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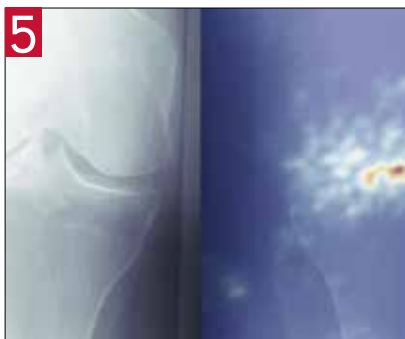
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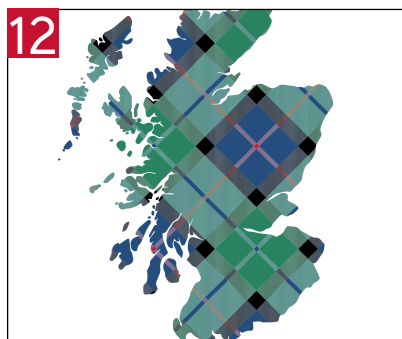
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Save the Date: RSNA Spotlight Course in Paris to Focus on AI

The RSNA Spotlight Course, “Practical Applications of Artificial Intelligence (AI),” will be held Sept. 23–24, 2018, in Paris, France.

This two-day course is for radiologists of all subspecialties who want to learn more about AI and its practical application to practice workflows and processes. Those completing the course will gain a better understanding of how AI can help, not replace, radiologists.

With a new *Radiology* journal on the topic of AI launching in 2019 and expanding programming at the Society’s annual meeting, RSNA is the recognized leader for radiologists who want to integrate AI with clinical practice.

Registration will open at the end of June. More information will be coming soon at RSNA.org/Spotlight2018.



RSNA SPOTLIGHT COURSE

ASNR Awards 2018 Gold Medals to Castillo and George



Castillo



George

The American Society of Neuroradiology (ASNR) awarded 2018 gold medals at its recent annual meeting in Vancouver, Canada.

Mauricio Castillo, MD, is the division chief of neuroradiology and the James H. Scatliff Distinguished Professor of Radiology at The University of North Carolina School of Medicine, Chapel Hill. Dr. Castillo is a former president of ASNR and former editor-in-chief of the *American Journal of Neuroradiology*.

Ajax E. George, MD, is a professor of radiology at NYU Langone Medical Center, New York. Dr. George received the ASNR Annual Meeting Best Paper Award numerous times over the years.

Numbers in the News

3

Percentage of increase in the number of radiologists in Scotland between 2010 and 2015. Read more about the shortage of radiologists in Scotland and throughout the U.K. on [Page 12](#).

55

Percentage of radiologists who primarily practice as generalists versus subspecialists, according to a new *Radiology* study. Read more on [Page 14](#).

100

Approximate number of institutions enrolled in the RSNA group billing service. Read more about this option for paying your RSNA dues on [Page 23](#).

Bisset Joins Children's Hospital in New Orleans as CMO



Bisset

George S. Bisset, III, MD, has joined Children's Hospital in New Orleans as its Chief Medical Officer.

A preeminent authority on pediatric imaging, Dr. Bisset most recently was a professor of radiology at Baylor College of Medicine and Radiologist-in-Chief and

Edward B. Singleton Chair of Radiology at Texas Children's Hospital, Houston.

Dr. Bisset served as RSNA president in 2012 and received an RSNA Gold Medal in 2017. He has authored or co-authored more than 200 articles and has served as a reviewer for *Radiology*.

RSNA to Support Imaging Physics Residencies

The RSNA Board of Directors has agreed to extend its partnership with the American Association of Physicists in Medicine (AAPM) to provide additional financial support to imaging physics residency positions. RSNA will contribute \$210,000 from 2020 to 2022 toward creating additional AAPM/RSNA Imaging Physics Residency Grants.

AAPM and RSNA partnered in 2012 to address concerns that an insufficient number of imaging physicists who are eligible for American Board of Radiology (ABR) certification were being produced with the number of Commission on Accreditation

of Medical Physics Education Program (CAMPEP) accredited imaging physics residency programs that existed at that time. Since then, RSNA and AAPM have awarded eight imaging physics residency grants and the number of programs has increased from 15 to 21.

Under ABR requirements for accredited residency training, medical physicists must complete an accredited two-year residency program in order to take board exams and achieve the Qualified Medical Physicist (QMP) designation.



Goodman Appointed Chair at Yale New Haven Hospital



Goodman

Rob Goodman, MBBChir, MBA, has been appointed chair of the Department of Radiology & Biomedical Imaging and chief of radiology and biomedical imaging at Yale New Haven Hospital, CT. He previously served as professor and section chief of pediatric radiology at Yale.

Dr. Goodman's clinical interests include

the reduction of radiation exposure for children and improved utilization of ultrasound in pediatric imaging.

He served as the pediatric community of practice president for the American Institute for Ultrasound in Medicine, which recently elected Dr. Goodman to its board of governors.

ABR Updates on OLA and Changes for RO Exam

The American Board of Radiology (ABR) continues to finalize its new Online Longitudinal Assessment (OLA) product for Part 3 of Maintenance of Certification (MOC). Diagnostic radiology will be the first of the four ABR specialties to implement OLA, expected in 2019.

OLA will replace the previous proctored MOC Exam required every 10 years. Part 3 is now aligned with the three other parts of MOC: annual licensing, continuing medical education (CME) and practice quality improvement. OLA will allow for more

flexibility in participation, provide immediate feedback and eliminate additional exam expenses, such as travel and time away from work.

In addition, ABR has changed the venue for the radiation oncology (RO) oral exam. Beginning in 2019, the exams will be administered in Tucson, AZ, at hotels adjacent to ABR headquarters. ABR also continues to develop the OLA for RO, which is expected to be available in 2020. For more information, visit theabr.org.



Suhny Abbara, MD, Named Editor of *Radiology: Cardiothoracic Imaging*

New specialized journal to launch in spring 2019.



Suhny Abbara, MD, will become editor of the new online journal, *Radiology: Cardiothoracic Imaging*.

Dr. Abbara is professor of radiology and chief of the Cardiothoracic Imaging Division at UT Southwestern Medical Center in Dallas, Texas. He is also chair of CT Operations and Texas Medical Board Accredited Program director for the Cardiothoracic Imaging Fellowship at UT Southwestern Medical Center.

He serves as an attending physician at three Dallas-based hospitals, Zale Lipshy University Hospital, Clements University Hospital and Parkland Health & Hospital System, where he is the medical director of Parkland Cardiothoracic.

"I was thrilled when I learned that RSNA was creating the new journal, *Radiology: Cardiothoracic Imaging*," Dr. Abbara said. "The next 10 years in cardiothoracic imaging will be very different from the last 10. This new journal can serve as a catalyst for the science and research that drive this positive change, and I am convinced that it can aid in the translation of research into clinical practice. I am honored to be able to serve as editor for this timely new journal."

Dr. Abbara's research focus has been in cardiac CT and MRI, lung cancer screening and early detection and the identification of imaging biomarkers to predict the outcomes of post-surgical procedures and anesthesia outcomes. He also specializes in cardiac CT angiography and coronary calcium scoring.

A 1995 graduate of Heinrich Heine University in Düsseldorf, Germany, Dr. Abbara completed a vascular surgery internship at the same institution in

1997, three years of residency in radiology at Georgetown University Hospital in Washington, D.C., in 2000, and an internship in surgery at the University of Hawaii Surgical Residency Program in Honolulu in 2001. From 2001 to 2002, he was the chief radiology resident at Georgetown University Hospital before receiving advanced training in cardiac imaging through a fellowship at Massachusetts General Hospital in Boston.

Dr. Abbara became an instructor and later an assistant professor of radiology at Harvard Medical School in Boston, where in 2009, he became an associate professor of radiology.

From 2003 to 2013, he was director of education for the Cardiac MR and CT Program at Harvard Medical School, where he also served as director of the Clinical Cardiac Imaging Division and director of the Clinical Cardiac Imaging Fellowship.

Dr. Abbara served on the editorial boards of the *Journal of Thoracic Imaging*, *Cardiovascular Diagnosis and Therapy* and *Imaging in Medicine*. He served as associate editor for the *Journal of Cardiovascular Computed Tomography* and *The International Journal of Cardiovascular Imaging*. Dr. Abbara has co-authored 250 peer-reviewed PubMed-referenced articles, several books and textbooks and over 40 clinical guidelines and reports. He has been a reviewer for nearly 25 scientific journals, including *Radiology* and *RadioGraphics*.

Dr. Abbara's many awards and honors include the Editor's Recognition Award from *RadioGraphics*, Golden Apple Award from UT Southwestern Medical Center and numerous Cum Laude awards from RSNA. Dr. Abbara received the RSNA Honored Educator Award in 2017.

A longtime member of RSNA, Dr. Abbara has served on the Cardiac Subcommittee of the Scientific Program Committee, was a member of the Education Exhibits Awards Committee and is currently chair of the Cardiac Track on the Refresher Course Committee. Dr. Abbara is also a member of the Cardiac Radiology Panel for *RadioGraphics*. He has presented over a dozen times at RSNA annual meetings and contributed to several cardiac "Cases of the Day."

"Suhny Abbara brings a wealth of cardiac expertise and years of dedicated service as an RSNA volunteer to his new position as editor," said Mary C. Mahoney, MD, RSNA Board liaison for publications and communications. "The RSNA Board looks forward to his stewardship of *Radiology: Cardiothoracic Imaging*."

Radiology: Cardiothoracic Imaging will emphasize research advances and technical developments in medical imaging that drive cardiothoracic medicine.

Launching in spring 2019, the journal will be published bi-monthly and available exclusively online. RSNA members will receive a complimentary subscription as a member benefit. Original research and editorial submissions to *Radiology: Cardiothoracic Imaging* will be accepted beginning Fall 2018.

WEB EXTRAS

Access the current RSNA journals at RSNA.org/Journals

June 2018 • Volume 28, Issue 6
Published monthly by the Radiological Society of North America, Inc.
820 Jorie Blvd., Oak Brook, IL 60523-2251. Printed in the USA.

POSTMASTER: Send address corrections or changes to: *RSNA News*, 820 Jorie Blvd., Oak Brook, IL 60523-2251

Non-member subscription rate is \$20 per year; \$10 of active members' dues is allocated to a subscription of *RSNA News*.

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LOOK AHEAD

The Future of Musculoskeletal Imaging

BY THOMAS M. LINK, MD, PHD, AND DANIEL I. ROSENTHAL, MD

While radiology has become progressively specialized over many decades, some areas of special expertise have developed earlier than others. Chest disease became an early focus of many radiologists because of the inherent ability of radiographs to demonstrate the structures of the lungs and heart and because of the importance of chest diseases such as tuberculosis. Pioneers including Felix Fleishner, MD, Benjamin Felson, MD, and Aubrey Hampton, MD, quickly developed a specialized body of knowledge. Gastrointestinal imaging as a field of study can be dated to the introduction of barium in 1908. Nuclear medicine came later (after World War II), but has always been a distinct subspecialty because of the specialized technology involved. Pediatric radiology was pioneered by innovators including John Caffey, MD, and was the first subspecialty to be recognized with its own certification program in 1994.

In this context, musculoskeletal (MSK) radiology is a young subspecialty. Although it might be said that the field of MSK radiology began with the first radiograph ever produced (the hand of Wilhelm Roentgen's wife, Bertha, taken on Dec. 22, 1895), the potential corpus of knowledge was limited. Bone tumors and metabolic bone disease could be evaluated with some sophistication, but they were rare. Soft tissue structures were all but invisible. For decades, imaging of bones remained the purview of general radiologists. Everything changed with the explosion of technology in the 1970s and 1980s that brought us CT, MRI, quantitative osteoporosis imaging and, eventually, high-resolution ultrasound.

Changing Patient Populations Create Challenges

History also played a part in spurring the growth of the specialty. During the "baby boom" years in the U.S. (generally defined as from 1945 to 1960–1964) more than 65 million babies came into the world. Baby boomers are now between 56 and 73 years of age, and either already have, or will shortly develop problems of the locomotor system.

Continued on next page



THOMAS M. LINK, MD, PHD, is chief of musculoskeletal imaging and clinical director of the Musculoskeletal and Quantitative Imaging Research Group in the Department of Radiology and Biomedical Imaging at the University of California, San Francisco. Dr. Link's research interests include imaging of osteoporosis, osteoarthritis and cartilage. He serves on the editorial boards of scientific journals including *Radiology* and is a member of the RSNA Committee on Scientific Affairs and Public Information Advisors Network.



DANIEL I. ROSENTHAL, MD, professor of radiology at Harvard Medical School and vice-chairman of radiology at Massachusetts General Hospital, Boston. His research interests include diseases of the skeleton and locomotor systems and he has aided in the development of new therapeutic treatments for osteoid osteomas as well as Gaucher's disease.

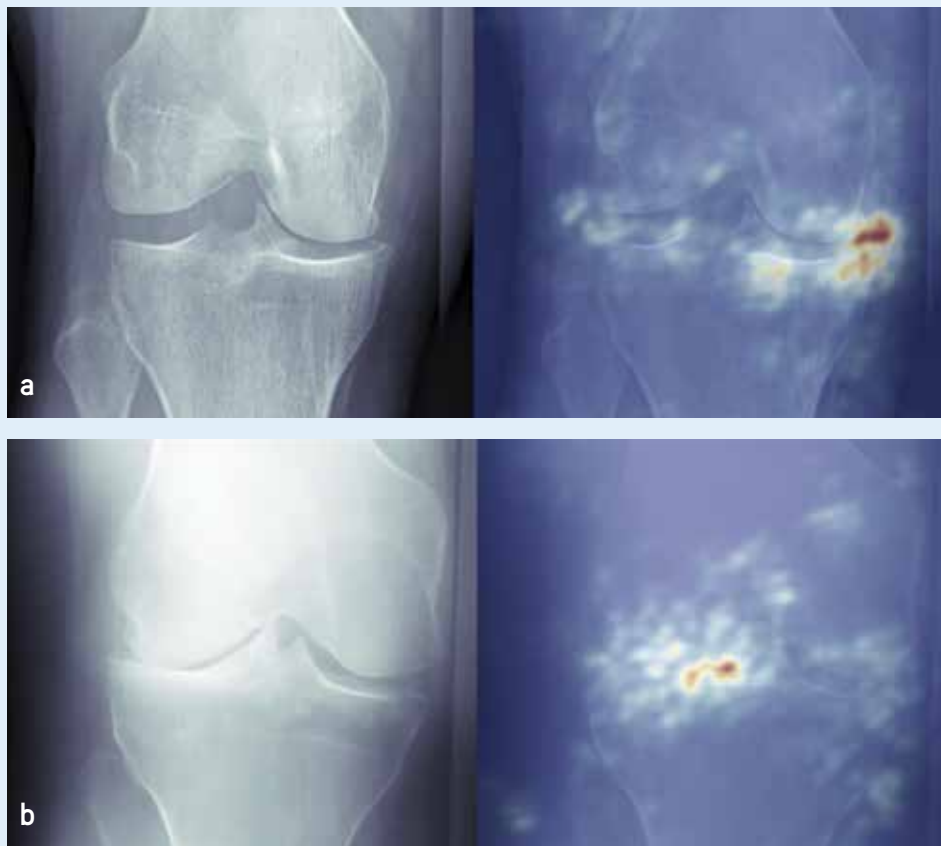


Figure 1: Two knee radiographs (1a and 1b) showing degenerative changes (left) with saliency heat maps (right) identifying pixels that the Artificial Intelligence uses more in assigning the diagnosis of osteoarthritis. Highlighted pixels correspond to osteophytes and joint space narrowing. Images courtesy of Valentina Pedoia, PhD, Department of Radiology and Biomedical Imaging, UCSF.

Continued from previous page

Every organ system is subject to its characteristic afflictions, and patients may experience one or more of them. However, virtually everyone who lives long enough will have to contend with problems that fall within the domain of orthopedics: osteoporosis, fractures, arthritis of one or more joints, back pain and spinal stenosis. Ironically, public health efforts to combat cardiovascular disease have encouraged participation of adults and even older adults in physical activities that can exacerbate these conditions. Therefore the recent past has seen a huge growth in the medical specialties that diagnose and treat these problems. The immediate future will probably generate even higher demands.

Most of the patients requiring these services will be elderly, many will be retired, some will be on Medicare. It is generally recognized that expenditures on healthcare have risen disproportionately and that this trend cannot be permitted to continue. Orthopedic diagnosis and treatment is particularly vulnerable to cost-cutting methods as almost all can be viewed as elective. What form will it take?

Future Requirements for MSK Imaging

Recently, a great deal of attention has been given to eliminating examinations

that do not meet some criteria for “appropriateness.” “Decision support” for this purpose is now federally mandated. This approach has yielded some benefits, but it is unlikely that they will be sufficient to satisfy the demands of payers. As imaging has improved, it has moved ever earlier in the care cycle, often becoming a precursor (or even substitute) for the history and the physical exam. Therefore, the concept of appropriateness, which depends upon prior knowledge of the patient, becomes less meaningful. The easiest method to save money is to pay less, and therefore further payment reductions are likely.

In order to survive in this environment, radiology departments will need to devise faster, less expensive methods to deliver their services. Every aspect of the imaging encounter will have to be re-imagined for greater efficiency from ordering to examination selection (protocoling), performance and interpretation.

Simplification and standardization will be key goals in cost reduction. Instead of envisioning a world where each examination is tailored to the specific patient’s needs, imaging will increasingly be viewed as either screening (similar to screening mammography), or focused problem solving.

As in the example of mammography,

the concept of an appropriate number of “call backs” will develop for much of imaging. Too many callbacks will call into question the expertise or confidence of the interpreting radiologist; but too few will indicate the possibility of over-imaging. These trends will probably work well for the common MSK concerns (knee, shoulder and spine), but will be problematic for the less commonly imaged body parts (hand, foot and elbow).

For example, lumbar spine MRI is known to have little clinical value in most patients with back pain. Is the time that the radiologist spends to protocol it justified? We know that sometimes the use of contrast is helpful. However, if contrast were never used as part of an initial study, but reserved for selected “call backs” would it be better or worse for most patients? What is the smallest number of images and the fastest scan that can be used to identify the important findings? Careful cost-benefit analysis can answer these questions and will be necessary for the majority of our most common high-tech imaging.

New Developments in MSK Imaging Research

Another global trend is related to the economic and scientific advances in Asia. The economic success of this

region has permitted many more people to participate in medical research. As a result, there has been a rapid rise in contributions to the medical literature from Asia.

The world of radiology is currently abuzz with discussions of what machine learning (ML) and artificial intelligence (AI) will do to our specialty. Musculoskeletal imaging appears to be a prime candidate for the introduction of computer-assisted image interpretation because of its very large number of measurements and grading systems. Radiologists know that their colleagues in orthopedics, podiatry and hand surgery make use of these measurements but frequently omit them from their reports. There are two reasons for this: they are tedious and time-consuming, and individual variation in measurements could lead to a conflict between the radiologist and the clinician.

Computer-assisted interpretation has the potential to address both. In the near future, imaging of every body part could come with a form or table indicating which measurements are normal and abnormal. For each diagnostic entity, there will be assistance to assign grades or stages when they exist. We do not think that full computer interpretation will occur in the near or intermediate term. However, it is very likely that the rapid progress in neural networks will enable computers to effectively recognize (and even grade) certain specific conditions (probably including degenerative arthritis and “normal”).

For example, Figure 1 demonstrates how AI (convolutional neural network) — without any a priori knowledge — is able to look at the training data and identify the correct features, in this case joint space narrowing and the presence of osteophytes, qaz `1zas distinctive osteoarthritis features. Figure 2 shows an example of cartilage automated segmentation with a novel voxel-based relaxometry approach to analyze local patterns in cartilage composition using T2 and T1 rho imaging biomarkers and statistical parametric mapping. As a result, the MSK radiologist of the future will have many more tools at his or her disposal and the job of image interpretation will become more sophisticated and demanding.

Interventional MSK Radiology is Also Evolving

Interventional procedures are also in a state of rapid change. Many MSK

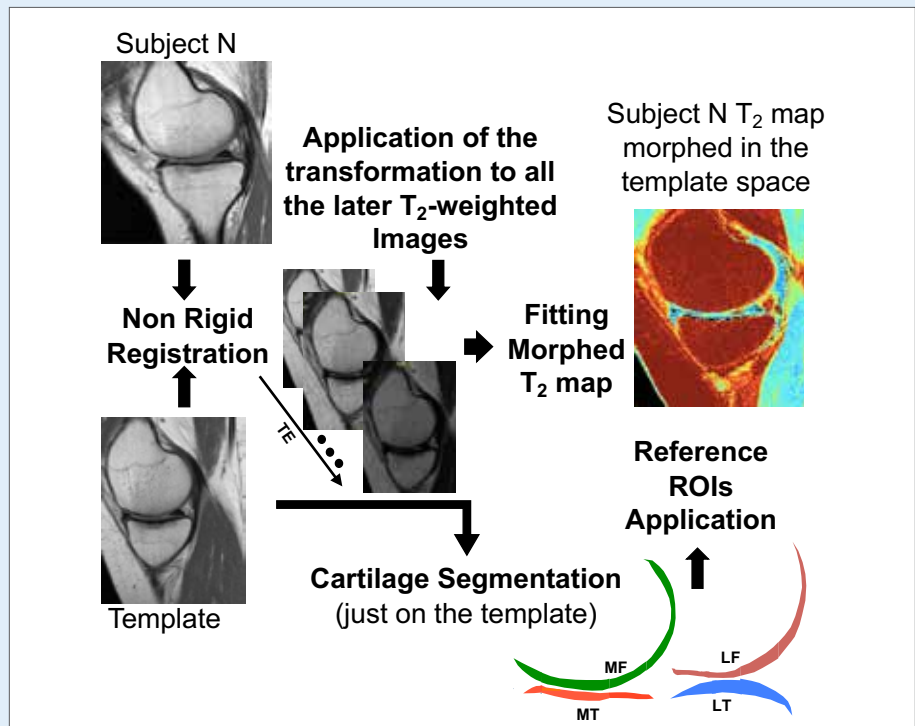



Figure 2: Automatic segmentation of cartilage using statistical parametric mapping of cartilage T2 with voxel-based relaxometry. Images courtesy of Valentina Padoia, PhD, Department of Radiology and Biomedical Imaging, UCSF.

radiologists perform an interesting mix of advanced diagnostic imaging and interventions including arthrography, biopsy, tumor ablation, vertebroplasty and pain management. There has been enormous progress recently, with the introduction of many percutaneous therapeutics including tumor ablation, percutaneous fracture fixation and percutaneous soft tissue release. The introduction of injectable active biological agents such as osteoinductive agents promises to greatly enhance the effectiveness of such procedures. Steady innovation in materials research also promises to enhance the effectiveness of percutaneous treatment.

There are, however, several major threats, both from outside forces and from within radiology. Clinicians are not unaware of these advances, and there is a strong tendency for each clinical specialty to develop minimally invasive procedures and proceduralists who will compete with interventional radiologists. There is also a distinct increase in the amount and specificity of documentation that is required if radiologists are to play the role of direct caregiver. This will undoubtedly take the form of procedure-specific credentials and documentation of quality and safety. In short, these changes blur the boundary lines between departments: clinicians are becoming more like radiologists and radiologists are becoming more like clinicians.

Finally, there is also a threat from within radiology. MSK radiology is often a mix of diagnostic and interventional procedures. The recent bifurcation of our specialty into diagnostic and interventional training tracks will create a new class of “interventionalists” who are specifically sanctioned to do these procedures. The current concept of what intervention means does not always extend to include MSK procedures, and individuals selecting this path will probably be more focused upon higher volume chest and abdominal procedures. MSK radiology practices will be faced with choosing individuals who have not expected to do any interventions (diagnostic trainees) or those who expect to exclusively do interventions of a different sort. It will be very difficult to maintain the attractive current blend of sophisticated diagnostic imaging and specialized interventions in MSK radiology.

Expanding Opportunities in MSK Imaging

We strongly believe that with new developments in MSK imaging we will see faster and more precise imaging with an expanding number of technologies and interventions ultimately improving patient care. However, this requires strategic planning and a combined effort of MSK radiologists to remain leaders in their field, educating their trainees and promoting research. 

Standardized Data is Critical to

BY RICHARD DARGAN

While machine learning (ML) continues to develop at lightning speed in many respects, one area is creating a bottleneck of sorts: the lack of high quality, annotated imaging data sets necessary to train algorithms.



Andriole



Halabi

Quality control issues such as lack of or inconsistent image labeling and patient privacy concerns are two areas that threaten to slow progress in creating such necessary data sets.

To that end, informatics leaders are working on solutions including developing standards and tools to facilitate labeling images, improving the capability of technology to de-identify images and encouraging collaboration among hospitals through data use agreements.

On the surface, the combination of ultra-fast computers, advanced graphics processors and a seemingly bottomless well of medical images make radiology fertile ground for ML. But the images themselves require much work before an algorithm can be trained to complete tasks like distinguishing between diseased and normal tissue or, in the case of deep learning (DL), sifting through large numbers of images and detecting patterns beyond the scope of even the most experienced radiologist.

“The whole pre-processing pipeline is a difficult piece of the puzzle right now,” said Katherine Andriole, PhD, director of research strategy and operations at the Massachusetts General Hospital & Brigham and Women’s Hospital Center for Clinical Data Science in Boston. “We’re spending 60 to 70 percent of our time on things like data acquisition, curation and annotation.”

As a result, algorithms may not have a sufficient quantity of data sets to learn from, said Safwan Halabi, MD, clinical assistant professor of radiology and pediatric radiology at Stanford University, in Palo Alto, CA, and a member of the RSNA ML Challenge Organizing Committee.

“For example, let’s say you have only 100 cases of pancreatic tumor ... that may not be enough to train an algorithm to recognize it,” Dr. Halabi said.

Labeling, Patient Privacy Top Concerns

Among the most common quality control issues for data is lack of or inconsistent annotation, or labeling. The quality of the labeling, which is closely tied to algorithm performance, can vary across institutions.

“When trying to teach a computer to distinguish between normal and abnormal using a supervised ML algorithm, the data needs to be labeled,” said Dr. Andriole, a member of

the RSNA Radiology Informatics Committee (RIC). “We have a lot of data, but that doesn’t mean it is all sufficiently labeled. We may have to use natural language processing to mine the radiology report for the label, or manually annotate the pixel data. Furthermore, care needs to be taken in comprising the patient cohort to insure heterogeneity across the data.”

Patient privacy and data security is another major concern. Institutions, mindful of the recent controversy over data leaks at Facebook and other companies, may be reluctant to share data without an assurance that it has been completely anonymized.

“Researchers in academia and in industry are asking, ‘Why can’t we just have the data?’” Dr. Andriole said. “The problem is, there is a lot of private health information in imaging data, and we are obligated by law to be stewards of that data.”

Even assuming proper labeling and anonymization, data from one study is not necessarily generalizable to the population at large. In addition, results drawn from one particular patient cohort cannot always be generalized to other institutions.

“Imaging data can come from different protocols, different machines, different vendors,” Dr. Andriole said. “It may be difficult for the computer to pick out patterns if everything is so different.”

Proprietary interests represent another obstacle to assembling sufficiently large data sets for training. Hospitals are unlikely to give away data that costs significant time and money to assemble and involves the work of high-level researchers.

“There is tremendous value in data,” Dr. Andriole said. “A lot of intellectual content and expertise goes into data in the electronic medical record.”

RSNA Competition Aids Algorithm Development

Radiology leaders are developing a number of solutions to ease the bottleneck in developing high quality, validated imaging data sets.

Competitions in which research data is made available to the public in order to solicit promising algorithms represent one avenue for advances in ML. A successful example of this approach is the RSNA ML Pediatric Bone Age



MACHINE LEARNING

Challenge launched by RSNA in 2017.

Participants were given a set of hand radiographs donated by Stanford Children's Hospital and Colorado Children's Hospital, Aurora, to develop and train prediction models for skeletal ages. The imaging data was de-identified prior to release and went through an institutional review board process.

The competition was well received, with 250-plus participants and 100-plus submissions. The winners, Mark Cicero, MD, and Alexander Bilbily, MD, radiology trainees at the University of Toronto, Ontario, went on to found a medical diagnostics AI company to distribute the algorithm to hundreds of U.S. hospitals free for public research use.

"The RSNA ML Pediatric Bone Age Challenge opened up a great collaboration among scientists, engineers and others," Dr. Halabi said. "It has been amazing to see how many people are requesting and using these bone age data sets."

Also at Stanford, work continues on developing Medical Image Net, a cloud-based, searchable, open repository of diagnostic imaging studies for developing intelligent image analysis systems.

"Lots of heavy lifting must happen to access data sets," Dr. Halabi said. "We need to figure out how we can promote the universal good of providing them, but backed by financial incentives to make it worth the investment."

Collaboration, Education Critical to ML Progress

Ultimately, experts say, these challenges will be overcome through radiology's embrace of ML and the continued collaboration between radiologists and other stakeholders. Key to that process is education, Dr. Andriole said, just as it was when she helped to bring PACS to fruition early in her career.

"Radiologists need to understand the promise and also the limitations of machine learning. That is the type of education the RSNA and others are focused on and will need to continue to develop." ❏

"The RSNA ML Pediatric Bone Age Challenge opened up a great collaboration among scientists, engineers and others. It has been amazing to see how many people are requesting and using these bone age data sets."

SAFWAN HALABI, MD

Identifying Stroke Patients Likely to Benefit from IAT

BY MIKE BASSETT

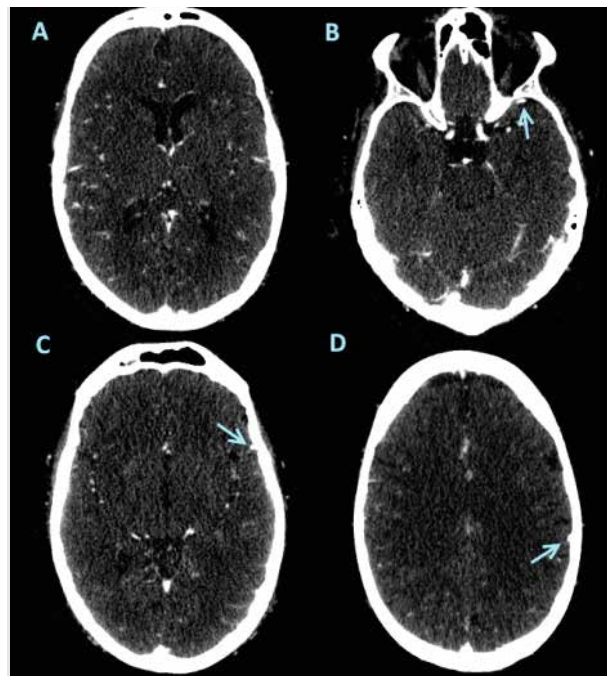
Recent studies have demonstrated the effectiveness of intra-arterial therapy (IAT) on patients who have suffered an acute ischemic stroke if administered within six hours after the stroke.



Jansen



van den Berg



Images from baseline CT angiography in 61-year-old man with right-sided segment M1 occlusion. (A) Image shows abundant arterial collateral flow in affected hemisphere (grade 3). Patient had moderate disability 90 days after IAT (mRS score, 4). (B–D) Images in unaffected hemisphere show full opacification (arrow) of sphenoparietal sinus (B), superficial middle cerebral vein (C), and vein of Labbé (D). However, opacification was absent in all three cortical veins in affected hemisphere. This resulted in a COVES of 0 for this patient. Images courtesy of Ivo G. H. Jansen, MD.

However, while most patients benefit from IAT, those same studies showed that others did not fare well in terms of functional recovery after treatment, leaving researchers with questions about the best way to select patients who will actually benefit from the procedure.

In a study published in the February 2018 issue of *Radiology*, Ivo G.H. Jansen, MD, Department of Radiology, Academic Medical Center, University of Amsterdam, the Netherlands, and colleagues evaluated the level of cortical vein opacification in stroke patients through the use of CT angiography (CTA), to determine which patients would or would not benefit from IAT.

While there are many patient characteristics — such as cerebral collateral flow — that may help physicians select patients who will benefit from IAT, none have been confirmed as reliable, Dr. Jansen said. And that creates a problem considering the potential effectiveness of IAT, he added.

“So if you want to exclude someone from this treatment because you do not expect him or her to benefit, you want to be really certain,” Dr. Jansen said. “This means that research on these patient characteristics must be fairly robust before we can reliably tell someone — or someone’s family — that we will not be able to use IAT.”

Research Focuses on Three Veins

While research has primarily focused on such patient characteristics as collateral status and ischemic changes, the venous system has been relatively overlooked, Dr. Jansen said.

In their research, Dr. Jansen and senior author, René van den Berg, MD, PhD, Department of Radiology, Academic Medical Center, University of Amsterdam, hypothesized that venous outflow — as indicated on CTA — could be a marker for determining how well a patient’s circulation is working.

“We thought that if the blood is going through the tissue and coming out, the tissue must be functioning in some way — or at least the microcirculation is functioning,” Dr. Jansen said. “This would indicate that the patient had less damage. But if venous drainage is totally absent in the hemisphere in which the occlusion is located, we theorized that the microcirculation is damaged in some way so that blood is going in, but not coming out. So we started thinking about how to grade this.”

With the idea of determining levels of venous drainage that are markers for severe damage, Dr. Jansen and colleagues chose to examine three veins (the superficial middle cerebral vein, the vein of Labbé, and the sphenoparietal sinus) that are primarily responsible for draining the territory surrounding the middle cerebral artery — the area most commonly affected by massive strokes.

Their study was based on the dataset from the Multicenter Clinical Trial of Endovascular Treatment for Acute Ischemic Stroke in the Netherlands (MR CLEAN) held between 2000 and 2014. From that database, Dr. Jansen and his colleagues retrospectively analyzed patients with baseline CT angiograms.

“We looked at each of the three veins

“Findings indicated that if a person has a severely damaged brain due to stroke, the venous drainage will also be impacted and it can be assessed in the way we proposed.”

IVO G.H. JANSEN, MD

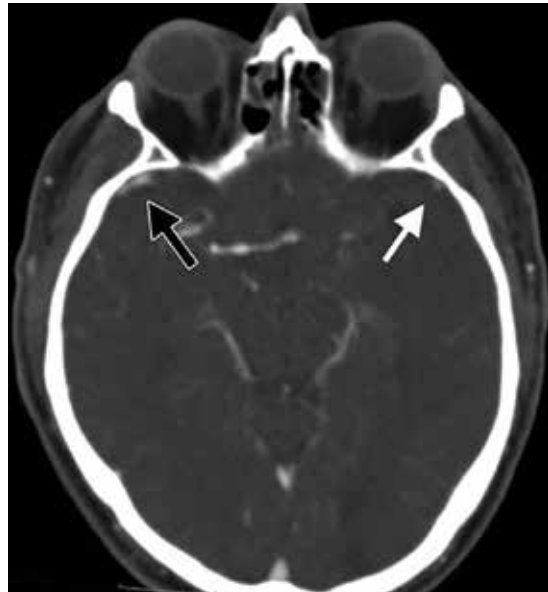


Image from a baseline CT angiography in 61-year-old man with left-sided occlusion. In the affected hemisphere, sphenoparietal sinus is moderately opacified, resulting in opacification grade of 1 (*white arrow*). In unaffected hemisphere, sphenoparietal sinus is fully opacified, with opacification grade of 2 (*black arrow*).

individually,” Dr. Jansen said. “We looked at their opacification compared to the contralateral hemisphere and assessed whether there was no, moderate or full opacification of the vein.”

Each of the veins was graded by a neuroradiologist on a 0- to 2-point scale (0 = not visible, 1 = moderate opacification, and 2 = full opacification). A total sum was then calculated, which resulted in a cortical vein opacification score (COVES) ranging from 0 to 6.

The researchers found that patients with a COVES score of 0 — no opacification in any of the three veins — gained no benefit from IAT, while patients with a venous opacification (COVES score > 0) did benefit from the procedure.

Specifically, Dr. Jansen and his colleagues determined that in patients with a COVES score of 0 there was no shift toward a better functional outcome (adjusted common odds ratio: 1.0; 95 percent confidence interval (CI) compared to a larger shift in patients with a COVES score greater than 0 (adjusted common odds ratio: 2.2; 95 percent CI).

Additionally, they found that mortality rates in patients with a COVES score of 0 at 7 and 30 days (18.7 percent and 26 percent, respectively) were higher than those in patients with a COVES score greater than 0 (5.8 percent and 13.4 percent, respectively).

“The results were pretty clear cut and what we expected,” Dr. Jansen said. “Findings indicated that if a person has a severely damaged brain due to stroke, the venous drainage will also be impacted and it can be assessed in the way we proposed.”

More Research Needed Before Clinical Use

In terms clinical applications of this finding, Dr. Jansen said more research is needed to confirm the results of this study. He added that using one particular parameter for patient selection for IAT may not be the best option.

“I think a combination of factors is the way to approach this,” he said. “Maybe a combination of a collateral grade with a COVES score can add to the prognostic value of both parameters and give a more complete picture of what is going on with cerebral vasculature during a stroke.” ❏

WEB EXTRAS

❏ Access the *Radiology* study, “Absence of Cortical Vein Opacification Is Associated with Lack of Intra-arterial Therapy Benefit in Stroke,” at [RSNA.org/Radiology](https://www.rsna.org/Radiology).

Radiology **SHORTAGE** in Scotland Underscores Need for a New Radiology Model

BY MIKE BASSETT

While Scotland continues to search for radiologists to fill the deepening gap in the workforce, Scottish radiology leaders are stressing the need for a big-picture solution they say is necessary to solve the problem long-term.

Scotland has been grappling with a radiology shortage for the last several years due to a combination of chronic vacancies, low trainee numbers and increasing demand. In a 2017 statement, the Royal College of Radiologists (RCR) reported that the shortage in Scotland “is well recognized and documented and is currently worsening.”

“There are short-term solutions underway, but the long-term strategy has to be producing more radiologists,” said Grant Baxter, MD, chair of the Standing Scottish Committee of the Royal College of Radiologists (RCR).

In fact, Dr. Baxter and other Scottish radiology leaders believe there is a need to create a whole new radiology model that would include significantly increasing the number of radiology trainees each year — not only to fill current shortages but to address the wave of retirements planned in coming years.

The National Health Service (NHS) is addressing the shortage on a number of fronts. In February 2018, NHS launched a global outreach recruitment for radiology applicants in India, the U.S., Canada, western Europe and Australia. NHS is also investing in information technology (IT) to reach more patients remotely.

And in 2017, NHS unveiled plans to invest 4 million pounds in radiology programs to improve patient services and increase the number of specialist radiology training places in Scotland. The NHS plans to fund an additional 10 radiology training posts each year for five years beginning in 2018. As of 2016 (the most recent data available), there were just over 300 radiologists working full or part-time and 115 radiologists in training in Scotland, which has a population of 5.4 million. But Dr. Baxter

said the number of radiology trainees continues to increase, and now stands at more than 130.

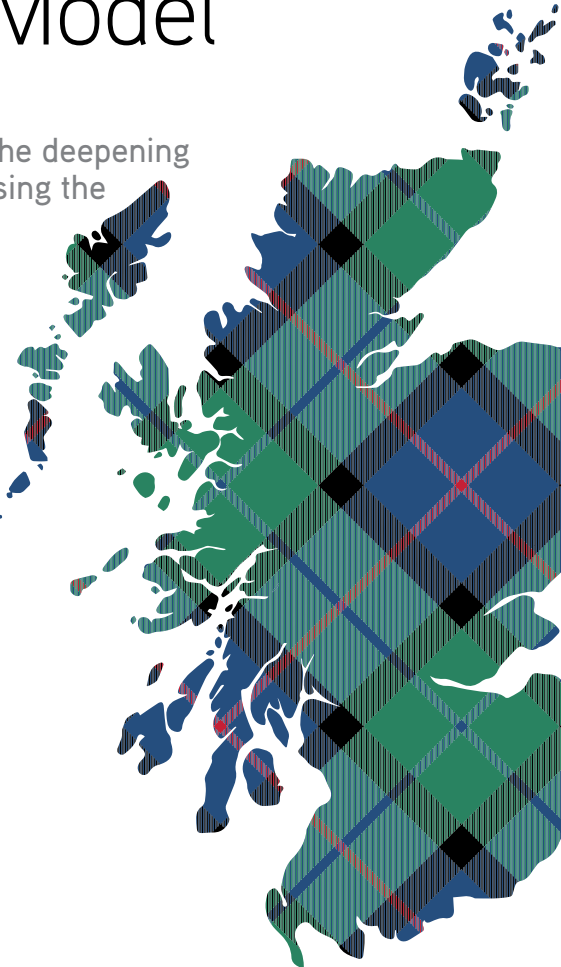
Hopefully, convincing radiologists that Scotland is a good place to practice will not be a difficult sell, said Edwin Van Beek, MD, PhD, SINAPSE chair of clinical radiology, Edinburgh Imaging, University of Edinburgh, and a native of The Netherlands who has been practicing in Scotland since 2009.

“I’m very happy where I am,” Dr. Van Beek said. “And the academic side of radiology is well supported. The capabilities in Scotland are immense with a full national PACS and images that are available nationally. With the introduction of a Safe Haven environment, which includes all images from around Scotland linked to clinical data, many opportunities exist for big data research.”

In fact, that need for more government-funded radiology positions is a key factor in the radiology shortage not only in Scotland, but the entire U.K., radiology leaders say. The U.K. has only seven radiologists per 100,000 population, while the European average is 12 radiologists per 100,000 people, according to a 2016 census report by RCR, which has conducted a census for the past seven years.

Those numbers hold true in Scotland, where the number of radiologists trained over the last five years has increased by about 1 percent each year, compared to an increase in demand that runs 11–13 percent per year, Dr. Baxter said. In 2016, 26 radiology training positions were added in Scotland. That number needs to double, Dr. Baxter said.

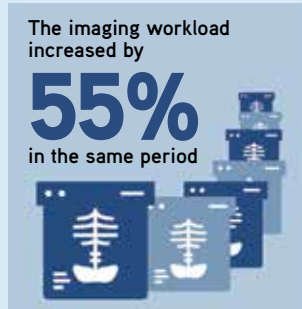
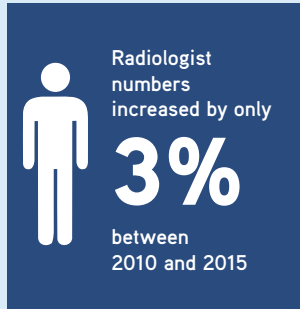
“About one in six of our jobs is chronically under-filled, and we will be seeing a tsunami of retirements coming in the next three years,” Dr. Baxter said.



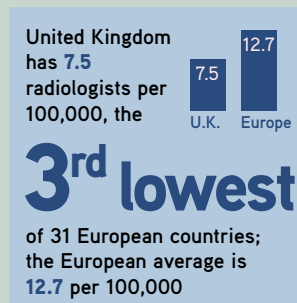
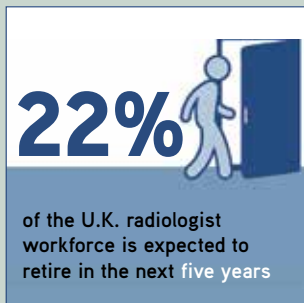
“The capabilities in Scotland are immense with a full national PACS and images that are available nationally. Many opportunities exist for big data research.”

EDWIN VAN BEEK, MD, PHD

Radiology in Scotland — By the Numbers



Radiology Shortage Impacts the United Kingdom



— Royal College of Radiologists (RCR) 2016 workforce census report, the most recent data available from RCR

“So, when you tie this all together, it is clear a number of significant challenges lie before us.”

The irony, said Dr. Baxter, is that there is more than enough interest by aspiring radiologists to fill these vacant posts.

“When we advertise for a radiology training post we will turn down four people for that one post, so we have about a five-to-one application ratio for people who are appointable,” Dr. Baxter said. “And if we had more money and more radiology posts, we could appoint more people. But we have seen a long period of under-investment in radiology training in Scotland and the U.K., so we have not seen a significant increase in training numbers.”

Other factors have contributed to the shortage as well, Dr. Baxter said, including the increasing demands for radiology services in the last 10–15 years. “And it’s not just the numbers that are increasing; it is also the complexity of the imaging exams. So, demand for imaging has not been met by an appropriate increase in radiologist numbers,” he said.

Teleradiology Use on the Rise

In more rural areas of Scotland, smaller hospitals are struggling to keep up with reporting of imaging exams, which has a direct impact on patients, Dr. Van Beek said. In those areas, IT capabilities are

being expanded to reach more of the population.

“What has happened is that there has been an increase in teleradiology capabilities,” Dr. Van Beek said. “In Edinburgh, we have teleradiology services essentially covering a region of southeastern Scotland with about one million people.”

But, according to the 2016 report by the RCR Standing Scottish Committee, outsourcing radiology services is not an optimal use of resources.

Between April 1, 2014, and March 31, 2015, Scottish radiology departments spent 5.25 million pounds on outsourcing (which included payments made to teleradiology companies, as well as extra payments to radiologists already contracted to their departments). The authors of the report pointed out that the money spent on outsourcing was equivalent to the combined salaries of 60 full-time radiology consultants, or 21 percent of the entire workforce.

In particular, Scottish radiology is especially struggling in terms of workload involving cross-sectional imaging.

“We try to report all cross-sectional imaging within a week if it isn’t urgent; if it is urgent, it is usually done within the same day,” Dr. Van Beek said. “But the increased need for cross-sectional imaging has detrimentally impacted plain film reporting, and that is where we



Van Beek



Baxter

struggle the most. It is not uncommon to see delays of several weeks in the reporting of plain films.”

In fact, according to that 2016 RCR statement, nine of out 10 hospitals in Scotland are unable to keep up with their daily imaging workload, with some patients experiencing reporting delays of a month or more.

While long-term fixes are in the works, improvements in technology will likely aid the situation in the near-term, Dr. Baxter said.

“We have a national system where we can see scans from anywhere in the country, but we can’t report them. We can do that in our own small regions,” Dr. Baxter said. “Hopefully, by 2019 our connection will improve so that someone in the south of Scotland can report from a hospital in the north, east or west and that in some way will help surmount some of these issues.”

Study Shows More than Half Radiologists are Generalists vs. Subspecialists

BY MELISSA SILVERBERG

Understanding the U.S. workforce of more than 30,000 radiologists is crucial for institutions planning training programs, practices making staffing decisions and patients looking for a doctor who can meet their needs.

It is a subject that Richard Duszak, MD, professor and vice chair for Health Policy and Practice, Department of Radiology and Imaging Science, Emory University, Atlanta, and Andrew B. Rosenkrantz, MD, professor and director of Health Policy at New York University (NYU) Langone Health, have been researching for a number of years.

The most recent study by Drs. Duszak, Rosenkrantz and colleagues, “Generalist versus Subspecialist Characteristics of the U.S. Radiologist Workforce,” was published in the April 2018 issue of *Radiology*.

“Overall, the goal is making sure we right-size our radiology workforce and provide the best services to our patients at the right time,” Dr. Duszak said. “It all sounds a lot easier than it is.”

In their study, researchers determined that while there has been an increased focus on radiology subspecialization, 55 percent of radiologists predominantly practice as generalists.

“While there is a lot of talk about increasing radiologist subspecialization, we have to recognize that generalists still represent slightly over half of radiologists practicing today,” said Dr. Rosenkrantz, who also serves as section chief of abdominal imaging and director of prostate imaging at NYU.

The research combined a variety of public datasets to study 33,090 radiologists across the country who billed Medicare between 2012 and 2014. Researchers used a validated classification system to map services to seven subspecialties and quantify subspecialty-focused work on the basis of relative value units (RVUs). Radiologists with more than half of their billed work RVUs in a single subspecialty were designated subspecialists; the remainder of radiologists were classified as generalists.

Among radiologists practicing as majority subspecialists, neuroradiologists (10 percent of all radiologists) and breast imagers (8.4 percent) were the most common, the study showed.

“Right-Sizing” the Radiology Workforce

Dr. Duszak said that variables including where doctors are trained and choose to live versus where patients live and the types of services they need can lead to a mismatch in the radiologist/patient relationship. Dr. Duszak defines “right-sizing” as “matching patient needs to physician talent, no matter where they live.”

While many radiology thought leaders are pushing for more focused subspecialization, which can be successful at a large academic or research institution in an urban environment, that focus is not always the best approach in other parts of the country.

“If a patient lives in a rural area with only five radiologists covering a portion of a state, not everyone can be subspecialized,” Dr. Rosenkrantz said. “An idealistic answer may be that more radiologists are subspecialists. The realistic answer is that a robust generalist radiologist workforce is needed to provide proper coverage and imaging to people all over the country.”

Length of time practicing, the size and location of the practice, gender and academic status were all factors in a radiologist’s decision to subspecialize or not, the study showed. For example, radiologists with fewer years in practice were more likely to subspecialize.

And while slightly more than half of the nation’s radiologists practice as generalists, those doctors still devote about one-third of their time to a specific subspecialty as well, the study found.

“Radiologists who are just finishing

WEB EXTRAS

- 📄 Access the *Radiology* study, “Generalist versus Subspecialist Characteristics of the U.S. Radiologist Workforce,” at [RSNA.org/Radiology](https://www.rsna.org/Radiology).
- 📄 Access the *JACR* study, “A County-Level Analysis of the U.S. Radiologist Workforce: Physician Supply and Subspecialty Characteristics,” at [www.JACR.org](http://www.jacr.org).

“An idealistic answer may be that more radiologists are subspecialists. The realistic answer is that a robust generalist radiologist workforce is needed to provide proper coverage and imaging to people all over the country.”

ANDREW B. ROSENKRANTZ, MD



Duszak



Rosenkrantz

training today can look at this research and understand that they should be prepared to handle more than just that one subspecialty and that their jobs might change over time,” Dr. Rosenkrantz said.

Research Analyzes Radiology Workforce by Location

Another recent study by Drs. Duszak, Rosenkrantz and colleagues published in the *Journal of the American College of Radiology (JACR)* analyzed geographic variation in terms of the extent of subspecialization of radiologists in 3,143 U.S. counties.

The sample of radiologists in the *Radiology* and *JACR* studies were drawn from the same underlying data source and used the same criteria for designating a subspecialist and a generalist.

Authors determined that disparities do exist at the county level in terms of each community’s overall radiologist supply and in the extent of subspecialization of radiologists in those communities.

Results showed that counties with at least one Medicare-participating radiologist had significantly larger populations, lower rural percentages, higher household incomes, higher mammography screening rates and lower rates of premature deaths. Among counties with at least one Medicare-participating radiologist (41.5 percent), the average percent of radiologists in the counties being subspecialized was 19.2 percent to 26.5 percent.

“Although many counties had no Medicare-participating radiologists, a far larger number of counties lacked a radiologist with a majority subspecialty practice,” Dr. Duszak said.

Table 1

Subspecialty Distribution

Subspecialty	No. of Radiologists (n = 33 090)
Generalist	18 290 (55.3)
Neuroradiology	3353 (10.1)
Breast	2765 (8.4)
Abdominal	2533 (7.7)
Vascular and interventional	2322 (7.0)
Cardiothoracic	1963 (5.9)
Musculoskeletal	1234 (3.7)
Nuclear medicine	630 (1.9)

Note.—Distribution was determined by applying a 50% threshold of work RVUs in a single subspecialty. Numbers in parentheses are percentages.

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While not every county in rural America needs every type of subspecialized radiologist, such disparities may have an impact on patients, Dr. Duszak said.

“Our services are often unevenly distributed around the country, partially because the technology is sometimes so expensive that only centers of critical mass can afford to offer these services,” Dr. Duszak said.

“Both teleradiology and regional consolidation initiatives could help address this issue,” Dr. Rosenkrantz said. ❏

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Cost-Effective Analysis of Percutaneous Femoral Artery Access in Endovascular Aortic Repair

Jacob Scott Thurston, BS, a 2016 FUJIFILM Medical Systems/RSNA Research Medical Student Grant Recipient, sought to evaluate the costs of percutaneous access over surgical exposure of the femoral arteries from a hospital expenses perspective, as well as evaluate discrepancies in outcomes between the two methods.

Thurston, a medical student at Medical College of Wisconsin, Milwaukee, showed that adoption of Percutaneous Endovascular Aneurysm Repair (PEVAR) versus Endovascular Aortic Repair (EVAR) significantly reduced operating room times by 19 percent and hospital length of stay by 50 percent. The outcomes observed ultimately translated into a 23 percent reduction in hospital costs.

“We believe our findings can change the current paradigm of EVAR. If there are no contraindications, our data supports the use of percutaneous access over surgical exposure of the femoral arteries for not only a more cost-effective



Thurston

approach, but also to reduce the time a patient spends within the operating room and hospital. I hope that this is only the first of many research opportunities to contribute to the growing role of interventional radiology in the future of medicine,” Thurston said.

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Radiology in Public Focus

Press releases were sent to the medical news media for the following articles appearing in recent issues of *Radiology*.

Abnormal Brain Connections Seen in Preschoolers with Autism

Preschoolers with autism spectrum disorder (ASD), have abnormal connections between certain networks of their brains that can be seen using diffusion tensor imaging (DTI), according to a new study in *Radiology*.

For the study, researchers compared DTI results between 21 preschool boys and girls with ASD (mean age of 4-and-a-half years old) with those of 21 similarly aged children with typical development. Applying graph theory to the DTI results, the researchers measured the relationships among highly connected areas of the brain.

“While developments in brain imaging have enabled the discovery of abnormal brain connectivity in younger children with ASD, the phenomenon has not yet been fully investigated at the brain

network level,” said study co-author Lin Ma, MD, Chinese PLA General Hospital, Beijing.

Compared with the typically developed group, children with ASD demonstrated significant differences in components of the basal ganglia and paralimbic-limbic networks, systems that play a crucial role in behavior.

Global topologic patterns of white matter networks in children with ASD were significantly altered, as indicated by a shortened characteristic path length and increased global efficiency and clustering coefficient.

“The observed increase in connections between the paralimbic-limbic system and the occipital network demonstrated the important role of the

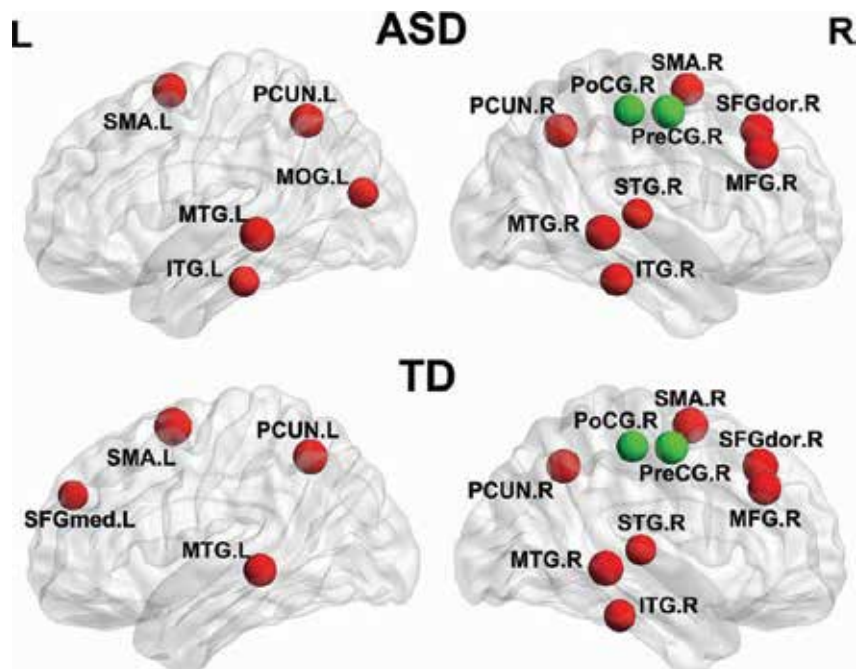
paralimbic-limbic system in childhood ASD,” Dr. Ma said. “Disconnections between these networks may be associated with an aberrant observation and imitation capacity in childhood ASD.”

The identification of altered structural connectivity in these networks may point toward potential imaging biomarkers for preschool children with ASD and may one day help guide treatments.

“The imaging finding of those ‘targets’ may be a clue for future diagnosis and even for therapeutic intervention in preschool children with ASD,” Dr. Ma said.

WEB EXTRAS

Access the study, “Alterations of White Matter Connectivity in Preschool Children with Autism Spectrum Disorder,” at [RSNA.org/Radiology](https://www.rsna.org/Radiology).



The distribution of hub regions in typical development (TD) and autism spectrum disorder (ASD) groups. Hub regions were defined as nodes with regional efficiencies at least one standard deviation higher than the average for the network by using three-dimensional rendering maps. These areas included association (red) and primary (green) regions.

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Fewer Recalls Associated with Higher Rates of Interval Breast Cancers

Lower screening mammography recall rates are associated with higher rates of breast cancers detected between screenings, or interval cancers, according to a new study in *Radiology*.

Researchers analyzed 5,126,689 screening episodes, or the period during which a set of breast screening activities for an eligible woman takes place, from 84 screening facilities in the U.K. National Health Service Breast Screening Program (NHSBSP). Data were drawn from a 36-month period with a three-year follow-up in women ages 50 to 70 years.

“The U.K. has established a maximum recall rate target of less than 7 percent for a patient’s first screening, also known as a prevalent screen, and less than 5 percent for incident screens, or those in which previous screening results exist,” said co-author Elizabeth S. Burnside, MD, MPH, from the University of Wisconsin School of Medicine and Public Health in Madison, WI. “However, no such consensus exists as to a minimum recall rate, below which additional cancers would be missed.”

The researchers found that lower recall rates correlated with higher interval cancer rates. In aggregate, 80 to 84 additional recalls would be required to avoid one interval cancer, a ratio that varied based on age group and prevalent screens versus incident screens.

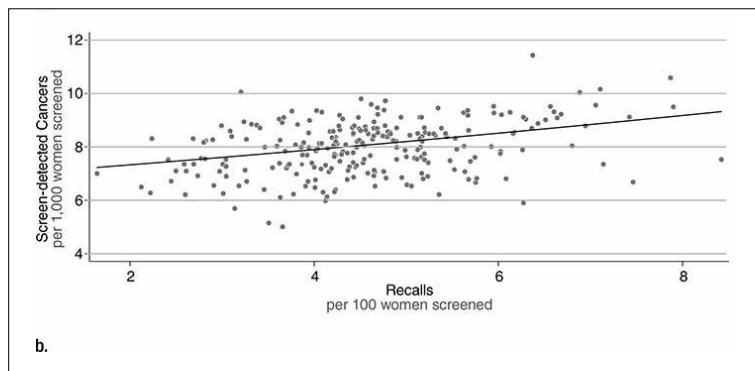
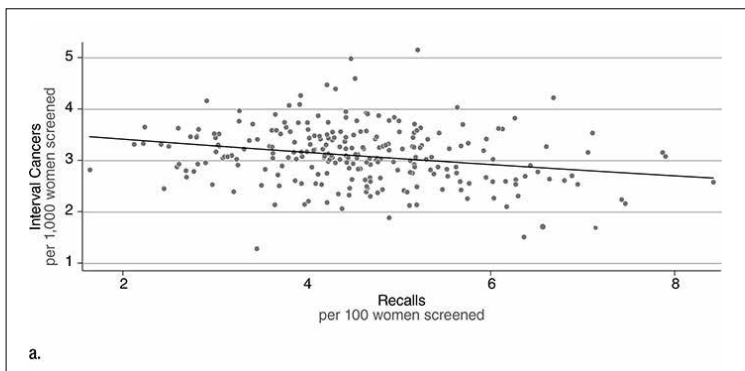
Screening mammography outcomes based on age demonstrated that both cancer detection rates and interval cancer rates were lower in younger age groups as expected, based on underlying breast cancer incidence according to age.

The study provides evidence of the potential importance of establishing and enforcing a lower threshold for recall rate. The study also underscores the crucial importance of comprehensive, accurate data collection of interval cancers in screening programs like the system in the U.K.

“A big-picture lesson in our study is the power of rigorous quality assurance infrastructure to help breast cancer screening programs learn from actual practice and use that information to make informed programmatic decisions for the future,” Dr. Burnside said. “This study documents the benefit of carefully tracking mammography use and outcomes as achieved in the NHSBSP.”

WEB EXTRAS

📄 Access the study, “Association between Screening Mammography Recall Rate and Interval Cancers in the UK Breast Cancer Service Screening Program: A Cohort Study,” at [RSNA.org/Radiology](https://www.rsna.org/Radiology).



Plots demonstrate association between recall to assessment rate and (a) interval cancer rate and (b) screening cancer detection rate. Points represent a year of screening mammograms in one of the 84 breast screening units. Line represents Poisson regression line.

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Media Coverage of RSNA

In February, 1,668 RSNA-related news stories were tracked in the media. These stories reached an estimated audience of 1.5 billion people.

Coverage included: *U.S. News & World Report*, *People*, *Philly.com*, WGN-AM (Chicago), Reuters, WebMD, *MSN.com*, *Drugs.com*, HealthDay, *Diagnostic Imaging*, *Auntminnie.com*, *DOTmed Business News*, *Radiology Business Journal*, *Radiology Today* and *Health Imaging & IT*.

RadiologyInfo.org – Physician Resources

Are you looking for resources you can use to amplify your patient-centered care? Visit the *RadiologyInfo.org* Physician Resources page for exam requisition forms, a radiation dose chart and links to printable *RadiologyInfo.org* procedure handouts. Check out the *RadiologyInfo.org* promotional posters and business cards, too. Save your time and reassure your patients with *RadiologyInfo.org*.

RadiologyInfo.org
For patients

Journal Highlights

The following are highlights from the current issues of RSNA's two peer-reviewed journals.

Detection and Characterization of Solid Pulmonary Nodules at Digital Chest Tomosynthesis: Data from a Cohort of the Pilot Swedish Cardiopulmonary Bioimage Study

Digital chest tomosynthesis (DTS) has been suggested as a low-dose alternative to CT for lung cancer screening, meta-static surveillance, follow-up of incidental nodules, and as a way to examine inconclusive findings on chest radiographic images.

In the June issue of *Radiology* (RSNA.org/Radiology), Carin Meltzer, MD, from Sahlgrenska Academy at the University of Gothenburg, Sweden and Oslo University Hospital, Ullevål, Norway, and colleagues investigate the performance of DTS for detection and characterization of incidental solid lung nodules.

A population study was conducted with 1,111 randomly selected participants (age range 50-64 years) who underwent a medical evaluation that included a chest CT; 125 participants met the criteria of having incidental nodules 5 mm or larger. DTS in conjunction with a follow-up CT were performed. Images were then assessed by four thoracic radiologists blinded to the true number of nodules in two separate sessions.

Overall detection rate ranges of CT-proven nodules 5 mm or larger and for 6 mm or larger were, respectively, 49 percent – 58 percent and 48 percent – 62 percent. Jackknife free-response area

Radiology

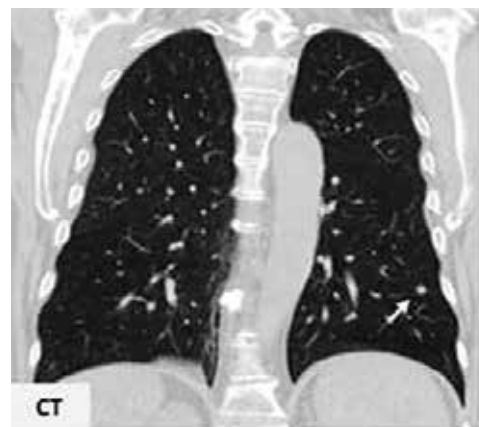
under the receiver operating characteristics curve figure of merit for detection of CT-proven nodules 5 mm or larger and for 6 mm or larger was 0.47 and 0.51, respectively and receiver operating characteristic area under the curve regarding recommendation for follow-up was 0.62 and 0.65, respectively.

The researchers conclude that routine use of DTS would result in lower detection rates and reduced number of small nodules recommended for follow-up. DTS might be suboptimal in clinical tasks that requires high sensitivity and specificity regarding detection and characterization of pulmonary nodules, such as screening and staging.

“The retrospectively high visibility combined with low radiation exposure and low risk of malignancy, could favor DTS as a modality for surveillance of known solid nodules. Further studies regarding this clinical task would be valuable to validate the modality in which specific size criteria for DTS could be considered,” the authors conclude.

Images in a 60-year-old woman examined at (a) CT and (b) digital tomosynthesis (DTS). A 7-mm nodule (arrow in a and b) marked with high confidence for both presence and indication for follow-up was observed at DTS by all readers.

(Radiology 2018;38;3:InPress) © RSNA 2018. All rights reserved. Printed with permission.



a.



b.



Listen to *Radiology* Editor David A. Bluemke, MD, PhD, discuss this month's research you need to know. Podcasts summarize the importance and context of selected recent articles. Subscribe today at RSNA.org/Radiology-Podcasts and never miss a single episode.

Highlights include:

- 📻 “Observed Deposition of Gadolinium in Bone Using a New Noninvasive in Vivo Biomedical Device: Results of a Small Pilot Feasibility Study,” Michelle L. Lord, BS, and colleagues
- 📻 “Systematic Review and Meta-Analysis of CT Features for Differentiating Complicated and Uncomplicated Appendicitis,” Hae Young Kim, MD, MS, and colleagues
- 📻 “Glioma Grade Discrimination with MR Diffusion Kurtosis Imaging: A Meta-Analysis of Diagnostic Accuracy,” Anna Falk Delgado, MD, PhD, and colleagues
- 📻 “The Incidental Splenic Mass at CT: Does It Need Further Work-up? An Observational Study,” Bettina Siewert, MD, and colleagues
- 📻 “Reduction in Thyroid Nodule Biopsies and Improved Accuracy with American College of Radiology Thyroid Imaging Reporting and Data System,” Jenny K. Hoang, MBBS, MHS, and colleagues

Radiology
PODCASTS

Tumors in von Hippel–Lindau Syndrome: From Head to Toe

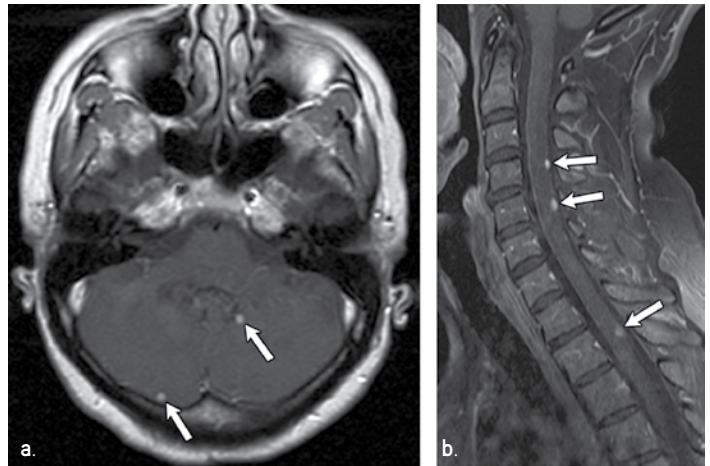
Von Hippel–Lindau syndrome (VHL) is an autosomal-dominant hereditary tumor disease that arises owing to germline mutations in the VHL gene, located on the short arm of chromosome 3. Patients with VHL may develop multiple benign and malignant tumors involving various organ systems. Familiarity with the clinical and imaging manifestations of the various VHL-related tumors is important for early detection and guiding appropriate management.

In the May–June issue of *RadioGraphics* (*RSNA.org/RadioGraphics*), Dhakshinamoorthy Ganeshan, MD, University of Texas MD Anderson Cancer Center, Houston, and colleagues discuss the molecular cytogenetics and clinical manifestations of VHL, review the characteristic multimodality imaging features of the various VHL-related tumors affecting multiple organ systems, and discuss the latest advances in management of VHL.

Multiple benign and malignant tumors may involve various organ systems, including retinal hemangioblastomas (HBs), central nervous system (CNS) HBs, endolymphatic sac tumors, pancreatic neuroendocrine tumors (NETs), pancreatic cystadenomas, pancreatic cysts, clear cell renal cell carcinomas (RCCs), renal cysts, pheochromocytomas, paragangliomas and epididymal and broad ligament cystadenomas.

While some of the VHL-related manifestations, such as renal and pancreatic cysts, are frequently asymptomatic, other manifestations such as retinal and CNS HBs, RCCs, pheochromocytomas and pancreatic NETs may be associated with significant morbidity and mortality.

“Early detection plays a key role in the optimal management of this condition. Radiologists should be aware of the imaging features of the various tumors that can occur in VHL. Familiarity with the current recommendations for VHL surveillance is also important, as these patients require lifelong follow-up,” the authors write.



Multiple cerebellar and spinal hemangioblastomas (HBs) in a 38-year-old man with von Hippel–Lindau syndrome (VHL). (a) Axial MR image of the brain shows small enhancing nodules (arrows) in the cerebellum, consistent with cerebellar HB. Although the patient did not have symptoms, MR imaging of the whole spine was performed. (b) Sagittal MR image of the cervical spine shows numerous tiny enhancing masses (arrows) in the spinal cord, consistent with spinal HB.

(*RadioGraphics* 2018;287:3:849-866) © RSNA 2018. All rights reserved. Printed with permission.

RadioGraphics

This article meets the criteria for *AMA PRA Category 1 Credit*. SA-CME is available online only.



Listen to *RadioGraphics* Editor Jeffrey S. Klein, MD, and authors discuss the following articles from recent issues of *RadioGraphics* at [RSNA.org/rg-podcasts](https://www.rsna.org/rg-podcasts).

RadioGraphics
PODCASTS

- “Advanced Imaging Techniques in the Evaluation of Colorectal Cancer,” Roberto García-Figueiras, MD, PhD, and colleagues.
- “Imaging of Intestinal and Multivisceral Transplantation,” Mitchell A. Rees, MD, and colleagues.

Education and Funding Opportunities

Clinical Trials Methodology Workshop

Application Deadline
June 15

Over the course of the six-day workshop, participants will learn how to develop protocols for the clinical evaluation of imaging modalities. Each trainee will be expected to develop a protocol for a clinical study, ready to include in an application for external funding.

The workshop will be held in the San Diego area (hotel to be announced) Jan. 5-11, 2019.

There are no fees associated with the workshop. For online applications and additional information, visit RSNA.org/CTMW.

Introduction to Academic Radiology for Scientists (ITARSc)

Application Deadline
July 1

Postdoctoral fellows and early-stage researchers in biomedical engineering and the imaging sciences, who received their degrees within the past six years, are invited to apply for this opportunity held during RSNA 2018.

The program consists of a combination of dedicated programming for ITARSc participants and shared sessions with participants of the ITAR program. Selected participants will receive a \$1,000 stipend to offset travel and hotel costs as well as free registration for the RSNA annual meeting. Applications are available at RSNA.org/ITARSc.



Advanced Course in Grant Writing

Application Deadline
July 1

Applications are now being accepted for this course designed to assist participants prepare and submit a National Institutes of Health, National Science Foundation, or equivalent, grant application. This course is beneficial for junior faculty members in radiology, radiation oncology or nuclear medicine programs. The course, held at RSNA Headquarters in Oak Brook, IL, will consist of four 1/2-day sessions:

- Session I: Sept. 14-15, 2018
- Session II: Oct. 26-27, 2018
- Session III: Jan. 25-26, 2019
- Session IV: May 3-4, 2019

Accepted participants are responsible for travel expenses for each session. Hotel accommodations will be provided by RSNA. There are no fees associated with this course. For more information and an application, visit RSNA.org/AGW.

Introduction to Academic Radiology (ITAR)

Application Deadline
July 15

This program exposes second-year residents to academic radiology and demonstrates the importance of research in radiologic sciences. Successful applicants will be assigned to either a seminar held during the 2018 RSNA annual meeting in Chicago, Nov. 25-Nov. 29, or the ARRS annual meeting in Honolulu, HI, May 5-10, 2019.

A \$1,000 award will be made to the departments of accepted applicants to be used to help advance the applicants' academic careers. There are no fees associated with this workshop. For more information and an application, visit RSNA.org/ITAR.

RFAs Available for New R&E Education Grants

Request for Applications (RFAs) for the new RSNA Research & Education (R&E) Foundation education grants open June 1, and the pre-application period closes Sept. 3. These grants will be awarded in

Education Innovation Grant

Amount: Up to \$175,000 per year for three years (\$525,000 maximum)

Topic: Point-of-care education

Education Development Grant

Amount: \$30,000 to \$100,000 per year for up to three years (\$300,000 maximum)

Topics:

- Imaging cancer
- Patient education
- Physician burnout
- Women and minorities in radiology leadership



For instructions and to apply, go to RSNA.org/Foundation

Value of Membership

Group Billing Offers an Easier Way to Pay Your RSNA Dues

To increase efficiency and ease of use in the membership renewal process, RSNA offers group billing as a hassle-free way for institutions or groups to pay for all their doctors' membership dues with one invoice.

Group billing eliminates the need for administrative or finance departments to wait for each member to submit individual dues invoices. Group billing

allows all members' renewals to be paid at once, via credit card or check and memberships are active as soon as the payment is applied.

Currently, RSNA provides group billing to more than 100 institutions and groups of all sizes, whether your organization has five or 150 members.

Group billing is just one of the many ways that members can pay their RSNA

dues, along with individual renewal and auto-renewal.

If group billing might be an option for your institution, share this article with your administrator or finance department. For more information or to set up a group billing account, contact RSNA membership staff at membership@rsna.org.

Residents & Fellows Corner

Studying for the ABR Core Exam? *RadioGraphics* Highlights Important Articles

Members-in-training who are studying for the diagnostic radiology examination administered by the American Board of Radiology (ABR) might want to bookmark the *RadioGraphics* online index of significant articles.

Collected under headings based on areas of expertise, the journal articles were chosen by experts in the field as covering material particularly relevant to each section of the exam.

Access the *RadioGraphics* ABR Diagnostic Radiology Core Exam Study Guide Article Index from the journal home page at RSNA.org/RadioGraphics.

RadioGraphics

Annual Meeting Watch

RSNA 2018 HICT Session Call for Abstracts Now Open

The process for submitting abstracts for the High Impact Clinical Trial (HICT) session at RSNA 2018 is now open. The session features the latest cutting-edge clinical science and research. It will provide a forum for practice-changing clinical research across radiology with the goal to present the most significant work in the field.

Submissions qualifying for consideration include:

- First presentations of the primary endpoints of a trial
- Presentations of new data or secondary analyses of a trial where the primary data has been presented previously
- A new registry or new data/analyses from a registry
- The latest and “hottest” findings in translational imaging sciences that have immediate clinical implications

Submission deadline is Aug. 1 at noon Central Time. Authors of accepted submissions will be notified Aug. 15. For more information, visit RSNA.org/Annual-Meeting.

Annual Meeting Watch

Reserve Your Hotel Room through RSNA

Begin planning for RSNA 2018 by reserving your hotel room in Chicago. RSNA has negotiated special room rates for meeting attendees. Additional savings can be earned by reserving your hotel room before Sept. 12. Hotel information is available at RSNA.org/hotel-reservations.

Why reserve with RSNA?

- We offer exclusive rates for RSNA 2018 attendees.
- Our hotel partners offer a wide range of options from economy to 5-star accommodations.
- Earn hotel loyalty points.
- Dedicated customer service professionals work on your behalf to make sure your reservation is right and we assist with any hotel issues, questions or concerns.



**OBSERVE
BEFORE
YOU
RESERVE!**

Experient is the only certified partner to reserve your 2018 RSNA hotel rooms! Be aware of fraudulent and counterfeit websites—only reserve your RSNA hotel reservations through Experient, our trusted partner since 1980.



RSNA has designated ESA Voyages and ACE Marketing as the official international travel agencies offering travel packages to the annual meeting. Contact RSNA hotel services at housing@rsna.org for additional information.

RSNA 2018 Registration Opens July 18

Mark your calendar for July 18 and to complete your registration for this year's RSNA annual meeting. Meeting Central (Meeting.RSNA.org) is the comprehensive tool for planning your visit to RSNA 2018 including the meeting program, exhibitor list, and more. Visit RSNA.org/Annual-Meeting to register and for up-to-date information about RSNA 2018.

Access the RSNA Meeting Program Online in 2018

In order to reduce our environmental footprint, RSNA will transition from a print to a digital meeting program beginning in 2018, offering the most important meeting information in these formats:

- **Meeting Central** (Meeting.RSNA.org): Explore the meeting program, review the roster of technical exhibitors and build your personalized schedule on My Agenda.
- **The RSNA 2018 Meeting App:** Browse the meeting program, access

maps to navigate McCormick Place and customize your daily meeting schedule with My Agenda. The app will be available in October via the App Store and Google Play.

While the Program in Brief will no longer be available in print, RSNA will continue to publish the onsite Pocket Guide, an easy-to-use reference to course and event information, floor plans at McCormick Place and transportation and dining.



Important Dates for RSNA 2018

July 18 Registration opens for all attendees

July 18 Program available online in Meeting Central

Oct. 26 Advance Registration Deadline; after this date rates increase \$160 for most categories

Oct. 27 Canceling a hotel reservation as of this date will result in the forfeiture of the hotel deposit equal to one night's room and tax

Nov. 25 – 30 104th Scientific Assembly & Annual Meeting

RSNA 2018
TOMORROW'S
RADIOLOGY TODAY
NOVEMBER 25-30

Member Spotlight

Ramji R. Rajendran, MD, PhD

Dr. Rajendran is a radiation oncologist at the Cancer Institute at Alexian Brothers Medical Center, Elk Grove Village, IL. He completed a combined MD/PhD program at the University of Illinois at Urbana-Champaign, and did his internship at Penn Presbyterian Medical Center and his residency in radiation oncology at the Hospital of the University of Pennsylvania, Philadelphia. He is a co-chair of the RSNA-ACR Public Information Website Committee and a member of the RSNA Public Information Advisors Network.



What or who sparked your interest in radiology oncology?

I completed my MD/PhD training through the University of Illinois Medical Scholars Program, which included a radiation oncology component through the Beckman Institute. It was at that time I met my first and most significant mentor, Theodore (Ted) Phillips, MD, who was the chair of the Department of Radiation Oncology at UCSF. When I expressed an interest in his research on ocular melanoma, he was willing to take me on as a second-year medical student. I spent three months at UCSF on scholarship doing research with Dr. Phillips, and that was how I became interested in radiation oncology as a medical student.

During that time I worked with Patricia (Penny) Sneed, MD, helping with technical data analysis, and Kavita Mishra, MD, who continues that research today. I truly would not be where I am now without those early mentors.

What would you describe as the biggest professional challenge you face today?

Unfortunately the changing insurance landscape makes it increasingly difficult to ensure our patients receive the most appropriate treatment. There are so many more hurdles to overcome.

What is the biggest reward?

I work in a large private practice group, which allows me to help many patients and offer all types of available treatment options. The ability to make a big impact on patients' lives at such a critical time for them is an honor. I feel privileged to have

the opportunity to treat in both the curative and palliative setting and improve quality of life for our patients.

How does volunteering for RSNA help you in your daily practice?

As a first-year attending radiation oncologist, I was nominated to the RSNA Public Information Website Committee by Dr. Ted Phillips. I have been especially interested in how patient information should be presented to the public, so that was a good fit. I love having the ability to relieve worries and stress about tests and treatments, and having the *RadiologyInfo.org* platform allows us to benefit large groups of patients. I am able to amplify my voice, helping many more than just the patients under my personal care.

I also learned new skills that helped me contribute to developing the website for my practice group, *Chicagocancer.org*. And most recently, my daughter Ananya had a chance to contribute to a new *RadiologyInfo.org* for Kids project being developed with RSNA. She added her voice to a video about her own experience receiving an MRI examination, which was really a great opportunity for both of us that will also help many more patients.

How do you like to spend your free time?

I like to spend time with my wife and three children. I love to travel, cook and exercise. I played tennis in high school and with a club when I was in graduate school, and I still enjoy playing whenever I find the time.

COMING
NEXT
MONTH

Next month, *RSNA News* will report on happenings from the recent meeting of the RSNA Resident & Fellow Committee at RSNA headquarters.

RSNA® 2018
TOMORROW'S
RADIOLOGY TODAY
NOVEMBER 25-30



TOMORROW'S RADIOLOGY TODAY

Save the Date

Registration Opens July 18!

[RSNA.org/Annual-Meeting](https://www.rsna.org/Annual-Meeting)

104th Scientific Assembly and Annual Meeting
November 25-30 | McCormick Place, Chicago