, and solitary fibrous tumor.

**(E-08) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Liver and Renal Transplant Emergencies: What the On-Call Resident Needs To Know**

Jacqueline Junn, MD, *Emory University School of Medicine, Atlanta, GA*; Michael T. Osipow, MD (*jacqueline.junn@emory.edu*)

**LEARNING OBJECTIVES:** 1) Describe normal postoperative renal and liver transplant anatomy. 2) Discuss common posttransplant emergent complications and how they are identified across different imaging modalities. 3) Discuss common interventional radiology procedures for the management of posttransplant complications. 4) Describe a checklist with imaging references for residents to facilitate comprehensive interpretations while on call.

**CONTENT DESCRIPTION:** Approximately 6000 liver transplants and 16,000 kidney transplants were performed in the United States in 2014. As transplantation becomes a more accepted therapy for certain liver diseases (cirrhosis, HCC, PSC, metabolic disease) and end-stage renal disease, understanding the surgical anatomy, normal posttransplant imaging appearance, and imaging manifestations of complications is imperative for radiologists. In the on-call setting, identifying emergent findings and relaying that information to clinical providers are of critical importance. As a transplant center, on-call residents are often at the frontline in interpreting immediate postoperative transplant images and images following suspected transplant complications at our institution. We will illustrate normal renal and liver transplant anatomy and expected posttransplant imaging appearance, followed by a discussion of common emergent renal and liver transplant complications. Lastly, we will discuss common interventional radiology procedures utilized in the management of these complications. To improve diagnostic accuracy and evaluation of posttransplant imaging, we have devised a checklist with corresponding images for on-call residents.

**(E-09) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Use of Microperforations to Create Double-Contrast Imaging for Esophagrams and Upper Gastrointestinal Series**

Waqar Ahmad, MD, *Bridgeport Hospital, Bridgeport, CT*; Steven Stein, MD; Shuo Li, MD; Kusum Hooda, MD; Sreelatha Diviti, MD (*waqar.ahmad@bpthosp.org*)

**LEARNING OBJECTIVES:** Effervescent crystals (such as E-Z-Gas II [Bracco Diagnostics, Princeton, NJ]) are currently used to produce both gas and contrast within the upper GI tract in patients undergoing upper GI series or esophagrams. These effervescent crystals are uncomfortable for the patient and generally not well tolerated. They produce excessive gas, bloating, and nausea for a majority of patients. Our hospital utilizes a special method to produce double-contrast imaging by placing a small microperforation in the patient's straw before the patient drinks contrast. By placing a microperforation with a 22-gauge needle outside the patient's point of contact with the straw, air becomes mixed with barium as the patient sucks contrast through the straw. The result is equally efficacious double-contrast images with zero to minimal patient discomfort.

**CONTENT DESCRIPTION:** This education poster will describe the traditional ways to obtain double-contrast images, followed by a protocol of our technique in detail, and follow-up with images comparing the traditional method of effervescent crystals and our method of microperforations within the patient's straw.

**(E-10)**  
**Withdrawn**

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

**(E-12) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Interpreting Body MR Imaging Cases: The “Aunt Minnies” of the Abdomen**

Leann M. Kania, MD, BS, *Thomas Jefferson University Hospital, Philadelphia, PA*; Flavius Guglielmo, MD; Donald G. Mitchell, MD\*  
 (leann.kania@jefferson.edu)

**LEARNING OBJECTIVE:** 1) Recognize “Aunt Minnie” findings of the abdominal organs utilizing only a few key images and sequences: (a) liver: cyst, hemangioma, biliary hamartomas, steatosis, hemosiderosis, FNH, adenoma, abscess, and HCC; (b) spleen: lymphangioma, cyst, hemangioma, and hemosiderosis; (c) gallbladder: stones, sludge, adenomyomatosis, and surgical clips in the gallbladder fossa; (d) biliary: pneumobilia, choledocholithiasis, and choledochal cyst; (e) adrenals: adenoma, cyst, and malignant mass; (f) kidneys: simple cyst, hemorrhagic cyst, AML, parapelvic cysts on postgadolinium MRCP, and solid mass; (g) pancreas: IPMN, chronic pancreatitis, solid mass, autoimmune pancreatitis, and pancreas divisum; and (h) bowel: duodenal diverticulum.

**CONTENT DESCRIPTION:** Beginning to interpret body MRI cases can be both daunting and disorienting to a radiologist with limited experience. After achieving a fundamental understanding of pulse sequence generation and utility, an important next step is to become familiar with and be able to recognize the “classic” appearance of common benign and pathologic findings, a reasonable expectation for radiologists early in their career. This expedites interpretation of the overall study and appropriate management or dismissal of the finding. The teaching points of this presentation will summarize the most common “Aunt Minnie” findings of the abdominal organs. Learners should expect to be able to differentiate among common pathologies utilizing a few key images and sequences.

**(E-13) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**“Help! I Am Missing a DeBaKey!” Speaking the Surgeon’s Language—Identifying Common Surgical Instruments on Intraoperative and Postoperative Radiographs**

Ramanujam Prativadi, MD, BS; Nicole Toscano, MD; Patrick J. Fultz, MD; Joel Thompson, MD, MPH, *University of Rochester Medical Center, Rochester, NY* (ramanujam\_prativadi@urmc.rochester.edu)

**LEARNING OBJECTIVES:** It is common for surgeons to obtain intraoperative and postoperative radiographs. Intraoperative imaging is an institutional policy when the surgical count is incorrect at the conclusion of a case prior to closing the surgical incision and leaving the operating room. It is important for radiologists to have a familiarity with common surgical instruments to not only better assist surgical colleagues in interpreting these radiographs, but also to ensure patient safety and minimize complications. The purpose of this exhibit is to review common surgical instruments visualized on intraoperative and postoperative radiographs and to provide an educational tool to assist radiologists in identification of these instruments on imaging.

**CONTENT DESCRIPTION:** I. Introduction II. Intra-abdominal and vascular instruments: pictorial and radiographic correlation and characterization of retractors, scissors, needle-drivers/needles, clamps, forceps, and miscellaneous. III. Case examples. IV. Summary.

**(E-14) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Follow the Swallow: A Guide to Interpretation of the Video Fluoroscopic Swallow Study**

Sameer Sandhu, MD, *Christiana Care Health System, Newark, DE*; Katie S. Traylor, DO; Kristina A. Siddall, MD; Dale Gregore, MS; Janet Sechrist, MA

**LEARNING OBJECTIVES:** 1) Define the purpose and indications of a video fluoroscopic swallow study (VFSS). 2) Describe the anatomy of the oral, pharyngeal, and esophageal stages of swallowing. 3) Identify examples of the causes of dysphagia during each of these stages.

**CONTENT DESCRIPTION:** The VFSS assesses swallow function with multiple solid textures and liquid viscosities to determine the cause of dysphagia and, subsequently, help the speech pathologist determine the best treatment or compensatory strategy for safe oral intake. Over 1000 VFSSs are performed in our hospital system each year, and understanding the normal and abnormal findings in these studies is critical to patient care. We outline the anatomy and pathology associated with the oral, pharyngeal, and esophageal stages of swallowing. The anatomy examined during the oral stage of swallowing extends from the lips anteriorly to the soft palate posteriorly. The functions of the oral stage include bolus acceptance, mastication, and lingual transfer. Causes of dysphagia during this stage include spilling from oral cavity, drooling, dysfunctional chewing, and oral residue. The anatomy examined during the pharyngeal stage extends from the oropharynx/back of tongue superiorly to the hypopharynx/pyriform sinus inferiorly. The functions of the pharyngeal stage include bolus transport through pharynx/upper esophageal sphincter (UES), airway protection, and pharyngeal evacuation. Causes of dysphagia during this stage include residue in the valleculae and/or pyriform sinus, supraglottic penetration, and aspiration. The anatomy examined during the esophageal stage extends from the UES superiorly to the lower esophageal sphincter (LES) inferiorly. The functions of the esophageal stage include bolus transport from UES to and through LES into the stomach. Causes of dysphagia during this stage include cricopharyngeal dysfunction, dysmotility, gastroesophageal reflux, diverticula, tracheoesophageal fistula, and achalasia. The causes of dysphagia can also be categorized into developmental, neurogenic, structural, and mechanical etiologies. The three phases of swallowing are often interconnected and contribute to these different causes.

**(E-100) Wednesday • 7:25–7:45 AM • E-poster, computer #7**

**Twist and Shout: Review of Torsions and Volvuli**

Vivek R. Patel, MD, *Yale University, New Haven, CT*; Aditi Vyas; Mahan Mathur, MD; Michael Spektor

**LEARNING OBJECTIVES:** 1) Describe normal anatomy and embryologic development of pertinent abdominal/pelvic structures. 2) Identify the mechanism and pathophysiology of twisting injuries. 3) Discuss a comprehensive multimodality pictorial review of torsions, volvuli, and other abdominal/pelvic twisting injuries.

**CONTENT DESCRIPTION:** The purpose of this exhibit is to review torsions, volvuli, and other abdominal/pelvic twisting abnormalities. Twisting injuries are often true medical emergencies, and prompt imaging and interpretation are fundamental for the treatment of these entities. This exhibit will provide annotated images, multimodality imaging correlation, review of associated findings, and imaging pitfalls; and a discussion will be presented for each entity. The discussion will contain relevant information about prevalence/epidemiology, pathophysiology (including embryology when relevant), differential diagnosis, treatment, outcome, and key teaching points. The key anatomic and pathologic issues to be discussed include (1) volvuli (cecum, sigmoid, transverse, gastric, and small intestine/midgut), (2) torsions (testicular, ovarian, splenic, transplant, and omental), (3) epiploic appendagitis, and (4) uterine fibroids.

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

**(E-101) Wednesday • 7:25–7:45 AM •****E-poster, computer #10****Radiologic Multimodality Imaging after Bariatric Surgery: A Review of Normal and Abnormal Findings and Their Treatment**

Bahar Mansoori, MD, *University Hospitals Case Medical Center, Case Western Reserve University, Cleveland, OH*; Majid Chalian, MD; Karin A. Herrmann, MD ([Bahar.Mansoori@uhhospitals.org](mailto:Bahar.Mansoori@uhhospitals.org))

**LEARNING OBJECTIVES:** 1) Describe the most commonly performed surgical procedures in bariatric surgery and their normal surgical anatomy. 2) Explain the role of radiologic imaging in the assessment of the immediate postoperative status and long-term follow-up of bariatric surgical procedures and how to make an appropriate choice of the most valuable diagnostic imaging modality. 3) Identify normal and abnormal imaging findings and complications of bariatric surgical procedures, and describe how to evaluate the outcome of their treatment.

**CONTENT DESCRIPTION:** Bariatric surgery is increasingly performed as a treatment of obesity. Radiologic imaging plays a key role in (a) the evaluation of the immediate postoperative status to identify postsurgical complications and (b) the long-term follow-up. This exhibit will review the various surgical procedures in bariatric surgery and illustrate the normal surgical anatomy related to these procedures. We will discuss the indications for radiologic imaging and the appropriate choice of the most valuable imaging modalities and will illustrate the radiologic imaging appearance of expected normal postsurgical changes after bariatric surgical procedures with multiple modalities, such as x-ray, fluoroscopy, and cross-sectional imaging. A review of the literature about the most common complications of bariatric surgery will be presented, and examples of the typical imaging appearance of these complications will be demonstrated. Furthermore, possible treatment options will be discussed, and radiologic imaging examples of the successful treatment of these complications will be provided.

**(E-131) Wednesday • 7:25–7:45 AM •****E-poster, computer #8****Image-guided Biopsy of Focal Pancreatic Masses: A Primer**

Benjamin D. Lack, MD; Kiran R. Nandalur, MD, *William Beaumont Hospital, Royal Oak, MI* ([ben.lack@beaumont.edu](mailto:ben.lack@beaumont.edu))

**LEARNING OBJECTIVES:** 1) Describe the indications for pancreatic mass biopsy, including confirming pathology before palliation and differentiating between adenocarcinoma and benign fibrosis related to pancreatitis. 2) Explain the different modalities used to obtain samples, including endoscopic techniques such as endoscopic sonography and ERCP and ultrasound/CT-guided percutaneous biopsy. 3) Discuss the techniques utilized at our institution, specifically explaining the advantages and disadvantages of CT versus ultrasound and fine-needle aspiration versus core biopsy.

**CONTENT DESCRIPTION:** Pancreatic mass biopsy is often performed by gastroenterologists or surgeons via endoscopic techniques. However, procedural radiologists have a distinct role in the diagnosis of pancreas abnormalities, especially lesions involving the body or tail and nondiagnostic endoscopic results. Relevant findings from 100 consecutive pertinent cases from the past 3 years at our institution will be presented, including (1) indications for biopsy, including pertinent imaging characteristics of lesions on ultrasound, CT, and MRI; (2) specific considerations, including anesthetic requirements, approach, and choice

of fine-needle aspiration versus core needle biopsy; (3) the choice of image guidance, with emphasis on ultrasound; and (4) managing complications. Early studies on the use of percutaneous biopsy for the diagnosis of malignant pancreatic disease demonstrated limited utility. However, with the use of newer imaging techniques for localization and larger needles, the sensitivity and specificity for malignant disease can be greater than 90%. Moreover, if performed with certain precautions in mind, percutaneous tissue diagnosis can be done with minimal complications. Overall, a thorough understanding of pancreatic lesion biopsy by radiologists can lead to improved patient evaluation.

**(E-159) Wednesday • 7:50–8:10 AM •****E-poster, computer #4****Prostate MR Imaging in the Era of MR/US Fusion Biopsy: An Update**

Elizabeth V. Craig, MD, *Vanderbilt University Medical Center, Nashville, TN*; Geoffrey Wile, MD; Ronald Arildsen, MD; Richard G. Abramson, MD\*; Sandeep Arora ([sandeep.s.arora@vanderbilt.edu](mailto:sandeep.s.arora@vanderbilt.edu))

**LEARNING OBJECTIVES:** 1) Discuss the Prostate Imaging Reporting and Data System (PI-RAD™) and highlights of the recent 2015 updates, with an emphasis on practical application. 2) Describe the current level of evidence supporting the ability of prostate MRI to detect/stage cancer and evaluating the clinical utility of MR/US fusion prostate biopsy. 3) List steps for successful implementation of a prostate MR/US fusion program.

**CONTENT DESCRIPTION:** PSA testing followed by ultrasound-guided transrectal extended-sextant biopsy is the most prevalent current screening-diagnostic combination used for detection of prostate cancer. Both the screening and diagnostic components of this approach are flawed. Magnetic resonance imaging (MRI) is an excellent tool to image the prostate gland due to its high contrast resolution and capabilities for functional imaging. The Prostate Imaging Reporting and Data System (PI-RADS™) was created to improve detection, localization, characterization, and risk stratification in patients with suspected cancer in treatment-naïve prostate glands. In our poster, we will review PI-RADS v2 recommendations and updates, focusing on (1) technical specifications for overall assessment, (2) imaging review of benign findings, and (3) describing differences between assessment of peripheral and transitional zone lesions, with help of examples. We will also present data from literature demonstrating the ability of prostate MRI to detect clinically significant prostate cancer and the potential for using MRI as a screening tool. MRI can also help guide biopsies in real time, which has resulted in increased detection of high-risk prostate cancers, compared to standard random US-guided biopsies, while reducing detection rates of low-risk cancer. We will review the current level of evidence supporting the efficacy of MR/US fusion biopsy, with special focus on (1) types of available devices, (2) efficacy of targeted versus random versus combined biopsy, and (3) performance of targeted biopsy in patients with previously negative biopsies versus other populations. Finally, we will list steps, based on our experience, for successful implementation of a prostate MR/US fusion program, focusing on tackling potential roadblocks.

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

## Cardiopulmonary Radiology

### (E-15) Wednesday • 7:00–8:15 AM • Hard-copy poster How to Start a Successful ER Coronary CT Angiographic Program: Forming a Partnership among Radiology, Emergency Medicine, and Cardiology

Nikhil Goyal, MD, *Staten Island University Hospital, Staten Island, NY*;  
Gregory N. Emmanuel, MD, MSc

**LEARNING OBJECTIVES:** 1) Explain the role of coronary CTA (CCTA) in the triage of patients presenting to the emergency room. 2) Discuss the roles and perspectives of different personnel involved in a CCTA program (nurses, technologists, radiologists, cardiologists, and emergency room physicians). 3) Describe a step-by-step approach to setting up a CCTA program. 4) Identify hurdles that may arise and how to deal with them.

**CONTENT DESCRIPTION:** I. Role of CTA: brief summary of trial data showing benefits of CCTA. II. Describe the roles of each person in the process of creating a CCTA program. III. Step-by-step approach to designing and running multidisciplinary meetings of radiology, cardiology, and ER physicians with regard to setting up a CCTA program. IV. Specific hurdles encountered while creating our program and how we addressed these issues.

### (E-16) Thursday • 7:00–8:15 AM • Hard-copy poster Cardiac Misadventures

Rydhwana Hossain, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*; Alan C. Legasto, MD; Stacey O. Verzosa, MD

**LEARNING OBJECTIVES:** Intrathoracic support lines and devices are encountered every day. As the heart occupies a significant portion of the thorax, it is vulnerable to inadvertent life-threatening injury by malpositioned lines. Furthermore, misplaced cardiac devices, such as pacemaker and defibrillator leads, can lead to malfunction and compromise patient safety. Prompt recognition of heart-related malpositioned lines is essential for radiologists and requires knowledge of normal cardiac anatomy on chest x-ray. The heart is also vulnerable to complications following cardiac surgery, including bypass graft placement and valve repair. Radiologists must understand the surgical technique of these procedures, the normal postoperative appearance, and how to recognize potential early and late complications on both plain radiography and computed tomography. We will review several cases of line-related and postoperative cardiac misadventures, relevant anatomy, the radiographic appearance of well-positioned lines, and a normal postoperative chest.

**CONTENT DESCRIPTION:** I. Review of common devices seen in everyday chest radiographs and their correct placement, with specific attention to cardiac devices, as well as noncardiac devices, that can lead to cardiac injury and how they relate to the heart. II. Review of frequently encountered cardiac surgical procedures, with a focus on technique, radiologic appearance, and complications. A. Chest tube in the pulmonary vein. B. Chest tube in the left ventricle. C. Pericardial drain in the right ventricle. D. Aortic valve replacement with large pericardial fluid collection. E. Misplaced ICD lead. F. Mediastinal hemorrhage after cardiac bypass. G. Bypass graft aneurysm.

### (E-17) Wednesday • 7:00–8:15 AM • Hard-copy poster Trimming the Fat: A Case-based Review of Fat-containing Lesions within the Chest

Adam Zybulewski, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*; Jaime Altabet; Stacey O. Verzosa, MD; James E. Silberzweig, MD

**LEARNING OBJECTIVES:** 1) Recognize a variety of fat-containing lesions within the thorax. 2) Describe how to narrow the differential diagnosis by lesion location and lesion morphology. The presence of fat within a chest lesion can often lead to a specific diagnosis or at least allow the radiologist to significantly narrow the differential diagnosis. Understanding other characteristics, such as the location, shape, and lesion complexity, will further aid the radiologist in making a confident diagnosis.

**CONTENT DESCRIPTION:** I. Review of fat-containing lesions of the thorax as categorized by location and morphology. II. Key anatomic areas and imaging findings. A. Lung, pleural, and airways. 1. Lipoma. 2. Lipoid pneumonia. 3. Hamartoma. B. Mediastinum. 1. Lipomatosis. 2. Thymolipoma. 3. Teratoma. 4. Thymic hyperplasia. 5. Liposarcoma. C. Cardiac. 1. Lipoma. 2. Lipomatous hypertrophy of the interatrial septum. 3. Arrhythmogenic right ventricular dysplasia.

### (E-18) Thursday • 7:00–8:15 AM • Hard-copy poster Bedside Lung US in a Multimodal Approach to Critical Care Pulmonary Pathology

Richard Tapnio, MD, MHS, *Mount Sinai Beth Israel Medical Center, New York, NY*; Navitha Ramesh; Stacey O. Verzosa, MD ([rtapnio@chpnet.org](mailto:rtapnio@chpnet.org))

**LEARNING OBJECTIVES:** 1) Describe an overview of the current usage, indications, and techniques of critical care ultrasound of the lungs and pleura. 2) Discuss several examples of real-world pathology, with direct comparisons of conventional radiography (XR), ultrasound, and CT imaging for specific disease entities to help the learner correlate findings on multiple modalities. 3) Discuss advantages and disadvantages of lung ultrasound as it exists today, along with future directions.

**CONTENT DESCRIPTION:** We will present a detailed up-to-date conceptual, technical, and pictorial review of the utility of bedside ultrasound imaging of the lungs and pleura in critically ill patients. First, we will provide a brief overview of the history of critical care imaging and developments in ultrasound technology, including transducers and equipment used in today's lung ultrasound examinations. We will then discuss relevant anatomical landmarks and focused scanning techniques before moving on to common indications and scenarios involving real-world pathology. Entities to be discussed include pneumonia, congestive heart failure, and pleural effusions, along with other interesting cases; side-by-side comparisons of CT, US, and XR examinations will be provided when available. Finally, we will conclude with the unique advantages and disadvantages of bedside ultrasound as currently performed by intensivists, followed by recent advancements and future directions. We hope to help the learner gain comfort in interpreting ultrasound studies performed by intensivists on critically ill patients, while offering key points to equip the learner in diagnosing common lung pathology on his or her own.

**(E-19) Wednesday • 7:00–8:15 AM • Hard-copy poster  
MR Imaging of the Thorax: Current Practice and Recent Advances**

Omid Khalilzadeh, MD; Maryam Rahimian; Rajiv Gupta, PhD, MD; Stacey O. Verzosa, MD; Julien Dinkel, MD; Jody Shen, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*

**LEARNING OBJECTIVES:** 1) Identify MR sequences used in lung imaging and the soft tissues of the chest wall and mediastinum. 2) Describe current applications of MRI in thoracic imaging, including the chest wall and diaphragm, pleura, paraspinal masses, mediastinum and hila, lung parenchyma, bronchogenic carcinoma, aortic disease, and pulmonary vascular disease. 3) Discuss recent advances in cardiothoracic MRI, including lung MRI.

**CONTENT DESCRIPTION:** The value of MRI in imaging cardiac and large-vessel disease is widely accepted; however, MRI currently has limited use in lung imaging, given cardiac pulsation and respiratory artifacts and the low proton density/signal intensity of the lung parenchyma. Sequences such as T2 HASTE (Siemens Healthcare; Malvern, Pa) and free-breathing TrueFISP (Siemens Healthcare) are robust against breathing motion and are therefore introduced for lung imaging. Recent advances in protocols have made MR imaging a feasible surrogate to CT, especially when it is critical to avoid radiation exposure (eg, in children and pregnant patients), and as a modality with added value in functional imaging (eg, diaphragm motion and lung perfusion studies). This educational exhibit will review the clinical applications of MRI in soft-tissue and lung parenchymal imaging and provide representative examples.

**(E-20) Thursday • 7:00–8:15 AM • Hard-copy poster  
Frozen: Everything the Thoracic Radiologist Needs to Know about the CT Imaging Findings of Lung Cryoablation**

Ashley Stanley, MD, *UT Southwestern Medical Center, Dallas, TX*; Ankaj Khosla, MD; Nagina Malguria, MD; Patrick Sutphin, MD; Stephen P. Reis, MD (*Ashley.Stanley@phhs.org*)

**LEARNING OBJECTIVES:** Cryoablation is gaining popularity as a modality for ablation of a variety of pulmonary lesions. However, there is limited information available to guide diagnostic radiologists on imaging findings, follow-up, and what to expect in the postablation period. Our objective is to state the indications for pulmonary cryoablation, review the intraprocedural CT findings, as well as the postprocedural evolution of cryoablated tissue, and review the common complications.

**CONTENT DESCRIPTION:** I. Indications for pulmonary cryoablation. II. Placement of cryoablation probes. III. Discussion of freeze-thaw cycles. IV. Intraprocedural CT findings. V. Complications of pulmonary ablation and associated imaging findings. VI. CT findings of the evolving cryoablation site, with timeline.

**Education of Medical Students, Residents, Other****(E-28) Thursday • 7:00–8:15 AM • Hard-copy poster  
How to Transform an Underperforming Radiology Elective or Clerkship by Using Available Peer-reviewed Resources and Best Practice Curriculum Design**

Jeffery Hogg, MD, *West Virginia University School of Medicine/Robert C Byrd Health Sciences Center, Morgantown, WV* (*jhogg@hsc.wvu.edu*)

**LEARNING OBJECTIVES:** 1) Describe steps for effective, thoughtful radiology clerkship/elective curriculum development. 2) Identify and integrate easily available valuable resources for central didactics, classroom instruction, and educational assessment. 3) Describe how to design an engaging educational experience with related tasks that medical students learn from and value highly.

**CONTENT DESCRIPTION:** *Describe Outcome of the Effort:* We narrate the transformation of an understructured radiology elective by applying curriculum design principles and selected peer-reviewed educational resources. *Design Scope and Sequence:* Lessons are taught in stepwise sequence that builds on fundamentals and requires integration of widely accepted resources like ACR Appropriateness Criteria®. Learners must apply what they learn to solve novel problems as they progress through elective teaching of the AMSER medical student curriculum in radiology. *Session Titling Describes the Learning:* Sequential delivery of online and classroom instructional sessions clues learners so they are receptive to the instruction in fundamental concepts of professionalism in imaging, appropriate utilization, imaging safety, cost consciousness, and clinical effectiveness. *Instructional Approach:* Flipped classroom teaching uses widely available online virtual patient cases created for medical students (MedU CORE cases) as independent prelearning to teach facts and concepts. Collaboratively created classroom interactive workshop sessions foster far transfer of knowledge, requiring learners to apply those facts and concepts to solve new clinical problems. Focused imaging labs and skills-based hands-on peer-to-peer teaching sessions at the PACS with cases identified during limited reading room rotations are related, integrated learner tasks. *Learner Assessment:* Online pre- and posttests are peer-reviewed, validated, and convenient NBME-style standardized assessments. *Curriculum Assessment:* Curriculum is assessed with formal student evaluations of instruction and increasing demand for the elective. Feedback to elective director from students improves the experience for subsequent cohorts.

**(E-29) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Increasing the Medical Student's Confidence in Interpreting Common Radiologic Studies: Effects on Medical School Curricula**

Pamela L. Brian, MD, *Penn State University College of Medicine, Hummelstown, PA*; James M. Brian, MD; Janet A. Neutze, MD; Chandan Misra, MD (*pbrian@hmc.psu.edu*)

**LEARNING OBJECTIVES:** 1) Describe how to increase the medical student's confidence in reviewing common imaging examinations. 2) Identify normal anatomy, thereby increasing the ability to identify pathologic anatomy when subspecialty interpretation is not available. 3) Discuss how to generate student endorsement of this program, in an effort to make this a longitudinal exercise throughout medical school, and thereby increase the medical student's exposure to the field of radiology.

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

**CONTENT DESCRIPTION:** There is no required radiology course at our institution. Medical students learn image interpretation through radiology electives and scattered lectures, often given by nonradiologists. This teaching is inconsistent with regard to content, frequency, and repetitiveness and results in limited ability of medical students to recognize normal and pathologic anatomy. We postulate that a structured, repetitive, and longitudinal curriculum in evaluating normal radiologic anatomy will increase the student's confidence in reviewing images and identifying abnormal and pathologic anatomy. As a result, the impetus for increased exposure to radiology throughout the curriculum may be driven by student demand. This can build the dialogue between clinical services that is recommended in the recent IOM report to reduce diagnostic errors. We describe a successful intervention. Third-year surgery and medicine clerkship students attended three imaging sessions: chest radiograph, abdominal radiograph, and body CT. Each session, taught by a radiologist, began with a review of normal imaging anatomy. A stepwise structured format for the evaluation was provided, and multiple images were presented and evaluated in identical structured format. Abnormal anatomy was presented for comparison. Sessions ended with review, in the same format, of images of patients currently being cared for by the students. After each session, students were asked to rate the value of the activity. Responses were overwhelmingly positive, often resulting in students asking for longer and more-frequent sessions. Extrapolating this information, it is clear that a structured approach to normal imaging anatomy taught in a longitudinal format throughout medical school is needed and desired by students.

**(E-30) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Application of Active Learning Strategies in the Large Classroom When Teaching Radiology to Medical Students**

Jorge Taboada, MD, *University of Texas at Austin, Austin, TX*; Anne Braseby, PhD; Dee Silverthorn, PhD (*jtaboada@sw.org*)

**LEARNING OBJECTIVES:** 1) Explain the rationale for using active learning in large radiology classes. 2) Describe examples of different strategies of active learning in the large group setting. 3) Implement one or more of these strategies in the classroom. This educational exhibit will give examples of application of active learning strategies in the large group setting.

**CONTENT DESCRIPTION:** A growing body of evidence indicates that active engagement of students in the classroom, known as active learning, enhances student performance. Use of the flipped classroom, with attention to team-based learning, will be discussed, with examples of research-based best practices of knowledge acquisition outside the classroom, with reinforcement and application of that knowledge inside the classroom. Active learning tools such as classroom response systems, visible quizzes, and immediate feedback assessment technique cards will also be discussed. The exhibit will demonstrate specific examples of how to implement these pedagogical styles and instruments as they relate to teaching radiology to medical students.

**(E-31) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Implementation of a Medical Student Summer Clinical Observership Program: A Promising Recruitment Tool?**

Meryle J. Eklund, MD, *Medical University of South Carolina, Charleston, SC*; Michael U. Antonucci, MD; Jeanne G. Hill, MD; Leonie Gordon, MBChB; Philip Costello, MD

**LEARNING OBJECTIVES:** 1) Discuss current trends in competitiveness for the National Resident Matching Program® match in diagnostic radiology. 2) Describe a new summer clinical observership program designed to increase early medical student exposure to radiology, including structure/content and objectives. 3) Discuss feedback from the clinical observership program, including potential implications on recruitment of medical students to the field of radiology.

**CONTENT DESCRIPTION:** Competitiveness of residency positions in diagnostic radiology has been trending downward since 2009, with a sharp decline in the percentage of total matched positions as well as those filled by United States-trained medical students between 2014 and 2015. The decrease in applications for radiology spots is alarming to residency programs that are now struggling to fill available positions with high-quality well-suited candidates. We created a program in which medical students completed a 4-week summer clinical observership in the Department of Radiology between their 1st and 2nd years of medical school, in order to increase exposure to radiology as a specialty and create a positive experience that could contribute to future recruitment into the field of radiology. Two students were accepted into the program and assigned rotations in five subspecialty areas. The students attended introductory didactic lectures geared toward 1st-year radiology residents and participated in a series of imaging-related activities. Results from a postprogram survey were overwhelmingly positive, with both students reporting that they were more interested in pursuing radiology as a specialty than prior to the program and would definitely recommend the program to 1st-year medical students next year. While our sample size is small and more longitudinal data are required, it is encouraging to find that the observership had such a positive impact on our enrolled students. Given the success of the program in its inaugural year, we intend to continue the program in future years and hopefully grow interest in our specialty among our local medical students.

**(E-32) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**The “Mini-Attending”: A New Role for the 4th-Year Radiology Resident**

Elina Zaretsky, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*; Jeremy Whang, MD; James E. Silberzweig, MD (*ezaretsky@chpnet.org*)

**LEARNING OBJECTIVES:** The structure and timing of the new ABR Core Examination allow ample opportunity for a 4th-year radiology resident to perform a minifellowship in a desired specialty. In addition, this structure allows the 4th-year resident to take a more active role in educating junior residents via weekly resident conferences. At our institution, we recently implemented a series of weekly conferences taught by 4th-year radiology residents. These conferences provide a mutual benefit to both senior and junior residents and allow senior residents to continue to be engaged in the learning process during their final academic year.

**CONTENT DESCRIPTION:** This educational exhibit will provide details as to how the weekly resident-run lecture series is structured at our institution. Our conferences include a series of senior lectures on board-relevant topics, interesting case conferences, physics reviews, and First-Year Core—a “Brant and Helms”-style curriculum directed at 1st-year residents. Peer evaluations of these presentations are used to ensure quality presentations. Discussion of the benefits of a resident-run conference series will be presented, as well as how these conferences allow 4th-year residents to satisfy the six core competencies set forth by the ACGME.

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

**(E-33) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Spending an Evening in the Dark: The Radiology Medical Student Call Experience**

Dennis Monks, Jr, MD, PhD, *Allegheny General Hospital, Pittsburgh, PA*; Matthew S. Hartman, MD; Brian Pagano ([dmonks@wpahs.org](mailto:dmonks@wpahs.org))

**LEARNING OBJECTIVES:** This project aims to assess the impact of radiology call on 3rd- and 4th-year medical students. Recently, an evening short call shift was added to the radiology rotation at our institution. The goal of this curriculum change was to expose students to the many roles radiology residents play outside normal hospital operating hours in situations such as stat reporting of trauma and stroke studies, triage and workup of interventional procedures, and performing emergent ultrasound examinations. The primary end point of this study is to determine whether call shifts positively or negatively affect medical student perception of the field of radiology and the role residents play in the clinical care of patients. To address these questions, ongoing data are being collected via an anonymous online survey of all allopathic and osteopathic 3rd- and 4th-year medical students rotating through our radiology department. To our knowledge, no studies to date have addressed these questions.

**CONTENT DESCRIPTION:** *Results:* Preliminary data from the 2015–2016 academic year demonstrate an overwhelmingly positive response, with two-thirds of students reporting that call was beneficial. Following call, 86% had a more positive perception of radiology, 71% felt that radiologists have an above-average or significant impact on patient care, and 71% felt that radiology residents work the same amount or more than other specialties while on call. *Conclusion:* Although medical students are exposed to the impact of radiology reports on the care of patients throughout their clinical rotations, few students are exposed to the rapid and independent decision making required to generate such reports during resident call. Following the implementation of required call shifts at our institution, medical students reported an overwhelmingly positive experience. As we continue to collect data, we hope to collaborate with other institutions where medical students take call, use these data to further improve the experience, and potentially draw more students into the field of radiology.

**(E-34) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Developing a Radiology Curriculum for Nonphysician Providers Pursuing Advanced Clinical Training**

Dexter Mendoza, MD, *Emory University Hospital, Atlanta, GA*; Richard Duszak, Jr, MD; Michael Bowen, MS, BSN; Mark E. Mullins, MD, PhD ([dmendoza3@emory.edu](mailto:dmendoza3@emory.edu))

**LEARNING OBJECTIVES:** 1) Discuss the increasing role of advanced practice providers (APPs), such as nurse practitioners (NPs) and physician assistants (PAs), in radiology and in health care more broadly. 2) Explain potential benefits of developing a dedicated curriculum for these providers, who increasingly refer to our practices. 3) Identify important components of a radiology curriculum for APPs. 4) Discuss how to assess needs for a structured curriculum for APPs in their respective practices.

**CONTENT DESCRIPTION:** *Introduction:* With a growing and aging population, NPs and PAs have seen an increasing role in health care delivery. The demand for highly trained APPs has also increased, and these individuals are increasingly referring patients for imaging. Recently, our critical care center NP residency program became the first American Nurses Credentialing Center (ANCC)-accredited nursing practice transition program. As an integral component of that residency, we developed the Radiology for Advanced Practice Providers (RAPP) curriculum. In this session, we will delve into the increasingly

important role of APPs in health care and in radiology in particular. We will discuss the impetus behind the development of RAPP and the potential benefits of such a program. *Curriculum:* The goal of our program is to provide dedicated instruction in radiology to APPs seeking advanced clinical training, so as to improve clinical practice and ultimately improve patient care. This is distinct from radiology assistant or radiology practitioner assistant programs. The curriculum consists of two main components: a tailored radiology lecture series (RLS) and a hands-on radiology reading room experience (RRE). In this session, we will share details of our RLS, which includes instruction on both interpretive and noninterpretive skills, as well as our RRE. We will also discuss important considerations in the development of a radiology curriculum targeted to APPs. *Outcomes and Future Direction:* We will discuss our experience during our 1st year of implementing the program, where we currently stand, and where we hope to take the program in the future.

**(E-35) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Effect of the Change in Timing of the ABR Diagnostic Radiology Examination: Results of a Survey of 2014 Radiology Residency Graduates, Academic Radiology Chairs, and Private Practice Leaders**

Gary G. Tse, MD, *UC Davis Medical Center, Sacramento, CA*; Ethan A. Neufeld, MD; Paul S. Lee, MD; Peter Shen, MD; Raymond S. Dougherty, MD; Albert Lu, MD ([gggtse@ucdavis.edu](mailto:gggtse@ucdavis.edu))

**LEARNING OBJECTIVES:** 1) Describe the recent change in new radiology board exam format. 2) Identify which groups are aware of the recent board exam format changes and of the new “board-eligible” status of graduates. 3) Discuss how the new board exam format affects the diagnostic radiology employment market and how hiring groups will adapt to these changes.

**CONTENT DESCRIPTION:** Radiology residents who finish residency in 2014 and later are subject to a new radiology board exam format. With the previous system, the only reason for a radiologist to finish residency and not be board certified is to have failed all or portions of the exams. These radiologists are traditionally known as “board eligible,” rather than “board certified,” if they failed the oral exam only. Three different online surveys were given to each of three groups. Group 1 comprised radiologists who graduated from residency in 2014 and are the first class of radiologists subjected to the new board exam format. Group 2 comprised the chairs of academic radiology departments. Group 3 comprised leaders of private practice radiology groups (including hospital/foundation groups and multispecialty groups) who are aware of the hiring policy of their group. Our survey found that during their job search, a significant number of 2014 graduates encountered groups that are either unaware of the board exam structure change and/or require board certification for employment. There is suggestion of a trend of decreasing numbers of groups that require board certification, compared with a recent published survey. A small but notable percentage of groups have a lower pay scale for board-eligible radiologists, with a significant percentage of groups remaining undecided on such a policy. The only statistically significant difference between responses from academic centers and private practice groups is that while all academic centers are aware of the board structure change, a significant percentage of private practice groups are still unaware.

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

**(E-36) Thursday • 7:00–8:15 AM • Hard-copy poster  
Radiology-Oncology Multidisciplinary Clinic: Best  
Practices in Direct Patient Communication**

Alexander M. Vezeridis, MD, PhD, *University of California, San Diego, La Jolla, CA*; Hsiang-Chi Chang; Andrew C. Yen, MD (*avezeridis@ucsd.edu*)

**LEARNING OBJECTIVES:** 1) Explain why the radiologist should care about maintaining excellent patient communication. 2) Discuss the format of a radiology-oncology multidisciplinary clinic that the authors have used successfully, and how to take this format back to the learner's home institution for application to patient care. 3) Describe the unique challenges related to direct patient communication in radiology, including reducing/eliminating vernacular, avoiding oversimplification, and knowing what questions patients most frequently ask, in order to best prepare for this valuable experience.

**CONTENT DESCRIPTION:** I. Why the radiologist should care about maintaining excellent communication skills and opportunities for discussion with patients and referring physicians. A. Directives, statistics, and trends for patient-centered care/communication in radiology are reviewed in detail. B. How communication with patients and referring physicians fosters diversity, inclusion, and culture competency in radiology. II. Where and when patient communication commonly occurs in radiology. A. Radiology-oncology multidisciplinary clinic: our experience. B. Suggestions for how to balance patient communication within a busy practice: is it feasible? III. How to present radiologic studies to patients: our experience. A. How to present information to patients: a model discussion incorporating tips on presentation, body language, and standard medical communication skills as applied to radiology. B. Words/phrases to use and words/phrases to avoid. C. How to avoid vernacular, yet not oversimplify and confuse patients. D. What not to discuss. E. What information to defer to ordering physicians. F. What type of information patients want to know. F. Patients' frequently asked questions. G. Patients' subjective satisfaction/experiences with discussion.

**(E-41) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Best Practices: A Successful Networking and Support  
Group for Women in Radiology**

Angela S. Gonda, MD, *Indiana University, Indianapolis, IN*; Logan H. Bell, MD; Dana N. Bonaminio, MD; Pauley Gasparis, MD; Vasantha D. Aaron; Darel E. Heitkamp, MD (*belllo@iupui.edu*)

**PURPOSE:** This presentation is designed to discuss the Women in Radiology Group at Indiana University, a successful forum for women, providing mentoring, networking, and career guidance in the field of radiology.

**METHOD AND MATERIALS:** The Women in Radiology Group at Indiana University was created by a resident in July 2013. With the full support of the program director and department chair, the objective of the group is to provide resources for female medical students, radiology residents, fellows, faculty, and alumni that would facilitate mentoring and networking. The group is officially recognized by the department and provided with an annual budget of \$3000. Meetings are scheduled on a quarterly basis, complete with agendas and invited speakers.

**RESULTS:** Monthly meetings are organized to connect trainees with women in both academic and private practice. Outside speakers are invited to give short presentations on controversial or hot topics of interest to women in medicine. A novel mentoring system was created to connect students, residents, and fellows with successful female radiologists in small diverse groups. Meetings also include journal clubs,

discussion of research projects, and sessions regarding fellowship and job opportunities. Many activities encourage collaboration on research, charitable giving, and the importance of work-life balance. The Women in Radiology Group has been active since July 2013 and has grown substantially in membership. Numerous research, fellowship, and job opportunities have been made available as a direct result of the relationships afforded by this group.

**CONCLUSION:** The Women in Radiology Group at Indiana University is a successful mentorship and networking organization that can be easily started at other training institutions.

**(E-42) Thursday • 7:00–8:15 AM • Hard-copy poster  
Unique Senior Radiology Resident Selectives (Areas  
of Concentration) Integrating Clinical Experiences with  
Radiology Rotations**

Joanna R. Fair, MD, PhD\*, *University of New Mexico, Albuquerque, NM*; Hollie P. Medina, BA; Tyson Bolinske, MD; Amanda F. Derylo, MD; Gamaliel Lorenzo, MD (*jjfair@salud.unm.edu*)

**LEARNING OBJECTIVES:** 1) Describe a process for incorporating clinical experiences into senior radiology resident selective subspecialty rotations. 2) Explain the challenges and benefits of offering selective subspecialty-focused rotations to senior radiology residents.

**CONTENT DESCRIPTION:** With the restructuring of the ABR examinations to test core knowledge at the end of the PGY-4 year, radiology residencies have increased flexibility in designing targeted educational experiences for senior residents. We have innovated the educational program for our senior residents by incorporating related clinical months alongside subspecialty-focused radiology rotations to create areas of concentration within select modalities. We now offer areas of concentration for up to 6 months to all PGY-5 residents in our integrated (categorical) residency program. Residents may choose the clinical months from among those previously chosen by our residents or may identify a faculty member in another specialty to serve as a mentor and evaluator. Residents utilize these areas of concentration to prepare themselves for fellowship and practice opportunities, combining related/useful clinical rotations such as a cardiology stress lab rotation with nuclear medicine, and an anesthesia ICU/critical care rotation with interventional radiology. During these clinical-radiologic selectives, senior residents hold responsibilities similar to fellows, including teaching and multidisciplinary board presentations. Challenges include shortages of senior residents available to staff other radiology rotations, identifying appropriate mentors for clinical rotations, and scheduling logistics to ensure all residents can choose areas of concentration within their desired fields. Materials presented include (1) sample senior resident rotation schedules with areas of concentration incorporating diagnostic radiology and clinical rotations, (2) sample goals and objectives for areas of concentrations and clinical rotations, (3) area of concentration policy, and (4) list of areas of concentration currently offered and choices by current residents and recent graduates.

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

**(E-43) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Flipping the Script: A Flipped Classroom Approach to Resident Physics Education**

Jeremy Whang, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*; Elina Zaretsky, MD; James E. Silberzweig, MD (*jerwhang@chpnet.org*)

**LEARNING OBJECTIVES:** This exhibit illustrates features of the flipped classroom, including benefits and limitations of this approach as reported in the education literature. We describe specific application and benefits for resident physics education.

**CONTENT DESCRIPTION:** Physics education for radiology residents traditionally centers around lectures delivered by a medical physicist. The flipped classroom is an alternative teaching method in which learners are expected to complete a reading assignment in advance of a classroom session. The classroom session is then free to take a flexible, interactive format, rather than spending time to deliver a comprehensive review of the subject from A to Z. We describe our experience in using the flipped classroom for resident physics education at our institution. This teaching method fosters greater resident engagement, offers the ability to emphasize key concepts and explore difficult topics in depth, and provides a dynamic platform to assess comprehension. Residents report greater satisfaction with this active learning method compared to the passive learning style of the traditional lecture format.

**(E-44) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Charting the Radiology Milestones: Assessing Resident Competency under the Next Accreditation System**

Nicole E. Curci, MD, *MetroHealth Medical Center, Cleveland, OH*; Timothy P. Kasprzak, MD\* (*ncurci@metrohealth.org*)

**LEARNING OBJECTIVES:** 1) Explain the Accreditation Council for Graduate Medical Education (ACGME) Milestones. 2) Discuss strategies for incorporating the ACGME Milestones into a radiology residency curriculum. 3) Explain the concept of entrustable professional activities (EPAs) and how they can be used to enhance the resident evaluation process.

**CONTENT DESCRIPTION:** In 2013, the ACGME began the implementation of the Next Accreditation System to assess resident training programs on educational outcomes in the six domains of clinical competency: medical knowledge, patient care, professionalism, interpersonal and communication skills, systems-based practice, and practice-based learning and improvement. As a component of this transition, specialty-specific educational milestones were created in order to establish a logical trajectory of professional development for residents in training. Implementing the ACGME Milestones in residency curricula can be challenging. The entrustable professional activity (EPA) concept was created as a way to translate the milestones into discrete observable clinical activities, making them easier to use. Professional activities encompass all actions performed by radiologists in the context of patient care, for example, interpreting a chest radiograph or performing a lumbar puncture. The neologism “entrustable” specifies activities that can be delegated to residents. Resident performance of these activities can be stratified on a five-level scale ranging from “unable to perform, even with assistance” to “able to teach the skill to others.” This scale can be directly mapped to the 5-point milestone scale. Faculty supervising residents perform these entrustment decisions on a daily basis. Distilling resident curricula into discrete EPAs enables program faculty to use these decisions to perform a continuous evaluation of their residents and more accurately judge competency. Applying the ACGME Milestones to the context of daily clinical activities makes them easier for both residents and faculty to understand and increases the efficiency of the resident evaluation process.

**(E-45) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Practical Approach to Understanding Techniques to Reduce CT Dose**

Jacqueline Junn, MD, *Emory University School of Medicine, Atlanta, GA*; Phuong-Anh T. Duong, MD (*jacqueline.junn@emory.edu*)

**LEARNING OBJECTIVES:** 1) Explain how to interpret the dose report. 2) Describe image acquisition parameters (mAs, kV, pitch, gantry rotation time, table speed, collimation, and reconstruction algorithms). 3) Explain the effect of each parameter on radiation dose. 4) Discuss how to choose the best dose reduction technique(s) in different clinical scenarios.

**CONTENT DESCRIPTION:** Over recent years, there has been an increased interest in the carcinogenic risk from radiation. Understanding and being able to interpret the dose report is key in this process. Furthermore, this interpretive skill requires knowing the imaging acquisition parameters. To address this issue further, it is also imperative that residents understand how to reduce CT radiation dose by adjusting each parameter without compromising the image quality. In addition to describing CT imaging acquisition parameters, the CT dose report, and the linear no-threshold model, we have provided case-based scenarios to help radiologists choose the best option for dose reduction in different situations.

**(E-46) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Radiology Resident Rotation Goals and Objectives Revisited: A Content-Rich Hyperlinked Approach**

Philip Wong, MD, *Emory University, Atlanta, GA*; Kristen L. Baugnon, MD; Christopher P. Ho, MD; Mark E. Mullins, MD, PhD; Brent P. Little, MD (*pwong2@emory.edu*)

**LEARNING OBJECTIVES:** 1) Discuss a content-rich rotation “goals and objectives” PDF document that serves as both a guide to resident expectations and an educational resource. 2) Describe potential benefits of having a clear systematic educational resource for the radiology resident.

**CONTENT DESCRIPTION:** Meeting expectations for a particular rotation can be a challenging task for radiology residents; “goals and objectives” documents often provide lists of general thematic knowledge/skill goals and—aside from textbook recommendations—often offer few resources to be used in meeting goals. The ACGME requires residency programs to document resident milestone progress in six key areas, but the milestones project does not provide rotation-specific guidelines or educational resources. While several subspecialty documents provide lists of expectations for resident skills and knowledge, they do not typically provide specific suggestions for resources to use in meeting these expectations. At our institution, we are addressing these concerns with content-rich “goals and objectives” documents that provide structured resident educational agendas and checklists incorporating ACGME milestones. Created with desktop publishing software (Adobe InDesign), these PDF documents contain hyperlinks to supplemental educational resources such as online didactic videos, seminal journal articles, Web sites, and other resources selected by faculty. These guides facilitate resident learning by providing a database of salient educational resources, decreasing resident stress and time expenditure in choosing from a plethora of available educational materials. Residents use these guides to assess progress, identify deficiencies outlined in the checklist, and subsequently remedy knowledge gaps by accessing appropriate hyperlinked resources. We will demonstrate the ease of production of interactive hyperlinked “goals and objectives” documents and will show the results of such an initiative in the form of user-friendly rotation curriculum PDF guides suitable for use on a desktop or laptop computer or mobile device.

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

### (E-47) Wednesday • 7:00–8:15 AM • Hard-copy poster Online Radiology-Pathology Resident Education: How to Make WordPress Work for You

Yaseen Mohiuddin, *University of Virginia, Charlottesville, VA*; Jason W. DeBerry, MD; Brandi T. Nicholson, MD\* ([bte6v@virginia.edu](mailto:bte6v@virginia.edu))

**LEARNING OBJECTIVES:** 1) Explain how to utilize WordPress for Web-based rad-path education of trainees. 2) Identify cases that have imaging findings and pathology that correlate and are of educational value to trainees. 3) Describe how to utilize WordPress to create content and generate a Web post of each case. 4) Discuss how to create the post in a way that the trainee can interact with the information, maximizing self-directed learning and ease of use.

**CONTENT DESCRIPTION:** Cases discussed at multidisciplinary breast tumor board at a tertiary care academic medical center were selected based on their appropriateness for radiology-pathology education. Those cases that were selected had typical imaging and pathology findings that correlated and were thought to be of educational value to residents. WordPress was then used to create content and generate a Web post of the case. Each post has at least one reference with a link that the trainee uses to get more in-depth information on the topic. The post is created in a way that the trainee can interact with and obtain all the information in one setting. The radiology images, pathology images, and references are all tagged so they can be found in many different ways (such as a “Google-like” search), which is a benefit of online education and WordPress. The information is hidden until the trainee clicks on a prompt that unveils the fact or image. This allows the users to test themselves without immediately revealing the answer. When a new post is made, the radiology Facebook page alerts the trainees that new material is available. We have successfully posted six radiology-pathology cases from July 2015 to September 2015, with a goal of contributing a case a week. An additional benefit of this project is that it has fostered a relationship between radiology and pathology. The early feedback from trainees is that the Web site is easily accessible and demonstrates high-yield radiology-pathology information. The method of hidden data encourages the trainees to think for themselves, rather than being given the information directly. Making educational materials utilizing a dynamic online interface will encourage trainees to utilize the material, make it available from anywhere, and increase the longevity of the content.

### (E-48) Thursday • 7:00–8:15 AM • Hard-copy poster Use of Team-building Activities to Build a Better Resident

James D. Ireland, MD, DVM, *University of Arkansas for Medical Sciences, Little Rock, AR*; Leah E. Braswell, MD; Victoria E. Major, MD; Linda A. Deloney, EdD; Kedar Jambekar, MD ([jamesdireland@hotmail.com](mailto:jamesdireland@hotmail.com))

**PURPOSE:** Fellow radiology residents may fulfill personal needs for friendship, camaraderie, emotional support, and a sense of belonging<sup>1</sup> while cultivating an environment of shared learning, accountability, and mutual respect. When residents work well together, departmental needs are better managed, including patient handoffs and call coverage. In our experience, each group of residents evolves into a team over time. As the benefits of a team approach in radiology are increasingly evident, we realized team building could be nurtured early in residency.<sup>2</sup> We will share our experience in conducting targeted activities.

**METHOD AND MATERIALS:** In 2013, we incorporated strategic team-building activities into our BOOT Camp orientation for new residents. The purpose of the activities is to provide an early framework for development of friendships and cooperation, to provide the foundation for a better residency experience, improved work environment, and better patient care. Key areas were identified with the intent of moving residents from a personal “me” to an inclusive “we.” Ideas for targeted activities were generated by staff and current residents and selected based on their ability to meet this goal.<sup>3</sup> A facilitator provided rules and guided discussion.

**RESULTS:** To date, three classes of R1s ( $n = 23$ ) have participated in activities in five key areas: personal history sharing; creativity; common bonds; cooperation; and shared team experience. At the end of BOOT Camp, residents provide feedback about a range of different activities. Comments about team-building activities over time have been 70% positive. The number and types of activities have evolved, based on this feedback. In the month-long 2015 orientation, there were 5½ hours of on-campus activities plus a new 8-hour recreational day (Table 1).

**CONCLUSION:** The traditional approach to radiology education encourages independence. It is our belief that this approach alone is to the detriment of resident education and patient care. It may never be possible to measure the impact of team-building activities on the radiology workforce, but by fostering a team atmosphere early in the radiology career, we believe we will improve the residency experience, work environment, and patient care.

### (E-49) Wednesday • 7:00–8:15 AM • Hard-copy poster Understanding Racial and Gender Disparities in Acute Stroke Patients: A Guide to Culturally Competent Imaging for Women and Ethnic Minorities

Paul-Michel Dossous, MD, MPH, *North Shore-LIJ Health System, New Hyde Park, NY*; Pina C. Sanelli, MD, MPH

**LEARNING OBJECTIVES:** 1) Explain disparities in access to care, treatment, and outcomes in women and ethnic minorities presenting with acute stroke. 2) Describe the effect of imaging disparities on clinical outcomes and quality assurance in women and ethnic minorities. 3) Discuss the role of cultural competency education for radiologists in reducing imaging disparities in women and ethnic minorities presenting with acute stroke.

**CONTENT DESCRIPTION:** When compared to white patients presenting with acute stroke, African-Americans have longer median computed tomography (CT) scan delay time, and males are more likely than women to be selected for diagnostic CT and magnetic resonance imaging (MRI) scans. African-Americans and women are less likely to receive imaging of the carotid arteries after presenting with acute stroke. In addition, African-Americans suffer increased mortality after acute stroke. Women have poorer functional outcomes, are more likely to suffer from depression, and have a lower quality of life after acute stroke when compared to men. Factors contributing to health care disparities result in more medical errors and increased length of hospital stay for vulnerable populations. In addition, these disparities result in increased hospital admissions and readmissions. Disparate care may also lead to overutilization or underutilization of procedures for minority patients. Cultural competency education has been used as a tool to combat disparities in health care because it has been proven to improve patient satisfaction, adherence, health outcomes, and quality care. It is imperative that radiologists and radiologists-in-training are informed about the underutilization of diagnostic scans in the presentation of acute stroke in minority and female patients. As physicians, radiologists are charged with addressing these disparities to ensure quality care and improved outcomes in vulnerable populations. Culturally competent radiologists are equipped with the expertise they need to implement institutional changes that ensure that minority patients and women enjoy improved outcomes after acute stroke.

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

**(E-50) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Radiology Education Portal: How to Establish a Teaching and Resource WordPress Web Site for Your Residency Program**

Jason W. DeBerry, MD, *University of Virginia, Charlottesville, VA*;  
 Jennifer A. Harvey, MD\*; Heather Peppard; Carrie M. Rochman, MD\*;  
 Brandi T. Nicholson, MD\* (*jwd7s@virginia.edu*)

**LEARNING OBJECTIVES:** 1) Purchase a domain name and host. 2) Install WordPress and essential plug-ins. 3) Configure user accounts and privacy settings. 4) Generate appropriate Web pages and posts. 5) Create appropriate tags and categories to organize content. 6) Link your WordPress site with Facebook to engage residents.

**CONTENT DESCRIPTION:** Building on prior experience with the wiki platform to create teaching files, WordPress provides a much more feature-rich and engaging solution for resident education and resources. WordPress is a content management system that powers over 20% of Web sites. The benefit of using WordPress to make an education portal is that it requires no programming knowledge to set up and administer. This education exhibit will instruct learners on how to go from providing residents teaching files in a PowerPoint format or PACS worklist to high-yield interactive multimedia-rich teaching files and useful resources with a cost of about \$150/year and little upkeep using WordPress. The radiology education portal will contain core Web pages, including call resources, podcasts (such as how to read a DEXA or do a specific procedure), rotation-specific requirements, quizzes, journal club articles, interactive teaching files including radiology-pathology correlation, and social media engagement. The learner will learn how to set up these resources and easily maintain them. Given that checking social media, such as Facebook, has become a ritual for many residents, it is important to integrate this into any education resource. The learner will gain the ability to have posts automatically publish to Facebook, such as interesting case of the week or the latest landmark article, so residents can be instantly updated and engaged with the portal. Creation of a radiology education portal for your residency program can be done with only a small investment of time and money. The portal provides an invaluable resource for educating and training residents in an engaging and novel way.

**(E-51) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Cost-effective Procedural Training: Fluoroscopic Lumbar Puncture Phantom**

George R. Wong, BA, *Creighton University School of Medicine, Omaha, NE*;  
 Johanna Schubert, MD

**LEARNING OBJECTIVES:** “See one, do one, teach one” has long been the mantra of procedural training for physicians. However, simulation has proven to be an effective method to train residents by allowing them to gain confidence before performing a procedure on patients. This method of training can be cost prohibitive, as phantoms for fluoroscopically guided lumbar puncture (FGLP) can cost thousands of dollars. In this project, I created an FGLP phantom for \$150 that rivals commercially available phantoms. The response to this model from attendings and residents has been positive. It is anatomically accurate under fluoroscopy and provides a realistic feel, with palpable access and return of fluid. In conclusion, this phantom is a cost-effective solution to train residents in FGLP. A similar method of construction can likely be used in the future to create effective phantoms for other procedural simulations.

**CONTENT DESCRIPTION:** This exhibit will cover the method used to create a cost-effective fluoroscopically guided lumbar puncture phantom, as well as the means by which to use the model for training purposes.

**(E-102) Wednesday • 7:00–7:20 AM •**  
**E-poster, computer #1**  
**Online Anatomy Cases: Building Clinical Context into Gross Anatomy Education as a Method for Increased Integration of Radiology into the Medical School Curriculum**

Allison M. Grayev, MD\*, *University of Wisconsin, Madison, WI*; Laura Gonzalez; Karen Krabbenhoft; Amy Stickford Becker; Christine Seibert (*AGrayev@uwhealth.org*)

**LEARNING OBJECTIVES:** 1) Describe adult learning theory and its applications in curricular design. 2) Explain how to construct a theoretical learning module for medical students in gross anatomy, with focus on hybrid pedagogy. 3) Discuss how to evaluate opportunities at their institution for vertical and horizontal integration of radiology within the curriculum.

**CONTENT DESCRIPTION:** **Section 1:** Review of adult learning theory (andragogy) and implications in curricular design. Key concepts include (1) moving from dependency to self-directed learning, (2) drawing on life experiences, (3) applying new knowledge to problem-centered learning, and (4) internal motivation is more important than external motivation (TEAL 2011). Self-directed learning transitions the student to an active participant, which increases long-term retention (Spencer and Jordan 1999). Having students tackle cases allows them to start to develop clinical reasoning skills (Bordage 1994). **Section 2:** Description of our hybrid pedagogy, including the concepts behind blended learning and suggestions to avoid the “course and a half” syndrome. We have used a replacement model (Twigg 2003) in which class lecture time is replaced by online activities. Protected time has been afforded to students to complete modules. **Section 3:** Horizontal integration—description of our online modules and their integration into the anatomy course. Online modules have been created in conjunction with dissections to keep the delivery uniform in time, allowing for more flexibility in lecture timing/construction. **Section 4:** Vertical integration. The goal is to create an integrated anatomy-radiology Web site, which would host the cases for students in the clinical phases to use for review, with consideration of the “integration ladder” (Harden 2000). **Section 5:** Call to action—ideas for members to pursue at their institutions. Review of the important questions when considering hybrid pedagogy: (1) How do my students learn? (2) What do my students expect? (3) How do I deliver content effectively? (4) What do my students need to know/do? (Strawser 2015).

**(E-103) Wednesday • 7:25–7:45 AM •**  
**E-poster, computer #1**  
**Dictation Privileges: A Value-added Experience for the Medical Student Radiology Rotation**

Patrick Craig, DO, *Wichita Center for Graduate Medical Education, Wichita, KS*; Luke Vierthaler, MD, MPH; Travis McKenzie, DO; Daniel C. Davis, MD; Charles W. McGuire, MD; Kamran Ali, MD (*pcraig2@kumc.edu*)

**LEARNING OBJECTIVES:** 1) Identify the pros and cons of the traditional approach to medical student radiology rotations. 2) Describe how our institution sought to improve medical student engagement with the radiology rotation by giving students dictation privileges and the experience of checkout with attendings. 3) Discuss the results of the data collected in the form of a survey given to all medical students after rotation to assess the effectiveness of this method.

**CONTENT DESCRIPTION:** For medical students, the traditional radiology rotation can often be perceived as largely observational. It is often difficult for radiologists to engage medical students as they work through studies. The largest portion of interaction is primarily reviewing anatomy and pathology. To improve the medical students’ experience on their rotation, we decided to employ a more interactive approach, in addition to the existing radiology rotation, by giving students dictation privileges and allowing them to check out directly with attendings. All medical students rotating through our department were given the opportunity to dictate. At the end of the rotation, students were given a survey rating their overall

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

experience. Specifically, students were asked to rate their satisfaction with the dictation process. The exit survey demonstrated higher satisfaction scores of the rotation with dictation privileges than those students who did not use these privileges. As this was the only variable difference in the two cohorts, a generalization can be made that dictation privileges afford a value-added experience to the rotation.

**(E-104) Wednesday • 7:50–8:10 AM •**

**E-poster, computer #1**

### **Flexible Radiology Teaching Modules in an Open-Source Platform Using Google Forms Powered by Google**

Allison Herring, BS, *University of Maryland, College Park, MD*; Durga Sivacharan Gaddam, BS; Theresa C. Kouo, MD; Jean Jeudy, Jr, MD (*siva.gaddam@som.umaryland.edu*)

**LEARNING OBJECTIVES:** 1) Discuss the benefits of using an open-source platform to create radiology teaching modules. 2) Create multi-format assessments with autograding capability. 3) Discuss participation in an example assessment using a personal handheld device.

**CONTENT DESCRIPTION:** Learning platforms have diversified significantly in the past few years with the development of cloud-based services, along with improvements in mobile-based technology. Traditional classroom-based lectures and assessments still have utility, but mobile technology can offer a valuable supplement for medical students and residents in the field of radiology. This Web-based teaching module is both flexible and simple to create with the use of Google Forms powered by Google (Mountain View, CA). Educators will be able to create customized multi-format assessments including JPEG versions of radiologic images with associated multiple-choice questions. Moreover, these assessments will have an autograding feature, along with the capability of automatically distributing grades and answer keys to respondents via e-mail. These grading features will be powered by Flubaroo®, a free add-on extension for Google Forms. The major benefit of this open-source platform is that it allows participation from any location with Internet or mobile network access and on any device, including smartphones and tablets. Furthermore, the open-source platform allows educators to generate teaching modules of various complexities without overhead costs that are often associated with subscription-based software. Thus, this Google Forms-based radiology teaching module is a flexible, simple, and progressive learning model that can strongly supplement on-site education. Note: The following is a link to an example teaching module; please make sure to enter a full working e-mail address to receive an e-mail with a grade: [https://docs.google.com/forms/d/170eVGnnqLms-taJcZzVy3OUNbDd6YYjMdJEOETcu5I0/viewform?usp=send\\_form](https://docs.google.com/forms/d/170eVGnnqLms-taJcZzVy3OUNbDd6YYjMdJEOETcu5I0/viewform?usp=send_form).

**(E-105) Wednesday • 7:00–7:20 AM •**

**E-poster, computer #2**

### **Implementing Outcomes-based ACGME Milestones for Abdominal Imaging Fellowship Training: What the Program Director Needs to Know**

Manjil Chatterji, MD, *Icahn School of Medicine at Mount Sinai Medical Center, New York, NY*; Eric J. Wilck, MD; Bachir Taouli (*manjil.chatterji@mountsinai.org*)

**LEARNING OBJECTIVES:** 1) Explain the context for the milestones reporting framework system sponsored by the ACGME for evaluation of radiology fellows. 2) Describe the five milestone-level criteria for fellow performance; review criteria for graduation readiness and high-stake decision making. 3) Identify the subspecialty assessment tools used in the milestone system. 4) Discuss the 13 practice areas suggested for evaluation and the various evaluation parameters suggested by the ACGME. 5) Review the implementation of the milestones evaluation program in semiannual program director–fellow meetings for improvement. This exhibit will illustrate the adaptation of the ACGME-sponsored milestones evaluation program for abdominal imaging fellows in radiology.

**CONTENT DESCRIPTION:** The Accreditation Council for Graduate Medical Education (ACGME)–sponsored Next Accreditation System (NAS) is a framework for evaluating residents and fellows based on

specific milestones in three major areas—resident skills, knowledge, and abilities—on a continuum, or milestone-based system. The program is meant to provide detailed insight into fellow performance utilizing assessment tools based on end-of-rotation global assessments, observation and feedback, review of reports, rate of major discrepancy, self-assessment and reflection, simulation-based assessment, completion of institutional safety programs, case-based logs, complications, and 360° evaluations. Diagnostic radiology was one of few pilot programs to undergo NAS implementation and is now expanding to fellowship programs, both ACGME-sponsored and otherwise. This exhibit will review the various components of NAS and the implementation of a milestone-based evaluation system at a major academic medical center. Additionally, the exhibit will show examples of ACGME reporting worksheets and how to best implement them in preexisting evaluation templates for accreditation purposes. The exhibit will also emphasize the implementation of these evaluations in semiannual program director reviews and for high-stakes decision making.

**(E-106) Wednesday • 7:25–7:45 AM •**

**E-poster, computer #2**

### **Ergonomics in the Reading Room: Creating a Healthy Work Environment for the Radiologist**

Shyam G. Patel, MD; Steven Reich, MD, *William Beaumont Hospital, Royal Oak, MI*; Sailaja Yadavalli, MD, PhD

**LEARNING OBJECTIVES:** 1) Describe potential disabilities that can be sustained by a radiologist in the reading room. 2) Discuss some of the important causative factors of disabilities that can lead to long-term decrease in quality of life for a radiologist. 3) Describe some of the health-promoting designs, systems, and behaviors that can easily be adopted in the reading room to improve work-space conditions, including future changes that may be available.

**CONTENT DESCRIPTION:** The occupational hazards of being a radiologist are often equated to radiation exposure, and rightly so, resident education emphasizes this aspect in extensive detail. However, very little attention is paid to occupational hazards encountered at the reading station, where, assuming average work hours, a radiologist can spend 40 hours per week, 1600 hours per year, and 40,000 hours over the course of his or her career. Suboptimal work-space conditions, including furniture, lighting, and posture, can exacerbate fatigue and induce eyestrain and headache. On a day-to-day basis, this can ultimately result in reduced productivity and quality. Prolonged sitting has been shown to be extremely harmful and may even lead to decreased life expectancy. Moreover, many degenerative musculoskeletal disorders, such as low back pain, carpal tunnel syndrome, and arthritis, can develop as a consequence of repetitive motions, poor posture, and reduced mobility, all of which can be commonplace in the setting of a busy practice. Left unchecked, these unhealthy everyday behaviors can lead to significant disability and long-term impaired function in adults of working age. These disorders can be mitigated, if not primarily prevented, with healthy lifestyle habits and better ergonomic design of the work environment. Behaviors learned during training are likely to set in and become permanent. This emphasizes the importance of early awareness and adoption of healthy habits in the everyday reading room for encouraging long-term health and optimized function.

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

(E-107) Wednesday • 7:50–8:10 AM •

E-poster, computer #2

### Overview of Available US Phantoms to Meet Your Training Needs for Teaching Vascular Access and Performing Biopsies

Kevan V. Stewart, MD, *University of Rochester Medical Center, Rochester, NY*; Devang Butani, MD; Vinit Khanna; Joseph Reis III, MD; Ashwani K. Sharma, MD ([kevanstewartmd@gmail.com](mailto:kevanstewartmd@gmail.com))

**LEARNING OBJECTIVES:** 1) Describe the types of ultrasound phantoms that can be created or purchased. 2) Select an appropriate phantom that meets budgets, time constraints, and teaching and training needs.

**CONTENT DESCRIPTION:** Medical students, residents, and other trainees benefit from hands-on practice with ultrasound to aid them in developing skills associated with vascular access and performing biopsies. Many phantom options are available, including using off-the-shelf supplies with ultrasound gel standoff/step-off pads by sandwiching surgical tubing or other items within layers of the pads. Gelatin phantoms are fun and easy to create and can be formed in layers with varying sizes, shapes, and consistencies to create very lifelike phantoms. Gelatin phantoms have a limited life span of weeks to a couple of months and should be created with specific training sessions in mind. Commercially available phantoms range from small pads, to small body parts, torsos, or lower bodies, to complete full-size mannequins. Chicken breasts or liver may also be used to simulate human tissue. Costs are always a factor, and many low-cost options exist. The key is to select from the many options available and incorporate it into your training program; and as needs change, there are many flexible options from which to choose.

(E-108) Thursday • 7:00–7:20 AM •

E-poster, computer #5

### E-mail Etiquette in the Health Care Setting: A Guide to Constructing and Sending Effective E-mail

Dayna M. Williams; Pallavi Cherukuri, MD; Rhonda Osborne, MD, *SUNY Downstate Medical Center, Brooklyn, NY*; Deborah L. Reede, MD ([dayna.williams@downstate.edu](mailto:dayna.williams@downstate.edu))

**LEARNING OBJECTIVES:** 1) Identify common everyday problems with e-mail in the health care setting. 2) Discuss HIPAA and JCAHO guidelines with regard to e-mail. 3) Describe guidelines for initiating and responding to e-mail.

**CONTENT DESCRIPTION:** Communication is central in all aspects of health care. Managing a department or a residency program, caring for patients, and interpersonal relations all depend on effective communication. Too often, informal e-mail suited for friends and family is seen in the professional arena. Inappropriate familiarity, “text speak,” emoticons, and obscure acronyms are prevalent, instead of proper grammatical English. Lack of politeness may lead to a breakdown in interpersonal relations. Few recognize that in health care, one’s e-mail may be an organizational record. It should be considered institutional property that may need to be accessed and retrieved in the future and possibly be examined and used in a court of law. Also, distinct from other industries, health care personnel must also consider HIPAA guidelines when e-mail involves patients or their families. This treatise will review the current print and electronic literature on professional e-mail communication and outline steps for successful and effective e-mail in the health care setting. Vignettes will be provided to assist the reader in constructing the proper e-mail for various settings. Guidelines presented herein should assist the reader in composing an appropriate e-mail for almost any communication.

(E-109) Thursday • 7:25–7:45 AM •

E-poster, computer #1

### Implementation of a Dynamic Teaching File by Using a Software App (Microsoft OneNote) for Radiology Education

Susana Calle, MD, *University of Texas Health Science Center at Houston, Houston, TX*; Rafael Madero; Eliana E. Bonfante-Mejia, MD; Roy F. Riascos, MD ([Susana.Calle@uth.tmc.edu](mailto:Susana.Calle@uth.tmc.edu))

**LEARNING OBJECTIVES:** 1) Explain the potential applications of a software app (OneNote; Microsoft, Redmond, WA) as a dynamic tool for radiology training. 2) Describe the steps needed to use this app to construct a teaching file that any authorized member can contribute to and continue to expand. 3) Compare the advantages of this software app over other methods of file archiving and sharing for the purposes of teaching radiology.

**CONTENT DESCRIPTION:** Our department has devised a dynamic, continually expanding teaching resource by using a software app (Microsoft OneNote) for trainee education. This application is free to download and provides easy on-the-go access by using a personal computer or mobile device. The user is able to quickly upload images from interesting or illustrative cases encountered during daily work, as well as add pertinent clinical information, differential diagnoses, pearls and pitfalls, and recommended readings related to the individual topic. Files, links, and figures can be attached to any case by using the application’s multimedia capabilities. For safe access from mobile devices, HIPAA compliance is maintained by eliminating patient identifiers from uploaded cases. By authorizing members of the department to edit, others in the group can contribute and continue to expand the folders. The use of a set template allows all contributors to preserve uniformity, which facilitates navigation of the file. The teaching file can be used to obtain images for presentations or publications. The integrated search capability makes finding specific diagnoses and imaging signs quick and simple. Cases can be copied to a separate folder with the final diagnosis hidden, to be presented in a case conference setting. Furthermore, the file can be subdivided into folders according to topic or level of training, to be reviewed during different rotations. The possible applications, flexibility of use, and the ability to access the file from virtually any mobile device truly represent an innovative take on radiologic teaching files. The customization of this teaching resource to a department’s specific needs and teaching objectives can prove to be a valuable tool in the education of residents and fellows in radiology.

(E-110) Thursday • 7:50–8:10 AM •

E-poster, computer #1

### The New “Edge of the Film”: Findings on Scouts, Surviews, Test Injections, and Other Ancillary Imaging in Cross-sectional Radiology

Joshua Jarvis, MD, *University of Vermont, Burlington, VT*; Judy Tam, MD; George E. Gentchos, MD

**LEARNING OBJECTIVES:** 1) Identify ancillary images commonly provided in cross-sectional radiology. 2) Discuss occult findings and pitfalls often associated with ancillary images in cross-sectional radiology. 3) Describe a search pattern that incorporates these ancillary images to avoid common pitfalls and improve sensitivity for occult findings.

**CONTENT DESCRIPTION:** In conventional radiography, looking at “the edge of the film” for occult or unexpected findings is a well-known practice. With the advent of cross-sectional imaging, the radiologist not only must attend to findings at the margins of the study itself but also must review the various ancillary images provided with the study to avoid missing clinically significant findings. Using select cases from our institution, this educational exhibit aims to illustrate some of the occult findings and pitfalls associated with CT scout, MRI localizer, and CT test injection images, as well as reviewing common unexpected findings on studies protocolled for other reasons and at the actual margins of the study. It is the hope that the viewer will come away with new awareness of the importance of reviewing these ancillary images.

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

**(E-111) Wednesday • 7:00–7:20 AM •****E-poster, computer #3****Business and Administrative Electives: A New Dimension for Resident and Fellow Education**

Elena Motuzko, MD, *Cooper University Hospital, Camden, NJ*; Danielle M. Senge, DO; Joshua D. Brody, DO (*elena.motuzko@gmail.com*)

**LEARNING OBJECTIVES:** 1) Discuss the value of business education to prepare new physicians for their future administrative and business roles. 2) Discuss our experience in developing and implementing business and administrative electives for residents and fellows in our hospital system. 3) Describe the content and structure of the course.

**CONTENT DESCRIPTION:** With the challenge of changing economy and increasing pressure on health care for good performance while dealing with limited resources, the management and business sides of medicine are becoming more demanding. This new paradigm creates a rising demand for business understanding and leadership skills among radiologists, including private practices, academic centers, and national professional organizations. To meet this challenge on a national scale, the exposure to business and administration practices should be incorporated into the professional physician's education and be introduced early in training. For that purpose, we developed and implemented a business and administrative elective curriculum for the residents and fellows of our institution. The elective encompasses various aspects of administration and business operations of our medical center and its different departments. Participants are exposed to the business and operational side of the medical profession by attending and engaging in hospital committee and board meetings, as well as one-on-one apprenticeship-type sessions with our chief executives and lead administrators. It is a resident-driven education, where he or she can choose an area of interest from the menu of various topics and activities, including management, finance, quality improvement, and GME administration. Additional time is dedicated to studying business modules, with options of obtaining lean Six Sigma certification, learning business plan development, and studying international and domestic health care models and insurance operations. The customizable format of an elective allows the participant to achieve good depth of exposure and to obtain practical knowledge tailored to personal interests and professional aspirations of a participating resident while setting a good basis for further career development.

**(E-112) Wednesday • 7:25–7:45 AM •****E-poster, computer #6****The Evolution of a Clinical Competency Committee**

Jeanne G. Hill, MD, *Medical University of South Carolina, Charleston, SC*; Melissa Picard, MD; Marques L. Bradshaw, MD; Russell Chapin, MD; Seth T. Stalcup, MD; Michael B. Anderson, MD; et al (*hillj@musc.edu*)

**LEARNING OBJECTIVES:** 1) Discuss one institution's implementation of the clinical competency committee. 2) Describe the components of one institution's curriculum and assessment tools for each of the diagnostic radiology milestones. 3) Discuss areas of curricular strength, gaps, and potential solutions.

**CONTENT DESCRIPTION:** As a result of the ACGME's Milestones project, the clinical competency committee (CCC) is a required component for accreditation of all diagnostic radiology programs. Although some guidelines are in place, the specifics of structure and process are less prescriptive, thereby affording programs a degree of individual variability and creativity in the implementation of the CCC. We continually assess the structure of our CCC, including the process of resident evaluation, current curriculum components, and the assessment tools utilized to determine how well our residents are progressing toward successful attainment of the required milestones, which has resulted in demonstrable improvements in our program. Areas of

relative strength in our curriculum, as evidenced by average resident milestone level, have been communication skills and professionalism. Initial areas of curricular weakness included scholarly activity and both systems-based practice milestones: quality improvement and health care economics. Since the inception of the CCC, new curricula have been created to address these areas of relative weakness. Although most residents have demonstrated appropriate development through the milestones, individuals have been placed on professionalism probation, others recommended for academic remediation, and one for dismissal as a result of the CCC process. Thus, the evolution of our CCC since 2013 has strengthened our residency program and enabled us to identify and attempt to rectify gaps in the curriculum, to recognize strengths and weaknesses of individual residents, and to provide more detailed and, therefore, useful feedback to our program directors and residents.

**(E-113) Thursday • 7:00–7:20 AM •****E-poster, computer #2****The Art of the Radiology Report: Practical and Stylistic Guidelines for Perfecting the Conveyance of Imaging Findings**

Andrew Lukaszewicz, MD, *St. Joseph Mercy Oakland, Pontiac, MI*; Joseph Uricchio; Grygori Gerasymchuk, MD (*a.lukaszewicz@utoronto.ca*)

**LEARNING OBJECTIVES:** 1) Identify the many (often overlooked) intricacies that comprise the radiology report. 2) Describe the impact of report nuances on ordering clinicians' decision making. 3) Discuss how to use vocabulary, grammar, formatting, and voice to create optimized reports.

**CONTENT DESCRIPTION:** The radiology report is the culmination of an elaborate process that includes image acquisition, meticulous interpretation, and the generation of pithy and thoughtful recommendations. It is essentially a translation of images into words and, as such, must convey as much pertinent detail needed by the clinician in as concise a format as possible. Several important factors affect the overall quality of the finished report. Drawing on a comprehensive review of the literature, we thoroughly explore each factor in a systematic manner. Active voice helps to convey information more confidently and in a way that is easier to read and understand. The use of several words and phrases is discouraged, as it makes the radiologist sound uncertain. The manner in which the impression is stated can significantly influence the ordering physician's decision as to whether or not to follow the radiologist's recommendations. Critical findings must be promptly communicated to the appropriate health care provider and documented in the final report. By following the guidelines we illustrate in this exhibit, radiologists will learn how to create a perfected report, one that is concise, conveys important findings while answering the clinical question posed, and is viewed favorably by the requesting physician.

**(E-114) Thursday • 7:25–7:45 AM •****E-poster, computer #2****Web-based Image Quizzes for Learning Concepts in Pediatric Radiology: A Repetitive Self-testing Strategy for Pattern Recognition**

Wendy Kim, MD, *University of Maryland Medical Center, Baltimore, MD*; Cara E. Morin, MD, PhD; Jason Hostetter, MD; Jane S. Kim, MD; Narendra S. Shet, MD

**LEARNING OBJECTIVES:** 1) Explain various available interactive formats for effective resident education, including spaced repetition and test-enhanced learning methods. 2) Describe how to apply open-source Web-based platforms to create image-based subject quizzes. 3) Discuss how to adopt and administer self-testing applications for student and resident teaching at respective training programs.

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**CONTENT DESCRIPTION:** Interactive educational computer programs are a useful means of learning radiology and have become increasingly utilized by radiology residents. Spaced repetition and test-enhanced learning methods can be more effective than traditional methods of passive reading or didactic lectures. A Web-based platform using open Web technologies including HTML, CSS, and JavaScript was developed to build image-based quizzes. With this platform, users can scroll through and manipulate images, allowing PACS-like interactions. Practice quizzes were assembled with multiple cases and normal exams gathered from our institutional database for several focused subjects in pediatric radiology. Residents are able to use the quiz as both a learning and testing tool immediately before and following a 2-week rotation in pediatric radiology. This platform emphasizes repetitive exposure to images, as this provides the ability to review images in a similar environment to standard work flow and allows for immediate feedback. Spaced repetition of these quiz sets further encourages pattern recognition, improving memory retention and diagnostic confidence. This Web-based platform can also be applied to other subject material as a useful adjunct to traditional learning methods in radiology education.

**(E-115) Thursday • 7:50–8:10 AM •**

**E-poster, computer #3**

**Mastering the ACGME Medical Knowledge Milestone for Body CT and MR Protocol Selection and Optimization of Images: A Training Module for Radiology Residents**

My-Linh Nguyen, MD, *Johns Hopkins Hospital, Baltimore, MD*; Kristin K. Porter, MD, PhD\*; Pamela T. Johnson, MD (*mnguyen@jhmi.edu*)

**LEARNING OBJECTIVES:** 1) Identify optimal contrast administration (IV contrast, negative vs positive oral contrast) to elucidate the pathology in question. 2) Describe how to select appropriate sequences/phases according to the clinical indication and utilize postprocessing techniques to answer clinical questions. 3) Explain the importance of radiation dose modulation in body CT and how protocol parameters affect radiation exposure.

**CONTENT DESCRIPTION:** I. CT protocolling. A. Radiation exposure (methods of radiation modulation, iterative reconstruction). B. Contrast agents (IV, negative vs positive oral contrast, issues with renal function and contrast allergies). C. Imaging phases (noncontrast, arterial, venous, delayed). D. Indications for narrow reconstruction sections. E. Utility of MPRs and 3D rendering. II. MRI protocolling. A. Safety. B. Contrast agents (IV, hepatobiliary agents). C. Imaging sequences (identification and optimization). D. Protocolling studies (selecting appropriate sequences). E. Postprocessing (CAD, phase contrast).

## Health Services for Radiology

**(E-53) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Reducing Overutilization of CT Angiography and MR Angiography in a Certified Stroke Center: An Analysis of Cost Savings**

Cody R. Quirk, MD, *Baylor University Medical Center, Dallas, TX*; Kenneth F. Layton, MD (*crquirk@gmail.com*)

**LEARNING OBJECTIVES:** 1) Discuss overutilization of resources in a certified stroke center. 2) Describe different approaches for reducing overutilization of advanced imaging in an era of increased scrutiny of imaging utilization. 3) Discuss how to apply the techniques used from our experience to form medical imaging utilization committees, in order to best evaluate potential areas of improvement in medical imaging overutilization.

**CONTENT DESCRIPTION: Introduction:** The content of our poster will describe our experience as a certified stroke center in reducing overutilization of CTA and MRA in the setting of acute stroke. After forming a medical imaging utilization committee, we focused on this area, given the large cost savings that could be achieved. **Methods:** Our initial focus was on finding the cases where both studies were performed during a single admission without specific indications to perform both. We implemented a strategy to reduce the number of double studies initially through direct radiologist interaction with the referring clinician. After an initial period, we analyzed our data and cost savings with a significant reduction in the number of double-ordered studies. The second stage involved implementing a warning window within the EMR to alert the ordering clinician that either a CTA or MRA had already been performed during the admission, with the ability to override the warning if there were clinical indications for both studies. We once again analyzed the decrease in ordering and cost savings. **Results:** Our conclusions will focus on our experience in reducing repetitive examinations by total number of ordered examinations and cost savings. We will propose additional ideas for reducing overutilization and suggest methods for other radiology departments to help reduce overutilization.

**(E-54) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Making Radiology More Inclusive: Perspectives of Women and Underrepresented Minorities**

Bilal Tahir, MD; Tiffany Sae Kho, MD, *Indiana University School of Medicine, Indianapolis, IN*; Hasina B. Ashe, MD; Tram N. Schroeder, MD; Pauley Gasparis, MD; Gitasree D. Borthakur, MD; et al (*btahir@iupui.edu*)

**LEARNING OBJECTIVES:** 1) Explain the current state of women and underrepresented minorities in radiology. 2) Discuss select narratives obtained from female and underrepresented minorities in various career stages, including medical students, radiology and nonradiology residents and fellows, and radiology and nonradiology staff, regarding reasons for and against pursuing radiology. 3) Describe strategies that may be beneficial in improving recruitment of women and underrepresented minorities into radiology.

**CONTENT DESCRIPTION:** Despite the innumerable advances in radiology, radiology as a career choice for female and underrepresented minority physicians continues to languish in the bottom quartile. By providing focused narratives from multiple female and underrepresented minority medical students, radiology trainees, and radiologists at various stages of their careers, we explore their motivations for pursuing radiology, deciding events that steered them toward radiology, and pertinent challenges along the way. Similarly, we explore the narrative reasoning from nonradiology female and underrepresented

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minority physicians and medical students as to why they decided against pursuing radiology. Lastly, we explore strategies that may help reverse radiology's standing in terms of the percentages of women and underrepresented minorities within the ranks compared to other medical specialties. These strategies include, but are not limited to, development of early mentorship programs, addressing any prevailing misconceptions or concerns about radiology, heavier involvement of women and underrepresented minorities in mentorship and trainee recruitment, and more.

**(E-56) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Cost Analysis of Concurrent Abdominal CT and US Orders in the Emergency Department**

Justin Sacks, MD, *Baylor University Medical Center, Dallas, TX*; John Garrett, MD; Kenneth F. Layton, MD (*justin.sacks@baylorhealth.edu*)

**LEARNING OBJECTIVES:** 1) Discuss resource utilization as it relates to imaging. 2) Identify potential sources of imaging overutilization. 3) Discuss the role of an interdepartmental imaging utilization committee, and outline techniques for identifying and addressing image overutilization. 4) Consider the possible cost savings of reducing simultaneous abdominal US and CT ordering.

**CONTENT DESCRIPTION:** The economics of medicine present many challenges to emergency medicine (EM). One of these daily challenges is the pressure physicians experience secondary to emergency department (ED) crowding: moving patients through the ED in a timely manner while conducting an accurate yet efficient diagnostic evaluation. During times of severe ED crowding, simultaneous ordering of abdominal computed tomography (CT) and ultrasound (US) is a method employed in the setting of clinically undifferentiated abdominal pain to circumvent the potential delay caused by serial imaging. This must be balanced with the increase in medical imaging utilization scrutiny. In this study, a joint EM and radiology utilization committee reviewed 12,138 imaging orders over a period of 12 months and identified those patients with simultaneous orders for abdominal CT and US. Rates of simultaneous ordering were normalized by ED census and then attributed to individual attending physicians. This information was then given to each provider on a monthly basis in a standardized manner, allowing an opportunity for feedback on the process, other techniques for managing ED crowding, and education. During the study period, there was no change in ED crowding scores. The rate of simultaneous orders was reduced over the review period, peaking at 2.3 simultaneous orders per 1000 patient encounters at the start of the project and decreasing to 0.11 patients per month over the study period ( $P < .001$ ). Overall, this also impacted the total number of patients who required both CT and US exams, dropping from 8.9 per 1000 patient visits to 5.6 during the same period. This corresponds to a reduction of 337 exams annually.

**(E-57)**  
**Withdrawn**

**(E-58) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Diversity 3.0 and Imaging 3.0: Is There an Alliance?**

Luis Perez, MD, *Mount Sinai St. Luke's-Roosevelt Hospital, New York, NY*; Mustafa Syed, DO; Nolan J. Kagetsu, MD\*; Kishore K. Chundru, MD (*luiperez@chpnet.org*)

**LEARNING OBJECTIVES:** 1) Define Imaging 3.0™ and Diversity 3.0, and discuss how they complement each other. 2) Describe diversity discrepancies in radiology and how the specialty is being affected. 3) Discuss possible solutions.

**CONTENT DESCRIPTION:** Radiology is known as a specialty where radiologists have the capability of interpreting studies at a high rate utilizing multiple imaging techniques within an advancing technol-

ogy. Unfortunately, being incentivized on volume has in part taken the radiologist's role out of the complete care cycle. Upcoming changes in health care payment models mark the need to make proper adjustments in our profession. Imaging 3.0™ is an ACR initiative to transition from volume-based to value-based imaging care. Important concepts necessary to thrive include involvement in quality and safety projects, outreach to referring physicians, adoption of Imaging 3.0™ technologies, use of data analytics, and patient connection. Diversity is also at the 3.0 level. The progression from Diversity 1.0 to Diversity 3.0 will be reviewed. Diversity 3.0 focuses on differences beyond race and ethnicity. This phase couples diversity with inclusion and is framed as integral to achieving excellence. As seen with companies, such as IBM and Wells Fargo, increased diversity has contributed significantly to success. The ACR Commission for Women and General Diversity was created as a Diversity 3.0 initiative to create awareness and leverage diversity to improve our service to profession. The current state of diversity in radiology will be reviewed. Although radiology is the ninth largest ACGME training specialty, in 2010 it ranked 17th for representation of women among the 20 largest programs. In 2012, radiology ranked 18th out of the 20 largest training programs in terms of overall underrepresented minority (URM) representation. Methods to achieve diversity goals, including holistic reviews of applicants and learning about unconscious bias, will be reviewed. In conclusion, aligning the integration of diversity and inclusion into the core workings of our host health care institutions is an Imaging 3.0™ opportunity to help secure our places in the medical profession as a whole. This will benefit our patients as well.

**(E-120) Wednesday • 7:00–7:20 AM •**  
**E-poster, computer #6**  
**Understanding Reimbursement of Radiology Services: From Sustainable Growth Rate to the Medicare Access and CHIP Reauthorization Act of 2015**

Wenshuai Wan, MD, *Hospital of the University of Pennsylvania, Philadelphia, PA* (*wenshuai.wan@gmail.com*)

**LEARNING OBJECTIVES:** 1) Describe the transition of medical services reimbursement in the United States from the sustainable growth rate (SGR) formula in the Balanced Budget Act of 1997 to the new Medicare Access and CHIP Reauthorization Act of 2015 (MACRA). 2) Identify and demystify the specific parameters and multiple phases of MACRA implementation. 3) Discuss the consequences and implications for radiology as a specialty.

**CONTENT DESCRIPTION:** I. Economic context of reimbursement for medical services. A. Elements of Medicare's repealed SGR formula. B. Pros/cons of SGR, including ideology behind the calculations. C. (In)effectiveness of current policies to control health care costs. II. Key components of MACRA. A. Programs for providers within the new reimbursement structure: merit-based incentive payment system (MIPS) and alternative payment mechanism/model (APM). B. Map of multiple implementation phases from 2015 through 2030. III. Examine how parameters, including planned increases and pay-for-performance incentives, will change reimbursement. A. Compare long-term changes with both general economic and medical inflation. B. Sensitivity analysis of reimbursement parameters. IV. What does this mean for radiology? A. New policies designed to increase financial incentives for cost-effective care. B. Heavily promote consolidation of providers into alternative payment systems. C. Need for and challenges in research connecting imaging services with health outcomes.

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

**(E-121) Wednesday • 7:25-7:45-AM •****E-poster, computer #3****Mobile Mammography from a Distance: Breast Cancer Screening for Northern Plains American Indian Women**Marilyn A. Roubidoux, MD\*, *University of Michigan Medical Center, Ann Arbor, MI*; Janet E. Bailey, MD; Annette I. Joe, MD\*; Katherine A. Klein, MD**LEARNING OBJECTIVES:** 1) Describe health care disparities in breast cancer and in screening mammography among American Indian women. 2) Explain how and why an academic radiology practice can work to improve access to mammography screening for an underserved population. 3) Discuss the benefits and challenges of screening mammography by distant mobile mammography.**CONTENT DESCRIPTION:** Significant health disparities exist for breast cancer among American Indian women. These women experience delays in time from diagnosis to treatment of breast cancer that are twice as long, and they have a higher mortality-to-incidence ratio. While nationally the mortality rate for breast cancer is decreasing, it remains unchanged for American Indian women. For these women, access is generally lower because mammography services are sparse in rural areas and on reservations. Travel times to breast imaging for American Indians are 3–20 times longer than those of other racial/ethnic groups. Studies have shown that missing annual mammography screening correlates with higher stage of breast cancer at detection and increases mortality. Intervention to improve access to screening mammography is needed. Mobile mammography can reduce the travel burden in rural areas, and academic medical centers can offer subspecialty expertise for an underserved population. Since 2005, the division of breast imaging at the University of Michigan has been collaborating with the Mobile Women's Health Unit of the Aberdeen Area Indian Health Service to provide screening mammography services at multiple scattered clinic sites in the Northern Plains, especially to the North and South Dakota reservations. Breast radiologists at the University of Michigan increase the diversity of their practice in terms of racial, geographic, and socioeconomic status while providing this needed service to this population.**(E-122) Wednesday • 7:50–8:10 AM •****E-poster, computer #5****Advanced Decision Support: Radiology Resident Consultant Service for Guiding Examination Selection to Ensure Best Practice**Davood Abdollahian; Michael Trakhtenbroit, *Johns Hopkins Hospital, Baltimore, MD*; Pamela T. Johnson, MD (*pjohnso5@jhmi.edu*)**LEARNING OBJECTIVES:** 1) Describe a resident-run consultation service for exam selection that enables professional development in concert with the ACR Imaging 3.0™ initiative, which encourages radiologists to become consultants who help clinicians choose among imaging tests. 2) Discuss how selection of the best imaging test ensures proper utilization, as encouraged by the Choosing Wisely® campaign.**CONTENT DESCRIPTION:** This exhibit describes the utility of a 4th-year resident consultant service for exam selection guidance and resident professional development. By 4th year, radiology residents have been exposed to all of the major radiologic subspecialties, are familiar with the majority of imaging indications, modalities, and protocols, and have passed the first part of the ABR Board Exam. They are therefore well qualified to evaluate clinical information and imaging literature to assist providers in developing a diagnostic plan. In July 2015, our department initiated a resident-run consultation service specifically designed to address questions about best radiology examinations. Each week, one 4th-year resident is assigned to the service. The resident can be contacted by filling out a form in Ping or by a direct phone call. Faculty, program directors, and house staff were notified about the

consultation service via e-mail. Community providers received similar notification via e-mail and fax. Residents were instructed to contact radiology faculty with any questions about complicated queries, and these faculty were informed. Consulting physicians ask a wide range of questions, including the accuracy of previous imaging, initial and follow-up imaging modality and protocol selection, and management of contrast-related complications. Residents log the queries they receive and recommendations they make; the program director reviews the log and provides feedback to the residents. Radiologists are uniquely positioned to help clinicians navigate the sea of available imaging options. A consultation service run by 4th-year residents is an excellent resource to provide this type of support, while providing senior residents the valuable experience of serving independently as a consultant.

**(E-123) Thursday • 7:00–7:20 AM •****E-poster, computer #6****Interpretative Error in Radiology: Etiologies and Potential Solutions**Travis A. Fuchs, MD, *SUNY Downstate Medical Center, Brooklyn, NY*; Stephen A. Waite, MD; Jinel A. Scott, MD; Srinivas Kolla, MD; Deborah L. Reede, MD; Brian Gale, MBA, MD\* (*stephen.waite@downstate.edu*)**LEARNING OBJECTIVES:** 1) Identify and classify errors in diagnostic interpretation. 2) Describe factors that contribute to interpretative error. 3) Explain methods to mitigate and prevent error.**CONTENT DESCRIPTION:** In addition to potential patient harm, there are significant medicolegal ramifications of interpretative errors in radiology. In 2008, the average indemnity payment for radiology was \$358,349. Oversight of abnormalities/misinterpretation of radiologic images, also termed *failure to diagnose*, accounted for 40%–54% of these radiology-related medical malpractice cases. Therefore, it is important that radiologists become familiar with the literature on interpretative error and factors that impact diagnostic interpretation. This presentation outlines categories of errors, contributing factors, and potential preventive solutions. **Types of Error:** This section outlines the different types of interpretative error, such as perception errors (search, recognition) and decision-making/cognitive errors. Topics include eye-tracking technology to determine the etiology of omission error, cognitive biases such as anchoring, satisfaction of search, and alliterative error. **Interpretative Error Contributors:** The influence of fatigue, workload, study complexity, availability of clinical history, and intrinsic characteristics of missed lesions ("lesion conspicuity") as they relate to perception and error are reviewed. Prevalence effects (where observer performance is affected by prior expectation) on interpretation are also discussed. **Solutions:** This section examines strategies for error mitigation such as educational tools (eg, discrepancy meetings with anonymized cases) and perceptual aids (contemporary computer-aided diagnostic tools). Also provided is a summary of the current literature on the utility of standardized reporting, methods of peer review, and use (utilization, implementation) of double reading.**(E-124) Thursday • 7:25–7:45 AM •****E-poster, computer #6****Nonanaphylactoid Factoids: A Review of the Recognition and Management of Nonanaphylactoid Intravenous Contrast Reactions**Francesco Priamo, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*; Jose R. Concepcion, MD, MPH; Vincent Lau, MD; James E. Silberzweig, MD (*fpriamo@chpnet.org*)**LEARNING OBJECTIVES:** 1) Describe the forms of nonanaphylactoid emergencies. 2) Identify factors intrinsic to both the patient and the agent being used that increase the risk of nonanaphylactoid reactions.

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3) Explain the management of these emergencies. Adverse reactions to intravenous contrast are reported to complicate a small but significant percentage of intravenous contrast administrations. Nonanaphylactoid emergencies are an underrecognized variant of acute intravenous contrast reactions. Failure to recognize these reactions and their treatments can result in serious harm to patients receiving contrast-enhanced exams.

**CONTENT DESCRIPTION:** I. Differentiation of anaphylactoid and non-anaphylactoid contrast emergencies. II. Review of the presentation of acute nonanaphylactoid intravenous contrast emergencies, including bronchospasm, vasovagal reaction, pulmonary edema, seizure, hypoglycemia, and contrast extravasation. III. Review of factors that may increase the risk of these emergencies intrinsic to both the patient and the type of contrast solution, including, but not limited to, the osmolality and ionic character of the contrast agent, asthma, cardiac disease, diabetes mellitus, and the presence of a language barrier. IV. Presentation of a logical approach to nonanaphylactoid contrast emergencies, with a review of management strategies.

**(E-125) Thursday • 7:50–8:10 AM • E-poster, computer #6**

### **The Medicare Access and CHIP Reauthorization Act (MACRA) and Radiology: What the Radiology Resident Can Expect for the Future and Unanswered Questions**

Naim Ali, MD, *University of Vermont Medical Center, Burlington, VT*;  
Anthony Dinizio, MD ([naim.ali@uvmhealth.org](mailto:naim.ali@uvmhealth.org))

**LEARNING OBJECTIVES:** 1) Describe the history of the sustainable growth rate (SGR) formula and its effects on physician payments. 2) Identify the provisions of the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA). 3) Discuss potential future impacts and implications of MACRA on radiology practice.

**CONTENT DESCRIPTION:** The sustainable growth rate (SGR) model was initially established in 1997 to curb increases in Medicare spending. The implementation of the SGR was sequentially delayed by Congress a total of 16 times between 1997 and 2014. On April 16, 2015, Congress passed MACRA to repeal SGR and provide annual 0.5% increases to physician payments until 2018. Starting in 2019, physician payments will be subject to cuts if providers do not participate in either the merit-based incentive payment system (MIPS) or an alternate payment model (APM). Under MIPS, physician payments will be increased or decreased based on four metrics: quality, resource use, electronic health records, and practice improvement. For the APM, physicians will be paid through an accountable care organization (ACO), medical home, or bundled payment system. Between 2019 and 2024, physicians in an APM will receive an annual bonus of 5%. Physicians who participate in the MIPS have the possibility of payment increases of up to 4% in 2019 based on performance on metrics, with possibility of cuts up to 4%; these go up to 5%, 7%, and 9% from 2020 to 2022. The decisions of radiology practices to enter into the MIPS or an APM will have a large impact on the way they practice and on their bottom line. It remains unclear how the four MIPS metrics will be defined for radiology. When these measurement criteria are defined, radiologists in the MIPS will be forced to adapt the way they practice in order to meet these metrics. For radiology practices that join an APM, they will have to secure a slice of a limited pie for physician payments. This may be particularly difficult if radiologists cannot demonstrate value-added service. Furthermore, in the world of bundled payments, nonradiologist physicians who feel they can interpret their own imaging (rightly or not) will have a strong incentive to remove radiologists from the equation altogether.

## Informatics

### AMSER Henry Goldberg Medical Student Award

**(E-59) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Creating a Novel Web-based Educational Application: An Algorithm for Success**

John Renfrew, BS, *University of Wisconsin School of Medicine and Public Health, Madison, WI*; Jason W. Stephenson, MD; Andrew Schemmel; Daryn Belden; Richard J. Bruce, MD\*; Shane A. Wells, MD

**PURPOSE:** Consistent and timely feedback on preliminary radiology reports (RRs) remains a cornerstone of trainee education. Increasing clinical and academic demands upon faculty, expanding after-hours coverage, and trainee work-hour constraints place added pressure on traditional teaching practices and may compromise RR feedback. This study will disseminate our experience in the development of a novel application that compares preliminary and finalized RRs, highlighting all edits.

**METHOD AND MATERIALS:** Recognizing the need for timely and accurate RR feedback among other metrics, institutional efforts were directed toward reverse engineering existing outside institution platforms to fit the specific needs of the department. Platform complexity, programmer turnover, and the absence of both faculty and trainee champions led to the demise of the project. Herein we describe the process of organizing an integrated team, leveraging existing resources, and engendering broad information technology (IT) professional support in the successful development and deployment of a novel RR feedback application. Technical considerations of application design will be discussed.

**RESULTS:** Successful development and deployment of a robust, home-grown RR feedback application were the product of collaboration between a self-directed integrated team including medical students, radiology trainees, clinical faculty, and IT professionals. Insights into intradepartmental work flow, IT constraints, and educational opportunities across the enterprise were critical components of the process. Our application, which uses Java™ programming language to extend a custom data connection, queries the dictation system and PACS databases and enables near real-time viewing of edited finalized RRs in a customizable user interface. Data access and application hosting strategies employ a modular design that allows for development of future QI applications within the framework.

**CONCLUSION:** Platform differences across institutions can impede importation of technology-based solutions. Diverse self-directed teams composed of physician champions with institutional knowledge and IT support may improve the development and dissemination of novel IT applications.

**(E-60) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Instant Consult: Imaging Group Consultation, Collaboration, and Education**

Mohammed I. Quraishi, MD, *University of Maryland, Baltimore, MD*;  
Piyush Madan ([quraishi@gmail.com](mailto:quraishi@gmail.com))

**PURPOSE:** There are many instances where collaboration on imaging is needed but cannot be reasonably performed. If a radiologist has a questionable finding and believes a consult from a remote radiologist would be of benefit, then there is not currently a quick and easy solution. There are Web applications where DICOM can be uploaded, but in those instances, real-time consultation can only be made through the phone; and, further, only one consultation radiologist's opinion can be achieved at any given time. What we have developed is a method where a DICOM imaging study can be viewed on the Web by many collaborators

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and is combined with a live messaging system for real-time collaboration and consultation. This work can also be used as an educational tool for a group of remote clinicians or radiologist trainees.

**METHOD AND MATERIALS:** With extensive use of JavaScript, a collaborative portal was designed. The “presenter” of the images exported the anonymized DICOM file to the Web server. The presenter is then given a temporary pass-code that he can give to any collaborators, who can use it to log into the portal. In the portal, the presenter has control over manipulating and annotating the DICOM images while the collaborators are spectators. Control over manipulation can be exchanged on demand by the presenter. However, each collaborator has a pointer that is viewable by all in the portal. Incorporated within the portal is a group chat where discussion of the image can be made in real time.

**RESULTS:** Our imaging portal for radiologists combines many needs for real-time collaboration. It has the needed tools for a robust collaboration, with the ability to annotate images and for collaborators to either be given control of manipulation or use their pointers at any time. Further, it not only allows consultation with one other individual but also gives the ability to collaborate with multiple individuals. The program lives on the Web and is accessible from any site that has an Internet connection.

**CONCLUSION:** We were able to develop a seamless collaboration portal for radiologists. Our solution is a one-stop shop for imaging collaborative needs.

#### (E-61) Wednesday • 7:00–8:15 AM • Hard-copy poster Converting Months to Days: Using a Clinical Informatics Infrastructure to Efficiently Evaluate 3 Years of Hip Fracture Admissions

Bimal Vyas, MD, *University of Maryland Medical Center, Baltimore, MD*;  
Leon Lenchik, MD

**LEARNING OBJECTIVES:** 1) Develop a methodology to extract information from the electronic chart. 2) Reformat and analyze the extracted data.

**CONTENT DESCRIPTION:** Although our institution implemented an electronic health record 3 years ago, most of the radiology research continued to rely on inefficient PACS report searches combined with manual chart reviews. The institution’s biomedical informatics team allows clinicians to submit data access requests, which are queried using the institution’s i2b2 tool. We piloted a project to characterize patients with emergency department (ED) visits that included orders for hip radiographs. The ED at our institution manages over 100,000 annual patient visits. The inclusion criteria isolated patients who were admitted to the ED from 10/2012 to 07/2015, were at least 60 years of age at the time of the admission, and had radiographs of the hip and/or pelvis. We requested age, sex, admission date, discharge date, reason for visit, encounter diagnosis, problem list, medications, allergies, and discharge disposition. The data were provided in the form of a Microsoft Excel workbook with separate work sheets for demographics, problem list, medications, allergies, and diagnoses. Consolidating the data required a relational database, and we opted to use Microsoft Access because it was widely available. Each work sheet was converted into a table within the database. We ran SQL queries on the tables to parse the data for further analysis. We chose to isolate ED visits with an encounter diagnosis of a femur fracture that was not a result of high-energy trauma. Over 34 months, there were 2169 ED visits by 1570 patients that met our inclusion criteria; 19% of those patients were diagnosed with hip fractures. The hip fractures involved the femoral neck (46%), intertrochanteric region (39%), subtrochanteric region (4%), and distal femur (11%). Hip fracture data from 34 months were analyzed in a few days, compared to the several months that would have been required to manually identify patients and review charts.

#### (E-62) Thursday • 7:00–8:15 AM • Hard-copy poster From Patient “Data” to Patient “Information”: Amalgamating Informatics with Clinical Medicine for Best Imaging Utilization

Supriya Gupta, MD, MBBS, *Georgia Regents Medical Center Hospital, Augusta, GA*; Robert A. Mackey, MD, MBA; Marc Buzzelli (*sugupta@gru.edu*)

**PURPOSE:** While “data” are mere raw collections of facts and figures, “information” is meaningful data. Presently, radiology departments are teaming with raw data as text reports and images. While we are currently developing advanced data mining tools for information analysis and retrieval, the future holds a possibility of metamorphosing these tools into another realm. We review the existing informatics platforms in health care systems and discuss opportunities for exploring and mobilizing these systems for enhanced data visualization.

**METHOD AND MATERIALS:** Relational queries and associative interactions between various report elements form the basis of the majority of the existing data mining health care technologies. Many use existing medical lexicons like the Systematized Nomenclature of Medicine (SNOMED), RadLex, and Natural Language Processing platforms to create a searchable database. Traditionally, informatics has been a zone of administrators, technologists, and finance managers. However, as these systems are integrated into health care, the role of radiologists and physicians is gaining ground. Even though multiple applications exist that require a single mouse click, radiologists and physicians usually require training before they feel comfortable. Not only is finding the lesion important on an image for a radiologist, but also creating a visual replica of the patient mentally to actually understand the temporal association of that finding with the other anatomical organs in the body, for providing an accurate impression.

**RESULTS:** Designing data mining applications to create a visual representation of the patient is the ultimate desire for clinicians, radiologists, and patients. One potential solution can be mapping medical ontology in dictated reports to a human model; or, alternatively, surface-rendered three-dimensional models can be built into the reports, customized for each patient. Real-time data mining technology can be extended to avoid laterality/gender errors and sending important finding alerts to the referring physicians.

**CONCLUSION:** Informatics and clinical resources can be synchronized to create an easy-to-navigate medical record where the physician and radiologist can comprehend patient information, instead of processing large amounts of data.

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**(E-63) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Web-based Radiology Simulator: Are You Prepared for Call?**

Umairullah Lodhi, MD, *Stony Brook University Hospital, Stony Brook, NY*; Uzair Sarmast, MD

**LEARNING OBJECTIVES:** 1) Discuss the need for replacing the traditional rudimentary call preparation methods with unique ideas such as the one presented. 2) Explain the concept of a structured, Internet-based case simulator that is accessible to any individual or program across the world without special technological requirements or expensive subscriptions. 3) Discuss how the use of such simulators is not limited to call preparation but can be applied for assessment/grading purposes.

**CONTENT DESCRIPTION:** Our online radiology simulator incorporates several key components required for realistic call preparation. It 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. The simulator contains a continually expanding comprehensive collection of actual cases spanning the full gamut of pathology, as well as normal studies, that one is likely to encounter in the emergent setting. The simulator also features accurate speech recognition technology powered by leading medical dictation software, thereby allowing trainees to dictate reports just as they would on call. Importantly, our system utilizes a learning management system (LMS), one that is employed by major universities and corporations, to organize the simulation cases into a curriculum of increasing difficulty and to offer individual user profiles. Users will be able to immediately compare their reports with official interpretations by attending radiologists, as well as having the option for grading by Web site administrators or program directors. Modules can be taken spontaneously or automatically released on a periodic basis. Lastly, recognizing the global benefit to radiology trainees and the resultant improvement in patient care, our Web-based simulator will be freely available to users worldwide and does not require the user to purchase extraordinary technology or an expensive subscription. All that is required is a Web browser with a free downloadable plug-in and a standard microphone.

## Interventional Radiology

**(E-67) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**VESSELS: A Step-by-Step Acronym for Medical Students and Interns Learning the Basics of Central Venous Catheter Placement**

Artur Narkiewicz-Jodko, MD; Richard Koff, MD, *Santa Barbara Cottage Hospital, Santa Barbara, CA*; Manu Singh, MD; Bernard Chow, MD

**LEARNING OBJECTIVES:** 1) Explain the VESSELS acronym and how each letter represents an important step in central venous catheter placement. 2) Describe the different types of central lines and basic vascular anatomy. 3) Identify the common indications for central venous catheter placement. 4) Describe important contraindications to central venous catheter placement.

**CONTENT DESCRIPTION:** Central venous catheter placement is one of the most routinely performed procedures in interventional radiology, the ICU, and the medical/surgical wards. The acronym VESSELS can be used by medical students and interns to facilitate learning the steps to central line placement: (1) Visualize the area with ultrasound guidance. (2) Evaluate the vasculature for contraindications like thrombus. (3) Stick the area with the lidocaine needle, and then stick with the puncture needle. (4) Slide the guidewire into the vessel, and slide the needle off. (5) Expand or dilate the vessel with scalpel and dilator. (6) Line then gets placed over the guidewire. (7) Slide the guidewire out, and secure the line. (Each S has two steps.) **Types of Vascular Lines/Access Points:** The most common central venous catheters placed include peripherally inserted central catheters (PICCs) and internal jugular, subclavian, and femoral lines. Commonly used access points often vary by the indication of the line and include the basilic, brachial, subclavian, internal jugular, and femoral veins. **Common Indications:** Common indications for central venous catheters include the administration of antibiotics/medications, TPN, chemotherapy, the need for multiple blood draws, dialysis, plasmapheresis, fluid resuscitation, and central venous pressure monitoring. **Contraindications:** Common contraindications to central line placement include thrombus in a selected vein or central vein, skin infection in the area of selected line placement, coagulopathy, and thrombocytopenia. **Complications:** The most common complications following central line placement include bleeding, infection, pneumothorax, air embolus, arrhythmia, and inadvertent arterial insertion of the catheter. Different access points have differing degrees of risk/complication rates.

**(E-68) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**The Expanding Role of Interventional Radiology in Bone Pathology: A Case-based Review of the Diagnosis and Treatment of Bone Disease**

S. Hamad Mirzan, MD; Omar Abousoud, *Mount Auburn Hospital/Harvard Medical School, Cambridge, MA (smirzan@mah.harvard.edu)*

**LEARNING OBJECTIVES:** 1) Describe the role of interventional radiology (IR) in bone pathology, including diagnosis and different IR-based treatments of bony metastases. 2) Discuss the following different procedures (some with case-based examples): bone biopsies, vertebroplasty and kyphoplasty, embolization of bony metastatic disease, and radiofrequency ablation.

**CONTENT DESCRIPTION:** Interventional radiology (IR) plays a central role in modern medicine in the diagnosis and treatment of many diseases, including bone pathologies. In particular, patients with insufficiency fractures and bony metastatic disease may benefit from the minimally invasive procedures offered by interventional radiology. Using a case-based format, we aim to educate the reader on common and not-so-common IR-based approaches for the management of bone diseases.

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

**(E-130) Wednesday • 7:00–7:20 AM •****E-poster, computer #8****Role of Interventional Radiology in the Management of Gynecologic and Obstetric Patients**Siavash Behbahani, *Winthrop-University Hospital, Mineola, NY*; April Griffith; Ahmed Fadl, MA, MD; Amanjit Baadh, MD; Jason C. Hoffmann, MD\* ([jhoffmann@winthrop.org](mailto:jhoffmann@winthrop.org))

**LEARNING OBJECTIVES:** 1) Explain the integral role that interventional radiologists play in the management of a variety of emergent and nonemergent obstetric and gynecologic conditions. 2) Describe how to support improved, efficient, and meaningful communication regarding care of obstetric and gynecologic patients who could benefit from interventional radiology procedures. 3) Discuss a variety of OB/GYN-related diagnoses, such as infertility, ectopic pregnancy, postpartum hemorrhage, pelvic congestion syndrome, uterine fibroids, adenomyosis, venous thromboembolism, and gynecologic malignancies.

**CONTENT DESCRIPTION:** I. Highlight the importance of strong work relationships among gynecologists, obstetricians, and interventional radiologists. II. Review the role of interventional radiology in the management of a variety of obstetric and gynecologic conditions by using an image-rich, case-based approach. A. Obstetric conditions. 1. Image-guided injection to treat ectopic pregnancy. 2. Fallopian tube recanalization. 3. Management of peri- and postpartum hemorrhage. B. Gynecologic conditions. 1. Pelvic congestion syndrome. 2. Uterine artery embolization for symptomatic uterine fibroids and/or adenomyosis. 3. Embolization of bleeding uterine malignancy. 4. Percutaneous ablation and/or embolization of gynecologic malignancy metastases. 5. Venous thromboembolism. 6. Percutaneous biopsy of uterine and/or adnexal masses. 7. Mediport placement for treatment of advanced gynecologic malignancy. 8. Postsurgical interventions (including fluid collection drain placement, abscess management, and cavity sclerosis). 9. Gastrostomy tube placement. III. Conclusions.

**(E-132) Wednesday • 7:50–8:10 AM •****E-poster, computer #10****Improving Quality of Life with Palliative Care Procedures Performed by the Interventional Oncologist**Sasan Partovi, MD; Nicholas Bhojwani, MD; Vasant Garg, MD, *University Hospitals Case Medical Center, Cleveland, OH*; Sahejmeet S. Guraya, BS; Alok Harwani; Indravadan J. Patel, MD; et al ([nbhoj08@gmail.com](mailto:nbhoj08@gmail.com))

**LEARNING OBJECTIVES:** 1) Describe the various palliative interventional radiology procedures that exist for cancer patients. 2) Discuss how these palliative procedures can be applied in various clinical situations with imaging guidance. 3) Describe the clinical outcomes of these palliative procedures in regard to improved quality of life.

**CONTENT DESCRIPTION:** I. Image-guided treatment modalities. A. Radiofrequency ablation. B. Cryoablation. C. Microwave ablation. D. Coblation. E. Embolization. F. Combination therapies. II. Malignant lesions requiring treatment. A. Painful osseous metastases. B. Head and neck tumors. C. Nerve ablations. D. Soft-tissue masses. E. Thoracic masses. F. Vertebral lesions. III. Patient selection. IV. Procedure details. V. Efficacy/treatment outcomes. VI. Complications.

**(E-133) Thursday • 7:00–7:20 AM •****E-poster, computer #8****Google Glass: Wearable Technology That Can Be Used in Image-guided Procedures**Junghwoon Yoon, MD, *Stony Brook University Hospital, Stony Brook, NY*; William H. Moore, MD\* ([junghwoon.yoon@stonybrookmedicine.edu](mailto:junghwoon.yoon@stonybrookmedicine.edu))

**LEARNING OBJECTIVES:** 1) Describe how Google Glass (Google; Mountain View, CA) can be used as a monitor in ultrasound-guided procedures. 2) Discuss how Google Glass can be coupled with a surgical navigational software during CT-guided biopsies. 3) Describe difficulties and current limitations in using Google Glass in the IR suite. 4) Discuss how Google Glass can be used to record procedures for educational and monitoring purposes.

**CONTENT DESCRIPTION:** Google Glass is a wearable technology that can be used in multiple ways in image-guided IR procedures. Google Glass can be used as a monitor in ultrasound-guided procedures. The operator does not have to look away at the monitor on the ultrasound machine when maneuvering the needle. Instead, the operator can use the Google Glass, which is in line of sight, to watch the access site and the needle trajectory at the same time. Moreover, Google Glass can be coupled with a surgical navigational software with fiducial markers during CT-guided biopsies where repeat CT scans are not required after initial imaging when advancing a needle. Some of the limitations in using Google Glass during a CT-guided biopsy includes a network that can accommodate the large volume of data sent over to the Google Glass to not experience image lagging. Secondly, the network has to be secure in order to not violate HIPAA policies. Google Glass can also be used to record procedures through its HD camera for educational purposes and also allows guidance from a remote user through the Internet.

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

## Musculoskeletal Radiology

### (E-69) Wednesday • 7:00–8:15 AM • Hard-copy poster Pearls and Pitfalls of Picture-perfect Conventional Fluoroscopia-guided Shoulder Arthrography: What's Right, What's Wrong, and How Do I Fix It?

Glenn C. Gaviola, MD, *Brigham and Women's Hospital/Harvard Medical School, Boston, MA (ggaviola@partners.org)*

**LEARNING OBJECTIVES:** 1) Explain techniques of both anterior and posterior approaches to conventional fluoroscopia-guided shoulder arthrography, including proper needle placement. 2) Describe the anatomy and expected postcontrast appearance of the normal glenohumeral joint on conventional fluoroscopia-guided arthrography, with correlation to the cross-sectional MR/CT appearance. 3) Discuss pitfalls in needle placement and abnormal contrast location and how to troubleshoot techniques used in real time to optimize needle placement and contrast location.

**CONTENT DESCRIPTION:** I. Normal anatomy of the scout precontrast fluoroscopia image for both anterior and posterior approaches for glenohumeral joint arthrography. II. Technique for optimal needle tip placement and normal arthrographic appearance of contrast in the glenohumeral joint. III. Common pitfalls in misplaced needle tip and contrast location. A. Intramuscular injection, both subscapularis and deltoid injections. B. Intralabral and biceps anchor injection. C. Subcoracoid bursal injection. D. Injection in adhesive capsulitis. E. Use of gas as a contrast agent in patients with contrast allergies. F. Use of exercise post injection to demonstrate occult rotator cuff tendon tears. G. Differentiating calcific tendinopathy from contrast injection. IV. Useful maneuvers during real-time injection to optimize needle tip and contrast location when encountering a pitfall.

### (E-70) Thursday • 7:00–8:15 AM • Hard-copy poster The Lisfranc Ligament: Anatomy, Pathology, and Pitfalls

Michael T. Perry, MD, *Ochsner Clinic Foundation, New Orleans, LA*; Gustavo Godoy; Richard Tupler; Mark S. Meyer; Ernest Rudman, MD (*erudman@ochsner.org*)

**LEARNING OBJECTIVES:** 1) Discuss common clinical presentations and considerations for the imaging of midfoot pain. 2) Describe the relevant anatomy of the Lisfranc ligament, and recognize common patterns of injury. 3) Discuss treatment options, postoperative imaging, and sequelae of a missed diagnosis of Lisfranc injuries.

**CONTENT DESCRIPTION:** The Lisfranc ligament is an important stabilizing structure of the midfoot, with injury often leading to chronic midfoot pain and advanced early osteoarthritis. We will review the normal anatomy of the Lisfranc ligament, typical clinical presentations of injury, and radiologic evaluation of midfoot pain. This poster will present the classic radiographic, CT, and MRI findings of Lisfranc injuries, including some common clinical and radiologic pitfalls. Finally, treatment considerations following injury, postoperative imaging, and complications of missed or delayed diagnosis will be reviewed.

### (E-71) Wednesday • 7:00–8:15 AM • Hard-copy poster A Radiologist's Guide to Musculoskeletal Joint Aspirations and Injections

Paul-Michel Dossous, MD, MPH, *North Shore-LIJ Health System, New Hyde Park, NY*; Patrick H. Kobes, DO; Jarett Burak, MD

**LEARNING OBJECTIVES:** 1) Explain indications and contraindications for joint aspirations, injections, and drainages. 2) Describe proper sterile technique and universal precautions for musculoskeletal joint aspirations. 3) Explain the proper technique to access joints with image guidance and anatomical landmarks. 4) Describe pertinent diagnostic laboratory tests relevant to musculoskeletal joint pathology.

**CONTENT DESCRIPTION:** This educational exhibit will provide the most common indications for major and minor joint aspirations, injections, and drainages. A comprehensive review will include the wrist, elbow, shoulder, sacroiliac joint, hip, knee, ankle, and the small joints of the hand and foot. The exhibit will review the relevant joint anatomy and anatomical landmarks pertinent to joint arthrocentesis. Appropriate imaging modalities and approaches to each joint will also be reviewed. Technique guidelines will include the most effective patient positioning for adequate joint access. Useful equipment and needle sizes differ for each joint and depend on the accessibility and volume of the joint. The exhibit will review the most practical materials needed to achieve the best outcomes while mitigating patient discomfort. Special considerations when accessing joints, such as joint arthroplasty and intraarticular postoperative changes, will also be addressed. Various joint pathology and diseases have characteristic laboratory findings when joint fluid is analyzed. The exhibit will review the pertinent laboratory findings associated with common joint pathology and provide guidance to what laboratory tests should be performed after arthrocentesis. Finally, complications associated with joint aspirations, such as local skin reactions and infections, and methods to prevent them will be discussed.

### (E-72) Thursday • 7:00–8:15 AM • Hard-copy poster Musculoskeletal Lymphoma: A Multimodality Imaging Case Review Demonstrating Its Various Manifestations

Brett Barker, MD, *Vanderbilt University, Nashville, TN*; Brent A. Roach, MD; John J. Block, MD; Katherine Hartley, MD (*brett.e.barker@vanderbilt.edu*)

**LEARNING OBJECTIVES:** 1) Explain that lymphoma in the musculoskeletal system can manifest in bone or soft tissues through both primary and secondary etiologies. 2) Recognize that musculoskeletal lymphoma has an unpredictable presentation, with multiple possible imaging characteristics and sites of disease. 3) Discuss when to include lymphoma in the differential diagnosis of a bone or soft-tissue mass, encouraging appropriate workup and referral.

**CONTENT DESCRIPTION:** Lymphoma is classically known to have a diverse, and often deceiving, imaging appearance throughout the body, the musculoskeletal system being no exception. Bone lesions typically demonstrate an expected aggressive appearance with a permeative lytic pattern but can also appear sclerotic. Radiographs have a tendency to underestimate or even completely fail to demonstrate the extent of disease, making correlation with MRI a necessity. Soft-tissue lesions tend to be nonspecific in appearance and can be occult on imaging when nonenhancing and isodense/intense to surrounding structures. Bone and soft-tissue involvement can occur both through primary lymphoreticular involvement and, most commonly, through secondary hematogenous dissemination. This is an important distinction, as treatment and staging differ significantly for a primary lymphoma (stage I) versus systemic disease with secondary musculoskeletal involvement (stage IV). Primary and secondary lymphomatous lesions in bone or soft tissue are indistinguishable by imaging. Therefore, a thorough metastatic workup must be conducted for staging. In this exhibit, we will review several cases of both primary and secondary musculoskeletal lymphoma and demonstrate the key role multimodality imaging plays in detecting, characterizing, and staging the disease. Upon recognizing the diverse presentation and potential pitfalls when imaging musculoskeletal lymphoma, the radiologist will be better equipped to think of this diagnosis in appropriate cases and encourage appropriate workup and referral.

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

**(E-73) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**It's a Soft-Tissue Mass ... Now What? A Resident's Guide for Interpretation and Reporting**

Juan P. Juan-Ramirez, MD, *Medical College of Georgia at Georgia Regents University, Augusta, GA*; Yulia Melenevsky, MD; Elsie Negron-Rubio, MD (*jjuanramirez@gru.edu*)

**LEARNING OBJECTIVES:** 1) Describe the optimal imaging protocols for adequate assessment of soft-tissue masses. 2) Discuss a systematic approach to soft-tissue masses for radiology residents to follow when interpreting imaging findings. 3) Describe a standard reporting structure to allow radiology residents to consistently produce comprehensive diagnostic impressions.

**CONTENT DESCRIPTION:** Throughout their training, radiology residents encounter soft-tissue masses routinely and are faced with the challenge to, in the most accurate way possible, describe and characterize them. Residents in all stages of training often find themselves struggling to produce a comprehensive description of a soft-tissue mass that is of clinical value. Producing a comprehensive description is of paramount significance, as it will aid in the accurate diagnosis and local staging of soft-tissue masses and ultimately guide management. The purpose of this education poster is to provide a framework for residents to follow when faced with the task of interpreting and reporting soft-tissue masses. For this, optimal imaging protocols, as well as specific and classic imaging characteristics of common soft-tissue masses, will be reviewed, with emphasis on MR imaging features. Finally, a systematic approach for interpreting and reporting soft-tissue masses in the form of a step-by-step checklist will be reviewed, to allow residents to consistently achieve comprehensive and clinically relevant reports. In all, we expect residents to become more comfortable and confident when approaching soft-tissue masses.

**(E-74) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Lateral Hindfoot Impingement: A High-Yield Pictorial Review**

Howard Dai, MD, *Scott and White Memorial Hospital, Temple, TX*; Stefan Friemel; Ricardo D. Garza-Gongora, MD; Linda Parman, MD; Connie C. So, MD (*hdai@sw.org*)

**LEARNING OBJECTIVES:** 1) Describe and illustrate the pertinent anatomy regarding lateral hindfoot impingement. 2) Identify the pathophysiology and resultant mechanical alterations leading to lateral hindfoot impingement. 3) Discuss radiographic, CT, and MR imaging features with case examples regarding lateral hindfoot impingement.

**CONTENT DESCRIPTION:** Lateral extra-articular hindfoot impingement is a common etiology for lateral ankle pain. Posterior tibial tendon dysfunction is the usual culprit leading to lateral hindfoot impingement, with resultant pes planus and hindfoot valgus. As the degree of pes planovalgus progresses, so do the stages of impingement. These stages commence with talocalcaneal impingement, with subsequent advancement to subfibular impingement. Grading schemes regarding hindfoot valgus have been created and will be discussed. Characteristic imaging features are exhibited with lateral hindfoot impingement, such as lateral talocalcaneal subcortical edema and cyst formation with neofacet formation. Sinus tarsi edemalike signal and peroneal tendon dysfunction also typically accompany lateral hindfoot impingement. This exhibit will highlight the classic features of lateral hindfoot impingement.

**(E-75) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**Ankle Impingement Syndromes: What the Radiologist Needs to Know**

Jordan K. Fite, MD, *Baylor Scott and White, Temple, TX*; Ricardo D. Garza-Gongora, MD; Linda Parman, MD; Connie C. So, MD (*jofite@sw.org*)

**LEARNING OBJECTIVES:** 1) Discuss the different ankle impingement syndromes. 2) Identify the pertinent anatomy involved in the various ankle impingement syndromes. 3) Discuss a pictorial review of findings associated with anterior, anterolateral, anteromedial, posteromedial, and posterior ankle impingement.

**CONTENT DESCRIPTION:** Magnetic resonance imaging (MRI) and magnetic resonance arthrography are important tools in the evaluation of osseous and soft-tissue structural changes associated with chronic ankle impingement syndromes. These syndromes are the result of structural changes that occur after prior trauma, such as ankle sprains, and the subsequent altered biomechanics of the osseous structures and regional soft tissues, allowing for impingement. For example, repetitive dorsiflexion trauma can lead to osteophyte formation at the anterior tibial plafond and proximal talus. These osseous irregularities can impinge upon each other in dorsiflexion and can entrap adjacent soft tissues, resulting in anterior ankle impingement syndrome. MRI can demonstrate these osseous changes, as well as demonstrate resultant edema, degree of cartilage damage, and associated synovitis. The different impingement syndromes of the ankle are classified as anterior, anterolateral, anteromedial, posteromedial, and posterior. A firm understanding of the pertinent anatomy and imaging findings helps the radiologist accurately diagnose ankle impingement syndromes or other etiologies of ankle pain. The osseous and soft-tissue changes in each location resulting in impingement will be reviewed with MRI examples and illustrations.

**(E-76) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Algorithmic Approach to Diagnose Arthritis**

Kuang-Wei Chang, MD, *Baylor Scott and White, Temple, TX*; Meagan Uzee, MD; Ricardo D. Garza-Gongora, MD; Linda Parman, MD; Spencer T. Sinclear, MD; Connie C. So, MD (*kchang@sw.org*)

**LEARNING OBJECTIVES:** 1) Identify common radiographic findings associated with an array of arthritic pathologies. 2) Utilize the provided algorithm for quick accurate diagnosis of arthropathies. 3) Recognize the classic patterns of joint space narrowing, distribution of disease, erosions, and periostitis associated with a variety of common arthropathies.

**CONTENT DESCRIPTION:** Arthritis is a broad and, at times, daunting disease process to correctly classify. A speedy and accurate diagnosis is paramount for selecting the appropriate therapy and reducing the associated long-term sequelae. The spectrum of the disease encompasses inflammatory as well as degenerative findings on radiographs. Identifying certain arthritic radiographic findings, such as joint space narrowing, bone repair, periostitis, and joint distribution, can aid in specific diagnosis. The involvement of a single joint with joint space narrowing may represent a septic joint, which requires a markedly different intervention than the typical osteoarthritis attributed to advanced age. Diagnosis of such variable and common arthropathies can be achieved utilizing a simplified algorithmic approach depicted on an image-rich presentation.

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

(E-134) Wednesday • 7:00–7:20 AM •

E-poster, computer #4

### In the Line of Duty: Imaging Musculoskeletal Injuries in Firefighters

Susan C. Lee, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*; Kevin R. Math, MD (*susancatherine.lee@gmail.com*)

**LEARNING OBJECTIVES:** 1) Describe the most common nonspine musculoskeletal injuries in urban firefighters. 2) Discuss and explain the MR imaging features and mechanisms of injuries sustained by firefighters.

**CONTENT DESCRIPTION:** Firefighters—like athletes—sustain a high number of work-related musculoskeletal injuries. We evaluated 175 MR examinations of local firefighters, tabulating the spectrum of injuries and their mechanisms. The MR imaging features of the spectrum of musculoskeletal injuries in firefighters will be discussed, with greater focus on acute injuries: (1) Imaging features and causes of pectoralis major musculotendinous injuries, ACL tears, athletic pubalgia, and isolated teres minor muscle atrophy will be reviewed. (2) Case examples of biceps tendon tears, Achilles tendon tears, and triangular fibrocartilage complex tears will be discussed. (3) Additionally, firefighters often present with more-advanced degenerative changes, given their age, with chronic shoulder and knee injuries being the most common—these will be briefly presented. (4) Reported mechanisms of injuries were related to carrying victims, pulling down walls during fires, direct trauma from collapsing ceilings, and falls in cluttered apartments and from the fire truck. Knowledge of the top musculoskeletal injuries in firefighters aids in radiologic diagnosis and offers information for management and injury prevention that can be applied to the layperson or athlete patient population.

(E-135) Wednesday • 7:00–7:20 AM •

E-poster, computer #5

### Hallux Pain: A Review of the Spectrum of Clinical Conditions and Their Imaging Characteristics

Sayed Ali, MD, *Temple University Hospital, Philadelphia, PA*

**LEARNING OBJECTIVES:** 1) Identify the multitude of etiologies responsible for great toe (hallux) pain. 2) Describe the imaging characteristics of the common etiologies. 3) Recognize imaging artifacts and normal variants that may lead to misdiagnoses. 4) Discuss the development of a checklist approach to narrow the differential and confidently suggest a diagnosis.

**CONTENT DESCRIPTION:** This exhibit will present a pictorial guide of the multiple etiologies responsible for the clinical entity of great toe pain, which can help the radiologist to focus on particular anatomical structures. The list of entities that are responsible for this clinical picture is extensive and includes osseous pathology such as fractures of the metatarsal, phalanges, or the great toe sesamoids, sesamoid synchondrosis separation, hallux valgus, and hallux limitus/rigidus. Other traumatic or arthritic causes include “turf” toe, gout, CPPD arthropathy, silicone synovitis/arthrititis, and rheumatoid arthritis. Tendon-related causes include tendinosis, tendon tear, tenosynovitis, and flexor hallucis longus (FHL) subluxation. Less well-known etiologies include the os interphalangeus syndrome, and attention will be paid to this entity and other less well-known etiologies. Digital nerve pathology, including neuritis or neuroma, will be shown. Finally, great toe infection, subungual exostoses, and tumors will be demonstrated. This pictorial review will focus on the common and less-common pathologies, the radiographic and CT techniques (including dual energy), MRI artifacts, and normal variants that simulate disease, thereby allowing the radiologist to develop a comprehensive checklist approach to diagnosis.

(E-136) Wednesday • 7:25–7:45 AM •

E-poster, computer #4

### Dynamic US Evaluation of Subcoracoid Impingement

Timothy Alves, MD, *University of Michigan Health System, Ann Arbor, MI*; Jon A. Jacobson, MD\*; David Fessell, MD (*talves@med.umich.edu*)

**LEARNING OBJECTIVES:** 1) Discuss the clinical relevance and pathophysiology of subcoracoid impingement, as well as the common clinical presentation and exam findings. 2) Explain the unique utility of dynamic ultrasound in the evaluation of subcoracoid impingement and how it is performed. 3) Identify the key dynamic ultrasound findings of subcoracoid impingement, as well as the important pitfalls and mimics.

**CONTENT DESCRIPTION:** Subcoracoid impingement syndrome is an uncommon but likely underrecognized condition characterized by dynamic impingement of the subscapularis tendon and adjacent soft tissues between the coracoid process and the humerus and is associated with pain and loss of function. The diagnosis is usually clinical, although recent studies have attempted to define imaging criteria for the syndrome with ultrasound (US) and magnetic resonance imaging (MRI). Ultrasound is a promising imaging modality due to the ability to perform dynamic real-time evaluation of this area, but there is a paucity of research on this topic in the literature. This educational exhibit will review the clinical manifestations of subcoracoid impingement, describe dynamic US techniques and key findings in the evaluation of subcoracoid impingement, and discuss important mimics and pitfalls. **Outline:** I. Clinical presentation of subcoracoid impingement and physical exam. A. History. B. Physical assessment of the subscapularis. C. Tests for subcoracoid impingement. II. US evaluation of the subscapularis. A. US technique. B. Dynamic assessment of subcoracoid impingement. III. US findings. A. Example cases varying in severity. B. Native joints and post-arthroplasty. C. MRI correlation. IV. Pitfalls and mimics. A. Improper technique. B. Superior glenohumeral ligament pathology.

(E-137) Wednesday • 7:25–7:45 AM •

E-poster, computer #5

### Upper Extremity Work-related Injuries: The Spectrum of Findings and Their Implications

Sayed Ali, MD, *Temple University Hospital, Philadelphia, PA*

**LEARNING OBJECTIVES:** 1) Identify the etiologies responsible for work-related upper extremity injuries. 2) Describe the imaging characteristics of the common etiologies. 3) Recognize imaging artifacts and normal variants that may lead to misdiagnoses. 4) Discuss the implications to the individual, workplace, and the overall economy.

**CONTENT DESCRIPTION:** Repetitive strain injuries (RSIs) are conditions resulting from repetitive tasks, forceful exertions, vibrations, compression, or sustained awkward positions. In 2010, RSIs accounted for 29% of all U.S. workplace injuries requiring time away from work, and RSIs are estimated to cost the United States over \$61.2 billion annually. Several conditions are included in this category of injury, and they predominantly affect the upper extremity. These include (from distal to proximal) finger tendinitis (which can sometimes be related to mobile texting devices), trigger finger, carpal tunnel syndrome, de Quervain's tenosynovitis, intersection syndrome, cubital and radial tunnel syndrome, medial and lateral epicondylitis, bursitis, and rotator cuff disease. Thoracic outlet syndrome is often included in RSIs, but it is a compressive neuropathy that is not always related to RSI. The goals of the exhibit are to review various RSIs and their imaging characteristics. Radiographic, CT, MRI, and ultrasound images demonstrating the common and uncommon RSIs will be demonstrated. After completion of the exhibit, the radiologist will have improved ability to recognize RSIs, know different treatment options, and be able to identify postoperative complications on radiographs and cross-sectional imaging. The correlation of imaging findings with clinical and biochemical data as well as potential clinical and economic consequences of these injuries will also be provided. A discussion of the demographics of each entity, in conjunction with the imaging findings, will enable the radiologist to focus on the relevant anatomy in order to prevent the later-stage disease, which is often more difficult to manage.

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

(E-138) Thursday • 7:50–8:10 AM •

E-poster, computer #10

### One View Is No View: Part 1. A Resident and Medical Student Primer on the Less-Common Plain Radiographic Projections of the Upper Extremity and Their Strengths and Limitations

Lauren Pringle, MD, *Johns Hopkins Medical Institutions, Baltimore, MD*; Tina Birchfield; Donna Magid, MD, MEd ([laurenpringle@jhmi.edu](mailto:laurenpringle@jhmi.edu))

**LEARNING OBJECTIVES:** 1) Explain the normal anatomy of the upper extremity and how plain radiographic projections beyond standard AP/lateral can assist the radiologist in accurate and effective diagnosis of pathology. 2) Describe the role of plain radiographs compared to advanced modalities and how cost, radiation dose, and ACR Appropriateness Criteria® influence choice of study and/or projections ordered. 3) Discuss strengths and weaknesses of specific radiographic projections after viewing examples from pediatric and adult cases.

**CONTENT DESCRIPTION:** This e-poster will discuss the current role of radiographs in today's clinical atmosphere, which is increasingly dominated by cross-sectional imaging. Specific discussion will include cost savings, lesser radiation dose, and ACR Appropriateness Criteria®. The poster will review patient positioning of additional radiographic projections beyond the standard AP and lateral views and review eponyms versus standardized view terminology, strengths/weaknesses, and case examples of normal exams and pathology for select joints and structures of the upper limb (including shoulder, wrist, and elbow). Pediatric and adult cases will be included.

(E-139) Wednesday • 7:50–8:10 AM •

E-poster, computer #6

### Law and Order: Basics of Radiologic Malpractice with Select Musculoskeletal Malpractice Cases

Corey Ho, MD, *Mount Sinai Beth Israel Medical Center, New York, NY*; Jeremy Whang, MD; Rohit Mallick; Robert D. Irish, MD ([cho@chpnet.org](mailto:cho@chpnet.org))

**LEARNING OBJECTIVES:** 1) Explain the basics of a medical malpractice lawsuit. 2) Describe selected cases that highlight conditions and findings that are often involved in medical lawsuits. 3) Discuss case outcomes.

**CONTENT DESCRIPTION:** **Background:** Medical malpractice is highly prevalent within the field of radiology. The ACR estimates that one in three radiologists has the chance of being sued. Nearly one-third of those claims are lost. It is paramount for radiologists, both in training and in practice, to understand medical malpractice and to see examples of cases that have been named. **Basics of Medical Malpractice:** Radiologists should learn the components required for a malpractice lawsuit. These are duty owed, breach of duty, breach of duty resultant in injury, and damages. Understanding outcomes of cases can help prevent errors. Careful review of films and prudent use of language/description can prevent one from being named in a lawsuit. Radiologists can also be used as expert witnesses, often altering the course of litigation. **Case Presentations:** Selected musculoskeletal cases illustrate examples of the findings and wording that proved to be key in determining outcomes. **Conclusion:** Litigation is an unavoidable part of the medical profession, especially in the field of radiology. Understanding the components of lawsuits and reviewing past cases can help practicing and training radiologists prevent problems in the future.

(E-140) Thursday • 7:00–7:20 AM •

E-poster, computer #1

### Implementing ICD-10 in an Academic Musculoskeletal Section: Lessons Learned

Leon Lenchik, MD, *Wake Forest University School of Medicine, Winston-Salem, NC*; Anna N. Miller, MD; Scott D. Wuertzer, MD; Bahram Kiani, MD, MHA; Maha Torabi, MD ([llechik@wakehealth.edu](mailto:llechik@wakehealth.edu))

**LEARNING OBJECTIVES:** 1) Describe how implementation of ICD-10 changed the approach to reporting of musculoskeletal studies. 2) Identify how various stakeholders, including referring clinicians, house staff, and patients, were impacted by the changes. 3) Discuss a team approach to ensuring efficient ICD-10 implementation.

**CONTENT DESCRIPTION:** Clinical documentation for ICD-10 is much more detailed than ICD-9, with 68,000 available codes, compared to the prior 13,000. Radiology coders are required to document laterality, specific anatomic location, severity of disease, and episode of care, among other new items. The new documentation requirements pose a disproportionately high burden on musculoskeletal examinations, compared to other organ systems. Importantly, the coding requirements have had a major impact on how musculoskeletal faculty, residents, and fellows report the studies. This exhibit shares our experience of adopting ICD-10 in a busy academic musculoskeletal section, with over 80,000 plain film, 2000 CT, and 5000 MRI interpretations per year. An efficient implementation of ICD-10 required regular meetings of radiology coders, referring clinicians, and radiologists. We also solicited feedback from patients and house staff. The dictation guidelines and templates from the musculoskeletal section were modified. Specific challenges included reaching a consensus on how to describe fracture follow-ups using the four ICD-10 categories: routine healing, delayed healing, malunion, and nonunion. The use of fracture eponyms, such as Colles' fracture, also required careful consideration. The exhibit will address these specific challenges and other lessons learned through the implementation of ICD-10.

(E-141) Thursday • 7:00–7:20 AM •

E-poster, computer #7

### Understanding Subtalar Arthroereisis

Jared Nesbitt, MD, *Stony Brook Medicine, Stony Brook, NY*; Valerie A. Brunetti; Bernard Martin; Mingqian Huang, MD ([jared.nesbitt@stonybrookmedicine.edu](mailto:jared.nesbitt@stonybrookmedicine.edu))

**LEARNING OBJECTIVES:** 1) Describe the indications of subtalar arthroereisis and the history of its development over the years, leading to the current design. 2) Discuss the normal imaging appearance of subtalar arthroereisis and its complications. 3) Explain what radiologists should look for in preoperative planning and what to include in postoperative evaluations.

**CONTENT DESCRIPTION:** Describe the indications of subtalar arthroereisis: mainly painful pes valgoplanus (flexible flatfoot) and posterior tibialis tendon dysfunction. Review the history of the implant and the modification of the procedure. Review photos of the current subtalar arthroereisis implant, with illustrations on how the implant functions mechanically. Pictorial review is provided of preoperative imaging assessment. Relative contraindications include angular deformity at the knee and torsional deformities. If instability at the midtarsal joint is noted, an osteotomy will typically be performed. Absolute contraindications include subtalar joint arthritis, peroneal muscle spasm, and excursive ligamentous laxity. Pictorial review helps to familiarize radiologists with common complications of the procedure, including biomaterial failure, reactive synovitis, sinus tarsi, undercorrection, overcorrection, wound infection, and nerve entrapment. Subtalar arthroereisis is a viable alternative, as it is a joint-sparing procedure, and it could be performed as a first step in a multistep surgical approach, with adjunct procedures later. Thus, better understanding of the biomechanical basis of the design and a systematic approach for evaluation will give radiologists a good grasp to provide a meaningful report.

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

**(E-142) Thursday • 7:25–7:45 AM •****E-poster, computer #4****Anterior Groin Pain: Role of MR Neurography and Related Image-guided Interventions**Amish Patel, MD, *UT Southwestern Medical Center at Dallas, Dallas, TX*; Hythem Omar, MD; Aws Hamid, MD; Kelly Scott, MD; Shai Rozen, MD; Daniel S. Moore, MD; et al

**LEARNING OBJECTIVES:** 1) Discuss 3D MR neurography (MRN) and diffusion-weighted imaging (DWI) techniques for depiction of pelvic nerves responsible for anterior groin pain. 2) Identify the imaging anatomy of relevant pelvic nerves, including procedural anatomy. 3) Describe MRN and DWI appearances of the various neural and perineural pathologies responsible for anterior groin pain. 4) Discuss the clinically relevant image-guided interventions to treat anterior groin pain.

**CONTENT DESCRIPTION:** *Technique:* Discuss the optimal anatomic and functional diffusion-tensor imaging techniques for the generation of 3D isotropic vessel suppressed MRN images, specifically of the femoral, obturator, ilioinguinal, pudendal, and genitofemoral nerves. *Anatomy:* Show normal 3D anatomic appearances of the above nerves. *Pathology:* Show examples of pathology of the above nerves in patients with anterior groin symptoms, including discogenic, traumatic, inflammatory, neoplastic, iatrogenic, and entrapment-related etiologies. *Intervention:* Discuss indications and techniques using case examples of image-guided interventions for the various pathologic etiologies described above.

**(E-143) Thursday • 7:25–7:45 AM •****E-poster, computer #5****Assessing Scaphoid Viability with MR Imaging: A Pictorial Review**Lowell H. Ellerbrook, MD, *Scott and White Healthcare, Temple, TX*; Jordan K. Fite, MD; Ricardo D. Garza-Gongora, MD; Linda Parman, MD; Connie C. So, MD (*l Ellerbrook@sw.org*)

**LEARNING OBJECTIVES:** 1) Discuss the complexities and limitations of imaging scaphoid fractures due to nonspecific imaging features found within various stages of healing, ischemia, and necrosis. 2) Explain differences in vascular status and types of fractures and how these findings affect surgical and nonsurgical management. 3) Identify the characteristic imaging features of viable, ischemic, and necrotic samples of the proximal fragments of scaphoid fractures.

**CONTENT DESCRIPTION:** Great debate has ensued in recent years concerning the best method to assess the viability of proximal bone fragments in scaphoid fractures. It has been agreed upon for some time that MRI is the best means to answer this question and that early imaging is better for both diagnosis and treatment. However, the specific MRI protocol is still in dispute, with numerous studies in contrast to one another. These studies are often admittedly distorted by variables of physiologic repair and disrepair whose imaging features overlap and fluctuate in timing and appearance, creating inconsistency within the sensitivities and specificities of these modalities. This is further complicated by the disarray of both repair and disrepair being concurrently superimposed and therefore rendering imperfect the gold standards traditionally used to measure imaging modalities (first, biopsy; and later, punctate bleeding of the exposed fracture surface). Early and accurate assessment of these variables is important for the radiologist, as this distinction is crucial for appropriate management and recovery following scaphoid fractures. An image-rich multimodality presentation will be used to demonstrate the numerous facets of the current conversation surrounding scaphoid fracture viability.

**(E-144) Thursday • 7:50–8:10 AM •****E-poster, computer #4****Stabilizing the Syndesmosis: Posttraumatic Ankle MR Imaging and Implications for the Orthopedic Surgeon**Grafe Lyons, MD, *New York-Presbyterian Weill Cornell Medical Center, New York, NY*; Keith D. Hentel, MD, MS; Roger J. Bartolotta, MD

**LEARNING OBJECTIVES:** 1) Explain the MR anatomy of the lateral ankle syndesmosis with reference to the medial deltoid ligament. 2) Describe patterns of ligamentous injury, including isolated syndesmotomous injury, syndesmotomous injury coupled with malleolar fractures, and syndesmotomous injury with deltoid ligament disruption. 3) Discuss surgical treatment options, and recognize their postoperative complications.

**CONTENT DESCRIPTION:** Ankle syndesmotomous injuries vary widely in their relative instability based on three factors: number of ligaments affected, degree to which these ligaments are disrupted, and type of associated fractures. While the latter is well evaluated by radiography and CT, only MR imaging fully evaluates the degree of ligamentous injury in order to guide preoperative planning. At our institution, all patients with acute ankle fractures undergo MR imaging, primarily to evaluate the syndesmotomous and deltoid ligaments. We begin by presenting the normal MR anatomy of these ligaments with particular attention to the posterior inferior tibiofibular ligament (PITFL) and deltoid ligament. We then review common patterns of syndesmotomous injury, including a few less-published entities, such as partial stripping of the PITFL (at the tibial and/or fibular attachments) and partial tear of the deltoid ligament. We present treatment strategies for these injuries, which may include PITFL and/or deltoid ligament repair in addition to internal fixation of associated fractures. We delineate the optimal features of MR reporting that enable surgeons to select syndesmotomous fixation and/or primary repair. Finally, we review postoperative complications of these procedures in order to guide management and interpretation of follow-up imaging.

**(E-145) Thursday • 7:50–8:10 AM •****E-poster, computer #5****Tumor or Rumor? Pearls and Pitfalls in Posttreatment Imaging of Musculoskeletal Tumors—Differentiating Posttreatment Changes from Recurrent or Residual Disease**Varand Ghazikhanian, MD, MS, *Brigham and Women's Hospital, Boston, MA*; Violeta Nikac, MD; Glenn C. Gaviola, MD (*ggaviola@partners.org*)

**LEARNING OBJECTIVES:** 1) Recognize and identify expected soft-tissue changes after either tumor resection or radiation therapy or both. 2) Describe expected bone marrow changes after chemotherapy, radiation therapy, or both. 3) Identify specific clues suspicious for tumor recurrence. 4) Describe imaging pitfalls that may masquerade as posttreatment change or may masquerade as tumor recurrence. The purpose of this presentation is to review the imaging features of musculoskeletal tumors that have been treated with surgery, chemotherapy, and/or radiation therapy.

**CONTENT DESCRIPTION:** Through a case-based pictorial style essay, we will present (1) a review of the more common musculoskeletal tumors and their treatment, (2) a review of the imaging characteristics of more common musculoskeletal tumors, (3) a review of the imaging of posttreatment changes of common musculoskeletal tumors, (4) clues to look for tumor recurrence or residual tumor, and (5) examples of imaging of recurrent tumors masquerading as posttreatment change and of posttreatment changes masquerading as recurrent tumors.

## Neuroradiology

### (E-80) Thursday • 7:00–8:15 AM • Hard-copy poster What Is So Hard about Connectional Neuroanatomy? The Easy Learning “Tract” via Diffusion-Tensor Imaging and Tractography

Krystle Barhaghi, MD; Enrique Palacios, MD; Jeremy B. Nguyen, MD, MS; Andrew Marshall, MD; Quan N. Nguyen; Sarah Castillo, MD, *Tulane University School of Medicine, New Orleans, LA*

**LEARNING OBJECTIVES:** 1) Discuss the physical principle and mathematics of diffusion-tensor imaging (DTI). 2) Explain the principle of tractography. 3) Describe principles of connectional neuroanatomy through correlative line drawing, which includes normal anatomy and function of the major white matter fiber tracts of the brain. 4) Discuss how to illustrate the major fiber tracts via the utilization of tractography.

**CONTENT DESCRIPTION:** Diffusion-tensor imaging (DTI) utilizes the motion of water molecules in tissues, allowing full characterization of molecular diffusion in the three dimensions of space. Diffusion anisotropy (DA) effects can be extracted fully and utilized to provide details on tissue microstructure. The two most-common scalar metrics that can be generated are fractional anisotropy (FA) and mean diffusivity (MD), which are used to generate images of the diffusion data. Tractography is performed using data from DTI to allow mapping of the white matter tracts in the brain. White matter fiber tracts are an integral part of brain functioning, since they modulate the distribution of signal from the gray matter. They essentially act as a relay and coordinate communication among different brain regions. White matter fiber tracts traditionally have been classified into three categories: Association fibers interconnect cortical areas in each hemisphere. Projection fibers interconnect cortical areas with deep nuclei, brainstem, cerebellum, and spinal cord. Commissural fibers interconnect similar cortical areas between opposite hemispheres. Illustrations will be provided to demonstrate the major fiber tracts. Multiple MR images of the brain based on diffusion data and fiber tracts will be displayed.

### (E-81) Wednesday • 7:00–8:15 AM • Hard-copy poster Pictorial Review of Sinus Pericranii

Sarah Castillo, MD, *Tulane University School of Medicine, New Orleans, LA*; Jeremy B. Nguyen, MD, MS; Enrique Palacios, MD; Juan S. Gomez, MD

**LEARNING OBJECTIVES:** 1) Discuss the medical entity known as sinus pericranii (SP) and its classification based on predisposing factors. 2) Identify the characteristic features of SP on imaging studies and histopathology slides. 3) Describe the most common locations, symptoms, and differential diagnosis of SP. 4) Discuss a literature review of SP treatment and management.

**CONTENT DESCRIPTION:** Sinus pericranii (SP) is an abnormal connection between the intracranial dural venous sinuses and the extracranial venous system. The superior sagittal sinus is usually involved, with lesions primarily occurring at midline. Usually diagnosed in childhood or in young adults in the 2nd decade of life, SP has an equal incidence in men and women. The most common locations of SP in descending order are frontal (46%), parietal (39%), occipital (8%), and temporal (2%) regions. SP may be congenital, spontaneous, or posttraumatic. Congenital cases are the result of incomplete fusion of cranial sutures or in utero dural sinus thrombosis. Spontaneous cases are secondary to venous disease and pressure erosion of the skull. Posttraumatic cases are often the result of skull fractures and may arise from emissary vein, diploic vein, or dural sinus injury. While most of the cases are asymptomatic, some patients report a painful lump associated with headaches and vertigo. Imaging findings of multiple cases are presented with magnetic resonance imaging, computed tomography with 3D reconstruction, and venograms. Discussions of the differential diagnosis of SP and its symptomatic manifestations, as well as the treatment and management, are presented.

### (E-82) Thursday • 7:00–8:15 AM • Hard-copy poster Tinnitus: Objective or Functional?

Sarah Castillo, MD, *Tulane University School of Medicine, New Orleans, LA*; Jeremy B. Nguyen, MD, MS; Enrique Palacios, MD

**LEARNING OBJECTIVES:** 1) Define and classify tinnitus. 2) Describe the multiple etiologies of tinnitus. 3) Discuss the current role of imaging in the diagnosis of tinnitus, including the use of functional imaging.

**CONTENT DESCRIPTION:** Tinnitus, defined as a ringing or buzzing in the ears, is a common problem affecting up to one in four Americans. It is classified as either objective tinnitus, originating from a source within the cranial vault, or subjective tinnitus, presenting without an identifiable cause. Objective tinnitus is further divided into pulsatile or nonpulsatile etiologies. While many nonpulsatile causes, such as tympanic muscle spasm or obstructive sleep apnea, require a clinical diagnosis, pulsatile causes such as carotid stenosis or arteriovenous malformations are often identifiable on CT, MR, MRA, and/or ultrasound. Multiple etiologies exist for subjective tinnitus, including ear-related, neurologic, infectious, and drug-related causes, as well as dysfunctional brain pathways. Numerous studies using PET/CT and functional MRI have shown changes in the metabolic activity of several nonauditory regions in addition to the auditory cortex in patients with tinnitus. These studies show an expansion of normal auditory networks and involvement of nonauditory networks in the tinnitus groups. Illustrations will be provided to demonstrate objective etiologies of tinnitus and cerebral auditory networks. Multiple MR, functional MR, MR angiogram, and CT images of the brain and head will be displayed.

### (E-83) Wednesday • 7:00–8:15 AM • Hard-copy poster CT-guided Percutaneous Biopsy for Vertebral Discitis/Osteomyelitis: A Procedure You May Be Asked to Perform on Call

Peter L. Shanahan, MD, *Vanderbilt University Medical Center, Nashville, TN*; James P. Harty, MD; Larry T. Davis, MD

**LEARNING OBJECTIVES:** 1) Discuss indications and preprocedural considerations in performing aspiration/biopsy of suspected discitis/osteomyelitis. 2) Describe pertinent spine anatomy in regard to performing aspiration/biopsy of suspected discitis/osteomyelitis. 3) Discuss technical considerations in performing aspiration/biopsy of suspected discitis/osteomyelitis.

**CONTENT DESCRIPTION:** Vertebral osteomyelitis/discitis can result in significant morbidity. In cases where the infectious source is not already apparent (eg, a positive blood culture), clinicians often request an aspiration and/or biopsy to search for a causative organism so that pharmacotherapy can be tailored. Current guidelines recommend that a biopsy be performed within 24 hours for a lesion with an imaging appearance of vertebral osteomyelitis/discitis. A percutaneous approach is favored over open biopsy for multiple reasons; therefore, radiologists may be asked to perform this procedure urgently. We offer this exhibit as a guide for those instances and include several case examples from our home institution.

### (E-84) Withdrawn

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

**(E-85) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Neurocutaneous Syndromes: A Pictorial Review**

Matthew J. Miller, MD, *West Virginia University, Morgantown, WV*;  
Abdul Rahman Tarabishy, MD; Cory A. Smith, DO (*mmille52@hsc.wvu.edu*)

**LEARNING OBJECTIVES:** This educational exhibit provides a review of the spectrum of findings associated with neurocutaneous syndromes. The approach is based on the official ABR Core Exam Study Guide and is organized by etiology, highlighting imaging findings while also providing a review of the epidemiology, clinical course, and pathology.

**CONTENT DESCRIPTION:** This educational exhibit is based upon a teaching file of pathologically and clinically proven cases encountered at a tertiary referral center. High-quality radiographic, computed tomographic, and magnetic resonance images illustrate the findings and complement a succinct review of each disease, as outlined by the official ABR Core Exam Study Guide. The exhibit spans subject matter including more-common disorders, such as tuberous sclerosis, Sturge-Weber syndrome, and neurofibromatosis 1 and 2, while also including rarer disorders such as Klippel-Trénaunay-Weber syndrome.

**(E-86) Thursday • 7:00–8:15 AM • Hard-copy poster  
“Hear It Here”: The CT and MR Imaging Findings in Children with Sensorineural Hearing Loss**

Ramanjot Muhar, MD, *St. Joseph Mercy Oakland, Pontiac, MI*;  
Andrew Lukaszewicz, MD; Sheena Saleem, MD; Mary Maunglay, MD (*ramanmuhar@gmail.com*)

**LEARNING OBJECTIVES:** 1) Understand better the normal temporal bone anatomy, specifically on CT. Sensorineural hearing loss is commonly encountered in the pediatric population. However, the radiologic findings in the population can vary greatly. After this review, the participants will better understand the radiologic appearance of the various forms in which sensorineural hearing loss can present—ranging from incomplete partitioning to absence of the external auditory canal—with CT and MRI examples collected over several years at our institution. Participants will also be given an example search pattern to apply in their daily practice when evaluating such cases.

**CONTENT DESCRIPTION:** I. Anatomical review of the temporal bone and internal auditory canal, including nerves, utilizing MRI and CT. II. Brief review of sensorineural hearing loss. III. Most common and not-so-common causes of sensorineural hearing loss demonstrated on CT and MRI, divided by location within the ear. A. Incomplete partitioning. B. Large vestibular aqueduct syndrome. C. Common cavity malformation. D. Trauma. E. Malformations of the semicircular canals. F. Malformations of the external auditory canal. G. Cochlear nerve anomalies. IV. Brief summary, with a checklist of what specifically to cover when reviewing imaging for a patient with sensorineural hearing loss.

**(E-87) Wednesday • 7:00–8:15 AM • Hard-copy poster  
Tumor or Not Tumor? That Is the Question—A Case-based Review of MR Perfusion in the Assessment of New Enhancing Brain Lesions**

Jessica Record, MD, *Ochsner Clinic Foundation, New Orleans, LA*; Noah A. Emerson, DO (*jrecord@ochsner.org*)

**LEARNING OBJECTIVES:** 1) Explain how to differentiate tumors from other processes such as abscess or tumefactive demyelination. 2) Discuss the application of MRP in tumor imaging and how to distinguish tumor progression from pseudoproggression in cases of treated high-grade tumors. 3) Explain and identify common pitfalls and limitations of MRP when analyzing an enhancing brain lesion.

**CONTENT DESCRIPTION:** MR perfusion (MRP) is an effective tool for characterizing a variety of brain lesions and is particularly useful for tumor imaging. Unfortunately, it has been underutilized despite its existence for over 2 decades. We offer a case-based review of MRP in the evaluation of enhancing brain lesions via several clinical scenarios. Five cases will be presented. Key diagnostic points will be highlighted in the discussion of each case, all of which include the use of MRP to distinguish tumors from alternative pathology when faced with an enhancing brain lesion. The list of cases is as follows: cerebral abscess, tumefactive demyelination, lung metastasis, posttherapy tumor progression, and posttherapy tumor pseudoproggression.

**(E-88) Thursday • 7:00–8:15 AM • Hard-copy poster  
Pitfalls in Posterior Inferior Cerebellar Artery Aneurysm Assessment: What the Radiologist Needs to Know**

Tyler A. Sandow, MD, *Ochsner Clinic Foundation, New Orleans, LA*;  
James M. Milburn, MD (*tsandow@ochsner.org*)

**LEARNING OBJECTIVES:** 1) Describe the commonly applied techniques in intracranial aneurysm assessment. 2) Explain variations in posterior inferior cerebellar artery (PICA) anatomy and their implications, with presentation and treatment. 3) Identify pitfalls that may occur during PICA aneurysm assessment, and explain pearls that may assist in the detection of PICA aneurysms.

**CONTENT DESCRIPTION:** The assessment of intracranial aneurysm is part of routine practice for most radiologists, with a prevalence of 4% and approximately 30,000 Americans suffering from aneurysm rupture each year. After a noncontrast CT demonstrates subarachnoid hemorrhage (SAH), a CT angiogram (CTA) is typically performed to assess for intracranial aneurysm as the source of bleed. Magnetic resonance angiography (MRA) may also provide an alternative means of aneurysm assessment in cases where CTA may be contraindicated (contrast allergy or renal failure). While CTA is slightly more sensitive than MRA in aneurysm assessment (90% vs 87%), digital subtraction angiography (DSA) remains the gold standard. Several recent studies have suggested that CTA may be superior to DSA in the assessment of certain intracranial aneurysms. Although PICA aneurysms are rare and represent 0.5%–3% of all aneurysms, they can present a challenging assessment for the radiologist due to the variable origin of the PICA. The PICA originates from the intracranial portion of the vertebral artery in 80%–95% of patients, but an anomalous PICA has been reported in 4%–16% of patients. This could lead to poor detection of PICA aneurysms for an unsuspecting radiologist, not to mention difficulty with surgical approach and endovascular treatment for the neurosurgeon and neurointerventionalist. With a case series, we will demonstrate the clinical presentation of PICA aneurysm rupture, radiologic assessment and variable appearance, technical considerations based on variant anatomy (including cases where PICA aneurysms may be missed from insufficient evaluation), and implications for endovascular and surgical treatment.

**(E-89) Wednesday • 7:00–8:15 AM • Hard-copy poster**  
**What an Eye Opener! Review of the Unique Radiographic Findings of Ocular Detachments, with Correlation to Funduscopy Imaging**

Jax H. Pham, DO, *University of Texas Medical Branch, Galveston, TX*; Daniel Feiler, MD; Eric Bih, MD; Tomas E. Uribe Acosta, MD (*hlpham@utmb.edu*)

**LEARNING OBJECTIVES:** Ocular detachments are common conditions diagnosed on the basis of clinical symptoms and ophthalmologic exam. Radiographic manifestations of ocular detachments can be confusing to radiologists lacking the pertinent clinical history. This educational exhibit will review the unique radiographic findings of ocular detachments, in addition to providing learners with a fresh cross-specialty correlation to the clinical funduscopy exam. After visiting the exhibit, the learner will be able to determine the most common types of ocular detachment with their unique pathophysiology, treatment, and radiographic findings: retinal detachment, posterior vitreous detachment, and choroidal detachment.

**CONTENT DESCRIPTION:** I. Pictorial review of the eye globe with color-coded subsections teaching the basic anatomy of the eye on CT/MRI and on funduscopy imaging. II. Summary table discussing the unique pathophysiology of retinal detachment, posterior vitreous detachment, and choroidal detachment. III. Schematic cartoon diagram teaching the basic morphologies of each type of detachment. IV. Real clinical examples of ocular detachments seen on CT/MR, with complete explanation and annotations. V. Complementary funduscopy imaging from a large ophthalmology clinic, providing a cross-specialty perspective on ocular detachments.

**(E-90) Thursday • 7:00–8:15 AM • Hard-copy poster**  
**Gamma Knife Surgery: What the Radiologist Needs to Know**

David Mosbach, *Tufts Medical Center, Boston, MA*; William Mehan, Jr, MD, MBA; Philip Panic; Julian Wu

**LEARNING OBJECTIVES:** 1) Explain the differences between gamma knife surgery and traditional external beam radiation in terms of physical properties and biological effects. 2) Enumerate indications for gamma knife surgery, including specific pathologies and tumor locations. 3) Identify the role of imaging in pretreatment planning for gamma knife surgery. 4) Describe posttreatment effects of gamma knife surgery, including treatment success, treatment failure, and complications.

**CONTENT DESCRIPTION:** I. Gamma knife background. A. Physics of gamma knife. 1. Gamma knife vs traditional external beam radiation. 2. Generation of gamma rays. B. Advances. C. Biological effects. 1. Necrosis types. II. Gamma knife uses. A. Specific conditions. 1. Primary brain tumors. a. Meningioma. b. Schwannoma. c. Glioma. 2. CNS metastases. 3. Arteriovenous malformations. 4. Trigeminal neuralgia. B. Location factors. C. Patient factors. 1. High-risk patients. 2. Patient choice. III. Imaging of gamma knife. A. Pre-gamma knife surgery imaging. 1. Protocols. 2. What the radiation oncologist wants to know. a. Vasculature. b. Cranial nerves. B. Postprocedure imaging. 1. Protocols. a. Role of perfusion imaging. 2. Posttreatment effects. a. Tumor success. b. Treatment failure. c. Complications. 1. Necrosis.

**(E-149) Wednesday • 7:00–7:20 AM • E-poster, computer #10**  
**Advanced Imaging of Demyelinating Brain Lesions**

Vasant Garg, MD, *University Hospitals Case Medical Center, Cleveland, OH*; Nicholas Bhojwani, MD; Tyler J. Richards, MD; Sasan Partovi, MD; Chaitra Badve, MD; Amit Gupta, MD; et al (*nbhoj08@gmail.com*)

**LEARNING OBJECTIVES:** 1) Explain advanced multiparametric MRI sequences and hybrid PET/MRI. 2) Describe imaging features. 3) Demonstrate clinical utility. 4) Describe advantages and disadvantages of the various advanced imaging techniques. 5) Discuss challenges of characterization.

**CONTENT DESCRIPTION:** I. Acquisition protocols. II. Contrast-enhanced MRI. III. Diffusion-weighted imaging. IV. Proton MR spectroscopy. V. Perfusion-weighted MR imaging. VI. Dynamic contrast-enhanced T1 (DCE-T1). VII. Dynamic susceptibility contrast (DSC). VIII. <sup>18</sup>F-Fluorodeoxyglucose PET. IX. 2D/3D computerized image analysis on multiparametric MRI. X. Diagnostic value of PET/MRI after chemoradiation to distinguish between active tumor and treatment effect. XI. Differential diagnosis. XII. Surgical guidance. XIII. Treatment planning.

**(E-150) Thursday • 7:50–8:10 AM • E-poster, computer #9**

**Navigating the Circle of Willis: A Road Map to Diagnosing Ischemic Pathology Utilizing a Multimodality Approach Including Correlation to Perfusion Imaging**

Ramanjyot Muhar, MD, *St. Joseph Mercy Oakland, Pontiac, MI*; Andrew Lukaszewicz, MD; Grygori Gerasymchuk, MD

**LEARNING OBJECTIVES:** 1) Describe the anatomy of intracranial circulation, focusing on the circle of Willis. 2) Explain CT perfusion imaging and how to differentiate between ischemic infarction and ischemic penumbra. 3) Describe a range of cases, with imaging findings from CT perfusion, MRA, and digital subtraction imaging, demonstrating the typical distributions of common patterns of ischemia/infarction. 4) Discuss how to be better equipped to determine the location of ischemic insult within the circle of Willis, based on CT perfusion imaging.

**CONTENT DESCRIPTION:** An overview of the anatomy of the circle of Willis is provided, detailing the major and minor arteries participating in intracranial circulation. A comprehensive review of the interpretation of computed tomographic (CT) perfusion imaging follows, including important nuances and how to discriminate between ischemia and infarction. Correlation of vascular territory to CT perfusion is made through a wide variety of usual and unusual cases, with corresponding digital subtraction images provided where available. Upon viewing this exhibit, the radiologist should have a better understanding of the correlation between anatomy and imaging findings and be able to apply them to daily practice.

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

## Nuclear Medicine

### (E-78) Thursday • 7:00–8:15 AM • Hard-copy poster Dopamine Transporter Imaging with $^{123}\text{I}$ -Ioflupane in the Evaluation of Patients with Suspected Parkinsonian Syn- dromes: What the Radiologist Needs to Know

Anjani Naidu, MD, *Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ*; Sarah Pettyjohn, MD; Murray Becker, MD; Philip Murillo, MD; Abiha Kazim, BA; Jeffrey Kempf, MD (*anaidu@univrad.com*)

**LEARNING OBJECTIVES:** 1) Discuss the clinical indications of  $^{123}\text{I}$ -ioflupane dopamine transporter (DAT) SPECT imaging. 2) Explain patient preparation, image acquisition, and processing parameters. 3) Discuss examples of normal versus abnormal DAT scans.

**CONTENT DESCRIPTION:** Parkinson's disease (PD) is the second most common neurodegenerative disorder, with nearly 1,000,000 people in the United States affected. The diagnosis is based on the UK Parkinson Disease Society Brain Bank clinical diagnostic criteria. However, misdiagnosis of PD is not uncommon and has been reported in up to 10% of cases by movement disorder specialists, thus emphasizing the need for confirmation of diagnosis through imaging.  $^{123}\text{I}$ -Ioflupane was FDA approved in the United States in January 2011 for the evaluation of parkinsonian syndromes. In this education poster, we will review the mechanism of action of  $^{123}\text{I}$ -ioflupane uptake, clinical indications for DAT SPECT scans, patient preparation, and quality control. We will also present interesting cases from our institution, demonstrating normal versus abnormal DAT scans.

### (E-146) Thursday • 7:25–7:45 AM • E-poster, computer #8 Role of FDG PET/CT in Infection and Inflammation Imag- ing: A Pictorial Review



Sammy A. Yacob, DO, *University of Cincinnati, Cincinnati, OH*; Jennifer L. Scheler, MD

**LEARNING OBJECTIVES:** 1) Explain the molecular basis of FDG imaging, particularly as it pertains to infection and inflammation. 2) Discuss the current and emerging evidence for the clinical implications of FDG PET/CT in a wide array of infectious and inflammatory processes. 3) Describe a pictorial case-based review illustrating the role of FDG PET/CT in the assessment of a variety of infectious and inflammatory conditions, including fever of unknown origin, CNS infections in the immunocompromised patient, osteomyelitis, endocarditis, large-vessel vasculitides, sarcoidosis, and other granulomatous infections. 4) Compare the advantages and limitations of FDG PET/CT with traditional radionuclide and conventional imaging techniques.

**CONTENT DESCRIPTION:** Nuclear medicine has an important role in the evaluation of infection and inflammation. For many years,  $^{67}\text{Ga}$ -citrate,  $^{99\text{m}}\text{Tc}$ -MDP,  $^{99\text{m}}\text{Tc}$ -HMPAO-labeled leukocytes, and  $^{111}\text{In}$ -oxine-labeled leukocytes have been used for diagnosing a vast array of infectious and inflammatory processes; however, these methodologies have their limitations. Well established for its role in oncologic imaging, cardiac medicine, and neurology, FDG PET/CT is quickly gaining recognition for its clinical implications in the evaluation of infection and inflammation. By using a case-based approach, this presentation will highlight the utility of FDG PET/CT for evaluation of various pathologic conditions characterized by infection and inflammation, including fever of unknown origin, CNS infections in the immunocompromised patient, osteomyelitis, endocarditis, large-vessel vasculitides, sarcoidosis, and other granulomatous infections. The presentation will include a discussion of the advantages and the limitations of FDG PET/CT in the evaluation of these conditions, compared with conventional radionuclide and anatomical imaging techniques.

### (E-147) Thursday • 7:50–8:10 AM •

#### E-poster, computer #8

### Benign Musculoskeletal Lesions That Demonstrate Hypermetabolism on PET/CT: A Case-based Review of Metastatic Mimics

Margaret K. Kincaid, MD, *Maricopa Integrated Health System, Phoenix, AZ*; Michael Weed, BS; Dan G. Gridley, MD (*mugskincaid@gmail.com*)

**LEARNING OBJECTIVES:** 1) Identify the common indications for PET/CT in the evaluation of osseous pathology. 2) Describe the potential causes of musculoskeletal hypermetabolism on PET. 3) Discuss a case-based review of common and uncommon causes of nonmalignant musculoskeletal hypermetabolism on PET. 4) Describe, in select cases, what additional clinical information or imaging can assist in further evaluation of these lesions.

**CONTENT DESCRIPTION:** PET/CT is being used with increased frequency in the workup and surveillance of both cancer and infection. Some health care systems use this imaging modality with high frequency as the core of disease staging and evaluation of treatment response. As the volumes of this examination increase, it is crucial to recognize potential mimics of disease, to direct appropriate treatment. The presence or absence of osseous metastasis in many common cancers, such as breast, lung, and colon, can completely change the staging, prognosis, and management of a patient. Misinterpretation of osseous findings and ensuing changes in management can therefore have devastating physical and psychological effects on patients and their loved ones. The purpose of this exhibit is to provide a case-based review of common and unique musculoskeletal conditions that are hypermetabolic on PET/CT and may be misconstrued as metastatic disease. Cases include degenerative conditions of the hip, shoulder, spine, and temporomandibular joints, dental disease, osteomyelitis, enthesopathy, fibrous dysplasia, healing fractures, postsurgical changes of bones and tendons, positional muscular hypermetabolism in an amputee, avascular necrosis, postchemotherapy changes, and CPR-related rib trauma in a patient with recent cardiac arrest.

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

## Pediatric Radiology

### (E-91) Wednesday • 7:00–8:15 AM • Hard-copy poster Congenital Small Bowel Disorders: A Pictorial Review

Matthew J. Miller, MD; Cory A. Smith, DO, *West Virginia University, Morgantown, WV*; Daniel Smothers, MD (*mmille52@hsc.wvu.edu*)

**LEARNING OBJECTIVES:** This educational exhibit provides the learner with a succinct but comprehensive review of congenital small bowel pathology, including etiologies listed on the ABR Core Exam Study Guide. The approach is based on etiology of the abnormality and presents imaging findings of the diseases, as well as providing a review of the epidemiology and relevant pathology.

**CONTENT DESCRIPTION:** This educational exhibit is based upon a teaching file of pathologically and clinically proven cases of congenital small bowel anomalies encountered at a pediatric tertiary referral center. High-quality radiography, fluoroscopy, computed tomography, and magnetic resonance images illustrate the findings and complement a succinct review of each disease with a focus on relevant anatomy and clinical context and course.

### (E-151) Wednesday • 7:00–7:20 AM • E-poster, computer #7

#### Unusual Pediatric Bone Marrow Findings: An Exercise in Difficult Diagnoses

Teresa Chapman, MD, MA, *Seattle Children's Hospital, Seattle, WA*; Natalie Valeur; Jeffrey P. Otjen, MD (*teresa.chapman@seattlechildrens.org*)

**LEARNING OBJECTIVES:** 1) Recognize subtle differences in radiographic bone densities that are suspicious for underlying infiltrative neoplasm. 2) Describe abnormal MR signal consistent with malnutrition and serous atrophy of marrow. 3) Identify and recommend appropriate laboratory and follow-up imaging studies, when indicated.

**CONTENT DESCRIPTION:** *Background:* Interpretation of radiographic and MR findings of the pediatric skeleton can be challenging, due to the physiologic changes of normal bones as the child ages. Couple the baseline difficulty of recognizing normal findings with the wide breadth of potential disease processes that are diagnosed in children, and the result can be confusing for any diagnostic imaging expert. Infiltrating processes involving bone marrow include neoplasms and metabolic disorders. The ill-defined nature of findings in these cases presents particular difficulties for the unsuspecting radiologist. *Purpose:* The purpose of this educational pictorial review is to present a variety of infiltrative pediatric bone diseases with radiographic and MR imaging findings. *Methods:* Imaging cases diagnosing infiltrative bone marrow diseases are displayed in an electronic anonymized format. The learner is presented with age-matched normal findings alongside pathologic cases to ensure recognition of findings, whether subtle or obvious. Diagnosis and appropriate workup are provided to the learner in a self-assessment format with multiple-choice questions. *Conclusion:* Practicing identification of abnormal pediatric infiltrative bone marrow imaging findings in an electronic format may aid the radiologist in solidifying a diagnosis or management plan for tricky cases in any general practice.

### (E-152) Wednesday • 7:25–7:45 AM • E-poster, computer #9

#### Utility of Imaging Signs in the Diagnosis of Acute Appendicitis in Children by Using MR Imaging

Larry A. Kramer, MD, *University of Texas Medical School-Houston, Houston, TX*; Steven S. Chua, MD, PhD

**LEARNING OBJECTIVES:** 1) Identify the appendix as reliably as possible. 2) Recognize subtle changes of early appendicitis. 3) Explain how to diagnose a perforated appendix and abdominal/peritoneal abscess. 4) Identify other causes of acute abdominal pain. Magnetic resonance imaging (MRI) without oral or intravenous contrast material has rapidly replaced computed tomography at our institution in ultrasound-equivalent cases of acute appendicitis in children. As with all modalities, there

are imaging signs that can be employed to improve the likelihood of efficient and accurate interpretation. Localization of the appendix is the first challenge, followed by the characterization of abnormalities. Similar to all modalities, early appendicitis can be challenging to diagnose.

**CONTENT DESCRIPTION:** I. Comprehensive description of the rapid free-breathing MRI protocol to rule out acute appendicitis in children. II. Introduction of four new novel descriptors in the evaluation of acute appendicitis. A. Spectacle sign. B. Ring sign. C. Dripping candle wax sign. D. Broccoli sign. III. MRI characteristics of appendicitis. IV. Description of useful imaging signs of ruptured appendix.

### (E-153) Thursday • 7:00–7:20 AM • E-poster, computer #10

#### Neuroendocrine Hyperplasia of Infancy: A Clinical, Pathologic, and Radiologic Review

Aditi Desai, MD, *Vanderbilt University Medical Center, Nashville, TN*; Yu Luo, MD, PhD

**LEARNING OBJECTIVES:** The purpose of this educational exhibit is to review the clinical presentation, pathologic features, and radiologic findings of NEHI. The differential diagnosis of NEHI will also be explored, with emphasis on the clinical and imaging features that help differentiate these alternate diagnoses from NEHI.

**CONTENT DESCRIPTION:** Neuroendocrine hyperplasia of infancy (NEHI) is a form of pediatric interstitial lung disease that was first described in the literature in 2005. Since the original report, much more work has been carried out to better comprehend this previously poorly understood entity. The radiologist's familiarity with the clinical presentation and associated imaging findings is key to making an accurate diagnosis and ensuring appropriate management of these patients, as their presentation can often be nonspecific. This poster will serve as an overview of the diagnosis of NEHI, organized as follows: I. Pathologic features. A. Pulmonary neuroendocrine cells: distribution and function. B. Pulmonary neuroendocrine cell hyperplasia. C. Pathologic criteria for diagnosis of NEHI. II. Imaging of NEHI. A. Radiographic and high-resolution CT findings. B. Imaging technique to enhance diagnosis. C. Imaging criteria for diagnosis of NEHI. D. Correlation of imaging abnormalities and pathologic findings. III. Clinical presentation. A. Persistent tachypnea of infancy. B. Pulmonary function testing. C. Treatment and clinical outcomes. IV. Differential diagnosis. A. Bronchiolitis obliterans. B. Surfactant protein abnormalities. C. Alveolar capillary dysplasia. D. GM-CSF receptor deficiency. E. Pulmonary interstitial glycosgenesis. F. Hypersensitivity pneumonitis. G. Cystic fibrosis. H. Asthma.

### (E-154) Thursday • 7:25–7:45 AM • E-poster, computer #9

#### Lemierre's Syndrome: The Forgotten Disease?

Laura K. Harper, BA; Kathryn E. Pflug, MD, *Ochsner Medical Center, Jefferson, LA*; Daniel April, BS; James M. Milburn, MD

**LEARNING OBJECTIVES:** 1) Describe the clinical presentation and pathophysiology of Lemierre's syndrome. 2) Describe the classic imaging findings of Lemierre's syndrome through different imaging modalities, including ultrasound, MRI, computed tomography (CT), and radiography. 3) Discuss management and treatment.

**CONTENT DESCRIPTION:** Lemierre's syndrome occurs when an oropharyngeal infection is complicated by septic thrombophlebitis of the internal jugular vein (IJV) or one of its tributaries, leading to sepsis and metastatic infection. Lemierre's syndrome affects mainly healthy young adults and has an incidence of one per 1 million. The main culprit organism is *Fusobacterium necrophorum*. CT of the neck and chest with contrast classically demonstrates thrombosis of the IJV, as well as complications like abscesses and septic pulmonary emboli. Ultrasound, radiography, and MRI can also be used to aid diagnosis and successfully identify sequelae.

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

## Women's Imaging

### (E-94) Thursday • 7:00–8:15 AM • Hard-copy poster Imaging of Ovarian Masses: How to Interpret like an "Ova-Achiever"

Neil Malhotra, MD, *Thomas Jefferson University Hospital, Philadelphia, PA*; Anuj Patel, MD; Sandeep Deshmukh, MD (*neil.malhotra@jefferson.edu*)

**LEARNING OBJECTIVES:** 1) Explain the three major cellular lines (epithelial, germ cell, and sex cord-stromal) from which primary ovarian masses arise. 2) Describe the typical and/or pathognomonic features of various primary ovarian masses on CT and MRI. 3) Identify features of ovarian masses that are typical for benign or malignant pathology.

**CONTENT DESCRIPTION:** Imaging interpretation of ovarian masses with CT and MRI relies on the knowledge of the underlying cellular composition of the ovaries. The ovaries contain epithelial, germ cell, and sex cord-stromal cellular lines and are susceptible to metastatic disease. Understanding these different locations of cellular origin can further clarify the differential diagnosis. From this launching point, learning and reviewing the pathognomonic or typical traits of certain lesions for each tumor category can lead to a more accurate diagnosis. Finally, interpreting typical imaging characteristics of each lesion as either benign or malignant can further guide patient management. Types of epithelial ovarian masses include serous, mucinous, endometrioid, clear cell, Brenner, and undifferentiated. Germ cell masses include teratoma, dysgerminoma, endodermal sinus, embryonal cell carcinoma, and choriocarcinoma. Types of sex cord-stromal masses include granulosa cell, fibrothecoma, sclerosing stromal, and Sertoli-Leydig cell. Imaging and captions of various primary ovarian masses will be included, as well as a figure for typical benign versus malignant imaging features.

### (E-95) Wednesday • 7:00–8:15 AM • Hard-copy poster Novel Touch Graphical User Interface for Breast Imaging Structured Reporting

Babak Saboury, MD, MPH, *University of Maryland Medical Center, Baltimore, MD*; Michael A. Morris, MD, MS; Cristina I. Campassi, MD (*bsaboury@umm.edu*)

**LEARNING OBJECTIVES:** 1) Explain how to use an interface augmentation device for touch-based reporting in place of a traditional structured reporting interface. 2) Describe how to utilize software validation to report breast imaging findings according to the ACR BI-RADS® lexicon and assessment categories. 3) Discuss how to establish pertinent recommendations for a given BI-RADS® assessment category. 4) Explain how to generate a consistent and complete report according to the ACR BI-RADS® reporting guidelines.

**CONTENT DESCRIPTION:** An interactive touch-based graphical user interface (GUI) was developed for the mobile platform in order to create an augmented experience for the diagnostic radiologist for use in efficiently reporting findings in breast imaging based on the American College of Radiology (ACR) Breast Imaging Reporting and Data System (BI-RADS®), 5th edition. The graphical and touch interface allows fast selection of breast composition. Similarly, the touch-based interface grants accurate and efficient selection of lesion type, description, and location. Natural language generation is utilized to describe the findings. BI-RADS® assessment category is assigned through software validation, ensuring agreement of lesion descriptors and assessment. Similarly, software assistance is utilized to establish congruency between the chosen BI-RADS® assessment category and recommendation(s), the latter utilized for reporting and patient tracking.

### (E-96) Thursday • 7:00–8:15 AM • Hard-copy poster Angiosarcoma of the Breast: A Multimodality Review

Rafik Zarifa, *USF Health Radiology, Tampa, FL*; Michael W. Daugherty, MD; Robert Weinfurter, MD (*mdaughter@health.usf.edu*)

**LEARNING OBJECTIVES:** 1) Discuss the pathologic basis for angiosarcoma of the breast, with emphasis on prognosis and possible surgical interventions. 2) Describe the imaging characteristics of angiosarcoma using a multimodality approach. 3) Compare and contrast the imaging qualities of angiosarcoma with other types of breast malignancy.

**CONTENT DESCRIPTION:** Primary angiosarcoma of the breast can be thoroughly detailed through imaging, which is typically utilized as an adjunct with biopsy sampling. This pictorial exhibit details the diagnostic qualities of breast angiosarcoma through utilization of the following modalities: ultrasound, mammography, computed tomography, magnetic resonance imaging, and positron emission tomography. Imaging characteristics of angiosarcoma can be unique, and in this exhibit, these qualities are compared and contrasted to the more commonly encountered breast malignancies, including intraductal carcinoma and interlobular carcinoma.

### (E-155) Wednesday • 7:50–8:10 AM • E-poster, computer #8 Masses in the Female Pelvis: Beyond Gynecologic Entities

Sameer Mittal, MD, *Winthrop-University Hospital, Mineola, NY*; Ayushi Singh; Jason C. Hoffmann, MD\*; Galina Levin, MD; Sabrina Mahboob, MBBS (*smittal@winthrop.org*)

**LEARNING OBJECTIVES:** This exhibit will provide an image-rich review of various nongynecologic pelvic masses in females. Knowledge of these masses is critical for radiologists in order to develop an accurate differential diagnosis. We will discuss specific cases of solid and cystic nongynecologic pelvic masses and their various presentations and will describe their imaging characteristics on ultrasound (US), computed tomography (CT), and magnetic resonance (MR) imaging.

**CONTENT DESCRIPTION:** The differential diagnosis of pelvic masses is quite broad. The pelvis contains numerous reproductive, gastrointestinal, genitourinary, and musculoskeletal structures and has a complex vascular, nervous, and lymphatic supply. Although most pelvic masses in females are of gynecologic origin, nongynecologic masses are also relatively common and have many different etiologies. We have provided specific cases illustrating the various pathologies that can present as pelvic masses of nongynecologic etiology and highlight the role of diagnostic radiology in making the diagnosis. The masses discussed will include (but are not limited to) extraskeletal Ewing's sarcoma/PNET, intraabdominal fibromatosis, tailgut cyst, peritoneal inclusion cyst, and retroperitoneal leiomyosarcoma. A review of the US, CT, and MR imaging appearances of these entities will be provided, which will also be accompanied by an appropriate review of the literature of each diagnosis.

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

(E-156) Wednesday • 7:50–8:10 AM •

E-poster, computer #9

### When Effective Contraception Fails: The Imaging of Intrauterine Devices with Concomitant Pregnancy

Lindsey M. Negrete, MD, *Scripps Mercy Hospital, San Diego, CA*;  
Lucy Spalluto, MD (*lindseymnegrete@gmail.com*)

**LEARNING OBJECTIVES:** 1) Explain proper and improper intrauterine device (IUD) positioning. 2) Describe cases of IUD with simultaneous pregnancy. 3) Discuss management of IUD with concurrent pregnancy.

**CONTENT DESCRIPTION:** Surveys indicate that more women are opting for long-acting reversible contraception (LARC) options like the intrauterine device (IUD). Candidates for this particular method include all women at various ages, including teenage girls. Though seemingly close to perfection (typical use failure rate of 0.8%), IUDs still face common clinical complaints and complications. The majority of these adverse situations will initially require ultrasound analysis. **Organization:** I. Review different types of IUDs, their imaging correlates, and the sonographic findings of correct and incorrect placement. II. Illustrate multiple cases of IUD with simultaneous pregnancy, including failed intrauterine pregnancy (IUP), live IUP, ectopic, and ruptured ectopic. 3) Discuss the clinical management options when IUDs are associated with pregnancy. **Summary:** After viewing this exhibit, an attendee should be familiar with the range of appropriate and inappropriate imaging appearances of the uterus after IUD insertion.

(E-157) Thursday • 7:00–7:20 AM •

E-poster, computer #9

### Review of Male Breast Masses: Tips and Tricks

Mohamad H. Gharavi, MD, *Aultman/Mercy/NEOMED Residency Program, Canton, OH*

**LEARNING OBJECTIVES:** 1) Discuss the anatomy of the male breast. 2) Describe the histopathology and radiologic manifestations of common male breast masses.

**CONTENT DESCRIPTION:** I. Anatomy and imaging of the normal male breast. II. Overview of pathology and radiologic manifestations of common male breast masses, including, but not limited to, benign gynecomastia, lipoma, pseudogynecomastia, myofibroblastoma, diabetic mastopathy, inclusion cyst, hematoma, abscess, PASH, malignant ductal carcinoma, DCIS, invasive sarcoma, metaplastic carcinoma, lymphoma, and metastasis.

(E-158) Thursday • 7:25–7:45 AM •

E-poster, computer #10

### Role of US in the Treatment of Chronic Granulomatous Mastitis

Shruthi Ram, MD, *University of California-Davis Radiology, Sacramento, CA*; Shadi Aminololama-Shakeri, MD; Emily Ritchie, MD

**LEARNING OBJECTIVES:** 1) Discuss the methodology and role of ultrasound-guided aspiration of symptomatic fluid collections as a treatment option in chronic granulomatous mastitis, presenting our institutional experience with corresponding illustrative images. 2) Describe the clinical presentation, radiologic and pathologic features, and diagnostic criteria of granulomatous mastitis. 3) Discuss existing treatment options for the disease and the morbidity associated with wide surgical excision and corticosteroid therapy, based on a comprehensive review of the current literature.

**CONTENT DESCRIPTION:** Chronic granulomatous mastitis is a benign inflammatory process of unknown etiology in the breast but is thought to have an autoimmune cause. Currently, wide local surgical excision and corticosteroid pharmacotherapy are the standard reported treatment options, both of which are associated with significant adverse effects and morbidity. Thus far, ultrasound is typically only used for the diagnosis and follow-up of granulomatous mastitis. We have developed a minimally invasive ultrasound-guided aspiration method for symptomatic fluid collections in treatment of the disease as an alternative to more-invasive surgical excision and corticosteroid pharmacotherapy. In the past 2 years, we have treated five patients with the diagnosis of chronic granulomatous mastitis in our institution using the aforementioned technique. All patients were able to avoid lumpectomy, mastectomy, and long-term corticosteroid use, with the eventual resolution of the inflammatory process and good cosmetic outcome. In addition to reviewing clinical, radiologic, and pathologic features of granulomatous mastitis, we would like to present our institutional experience, including the details of our unique treatment technique, and discuss the natural course of the disease and patient outcomes.

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