RSNA 2018 TOMORROW'S

RADIOLOGY TODAY

MONDAY

THE OFFICIAL NEWSPAPER OF THE RSNA ANNUAL MEETING • ONLINE AT RSNA.ORG/BULLETIN

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EXCLUSIVE ONLINE CONTENT

Research Compares Impact of ACA to Revised USPSTF Guidelines on Breast Cancer Screening Rates







Embracing Technology Will Lead Radiology to the Epicenter of Patient Care

The rise of technologies, such as artificial intelligence and machine learning, will never replace radiologists, but instead provide the opportunity to enhance and transform the practice of radiology to the benefit of both patients and medicine, according to RSNA President Vijay M. Rao, MD.



Rao

"No matter where I travel, I see the hype, the hope and the fear created by the rapid rise of technologies, such as artificial intelligence and machine learning," Dr. Rao told the audience in Arie Crown Theater for Sunday's Opening Session. I believe more firmly than ever that AI has the potential to enhance our profession and transform the practice of radiology worldwide. It will allow radiologists to spend more time on initiatives that will benefit both patients and physicians.

Vijay M. Rao, MD

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radiologists to spend more time on initiatives that will benefit both patients and physicians."

In her President's Address, Dr. Rao looked into the future to imagine how the

growth in digital imaging and the overall explosion of data now available in medicine will address some of the current challenges faced in radiology.

Exhibitor Products

She called for a rebranding of reading rooms into digital diagnostic data hubs where clinical teams could gather, or even participate virtually, to make patient management decisions as a group.

The diagnostic data hub could be where radiologists would rely on AI to aggregate the current imaging findings with those of

prior images from other modalities, along with lab results, biopsy findings and key aspects of the history and physical exam of the patient, according to Dr. Rao.

"Creating this type of data hub could lead to a diagnosis that might otherwise be missed if one just considered the current imaging exam in isolation," Dr. Rao said.

CONTINUED ON PAGE 14A

Creative Use of Technology Key to the Future of Radiology

Through the creative use of informatics, business analytics and artificial intelligence (AI), radiologists can increase their value and job satisfaction while expanding their profile with patients, according to a leading expert who delivered the Annual Oration in Diagnostic Radiology Sunday at the Arie Crown Theater.

Michael P. Recht, MD, chair of the Department of Radiology at NYU Langone Health in New York City, began his talk, "Artificial Intelligence, Analytics, and Informatics: The Future is Here," with a look back to the days when the reading room was the hub of the hospital and radiologists were "the doctors' doctors" with routinely high rates of job satisfaction. Then, after playing a clip of Bob Dylan singing "The Times They are a-Changing," Dr. Recht described how developments like decreased reimbursements and the rapidly developing field of AI have pushed the profession to a point where the rewards of the job are being overwhelmed by the pressures of an increasingly demanding clinical workload.

Nevertheless, the future is far from bleak, Dr. Recht suggested, as long as radiologists recognize that technol-



ogy can drive positive change, allow-

ing them "to go back to the future and

return to their central role in the clinical

Recht

team."

I believe that through the creative use of technology we can create new value and help return radiologists to their central role in the clinical care team, thereby increasing our purpose and our sense of satisfaction. Informatics innovations like virtual rounds and virtual consults, enhanced imaging reports and collaborative imaging pathways can help radiologists increase their visibility and value while saving time, Dr.

Michael P. Recht, MD

Recht said. He strongly advised departments to consider adding reading room coordinators to handle phone calls and interface with the IT department.

"This has been a great timesaver for our radiologists and I can tell you that of all the IT innovations we have introduced, this is



Always Discover, Always Develop Be an RSNA Member.

Radiologists look at problems and discover solutions. It's what we're good at.

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LEARN: free CME, online courses, and webinars and other critical education opportunities that keep you up-to-date with the latest advancements in the field. **EXPAND**: free advance standard registration to the RSNA annual meeting, the most-important meeting of radiology professionals, industry leaders and researchers in the world. ADVANCE: Subscriptions to publications *Radiology* and *RadioGraphics* and three journals launching in 2019: *Radiology: Artificial Intelligence, Radiology: Cardiothoracic Imaging* and *Radiology: Imaging Cancer.*

Always Discover, Always Develop **RSNA.org/Membership**

8:30 AM – 4:30 PM CT | *membership@rsna.org* 1-877-RSNA-MEM (776-2636) | 1-630-571-7873 (*outside the U.S. or Canada*)

Monday At a Glance



Arie Crown Theater Plenary Lecture: Can Clinicians Lead Radical Redesign? Dr. Berwick will explore the basic principles of radical new designs that are necessary in health care and discuss how clinicians can take the lead in nurturing these

Monday Plenary

Donald M. Berwick, MD

Session

1.30-2.45

Berwick

designs into reality. A leading advocate for high-guality health care, Dr. Berwick is president emeritus and senior fellow of the Institute for Healthcare Improvement in Boston.

RSNA Honorary Membership Presented Today

Monday's Physics Tip

Image quality is task-dependent. Specialty scans where the task is narrowly defined are often prime targets for dose reduction.



7:15-8:15

RSNA Diagnosis LiveTM You Take the Red Pill — You Stay in Won- derland and I Show You How Deep the Rabbit Hole Goes (E451B)	Series Co 10:30-NC Scientific
Controversy Session Screening Breast MRI: Abbreviated ver- sus Full Protocol (E350)	Australia Clinical I Oncology
Hot Topic Session 3D Printing in Urologic Oncology (E450A)	BOOST: and Onco Tomorroy
8:30-5:00	CNS (S10
Molecular Imaging Symposium (S405AB) 8:30-10:00	Gynecolo 11:00-2:0 Machine
Educational Courses	tations (N
View the full program and add sessions to My Agenda on the RSNA 2018 App or at	12:15-1:15

My Agenc Meeting.RSNA.org. 9.20 NO ON urses)ON Paper Sessions and New Zealand Present Radiology and Radiation (E351) **Bolstering Oncoradiologic** oradiotherapeutic Skills for)3AB) gic (S103CD) 0 Learning Theater Presen-North Building Hall B)

Scientific Poster Discussions (Learning Center)

DailyBulletin

The RSNA 2018 Daily Bulletin is the official publication of the 104th Scientific Assembly and Annual Meeting of the Radiological Society of North America. Published Sunday, November 25–Thursday, November 30.

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Contrast-Enhanced Digital Mammography May Reduce Benign Breast Biopsies

By Nick Klenske

In the U.S., more than 1 million breast biopsies are performed annually, yet less than 25 percent of these biopsies yield a diagnosis of breast cancer.



Zuley

One reason for this low predictive value is that most lesions categorized as needing biopsy are of relatively low suspicion. These include lesions classified as 4A, where probability of malignancy ranges from >2 to <10 percent, or 4B, where probability of malignancy ranges from >10 to <50 percent under the Breast Imaging Reporting Data System (BIRADS).

Speaking at a Sunday session, Margarita Zuley, MD, a radiologist at the University of Pittsburgh Medical Center, said anatomic characterization of lesions using non-enhanced methods such as mammography, tomosynthesis (3D mammography) and ultrasound (US) are insufficient to significantly improve the positive predic-



LMLO 2D (image 2.0) and 3D (image 2.1) demonstrate an indeterminate focal asymmetry rated as BIRADS 4A (white arrows). LMLO CEDM (image 2.3) demonstrates no enhancement in the area of concern. Biopsy revealed a benign concordant result.

Contrast-enhanced digital mammography may be an important new tool for eliminating unneeded biopsies of some actually benign breast lesions without having a significant impact on sensitivity.

tive value (PPV) of a biopsy. On the other hand, contrast-enhanced digital mammography (CEDM) has been shown to have a high negative predictive value for classifying indeterminate mammographic or US findings as benign when no enhancement is seen.

Margarita Zuley, MD

In her study, Dr. Zuley investigated whether CEDM used during diagnostic evaluation could increase biopsy PPV for soft tissue density lesions by reducing benign biopsies while not impacting the biopsy rate of cancers. Patients were prospectively enrolled into an International Review Board-approved trial that included a research CEDM study immediately prior to biopsy of their 4A or 4B imaging-identified lesions.

"Our study looked at mammography, tomosynthesis or US identified lesions that were masses, asymmetries or areas of distortion with or without calcifications," Dr. Zuley said.

Researchers then performed a reader study that included eight radiologists reviewing 60 cases three times, rating each using the BIRADS scale. Initially, readers rated the mammogram and tomosynthesis only, then re-rated the case after adding US.

The team then re-rated the case again with the addition of CEDM. Looking at the performance of each rating, Dr. Zuley noted that CEDM significantly improved appropriate use criteria (AUC) over the performance of mammogram, tomosynthesis and US.

Although larger studies are needed to validate this trial, Dr. Zuley said the potential impact of these results for patients - not to mention the economic considerations - is significant because the majority of biopsies in the U.S. are performed for lesions classified as 4A and 4B.

"Contrast-enhanced digital mammography may be an important new tool for eliminating unneeded biopsies of some actually benign breast lesions without having a significant impact on sensitivity," Dr. Zuley said. "If validated, this paradigm could alter the benefit/risk ratio of screening mammography."

R&E Foundation Nurtures Radiology's Future

By Shelly Taylor

Addressing the audience in Arie Crown Theater on Sunday, N. Reed Dunnick, MD, chair of the RSNA Research and Education (R&E) Foundation delivered an update on Foundation activities.



Dunnick

FOUNDATION "Nurturing both research and education is key to ensuring that the specialty

thrives," Dr. Dunnick said. He recognized former R&E grant recipients Drs. Deborah Levine, Carolyn Meltzer and David Yousem, whose remarkable professional accomplishments will be honored this week. Also Dr. Sarah Donaldson, whose tremendous leadership and support guided the Foundation over the years, will be awarded an RSNA Gold Medal.

Dr. Dunnick noted the importance of continued support for the Foundation to sow more seeds for future leaders of the specialty. "Current R&E grant recipients are envi-

sioning tomorrow's radiology today, and

they will shape the future of the specialty," he said.

One example is Dania Daye, MD, PhD, who is applying quantitative image analysis and machine learning techniques to discover ways to optimize prognosis prediction and treatment decisions for metastatic colorectal cancer patients through minimally invasive methods. Dr. Daye's research is funded by an RSNA Research Resident Grant.

He also highlighted Rupa Radhakrishnan, MD, who secured an RSNA Research Seed Grant to identify MRI biomarkers that can help predict withdrawal symptoms in infants exposed to opioids.

These forward-looking projects will help ensure radiology is at the forefront of medical discovery in the years to come. In fact, the Foundation invested \$4 million this year, for the third consecutive time, in researchers like Drs. Daye and Radhakrishnan.

"Healthy growth, however, requires constant assessment and cultivation," Dr. Dunnick said.

To that end, the R&E Foundation Board of Trustees reimagined the education grant program this year to align the awards with RSNA's education goals. New grants will focus on developing products that can be made available to RSNA members and

become valuable resources for the next generation of radiologists.

A recent R&E project is already available through the RSNA Education Center. Richard Duszak, MD, developed a series of

Economics and Health Care Policy online courses with the support of an R&E Foundation education grant.

Dr. Dunnick thanked the many individual, corporate and private practice donors who make this level of funding possible and encouraged members to join those donors in supporting the Foundation. He noted that grant recipients report receiving an additional \$50 in funding from other sources for every \$1 awarded by the Foundation.

"That remarkable return on investment should give you confidence in putting your support squarely behind the Foundation's programs," Dr. Dunnick said.

Meeting attendees can learn about the innovative projects funded by the

R&E Foundation and make a gift by visiting the R&E Foundation booth in the Connections Center or by visiting RSNA.org/ Foundation.



Monday's American Asso Physicists in M Physics Quiz What is the typical effective dose for a screening mammogram? [Answer on page 14.]

Where Will RSNA Spotlight Courses Take You?

Practical insights. Customized content. Only from RSNA.

Mark Your Calendar

- April 12–13, 2019 | Santiago, Chile Explore important topics in chest imaging in this Spanishlanguage course.
- May 3–4, 2019 | Paris, France Discover the role AI can play in your radiology practice.
- May 31–June 1, 2019 | San Francisco, USA Learn how AI will affect clinical practice in this 2-day course: Radiology in the Age of AI.

Visit RSNA.org/Spotlight



RSNA Honorary Members

Honorary membership is presented for significant achievements in the field of radiology. Today RSNA will award three honorary memberships during the afternoon plenary session.

Sneh Bhargava, MD

An internationally respected leader in radiology education, Sneh Bhargava, MD, is the medical director of Sitaram Bhartia Institute of Science and Research and chair of the department of radiology at Dharamshila Narayana Super Specialty Hospital, both in New Delhi. She is professor emeritus of the Department of Radiology at All India Institute of Medical Sciences (AIIMS), New Delhi.

Dr. Bhargava received her medical degree from Lady Hardinge Medical College, New Delhi, and completed her fellowship in diagnostic radiology at Westminster Medical School (now the Imperial College School of Medicine), London. She returned to India with a DMRD awarded from the Royal College of Physicians and Surgeons.

Dr. Bhargava joined AIIMS as an assistant professor and later became professor and chair of the Department of Radiology. She was involved in the development of the department's post-graduate medical school program, in which she worked to set standards for radiology education throughout India. She also advocated for the first CT scanner and ultrasound for AIIMS, which created new avenues of medical assistance for local patients as well as patients from Nepal, Bangladesh and Sri Lanka.

Named the first female director of AIIMS and the only one in its 60 year history, Dr. Bhargava also served as chair of the hospital board of directors. Over her 30 year career at AIIMS, she helped establish the departments of neuroradiology, cardiovascular radiology, oncoradiology, pediatric radiology and interventional radiology. She also established the Medical Education and Technology Center at AIIMS, designed to offer medical students with information about learning to teach in medicine. She also was part of the team that established The National Medical Journal of India.

Dr. Bhargava is a former president of the Indian Radiology and Imaging Association (IRIA) and has served as chair of several committees for the Medical Council of India. She has received numerous lifetime achievement awards including the Millennium Award 2000 from IRIA. She also received the Padma Shri, one of the highest civilian awards in India, for her distinguished contributions to medicine.

Paul M. Parizel, MD

An internationally recognized leader in the area of neuroradiology and MRI, with a focus on integrating scientific research with patient-oriented clinical applications, Paul M. Parizel, MD, PhD, is chair of the Department of Radiology at the Antwerp University Hospital, Belgium and founder of the neuroradiology division at the hospital. He is also a professor of radiology and a member of the board of trustees at the University of Antwerp.

Dr. Parizel received his undergraduate, medical and doctorate degrees from the University of Antwerp, Belgium, where he also completed his residency. He completed his clinical fellowship in neuroradiology at Massachusetts General Hospital, Harvard Medical School, Boston and at Hôpital Erasme, University of Brussels, Bruxelles. His research interests focus on neuroradiology and MRI, with an emphasis on integrating scientific research with patient-oriented clinical applications.

Dr. Parizel served as president and chair of the Board of Directors of the European Society of Radiology (ESR) and is currently the past-president. He also serves as the ESR representative to the RSNA Committee on International Radiology Education. He is a former president of the European Society of Neuroradiology and the Royal Belgian Radiological Society, and a founding member of the Russian National Society of Neuroradiology.



A worldwide lecturer on neuroradiology, Dr. Parizel's expertise has been recognized with honorary memberships in numerous international radiology and neuroradiology societies, including most recently the American Society of Neuroradiology, the Iranian Society of Radiology and the Algerian Society of Radiology and Imaging.

Dr. Parizel's accomplishments have earned him international recognition, including receiving the scientific prize of the European Society of Neuroradiology. In 2018, he was awarded the Swiss Society of Radiology's highest honor, the Schinz Medal, recognizing particular merit in the field of radiology.

In 2019, Dr. Parizel will begin a new appointment as the David Hartley Chair of Radiology at the University of Western Australia and a part-time clinical appointment at Royal Perth Hospital, both in Perth, Australia.

Jacob Sosna, MD

An international leader in advancing clinical applications of abdominal imaging with cutting-edge CT technology, Jacob Sosna, MD, is the chair of the division of radiology at Hadassah Hebrew University Medical Center in Jerusalem, Israel. He is the current president of the Israel Radiological Association (ISRA).

Dr. Sosna earned his medical degree from the Sackler Faculty of Medicine of Tel Aviv University in Israel and completed his residency at Hadassah Hebrew University Medical Center. He completed his fellowship in abdominal imaging and advanced cross-sectional imaging at Beth Israel Deaconess Medical Center, Boston.

He began his career by returning to Hadassah Hebrew University Medical



Parizel

Center (Hadassah) as a senior radiologist, head of CT and director of the 3D Imaging Laboratory. In 2011, he was named chair of radiology and in 2016, was named director of the imaging and nuclear medicine division. As the radiology research coordinator at Hadassah, he established and leads the Experimental CT Laboratory and serves as a co-director of the Applied Radiology Laboratory. He also serves as the co-director of the Wohl Center for Translational Research and Pre-Clinical Imaging at Hadassah. Dr. Sosna is also vice dean of the Hebrew University Hadassah Faculty of Medicine.

Recognized for his educational outreach in radiology throughout the Middle East and around the world, Dr. Sosna was recently awarded an honorary fellowship from the American College of Radiology and an honorary membership from the Croatian Society of Radiology.

In addition to his role as president of ISRA, Dr. Sosna set the standards for radiology in the Middle East by serving as chair of the scientific committee for its annual meeting for four years. He also is a member of the Israel Imaging National Council through the Israeli Ministry of Health, where he serves as chair of the subcommittee on hybrid imaging and the subcommittee on imaging standards. Dr. Sosna is a member of the executive committee of the accreditation council of the Israel Medical Association.

Dr. Sosna was the 2006 RSNA Eyler Editorial Fellow and received a 2012 RSNA Honored Educator award for his work to further educational scholarship in radiology. He serves on the editorial board of Radiology as a consultant to the editor and was previously an associate editor of Radiology. He also serves as a RadioGraphics reviewer.

Cutting–Edge Radiology Topics Featured in Special Interest Sessions

The RSNA Board of Directors has determined these courses to be of particular importance, and increased audience interest is expected. All courses are presented from 4:30 to 6 p.m. today.

Imaging Cognition 2018: Addiction ROOM E353C

Sessions cover the increasingly important role of radiology in understanding the science of imaging as it relates to studying addiction. After an introduction on "Addiction in America 2018," sessions will focus in PET, fMRI and MR spectroscopy in addiction, concluding with a panel discussion.

Quantitative Imaging Applications in Screening, Treatment Selection, and Treatment Assessment - The Need for Standardization in the Era of Personalized Medicine **ROOM S54AB**

Presenters will discuss opportunities and advantages of quantitative imaging biomarkers in clinical research. The session will highlight initiatives of the RSNA Quantitative Imaging Biomarkers Alliance (QIBA) and other quantitative imaging

efforts seeking to translate quantitative imaging measures from academic centers of excellence to clinical trial applications to patient care in the era of precision medicine.

Demystifying Machine Learning and Artificial Intelligence for the Radiologist **ROOM E451A**

Presenters will address the current concerns of radiologists, present cutting-edge research and provide insight into the impact of machine learning and artificial intelligence on the future of radiology. The session will conclude with a Q&A with presenters.

High-Value MRI: Updates from the February 2018 ISMRM-RSNA Co-provided Workshop ROOM E450B

The session offers a review of the RSNA/ International Society for Magnetic

Resonance in Medicine (ISMRM) workshop on High-Value MRI. Sessions will focus on clinical advances that are achievable, meaningful and impactful in moving the value of MRI forward.

Academy for Radiology and Biomedical Imaging Research Imaging Shark Tank Session ROOM S502AB

A panel of experts in IP, venture capital and industry will discuss how investigators can best present translational research and technology ideas to the industry and alternate non-governmental funding sources.

Integrated Diagnostics-Combining Genomics, Pathology and Radiology: The Future Now **ROOM N226**

Presenters will discuss the concept of integrated diagnosis, which combines radiology, pathology and genomics into an innovative diagnostic tool.

High Impact Clinical Trials

ROOM N229

Late-breaking clinical trials selected for their significant contributions to radiology research will be discussed:

- · Efficacy and Safety of Transdermal, Sublingual, and Oral Nitroglycerin Administration for Coronary CT Angiography: Results of a Prospective Randomized Trial
- Optoacoustic Imaging is Helpful in Predicting Breast Cancer Molecular Subtypes
- · Safety and Tolerability of High-Specific-Activity I-131 MIBG (AZEDRA®) in Patients with Iobenguane Scan Positive Cancers: A Pooled Analysis Across **AZEDRA** Clinical Studies







Three New RSNA Journals Coming in 2019!

Radiology



Imaging Cancer





Submissions Now Open:

Radiology: Artificial Intelligence and Radiology: Cardiothoracic Imaging

Submissions Opening April 2019: Radiology: Imaging Cancer

Visit *RSNA.org/Journals* for more information.

Meet the RSNA Journal Editors in-person at the **RSNA Publications booth 1011** in the Technical Exhibit South Hall A.

- Meet **Dr. Gary D. Luker**, Editor, *Radiology: Imaging Cancer*, Monday, 10 AM
- Meet Dr. Charles E. Kahn, Editor, *Radiology: Artificial Intelligence*, Monday, 2 рм
- Meet Dr. Suhny Abbara, Editor, *Radiology: Cardiothoracic Imaging*, Tuesday, 10 ам
- Meet **Dr. Jeffrey Klein**, Editor, *RadioGraphics*, Wednesday, 10 ам
- Meet **Dr. David Bluemke**, Editor *Radiology*, Wednesday, 11 ам





RSNA 2018 ATTENDEES EXPERIENCE TOMORROW'S RADIOLOGY TODAY

Throughout McCormick Place the future of radiology is apparent. Attendees can explore the latest innovations and ground-breaking technologies in the Technical Exhibits Halls, Learning Center and through hundreds of presentations and exhibits this week.



Presentations in the Machine Learning Showcase and 3D Printing & Advanced Visualization Showcase in Technical Exhibits are drawing crowds.



During Sunday's Opening Session in Arie Crown Theater, RSNA President Vijay M. Rao, MD, (center) presented the Society's Outstanding Researcher Award to Carolyn C. Meltzer, MD, (left) and the Outstanding Educator Award to David M. Yousem, MD (right). Each year, the RSNA Board of Directors selects recipients who have demonstrated significant contributions and a long-term commitment — 15 years or more — to radiologic education or research.



Machine Learning Enables Evaluation of Ultrasound HCC Surveillance

By Lynn Antonopoulos

Researchers at Stanford University developed a model employing machine learning (ML) techniques to assess the efficacy of ultrasound (US) surveillance of hepatocellular carcinoma (HCC) in high-risk patients.

Long-term, longitudinal data from the study may help validate and improve care recommendations and assess the clinical outcomes of HCC surveillance programs.

"The development of robust AI natural language processing techniques, and the introduction of structured reporting with the American College of Radiology (ACR)'s ultrasound Liver Imaging Reporting and Data System (LI-RADS) in recent years, presented an opportunity for us

to review our own clinical experience with US screening for HCC on a large scale," said Hailey Choi, MD, PhD, now an assistant professor of Clinical Radiology at University of California, San Francisco (UCSF).

Dr. Choi and her team assessed the freetext in a selection of 13,860 US screening and surveillance exams from 4,830 subjects performed between 2007 and 2017, prior to



the release of US LI-RADS specifications.

Then using 1,744 more recent reports containing US LI-RADS specifications, they applied a scalable, ensemble ML approach to build a model that inferred US LI-RADS categories from neural word embedding analysis of the body text — a process that mathematically represents words and can gauge the relationship between them. 'We created a lexicon of

key terms used in ultrasound liver imaging to provide a framework for analysis and machine learning algorithms on the report text," Dr. Choi said, adding, "We also labeled a subset of the unstructured reports for further training of the model."

Model Exposes Gaps in Surveillance Adherence

The model was successful in rapidly assessing the free-text reports. Based on a validation set of 215 reports retrospectively categorized by two readers, when applied to the free-text reports, it scored an average of 0.74 precision, 0.64 recall and 0.66 F1-1 score (a measure of

Although limited by its

in the real world.

retrospective nature, the

study provides a glimpse of

Hailey Choi MD PhD

accuracy). According to the model's predictions, 84 percent of subjects remained in the same LI-RADS category over US LI-RADS performance time. Of the remaining subjects, three percent progressed to and remained in the US-3

category developing lesions that warranted further work-up.

About half of the subjects, 2,270, received at least two serial surveillance exams and an average of five exams with a mean screening interval of 13 months and a mean follow-up duration of 43 months. They were assessed for LI-RADS changes over time.

Dr. Choi noted the gap between the initial number of subjects and those who received

additional screenings. "The limited number of follow-up exams in our population of high-risk subjects reflects limited adherence to HCC surveillance recommendations in

the real world," she said. "Although 4,830 subjects received a surveillance ultrasound in our 10-year interval, only 2,270 had at least two exams."

"Our study enabled us to get an estimate of the effectiveness of our ultrasound HCC screening program on a large scale and

identify 'hits' and 'misses' in our screening and surveillance population," Dr. Choi said. "Although limited by its retrospective nature, the study provides a glimpse of US LI-RADS performance in the real world."

She indicated that future research efforts will include a multi-institutional analysis as well as investigation of subthreshold (US-2) exams and stratification by underlying liver disease.

New Techniques Help Predict Major Adverse Cardiac Events

By Michael Bassett

Combining analysis from both dynamic CT myocardial perfusion imaging (CTMPI) and CT coronary angiography (CCTA)derived fractional flow reserve (CT-FFR) is a promising technique for predicting major adverse cardiac events (MACE) in patients with coronary artery disease, according to research presented Sunday.

In her presentation, Marly van Assen, MSc, Medical University of South Carolina, Charleston, reported that while CTMPI has a higher predictive value for MACE compared to CT-FFR, the combination of CTMPI and CT-FFR is more accurate in predicting MACE in patients with coronary artery disease than either alone.

According to van Assen, CCTA alone is a poor predictor of the functional significance of a stenosis, while CTMPI and CT-FFR provide functional information. She also noted that CTMPI and CT-FFR can play a role not only in diagnosis, but in prognosis, as well.

"There has been a big switch from anatomical evaluation [of coronary artery disease] to functional evaluation, and both perfusion and CT-FFR are two of the big up and coming topics on the functional side of coronary artery disease evaluation," van

Assen said. "And there are few studies comparing the two."

"We do a lot of CT-FFR and perfusion at our institution," she added. "And we wanted to compare them side by side and see if we get the same outcomes.'

In this study van Assen and her colleagues analyzed results from 81 patients who underwent CCTA and stress dynamic CTMPI with a follow-up of 18 months or until MACE occurred. CT-FFR was computed for each coronary artery.

Combined Approach Shows Promise

Of the 81 patients in the study, 25 (31 percent) experienced MACE. van Assen and the researchers found that CCTA alone had an area under the curve (AUC) of 0.655 for predicting MACE, with a sensitivity and specificity of 56 percent and 75 percent, respectively. The CT-FFR AUC for

predicting MACE was 0.703, with a sensitivity and specificity of 64 percent and 80 percent, respectively. And dynamic CTMPI had an AUC of 0.812 with a sensitivity and specificity of 88 percent and 75 percent, respectively.

The combination of CCTA, CT-FFR, and CTMPI resulted in an improved AUC of 0.857 compared to CT-FFR and CTMPI alone.

"Both CT-FFR and CT perfusion increased hazard ratios and increased prognostic value, while perfusion actually showed the best or highest hazard ratio," van Assen said. "But CT-FFR and perfusion



van Assen

both significantly added value to CCTA."

The researchers concluded that combining CT-FFR and dynamic CT perfusion imaging "is a promising approach for the prediction of MACE in patients with coronary artery disease."

One of the issues with CT-FFR is that it is currently not possible in patients with coronary stents and bypasses, van Asssen noted. "So, perfusion studies could have a big role in these patients," she said.

However, CT perfusion also incrementally increases radiation dose beyond that of CCTA. "So, we would suggest that it is a per patient decision on what would be most valuable to that patient," she said. "But, both studies add value compared to the CCTA."

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Deep Learning Shows Predictive Power in COPD Patients By Richard Dargan

A deep learning (DL) algorithm can discern features of chest CTs and potentially predict the prognosis for patients with chronic obstructive pulmonary disorder (COPD), according to research presented Sunday.

Imaging is frequently needed for patients with COPD, which affects more than 16 million Americans and 251 million people worldwide, as many develop a host of respiratory problems.

Researchers lead by Tara A. Retson, MD, PhD, a firstyear resident at the University of California in San Diego, studied the potential of DL. a type of artificial intelligence to glean informa-

tion from a chest CT scan that might predict the course of the disease; predictions for outcomes like hospitalization, chronic bronchitis and mortality that could then be compared with a group of

COPD patients who were followed for five years. Deep learning processes information through convolutional neural networks, which are designed like a series of layers that get progressively more complicated.

With deep learning, we can give the algorithm a scan and it comes up with features that in thinks are important, like the percentage of emphasema," Dr. Retson said. "It's pretty revolutionary. We used to have to provide every single detail, and



Our ultimate goal is to develop

predictive measures from

give to clinicians.

COPD we can take from the

deep learning algorithm and

figure it out on its own." Dr. Retson tested the

algorithm this past summer on CT scans for 160 COPD patients from the San Diego area who were enrolled in the COPDGene® multicenter study examining the underlying genetic factors of the disease. She trained the algorithm on 20 chest CT scans with assess-

> ment by five-fold cross validation,

an approach that divides data into five pieces and runs it five times to determine average accuracy. Dr. Retson is

in the process of Tara A. Retson, MD, PhD studying the algo-

rithm on a much larger data set consisting of 10,000 images from the COPDGene program. She has evaluated the algorithm on 2,000 of those images, using 80 percent of the images to train the algorithm and the remaining 20 percent to test it.

So far, the results show a strong correlation between the algorithm's predictions and the actual outcomes.

"These results are pretty solid, especially in terms of predicting total lung capacity and percent of emphysema," Dr. Retson said. "Now we want to make some technical adjustments and enlarge the study."

Algorithm Tested on Larger Scale

The algorithm could present an improvement over existing methods since it may provide information on how the disease is progressing.

"Our ultimate goal is to develop predictive measures for COPD we can take from the algorithm and give to clinicians," Dr. Retson said.

While the algorithm needs further development before it can assign patients a specific percentage of risk for future

outcomes like chronic bronchitis or hospitalization, Dr. Retson noted that the measures inferred from the scans, including total lung capacity, emphysema and functional residual capacity, have previously been correlated with patient outcomes.

"Because of this, something these measures can do is help physicians understand, track, and make informed decisions about a patient's health and likely trajectory," she said. "As an added benefit, clinically making the same measurements requires advanced testing or manual image analysis, so automation can ideally save time and money."



Convolutional neural networks (CNN) are capable of accurately inferring pulmonary measurements from chest CTs by automatically identifying the image features most important for determining outcomes. These two patients had similar manually calculated percentages of emphysema. The algorithm "underestimated" emphysema on the right image, possibly due to the large bullae, a structure it may not have classified as lung. Left: Predicted emphysema: 25.01 percent, Calculated ground truth: 24.43 percent. Right: Predicted emphysema: 10.90 percent; calculated ground truth: 25.73 percent.

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Radiologists' Input on ED Imaging Orders Can Add Value to Patient Care

By Jennifer Allyn

In the emergency department (ED), imaging studies are requested by a wide spectrum of health care providers, many of whom are not educated in the finer details of imaging protocols. This lack of expertise can lead to suboptimal diagnostic imaging resulting in decreased diagnostic accuracy, unnecessary cost and added radiation.

A new study presented on Sunday looked at the value of radiologists' input on diagnostic imaging at the time of order entry.

"Order entry algorithms have been implemented in many hospitals and institutes, but it varies," said Sarvenaz Pourjabbar, MD, Yale School of Medicine. New Haven, CT. "The challenge is picking the right study for the right indication, because diagnostic imaging is meant to answer a clinical question. If we do not perform the right study to best answer that question, we are not giving the patient the best possible care."

Researchers reviewed 631 eligible exam orders from one ED. Specifically reviewed were CT/CTA orders of the chest, abdomen or pelvis. These orders were requested over the course of 90 ED shifts (10 p.m. to 7 a.m.) from September 2017 until March 2018.

Out of the eligible exam orders, 14 percent were modified and, of these modifications, 15 percent resulted in cancellations.



More than 70 percent of the cancellations were made due to lack of evidence-based clinical indication.

Additionally, 84 percent of the modified orders were done so because contrast was improperly added or omitted.

Suggested order alterations were more often related to oral contrast (52 percent) than intravenous contrast (31 percent). The anatomic

area scanned was changed in 15 percent of modified orders, while in 13 percent of modified orders, the type of study was changed entirely.

"There are tangible benefits to patient care resulting from radiology consultation on all aspects of imaging from ordering to recommendations," Dr.

Pourjabbar said. "Per our study results, 14 per 100 patients benefited from a radiologist overseeing the requested orders and the use of contrast was optimized in 74 percent of cases."

Team Approach Improves Care

Interactions between radiologists and ordering physicians can improve patient care and provide an opportunity to educate clinicians for future orders.



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In addition, this added layer of quality control can be facilitated by trained radiology staff, predefined protocols and an embedded interface into the electronic medical record.

"In the era of value-based health care, it is essential to tailor patients' imaging to address specific clinical questions at a



reasonable cost," Dr. Pourjabbar said. "Having radiology staff available to identify suboptimal diagnostic CT orders can add value to patient care by optimizing contrast protocols, ensuring the clinical question will be addressed and avoiding redundant examinations."





A non-contrast CT of the abdomen and pelvis was performed in a patient with urosepsis to evaluate for obstruction of collecting system or abscess. Due to lack of intravenous contrast abscess could not be excluded, which prompted an extra ultrasound study. This resulted in additional imaging, technologist time, additional patient's transfer, patient anxiety and increased time of imaging to diagnosis.

On-Call Experience Proves Valuable to Radiology Clerkship

By Melissa Silverberg

When Janki Patel was completing her radiology clerkship at Rutgers Robert Wood Johnson Medical School, she wished she had on-call experience. However, since the radiology clerkship was an elective, students were not required to work outside of normal business hours.

In a Sunday session, "Introducing On-Call into Medical Student Radiology Clerkship: Our Experience, Patel, now a fourth-year medi-

cal student, described a research project to determine whether an on-call experience provides educational value to medical students in an elective radiology clerkship. Traditionally, on-call experiences are part of clerkships such as medicine, surgery, ob-gyn and emergency medicine, but generally not radiology.

Patel

how hard radiology residents work

radiology is no longer an 8 a.m. to

5 p.m. position like people may think.

after hours. It's important to show that

"We thought it was important to show medical students who are going to be future physicians that radiology has a role to play 24-7, 365 days a year in health care and patient management," Patel said.

In the study, 129 medical students were

required to take calls on two evenings for two hours *A lot of the students were amazed at* each night from 5 p.m. to 7 p.m. as part of their fourweek diagnostic radiology clerkship. The on-call experience com-

prised 15 percent

of the final grade and each student was asked to anonymously evaluate the usefulness of the on-call component at the end of their experience.

Most Students Value On-Call Experience

Medical students named a variety of valuable experiences during their on-call hours including collecting patient history, interpreting images, contacting the primary care physician and accompanying patients for exams or procedures.

"We wanted it to be an active experience, not a passive one," Patel said. It helped that the 5 p.m. to 7 p.m. hours are typically busy for radiologists, so students were able to get a full experience of what it will be like as a radiologist in the field, she said.

At the end of the radiology clerkship, a majority of students said they were satisfied with their experience. Of the responses, 49.7 percent said the on-call experience was somewhat useful and 44.3 percent said the call

experience was very useful. "A lot of the students were amazed at how hard radiology residents work after hours," Patel said. "It's important to show that radiology is no longer an 8 a.m. to 5 p.m. position like people may think."

Regarding their interaction with the residents, 69.5 percent of evaluators were very satisfied and 28 percent were satisfied. Patel said it was gratifying that so many of her fellow students had a good experience and she hopes that by sharing her research at RSNA, other medical schools will incorpo-

rate on-call experiences into their radiology rotations, as well as those of other elective clerkships

'We want other schools to take this back and implement it into their programs," she said.

Patel's mentor, Judith Amorosa, MD, professor of radiology at Rutgers University's Robert Wood Johnson Medical School. said the experience of on-call radiology during clerkship is beneficial for all medical students, even those who do not become radiologists.

Janki Patel

"It's about giving them the experience so that when they are in the field they recognize that radiologists are busy. We are working around the clock and we want physicians in all fields to appreciate that," Dr. Amorosa said.

Researchers Analyze Impact of 24/7 Emergency Room Radiology Staffing for Brain CT

By Nick Klenske

Of the more than 90,000 patients who enter the Emergency Room (ER) at Vancouver General Hospital (VGH), British Columbia, each year, more than 55 percent arrive outside the 8 a.m. to 5 p.m. timeframe when radiologists are available.

Even though the majority of these patients require urgent medical imaging, they must wait for the on-call radiologist to arrive. In a life-threatening situation, this delay could have critical consequences. Thus, the question arises: should ERs be staffed with 24/7 onsite radiologists?

In search of an answer, Sabeena Jalal, MBBS, MSc, a research fellow, and Savvas Nicolaou, MD, head of Emergency & Trauma Radiology at VGH, studied the impact of a 24/7 onsite staff radiologist on turnaround times (TAT) for CT brain scans at the hospital, where specially trained staff radiologists are onsite all day, every day.

"The quality of care should not depend on the time of day the patient arrives, as patients suffer from life-threatening conditions at all hours of the day," said Dr. Jalal during a Sunday presentation in the Learning Center.

The retrospective study utilized data extracted from the hospital information system (HIS) for all consecutive patients requiring a CT brain scan before and after the 24/7 onsite radiologist model was implemented. The pre-24/7 period ran from March 30 to Sept. 30, 2013. The post-24/7 period ran from Sept. 30, 2014 to March 30, 2015.

Analyzing Turnaround Time

During both periods, researchers studied two TATs: TAT-1 is the difference between the time an exam was completed and the time it was transcribed; TAT-2 is the difference between the time the exam report was transcribed and the time the radiologist finalized the report. From this data, researchers tallied the median time for both TATs.

For TAT-1, the pre-24/7 group had a median time of 578 minutes, or about 10 hours, compared to just 54 minutes for the post-24/7 group. For TAT-2, the pre-24/7 median time was 1,577 minutes, approximately 26 hours, compared to 121 minutes for the post-24/7 group.

In addition, the odds of having a significantly lower TAT with 24/7 onsite staff radiologist coverage was 3.46 times higher compared to the TAT when no 24/7 coverage was provided.

"This study shows that having 24/7 onsite staff ER radiologist coverage has a significant impact on reducing turnaround times for CT brain scans, which are usually done to aid in deciding whether an acute medical or surgical intervention is needed," Dr. Jalal said.



Jalal

But this study is more than just theory. Since VGH implemented 24/7 radiology in its ER, Dr. Jalal says that data already shows improvements in quality of care and patient length of stay, and could also result in significant cost savings.

"The system prioritizes acute patients, improves report turnaround time and eliminates discrepant preliminary reports," Dr. Jalal said. This study shows that having 24/7 onsite staff ER radiologist coverage has a significant impact on reducing turnaround times for CT brain scans.

Sabeena Jalal, MBBS, MSc

Understanding Economics Helps Deliver Value in Health Care

By Michael Bassett

While radiologists have their strengths in the clinic, they also need to be more aware of — and involved in — the economics of health care as a whole, and their specialty in particular, especially as it relates to efforts to provide value.

That was one of the messages of a presentation Sunday by Yoshimi Anzai, MD, University of Utah Health.

Whether the issue is one involving payment reform, reimbursement or changes in the health insurance landscape, radiologists need to be aware of what's happening, Dr. Anzai said, particularly younger residents and radiologists who may become leaders one day.

She added that it's also important that young radiologists comprehend the principles of value, and why that concept has become so important in health care.

Much of that has to do with the rising cost of health care, Dr. Anzai said, and the fact that costs associated with health care are increasingly being transferred to patients.

"Health insurance used to cover everything," she said. "But now, many employers have identified health care as being a huge cost to them, and they are shifting costs to the patients." The result, Dr. Anzai said, is that patients are often faced with selecting health care plans that have very high deductibles.



Anzai

For example, according to the Kaiser Family Foundation's annual employer health benefits survey, family health insurance premiums have increased by 55 percent since 2008, while the average deductible for a single plan has more than doubled from \$735 in 2008 to \$1,573 in 2017.

"Patients have higher out-of-pocket expenses on top of higher premiums," she said, adding that this not only has implications for a family's pocketbook, but also dissuades patients from seeking needed medical care, preventive care and screenings.

Better Cost Management Delivers Efficiencies

Since patient costs are clearly associated with those of the health system — direct facility and professional costs — it is critical for those health systems to understand the real costs of providing health care if they want to contain costs.

Dr. Anzai referred to a study published last year in Academic Radiology, in which she and her colleagues "dissected" the costs of performing an abdomen and pelvis CT, and identified ways to improve efficiency in delivering this service.

That study found that 80 percent of the direct costs of abdomen and pelvis CT are related to labor, with radiologists' interpretations accounting for 40.1 percent of those costs.

Consequently, Dr. Anzai said, radiology departments or practices should be doing everything possible — whether it's embracing machine learning to improve workflow, or reducing "dead time" in the patient preparation time — to increase radiology's efficiency and reduce costs.

"This is something we should embrace, rather than fear," Dr. Anzai said.

Finally, Dr. Anzai also noted that since patients are covering more of the costs associated with their health care, they want more price transparency.

She pointed out that her home institution, the University of Utah Health, has an online price transparency tool that can tell a patient, for example, what a CT exam of the abdomen with contrast might cost, depending on whether the patient is insured or is self-paying, and if insured, what type of insurance the patient has.

"We have to work toward that direction, because otherwise you have this inaccurate information floating around on websites or blogs," she said. "The public is demanding it."

Embracing Technology Will Lead Radiology to the Epicenter of Patient Care

CONTINUED ON PAGE 1A



Additionally, future radiologists will take over the complete imaging care of patients in what Dr. Rao called, "total imaging care."

"We need to act like clinicians rather than just image-readers. This is what I mean by 'total imaging care'," she said. "And the good news is that AI and related technologies give us exactly the tools we need to make this vision a reality."

To illustrate how these two initiatives, the digital diagnostic data hub and total imaging care, would work, Dr. Rao asked the audience to fast-forward 25 years imagining that her granddaughter, Priya, was an early career radiologist.

While future radiologists will start the day in a familiar way, clicking through the list of cases at their reading stations, AI algorithms will have replaced older methods of decision support and prioritized their worklists. For some cases, AI will also have automatically measured lesions against the patient's prior exams and suggested a diagnosis based on similar findings and proven diagnoses. Dr. Rao noted that the imaging report of the future will include image-based responses that incorporate molecular, therapeutic and physiologic parameters for each patient. She speculates that in the future, the radiologist's email and mobile phone number will appear at the bottom of every report to remind patients that radiologists are physicians who are accessible to them.

"I believe AI's most important impact on radiology will be to enable us to work more efficiently and effectively," Dr. Rao said. "This will in turn mean that we will have more time for so-called noninterpretive activities – the kinds of things that will enhance our value and visibility in the patient care continuum."

Practicing at the epicenter of care providing value to both the patient and other physicians—continues to be radiology's longstanding goal, according to Dr. Rao, and should provide inspiration for radiologists to do the right things today to make this vision come true.

"We'll need to embrace AI rather than fear it," she said. "We'll need to recommit to the patient-centric model of radiology. We'll need to develop the necessary ethical and medicolegal standards for protecting data as well as machine learning algorithms.

"Importantly, we'll need to form new cross-sector partnerships with colleagues in other specialties," Dr. Rao concluded. "We can get there, but work remains ahead of us."

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Creative Use of Technology Key to the Future of Radiology

CONTINUED FROM PAGE 1A



probably the most popular and has brought the most job satisfaction," Dr. Recht said.

Data Must be Accurate, Accessible, Actionable

Business analytics represent another vital way for radiologists to improve their job satisfaction, according to Dr. Recht. He bemoaned the slow uptake of advanced metrics and analytics in radiology departments.

"Even when used, the data are typically not real time, and their extraction and display, require the services of dedicated IT or analytics personnel," Dr. Recht said. "To truly derive value from data, it is necessary to ensure that the data is accurate, easily accessible, and most importantly, actionable."

Analytics can help departments understand the impact of upgrades, such as the addition of dockable tables and dedicated prep rooms in the MRI suite to decrease turnaround time and increase revenue.

"Data translates into power," he said. "Without it, we fall prey to HIPPO syndrome, which, as you may know, translates into 'the highest-paid-person's opinion.""

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Like many radiology leaders, Dr. Recht expressed optimism that AI will augment rather than replace radiologists. He focused his AI discussion on data acquisition and the potential of deep learning (DL) algorithms to produce diagnostic-quality MRI scans in as little as five minutes. In side-by-side comparisons, the DL musculoskeletal image reconstructions Dr. Recht displayed were almost indistinguishable from conventional scans.

Chief among the challenges to AI implementation is the lack of large, curated data sets. Dr. Recht and his colleagues at NYU Langone are helping to tackle this shortfall through a collaboration with the Facebook Artificial Intelligence Research Group (FAIR). The NYU-FAIR group just released what Dr. Recht called "the largest fully sampled data set in MR," including 1,600 data sets of the knee.

"I believe that through the creative use of technology we can create new value and help return radiologists to their central role in the clinical care team, thereby increasing our purpose and our sense of satisfaction," Dr. Recht said.

Monday's Answer

[Question on page 4A.]

0.4 mSv – less than an abdominal x-ray, but more than a chest x-ray.

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