BEYOND IMAGING RSNA 2016

Daily Bulletin

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Research Still Needed to Improve Prostate Cancer Outcomes

RSNA President Richard L. Baron, MD, presents Colleen A. Lawton, MD, with a commemorative scroll of her Annual Oration in Radiation Oncology delivered Wednesday.

By Mike Bassett

DESPITE AN IMPRESSIVE amount of science that has been accomplished in the area of prostate cancer, Colleen Lawton, MD, reminded her colleagues during Wednesday's Annual Oration in Radiation Oncology, "Prostate Cancer: Improving the Flow of Research," that a lot of research remains to be done.

According to Dr. Lawton, vice chair of the Department of Radiation Oncology at the Medical College of Wisconsin, Milwaukee, prostate cancer in many ways resembles "an ugly stepsister" when it comes to the amount of funding and research that's been committed to the disease.

She noted, for example, that prostate cancer is diagnosed in over 200,000 men and is responsible for the deaths of 27,000 men annually in the United States. "Yet we think of it as a disease in our country that men don't really have to worry about."

By contrast, she pointed out, breast cancer is diagnosed in about the same number of women, kills over 40,000 women annually, and is thought of as an epidemic that must be stopped.

"We have a dichotomy here that needs to fixed," she said.

Screening Standards Still Lacking

She referred to what appears to be different approaches to screening breast and prostate cancer. While there has been much debate about both mammography and prostate cancer screening, there seems to be a consensus that women of a certain age should have yearly mammograms.

When it comes to prostate cancer, however, the test that was considered most appropriate — PSA screening — has been questioned over time, to the point that the United States Preventive Services Task Force now recommends against it.

"On the prostate cancer side, clearly we have much more work to do to come up with the best way to screen," Dr. Lawton said.

Dr. Lawton went on to discuss how research into, and the treatment of prostate cancer has evolved — from low-risk and intermediate-risk prostate cancer, to metastatic and post-operative disease.

She also described the significant role diagnostic radiology has played in helping radiation oncologists detect and treat prostate cancer.

Ehman is RSNA President

RICHARD L. EHMAN, MD, is RSNA president for 2017. Dr. Ehman is professor of radiology and Blanche R. & Richard J. Erlanger Professor of Medical Research at the Mayo Clinic in Rochester, Minn.

As president, Dr. Ehman will work to emphasize RSNA's commitment to foster continuous innovation in patient-focused radiology.

"Advances in medical imaging over the last few decades have provided amazing benefits for healthcare," Dr. Ehman said. "We need to recognize and quantify these contributions, not just so that we can celebrate them, but also because they provide evidence of an extraordinary return-on-investment for research in our field. As the leading radiology organization in the world, RSNA can help spread awareness outside of the radiology community of the high productivity and rapid clinical impact of our science."

Dr. Ehman earned his medical degree in 1979 from the University of Saskatchewan in Saskatoon, Canada. His internship at Foothills Hospital in Calgary, Alberta, was followed by a residency in diagnostic radiology at the University of Calgary. In 1984,

he completed a year-long research fellowship at the University of California, San Francisco. This was followed by a clinical fellowship and his appointment to the staff of the Mayo Clinic in 1985.

Ehman

Dr. Ehman has authored or co-authored more than 300 peer-reviewed scientific articles and has completed many invited lectures and visiting professorships. He has served on the editorial boards for multiple journals, including *Radiology* and *Magnetic Resonance in Medicine.*

Dr. Ehman served on the Mayo Clinic Board of Governors from 2006 to 2014. In 2014, he was elected as an emeritus member of the Mayo Clinic Board of Trustees. He has been an active member of many medical societies and is past-president of several organizations, including the International Society for Magnetic Resonance in Medicine (ISMRM), Academy of Radiology Research, and the Society for Body Computed Tomography and Magnetic Resonance.

Jackson Named Board Chair

VALERIE P. JACKSON, MD, is chair of the RSNA Board of Directors for 2017. An expert in the field of breast imaging, Dr. Jackson is the executive director of the American Board of Radiology (ABR), a position she has held since 2014. She previously served on ABR's board of trustees from 2001 to 2010.

Dr. Jackson received her medical degree in 1978 from the Indiana University School of Medicine, and completed her residency at the Indiana University Medical Center in 1982. Dr. Jackson is the Eugene C. Klatte Professor Emeritus and has had numerous academic appointments at Indiana University School of Medicine over the years, including lecturer, professor and chairman of the Department of Radiology and Imaging Sciences.

As chair of the RSNA Board, Dr. Jackson is committed to helping the Society capitalize on education and research opportunities.

"RSNA is a world leader in education and research, and my goal is to build upon the traditions of the past to move the organization and its members into the future," Dr. Jackson said. "In these times of rapid change, I will listen to our members about

their needs and wants. I feel truly honored to have the opportunity to serve this great organization as the chair of the Board of Directors."

Valerie P. Jackson, MD

Dr. Jackson has published more than 100 peer-reviewed articles and 20 books and book chapters with an emphasis on breast imaging and radiologic education. She has served as principal investigator on numerous funded grants including several focused on radiologic education. Dr. Jackson has been a co-presenter of the RSNA Faculty Development Workshop and is a sought-after lecturer and educator, who has made more than 300 scientific and educational presentations at meetings worldwide.

Dr. Jackson has served on the editorial boards of multiple journals, including *Contemporary Diagnostic Radiology*, *Journal of the American College of Radiology*, *The Breast Journal* and *Seminars in Breast Diseases: Radiologic, Pathologic, and Surgical Considerations.* She has served as a manuscript reviewer for numerous journals

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Patient Safety
Tip of the Day

Reducing the voxel size of an isotropic MRI acquisition will result in higher spatial resolution at the cost of reduced signal-to-noise.

American Association of Physicists in Medicine

INSIDE THURSDAY

Machine Learning in Radiology

How are machines impacting radiology? Experts debate the issue. Page **6A**

Shattering the Glass Ceiling

Women radiology leaders discuss challenges and barriers. **10A**

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Thursday/Friday at a Glance

THURSDAY AT A GLANCE

7:15–8:15

Controversy Session:

Is It Time to Put Whole Brain Radiotherapy to Pasture? What's New in the Treatment of Limited Brain Metastases (E450B)

Hot Topic Session:

The Promise of Machine Learning (and Pattern Recognition) in Radiology (E350)

RSNA Diagnosis Live™:

Musculoskeletal and Emergency Department Imaging-From Sports to Trauma (E451B)

8:30–10:00

Educational Courses

8:30–NOON

Series Courses

10:30–NOON

Scientific Paper Sessions

11:00–1:00

3-D Printing Theater Presentations (Learning Center)

12:15–1:15

Exhibit & Poster Discussions (Learning Center)

1:30–2:45

Plenary Session (E450A)

RSNA/AAPM Symposium

Precision Imaging in Medicine
Daniel C. Sullivan, MD, Maryellen L. Giger, PhD, Paul E. Kinahan, PhD

1:30–6:00

Interventional Oncology Series:

Management of Hepatic Metastases from Colorectal Cancer, Neuroendocrine Tumors and more (S405AB)

3:00–4:00

RSNA Diagnosis Live™:

Peds, IR, Potpourri (E451B)

Hot Topic Sessions:

Personalized Screening for Breast Cancer (S406B)

Dual Energy Chest CT: Ready for Prime Time? (S402AB)

Radiation and Immune Therapies: Challenges in Evaluation of Treatment Response (E353B)

Track and Treat - Advancements in Theranostics (E352)

4:30–6:00

Educational Courses

FRIDAY AT A GLANCE

8:30–3:00

Novel Concepts in Hepatobiliary Tumor Imaging Symposium (E253BCD)

8:30–10:00

Educational Courses

8:30–NOON

Interventional Series:

Peripheral and Visceral Occlusive Disease (E352)

8:30–10:00

Scientific Paper Sessions

12:30–3:00

Friday Imaging Symposium (E353C)

Artist Nancy Pochis Bank and her team spent three days onsite creating a custom work of art for RSNA 2016. The large canvas mural is located at the entrance of the Connections Center from the sky bridge.

Smartphone Technology Could Enhance the Diagnosis of Lymphoma

By Michael Hart and Paul LaTour

Researchers may have found a way to diagnose lymphoma in patients who live in remote, low-income areas like sub-Saharan Africa using modified smartphones.

The research, presented Wednesday by Aoife Kilcoyn, MBBCh, of Massachusetts General Hospital (MGH), shows promise for empowering resource-poor communities with complex laboratory tests.

"It's cheap, accessible, easy to do and easily replicable," Dr. Kilcoyn said.

Employing fine-needle aspiration, a thin needle can be inserted into abnormal-appearing tissue to obtain a sample. The sample is placed in saline and immunolabeled with microbeads, then a photo can be taken with a smartphone fitted with a lens attachment that creates a hologram. The image is then sent to a remote server via the cloud.

Within as little as an hour, a diagnosis can be delivered indicating the presence (or not) of lymphoma and the likely treatment. The total cost of the procedure could eventually be less than $1.

"In Africa the physician-to-patient ratio is not that great," said Divya Pathania, PhD, a study co-author and post-doctoral research fellow at the MGH Center for Systems Biology. "Often, by the time a patient gets screened, it is quite late."

The team analyzed eight tissue samples obtained with the technology and compared the results with standard technology.

"Our technology was 100 percent accurate," Dr. Kilcoyn said.

She said the team hopes to expand the

Technology that shows promise in diagnosing lymphoma is aiding patients in sub-Sahara Africa, said Aoife Kilcoyn, MBBCh.

clinical trial deploying the technology in Botswana within the next two years. They have already identified a hospital and tested the strength of the internet connection to assure the process won't be hampered by insufficient technology.

If successful, the new technology could help treat patients who may live hundreds of miles from a hospital, she added.

"We wanted to generate a mechanism for diagnosing a cancer early and thus triaging patients into, for instance, those who may need chemotherapy and those who may need treatment for infections," Dr. Kilcoyn said.

While the initial study involves lymphoma, she said the same technology could be used to sample other kinds of cancer as well.

Hyungsoon Im, a study co-author, said this advance in radiology would not have been possible without enhancements over the last few years in smartphone technology. "This has a great future," Im said.

Research Still Needed to Improve Prostate Cancer Outcomes

Dr. Lawton said that the use of multiparametric MRI has been exceedingly helpful to radiation oncologists in several ways. For example, while low-risk patients who probably don't need treatment may follow an active surveillance approach to their prostate cancer, she pointed out that the use of MRI allows both the radiation oncologist and patient to be more comfortable with that approach.

"However, if you do an MRI and it shows a lesion likely to be in an area that was not biopsied, then a directed biopsy of that area sometimes shows that it is a cancer that needs treatment, instead of surveillance," she said.

There also has been a lot of progress in the ability to see lymph nodes, whether it's with MRI and nanoparticles, choline PET/CT, or PSMA (prostate specific membrane antigen), she said. "A number of these imaging agents are being developed."

If we want to keep research flowing, it's important that all of us should donate to these sources of funding. We have to be part of the solution.

Colleen A. Lawton, MD

Collaboration Can Help Identify Solutions

Looking forward, Dr. Lawton suggested that there are several areas where diagnostic radiologists could help their radiation oncology colleagues "in specific areas we cannot understand."

One area involves the ability to see where the urethra traverses the prostate. "As we think about localized disease and our ability to increase radiation doses, and know that increasing doses cures more cancers, the organ at risk within the prostate becomes the urethra," she said.

If radiation oncologists could identify where the urethra traverses the prostate using imaging techniques, then they would know how to avoid it. "Currently the only way to do that is to put a Foley catheter in, and that is clearly undesirable," Dr. Lawton said.

"We also need to better understand where microscopic disease is," she said, adding that with the assistance of MR, other modalities, or new contrast agents, radiation oncologists can better understand if the prostate cancer is through the capsule, if the lymph nodes are involved — even on a microscopic level — and if the disease is in the bone or other areas of the body.

"Clearly we have made strides in each of these areas, but we need more help," she said.

Dr. Lawton concluded her talk by lamenting the state of funding available for radiation oncology research.

"The reality is we have many more researchers and great ideas than funding," she said, pointing out that radiation oncology secures only about 1.6 percent of the funding that goes toward cancer research by the National Institutes of Health (NIH).

"So we still have much to do get the NIH or the National Cancer Institute to cough up more money to help us," Dr. Lawton said.

In the meantime, she noted that RSNA, through its Research & Education Foundation, and the American Society for Radiation Oncology, through its Radiation Oncology Institute, have been useful sources of research funding.

"If we want to keep research flowing, it's important that all of us should donate to these sources of funding," she said. "We have to be part of the solution."

Ehman is RSNA President

Dr. Ehman has served as chair of the Radiology and Nuclear Medicine Study Section of the National Institutes of Health (NIH), where he has also served terms on the Advisory Council of the National Institute of Biomedical Imaging and Bioengineering and on the Council of Councils.

Dr. Ehman is an NIH-funded clinician-scientist and inventor. He holds more than 70 U.S. and foreign patents, and many of these inventions are widely used in medical care. Dr. Ehman was awarded the ISMRM gold medal in 1995, the RSNA Outstanding Researcher Award in 2006, an RSNA Honored Educator Award in 2016, and the gold medal of the Asian Oceanian Society of Radiology in 2016. He was named Mayo Clinic Distinguished Investigator in

2014. He is a Fellow of the American College of Radiology. In 2010, Dr. Ehman was elected as a member of the Institute of Medicine of the National Academies of Science, which is one of the highest honors in medicine in the U.S.

As an RSNA member, Dr. Ehman has served on the Refresher Course Committee, Scientific Program Committee, *Radiology* Editorial Board, Research Development Committee, Grant Program Committee and the RSNA Research & Education Foundation Board of Trustees. In 2010, he was elected to RSNA's board of directors and in 2011 became the liaison for science. He served as board chair from 2014 to 2015 and president-elect from 2015 to 2016.

Jackson Named Board Chair

including *American Journal of Roentgenology, Investigative Radiology, Medical Physics, Academic Medicine and Radiology,* where she served as associate editor on the editorial board from 1989 to 1998, and as consultant to the editor in 1999.

An RSNA member since 1982, Dr. Jackson has served the Society in numerous roles, including as chair of the Refresher Course Committee from 2009 to 2012, chair of the Breast Imaging Subcommittee of the Scientific Program Committee from 2003 to 2006, a member of the Public Information Advisors Network since 1997, and a member of the RSNA News Editorial Board from 2005 to 2008. She served RSNA as first vice president from 2008 to 2009 and was a member of the RSNA Centennial Committee. Dr. Jackson has been active on many committees of the RSNA Research & Education (R&E) Foundation and served on the R&E Foundation Board of Trustees from 2009 to 2015.

Dr. Jackson has held committee or leadership positions in a number of radiologic organizations, including the Indiana Radiological Society (IRS), American Roentgen Ray Society, Association of University Radiologists, Radiology Research Alliance, Academy of Radiology Research, Society of Breast Imaging (SBI) and the American College of Radiology (ACR).

Dr. Jackson is a fellow of the ACR and has received numerous honors including the gold medals of the IRS, SBI and ACR. The Valerie P. Jackson Education Fellowship also recognizes her work with ACR. Dr. Jackson delivered the Annual Oration in Diagnostic Radiology, "Screening Mammography: Controversies and Headlines," at RSNA 2002.

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That's Radiological

Not So Elementary: Experts Debate the Takeover of Radiology by Machines

*Radiologists could be replaced by computers in 20 years — **or not**, depending on who you were listening to during the Wednesday Controversy Session, "Elementary My Dear Watson: Will Machines Replace Radiologists?"*

John Eng, MD

Bradley J. Erickson, MD, PhD

Eliot Siegel, MD

by Richard Dargan

PANELISTS John Eng, MD, Bradley J. Erickson, MD, PhD, and Eliot Siegel, MD, participated in the spiritied debate. Dr. Erickson, of the Mayo Clinic in Rochester, Minn., said that improvements in graphic processing units (GPUs) and developments like deep learning (DL) have enabled computers to surpass humans in some cases of image recognition. He cited the potential of DL to improve radiology by identifying normal screening exams and delivering high quality preliminary reports. In five years, DL will likely be able to create reports for mammography and chest x-rays, he said, and in 15 to 20 years for most of diagnostic imaging.

But co-presenter Dr. Siegel, of the University of Maryland Medical Center in Baltimore, argued that these image recognition improvements are not applicable to radiology.

"Radiology represents a completely different challenge, with much larger and more complex information," he said. "The information is extraordinarily more complex than picking out a dog or a cat. There are so many reasons why it is silly to think we'll be replaced in 20 years or in our lifetimes."

Dr. Siegel expressed concern that the hype around machine learning (ML) is becoming a major and unfounded source of anxiety among radiologists that could hurt recruitment in medical schools. He cited a story in the September 2016 *Journal of the American College of Radiology* that described machine learning as an "ultimate threat" that could "end radiology as a thriving specialty." Two radiology residents recently emailed him asking if they should quit the practice or risk not finding jobs when they graduate.

On the contrary, Dr. Siegel predicted that there will be more radiologists in 20 years, not fewer, and that computers will be regarded as trusted friends, able to create preliminary reports, but not primary ones.

The implementation of DL in radiology faces other hurdles, including the amount of time and money needed to train a machine to learn from vast databases like the National Lung Cancer Screening Trial, Dr. Siegel said. Also, the U.S. Food and Drug Administration (FDA) would be hesitant to approve technology that elevated computers to healthcare decision makers, he said, adding that medicolegal issues abound.

"Who do you sue when a computer that replaced radiologists makes a mistake, even assuming you get FDA clearance?" Dr. Siegel asked.

Dr. Erickson countered that massive investment in the DL space and its associated political power would make regulatory bodies move faster to approve new roles for computers in radiology. He also pointed to the exponentially faster computing processing power as a harbinger of a greater role for DL.

Dr. Siegel remained unimpressed, noting that processing speed is largely irrelevant if the computer is making mistakes in diagnosis.

Machines Could Make Radiology More Vibrant

Despite the good-natured ribbing, the two radiologists reached something of a consensus at the close of the session. They agreed that, in the future, computers will be performing many tasks performed by radiologists today, and that they provide a useful service in areas like quantitative imaging, biometric measures, workflow and patient safety.

"It's a natural reaction for radiologists to think the computer is going to replace them, but this fear represents an oversimplification of what a computer can do and what the profession of radiology is," Dr. Erickson said. "What machine learning can do is help remove the humdrum and make the profession more exciting and vibrant."

"Radiologists judge, explain, quality check, counsel, teach, discover, console, explore, create and dozens of other things computers aren't even close to being able to do," Dr. Siegel added.

> *The information is extraordinarily more complex than picking out a dog or a cat. There are so many reasons why it is silly to think we'll be replaced in 20 years or in our lifetimes.*
>
> **Eliot Siegel, MD**

Origins of Interventional Oncology Can Be Traced to a Chicago Pizzeria

by Paul LaTour

As strange as it sounds, the roots of interventional oncology can be traced back to a gathering at an iconic Chicago pizzeria during an RSNA annual meeting nearly 20 years ago. But it wasn't just the pizza that brought more than 20 radiologists to Gino's East in Chicago's River North area on that Tuesday night in November 2000.

It was their collective curiosity and sense of exploration about the future of ablation that led to their meeting and laid the groundwork for what would become interventional oncology. The pizza was just a bonus.

"I'm emotionally attached to that meeting because that was truly the start of a new chapter of medicine. That was the core group that eventually developed this branch of interventional oncology. We shared these values and a vision," said Riccardo A. Lencioni, MD, now one of the world's foremost interventional oncologists and founder of the European Conference on Interventional Radiology (ECIO).

At the time of the gathering, the term interventional oncology hadn't yet been coined. Using radiofrequency ablation for liver tumors was in its embryotic stage, though it was used more frequently in Europe, especially in Italy where Dr. Lencioni and Luigi Solbiati, MD, practiced.

Dr. Solbiati was one of the organizers of the Gino's meeting, along with J. William Charboneau, MD, who presented the RSNA 2006 New Horizons Lecture about the then-emerging field of image-guided cancer treatment.

For three hours in a semi-private enclave of the restaurant, the group shared their experiences using radiofrequency ablation to target liver tumors, and to some extent, kidney tumors and bone cancers. They saw the potential for this technique, even though they didn't know quite where it was headed.

"The specialty has gone in a few directions I didn't anticipate back then," said Matthew R. Callstrom, MD, PhD, a consultant in the Division of Diagnostic

The group pictured above were among the attendees at a Gino's East pizzeria gathering nearly 20 years ago that spurred the growth of interventional oncology.

Radiology at Mayo Clinic and a professor of radiology at Mayo Clinic College of Medicine in Rochester, Minn.

Dr. Callstrom pointed to kidney ablation as an area in which he didn't anticipate growth. At the start, interventional oncologists focused on liver ablation because that was where the technique was first employed.

"Kidney ablation was just starting to come online when we met, so people didn't know if that was going to be a significant area. That's turned out to be what climbed the ladder of clinical acceptance the fastest," Dr. Callstrom said.

Interventional oncology saw rapid growth as the image-based, minimally invasive approach became more widely accepted as an alternative to surgery. Some of the newest technologies include radioembolization, microwave ablation, tumor cryoablation, focused ultrasound, light-activated therapy and ultrasound-mediated drug delivery.

As the technologies developed, the group stayed in touch to keep current on their latest findings, allowing the field to experience a grass-roots style growth.

"That was very useful because if somebody was doing something unique, we were able to disseminate information quickly before it was published in any peer-reviewed journal," said Damian E. Dupuy, MD, director of tumor ablation at Rhode Island Hospital and a professor of diagnostic imaging at Brown Medical School in Providence, R.I.

Eventually, the informal meetings became more structured and led to the creation of the Society for Interventional Radiology (SIR) and the Cardiovascular and Interventional Radiological Society of Europe (CIRSE). An annual conference, the World Conference on Interventional Radiology (WCIO), was also created and is held in the United States each year, in addition to the annual ECIO held in Europe.

An interventional oncology multisession series at RSNA's annual meeting also developed as the group continued to meet over the years. The series, which began at RSNA 2005, has blossomed to a five-day symposium that ends Thursday at RSNA 2016.

Many of the original group serve as moderators or presenters of the symposium, including Drs. Callstrom, Dupuy, Lencioni and Solbiati. They've earned international renown as their careers progressed and ablation gained wider clinical acceptance.

"RSNA, because of its wide-reaching international interest, was the perfect opportunity at that time to bring together experts from various countries. It allowed the meeting at Gino's to occur. If you didn't have the RSNA annual meeting, the growth of interventional oncology might not have happened as easily or as organically," said Dr. Dupuy.

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NOVEMBER 26 – DECEMBER 1

Researchers Harness Big Data to Better Serve Patient Populations

A study presented Wednesday emphasized the growing need for radiologists and other healthcare professionals to develop patient-centered, socially sensitive solutions to improve patient engagement and healthcare access.

By Lynn Antonopoulos

ACCORDING TO EFREN FLORES, MD, director of radiology community health improvement at Massachusetts General Hospital (MGH), terms like "no show," "non-compliant" and "disruptive" unfairly place all responsibility for missed appointments on the patient. He said patients and providers share responsibility and should view missed appointments as missed care opportunities (MCOs). "MCOs should not be considered an inefficiency of the system, but rather a failure of the system to engage patients into their healthcare," he said.

Dr. Flores and his colleagues developed the Patient Engagement for Equity in Radiology (PEER) project to identify socioeconomic and demographic factors negatively affecting patient care. They obtained data from 1.1 million patient records during a 25-month period at MGH and conducted an in-depth, subset analysis of 120,000 exams to develop a predictive model to determine factors contributing to MCOs.

The analysis included 21 possible predictors such as patient age, gender, race, ethnicity, education level and more. The team also examined data from external sources, including the U.S. Census to obtain factors like weather conditions, median household income and distance to appointments among others.

Study results showed that factors like languages other than English, ethnicity—notably black and Hispanic—and lower education level were significantly associated with MCOs. In patients scheduled for breast imaging, conditions including congestive heart failure, COPD and depression were notably associated with MCOs.

Dr. Flores and his team also performed a subset analysis of pediatric patients and found that child abuse/neglect, obesity and missed clinical visit appointments were factors contributing to MCOs. He commented, "Children are more susceptible to the surrounding social environment.

> *We need to move beyond imaging to help these populations and decrease MCOs.*
>
> Efren Flores, MD

Efren Flores, MD

How they access the healthcare system is a reflection of the home environment and support system."

Dr. Flores noted that radiology can take an active role in population health management by combining big data analytics from electronic medical records with imaging data analysis to provide evidence-based guidance in healthcare decisions.

He suggested possible methods for care coordination might include scheduling multi-appointment visits to facilitate care for patients with transportation difficulties, utilizing predictive analytics to identify patients at risk for low engagement and providing these patients additional resources like healthcare navigators and text message appointment reminders in their preferred language.

In addition to focusing on the patient experience during care, Dr. Flores suggested a possible benefit in using patient surveys to learn more about the patient's experience during the time between ordering an exam, engaging into the upcoming appointment and accessing the healthcare facility. He also noted that institutions like MGH can partner with other community health centers to deliver radiology services in areas that do not have ready access to radiology care.

For Dr. Flores and his team, one of the main challenges of the initial PEER project study was determining the best approach to the big data set to establish guidelines for data mining and analysis in a productive way. He commented, "It is harnessing business intelligence principles and combining them with healthcare redesign in order to develop best practices in healthcare, to improve the patient experience and to deliver equitable healthcare."

Looking ahead, the researchers would like to collaborate with other medical specialties to understand patient populations from an organizational perspective and provide better service. They will also focus research efforts on developing programs and evaluating their effectiveness to increase patient engagement. Dr. Flores said, "More than numbers, this study represents patients. Radiology has been passive, and we need to move beyond imaging to help these populations and decrease MCOs."

3-D Scoliotic Spine Model Aids Pre-Surgical Planning in 8-Year-Old Girl

A 3-D model of an 8-year-old girl's scoliotic spine proved so helpful in pre-surgical planning that surgeons used it in the operating room to help guide a complex — and ultimately successful — multi-stage procedure.

By Elizabeth Gardner

THE PATIENT, AN ORPHAN from Armenia — a country without advanced medical care — had a severe rotatory kyphoscoliosis, multilevel malsegmentations of the vertebrae and ribs, and Type I diastematomyelia, or "split cord syndrome."

While routine 3-D reconstruction couldn't adequately display all of the anomalies, presenter Javin Schefflein, MD, on Wednesday outlined production methods for 3-D printed models created at New York's Mount Sinai Hospital. "We contacted the neurosurgery team who were excited at the prospect of generating a precise physical model to help visualize the pathology and plan surgery."

On-site 3-D printing can be a boon for numerous medical applications, but producing complex models needs to be a group effort among radiologists, engineers, surgeons and computer scientists.

"The collaborative nature of this endeavor cannot be overstated," Dr. Schefflein said. "Each member of the team contributes to every pre-operative 3-D printing project we work on. The uses for this technology are boundless, and every time we have added a different

Javin Schefflein, MD

discipline to our modeling collective, a new purpose has emerged."

The model was used to plan a two-stage surgery involving T12-L2 laminectomy, resection of the midline bony spur at L1, intradural exploration to de-tether the spinal cord, asymmetric pedicle subtraction osteotomy at T1-L1 to straighten the curvatures and long-segment posterior fusion with instrumentation from T2-L5. The model was also used during the surgery to help surgeons visualize steps in the procedure.

Mount Sinai has an on-site dedicated 3-D printing lab. The first step was to obtain CT images of the full spinal column and proximal ribs. Initial seeding for the segmentation was completed via high-contrast thresholding of the image. A connected component growth model with origins from the seed mask completed the rough mask of all the bony components.

> *Our neuroradiologists worked hand in hand with the neurosurgery department to define what should be included in the print, which was then explained to the computer engineering arm of the modeling group.*
>
> Javin Schefflein, MD

The model was refined using a low-propagation level-set model. Geometry-preserving Taubin smoothing followed by quadratic edge collapse decimation yielded the final model, which was printed at life size with a gypsum powder-based 3-D printer. The finished model had

weight and texture very similar to bone.

Human Intervention Still Needed

Even with advanced software, some human intervention was needed to tweak the instructions for producing the final model, Dr. Schefflein said.

"Our neuroradiologists worked hand in hand with the neurosurgery department to define what should be included in the print, which was then explained to the computer engineering arm of the modeling group," he said.

Surgeons planned the procedure by physically rotating the printed model to see the interconnections among fused ribs, fused vertebrae and anterior and posterior attachments of the bone spur, as well as the relationships of all the spinal curves to the plane of the pelvis. As the child underwent the two-stage surgery, a member of the surgical staff held up and manipulated the model so the surgeon could "visualize" the portions of the spinal anatomy that weren't visible at a given point in the procedure.

The operation, according to Dr. Schefflein, was a complete success.

In terms of creating the model itself, the process took more than 10 hours including

Researchers created a 3-D anatomic model printed life-size *(right)*.

scanning (10 minutes), segmenting (three hours), printing (five hours) and drying/hardening time (two to three hours), and it cost about $710.

"The materials and labor were cheaper than we expected, though the start-up cost for accurate modeling can be daunting," Dr. Schefflein said. Mount Sinai's printer alone cost about $60,000.

Finding a workable payment policy is the key to spurring adoption, Dr. Schefflien said. So far, surgery teams pay for the models generated at Mount Sinai, but that option isn't sustainable. Paradoxically, there are already billing codes covering models produced by outside contractors, and Dr. Schefflein urged radiologists to press for a code for in-house models. "It's not a drastic change," he said.

Image Perception in Radiology Remains an Important Topic

Image perception in radiology is not a new topic to the RSNA annual meeting. In fact, W. Edward Chamberlain, MD, broached the topic in his Annual Oration in Diagnostic Radiology at RSNA 1941.

By Felicia Dechter and Paul LaTour

SINCE THEN, a wide variety of tools and techniques have been developed to improve the understanding of how images are perceived, abnormalities detected and diagnostic decisions made.

There is room for improvement considering radiologists still make mistakes even using advanced image processing and analysis tools, said Elizabeth A. Krupinski, PhD, during her Wednesday presentation, "A Short History of Image Perception in Radiology."

Elizabeth A. Krupinski, PhD

Improved understanding of how these image manipulations and decision support systems impact radiologists' decision-making processes is critical to further improving their effectiveness, said Dr. Krupinski, professor and vice chairman for Research Department of Radiology and Imaging Sciences at Emory University in Atlanta.

"Determining the best ways to integrate these tools into everyday clinical workflow is critical as well, since poorly integrated systems, no matter how good they are in a stand-alone setting, will not impact performance positively," Dr. Krupinski said.

It's important to consider the radiologist's perceptual and cognitive capabilities when developing new imaging technologies and tools, she said. Better training and education methods and better integration of technology into clinical workflow can impact patient care and outcomes without placing undue burdens on the radiologist.

"If we understand why errors are made we can develop tools or processes to reduce them or we can develop better training methods," Dr. Krupinski said.

Image analysis tools, eye-tracking, better software and hardware – there are a multitude of ways technology can be used to understand and then aid or complement the human visual system and decision making processes, she said.

The role of fatigue also needs to be understood, Dr. Krupinski said.

"Studies have demonstrated that after only eight hours of clinical work radiologists are fatigued and their diagnostic accuracy drops significantly," Dr. Krupinski said. "We need to improve our understanding of the role of fatigue and how to ameliorate its impact."

Does Lighting Impact Performance?

In another session, Francine Jacobson, MD, MPH, said that in the early days of the specialty, radiologists used red goggles for dark adaptation to better see fluoroscopic images. Red light remained in dark rooms for film development until digital conversion was completed in the early 2000s.

Yet in 2006, after an RSNA lecture, a radiologist approached her to suggest that reading should be done in neutral gray lighting rather than the long-standing dictum to recruit darkness. Ambient lighting is also needed for non-image computer work, said Dr. Jacobson, director of lung cancer screening at Brigham and Women's Health Care, staff radiologist at Brigham and Women's Hospital, Division of Thoracic Imaging, and assistant professor of radiology, Harvard Medical School in Boston.

Dr. Jacobson pointed toward aviation and other industries that use blue light to improve performance as a guide

Francine Jacobson, MD, MPH

for radiology. She said blue light improves alertness, attentiveness and mood. And as the use of color in imaging increases, basic color effects and color interactions also become more important.

"The most basic perceptual task is detection," Dr. Jacobson said, adding the attribution of the finding and the company it keeps can be most important.

"Radiologists are increasingly the integrators of visual and non-visual data," Dr. Jacobson said. "CT scans now often replace physical examination, requiring more consideration of the history that is not given to the radiologist as part of the order."
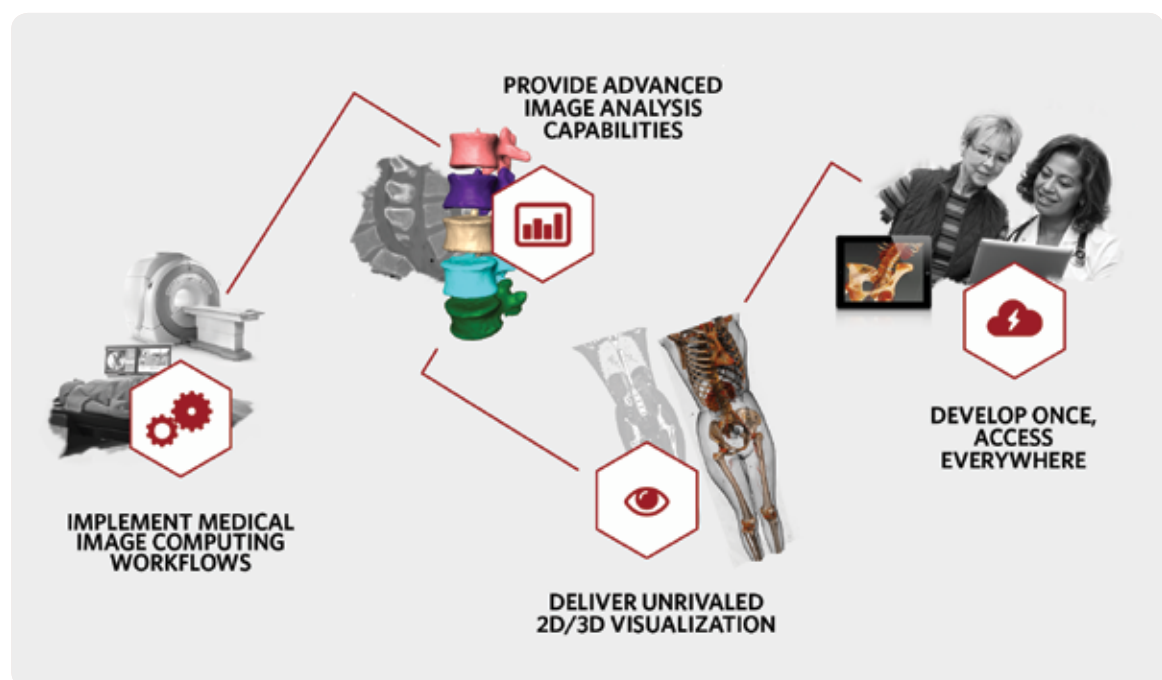
Additional Image Perception Courses at RSNA 2016

Radiologic Expertise-Incorporating Perception into Training
Thursday 8:30 – 10 a.m., Room S103CD
Presenters will discuss the development of expertise in image interpretation, how to teach trainees interpretation strategies and formal assessment of practicing radiologists.

Computational Perception
Thursday 4:30 – 6 p.m., Room E353B
Presenters will cover the status of CAD in clinical radiology, the role of imaging informatics in perception and review the effects of reading paradigms and visualization on radiologists interpretation.

Perception in the Clinic
Friday 8:30 – 10 a.m., Room E263
Presenters will discuss the impact of fatigue on radiologists' performance, the perception of volumetric image data and the role of image quality in perception.

Women Climbing the Radiology Career Ladder Still Face Challenges, Barriers

By Felicia Dechter

Despite making progress in many areas, women in radiology still face substantial challenges and barriers in shattering the glass ceiling, according to four leading women who discussed the issue at the Wednesday session, "Women in Leadership Roles."

Women traditionally have not asked for what they need to be successful, mainly due to cultural expectations that they should wait to be asked, said presenter Carol Rumack, MD, professor of radiology and pediatrics at the University of Colorado Medical School in Aurora.

Dr. Rumack encouraged women radiologists to ask for what they want in areas including their salary and in securing research support. She stressed that radiology leaders need to encourage women to participate in leadership roles.

"Both women radiologists and radiology leaders need to strongly support the inclusion of women at the highest levels of radiology organizations so that diversity will be a positive force for change," said Dr. Rumack, who is a former chair of the *Daily Bulletin* and a past president of the American College of Radiology.

Only 25 percent of practicing radiologists are women although 50 percent of medical students are women, Dr. Rumack, who also served as the first female president of the American Association for Women Radiologists. In addition, residency programs tend to pick men as residents, she said.

Define Your Own Success

Because the definition of success is very individual, women should start by defining their specific purpose and goals, said Rebecca Leddy, MD, an associate professor of radiology and assistant director of Breast Imaging in the Department of Radiology at the Medical University of South Carolina in Charleston.

It's important to think positive, she said.

"Most people spend their life looking at their weaknesses," Dr. Leddy said. "Find your strengths."

Common barriers include a lack of purpose or direction, mentorship and support, time, personal and professional life balance or integration and disparity, Dr. Leddy said.

She encourages women to define their purpose and goals, determine their core strengths and value, to be innovative and proactive, stay open to opportunity, be willing to ask for what they want, find mentors and sponsors and get out there and do some networking, she said.

Overcoming Fear of the Unknown

Making a smooth transition from trainee to attending physician is also critical to a successful career path, said Meryle Eklund MD, assistant professor of pediatric radiology at the Medical University of South Carolina in Charleston.

The biggest challenge is fear of the unknown – will the trainee get a job, what will that job be like, and how can one achieve success in a new position, Dr.

Panelists discuss strategies for more women to rise to leadership roles in radiology.

Eklund asked. New attending radiologists feel as though they must prove themselves in their work, often while adjusting to a new city, institution and lifestyle. That amount of change in a short time can cause anxiety in a junior radiologist.

"All of these questions must be weighed in the setting of an unfamiliar environment that involves a heightened level of professional responsibilities," Dr. Eklund said.

Being aware of upcoming challenges and tackling them in a systematic way is critical She suggests finding a mentor who can give advice on navigating the system and setting achievable short- and long-term goals.

And despite women making strides toward pay equality in recent years, there are still considerable differences in the types of positions held by men and women radiologists, Dr. Eklund said.

Concurring with Dr. Rumack, Dr. Eklund stressed the importance of asking.

"A man may easily lay out his strengths and potentially overestimate his worth to an institution, but females have a harder time with self-promotion and asking for what they want," Dr. Eklund said. "Becoming aware of these differences can help junior female radiologists be well equipped for success from the very beginning of their careers."

In terms of moving up the career ladder, presenter Elizabeth Oates, MD, chairman of the Dept. of Radiology and chief of the Division of Nuclear Medicine and Molecular Imaging at the University of Kentucky College of Medicine in Lexington, suggested a number of approaches women can take in radiology.

Look around your department or workplace, said Dr. Oates, who founded Women in Medicine and Science at the University of Kentucky. Look at specialty and subspecialty organizations for volunteer positions, she said.

"Be willing to do what needs to be done, even if unpleasant," Dr. Oates said. "Show zest and initiative; have, share and execute innovative ideas; complete assignments on time; do a good job; maintain a current CV ready at a moment's notice; be willing to travel, speak and write."

RSNA/AAPM Symposium Explores Precision Medicine

In this symposium presented in conjunction with the American Association of Physicists in Medicine (AAPM), Maryellen L. Giger, PhD, and Daniel C. Sullivan, MD, will help radiologists and medical physicists further understand what their roles will be within the Precision Medicine Initiative (PMI).

Dr. Giger is the A.N. Pritzker Professor of Radiology, the Committee on Medical Physics, and the College at the University of Chicago (UC). A pioneer in the development of computer-aided diagnosis (CAD), Dr. Giger has conducted research on CAD and quantitative radiomics in the areas of breast cancer, lung cancer, prostate cancer and bone diseases for 30 years. Her research in computational image-based analyses of breast cancer for risk assessment, diagnosis, prognosis and response to therapy has yielded various translated components, and she is now using these image-based phenotypes in radiomics-

Maryellen L. Giger, PhD
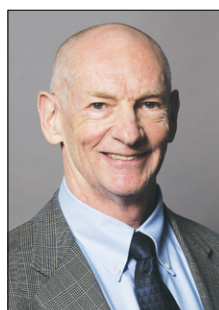
Daniel C. Sullivan, MD

genomics association studies for cancer discovery and implementation through the development of digital virtual biopsies.

A past president of AAPM, Dr. Giger is a former RSNA third vice president and served as chair of the RSNA Research & Education (R&E) Foundation Research Study Section. She is a member of RSNA's Public Information Advisors Network. Dr. Giger is a PI in the NCI Quantitative Imaging Network and co-leader of the TCGA Breast Phenotype Research Group.

Dr. Sullivan is professor emeritus at the Department of Radiology at Duke University Medical Center in Durham, N.C. His areas of clinical and research expertise are in nuclear medicine and oncologic imaging, in particular focusing on improving the use of imaging as a biomarker in clinical trials and facilitating translational research involving new and established imaging methods. While at the National Cancer Institute (NCI) from 1997 to 2007, Dr. Sullivan had key roles in designing and implementing the National Lung Screening Trial and the Digital Mammography Imaging Screening Trial.

Dr. Sullivan founded and chaired RSNA's Quantitative Imaging Biomarkers Alliance (QIBA), and served as RSNA science advisor from 2007 to 2015. He currently serves as the QIBA external relations liaison. In 2014, he was appointed to a three-year term on the National Advisory Council for Biomedical Imaging and Bioengineering at National Institutes of Health.

Survey: One-Fifth of Patients Not Getting Pre-Exam Imaging Information

By Felicia Dechter

More than 20 percent of patients are not receiving any information prior to a radiology examination and the majority of information patients are getting about imaging exams is being provided by referring physicians — and patients prefer this method.

These were among the findings of a multi-institutional U.S. survey presented during a Wednesday poster discussion by Jay K. Pahade, MD, director of radiology quality and safety at the Yale Department of Radiology and Biomedical Imaging in New Haven, Conn.

"The survey exposed that nearly one-fifth of patients/patient caregivers are not receiving information regarding their imaging exam highlighting an opportunity to improve patient engagement and awareness before the radiology encounter," said Dr. Pahade, adding the results were somewhat surprising.

In early 2015, Dr. Pahade and co-lead investigator Andrew Trout MD, chief of nuclear medicine in the Department of Radiology/Medical Imaging at the Cincinnati Children's Hospital, led a team who conducted a 24-item survey to assess what information patients find useful before their imaging exam, who they want to get the information from, and how preference varies based on demographics and patient-specific variables.

The survey comprising 1,542 patients, was conducted at three sites primarily caring for adult patients, Yale-New Haven Hospital, Massachusetts General Hospital and the University of Alabama at Birmingham — and at three sites primarily serving pediatric patients, Cincinnati Children's Hospital Medical Center, Indiana University, Riley Children's Hospital and Stanford University Lucile Packard Children's Hospital. Results included responses from all facilities combined.

Key findings showed that 22 percent of respondents reported receiving no information regarding their radiology exam before presenting for imaging, Dr. Pahade said. Results also showed that the ordering provider was the most common source of information (65 percent) about a patient's radiology exam and that 72 percent of respondents said the referring physician was the preferred source for getting exam information.

Other significant results showed that 52 percent of respondents independently tried to find information about their radiology exam with most (43 percent) utilizing multiple sources and the fewest number (5 percent) using radiology specific-web sites, Dr. Pahade said. The findings were surprising to researchers, he said.

"We were surprised by the proportion

We were surprised by the proportion of patients who reported receiving no information on their radiology exam.

Jay K. Pahade, MD

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of patients who reported receiving no information on their radiology exam," Dr. Pahade said. "We were also surprised that while more than half of respondents reported trying to find information on their own, only 5 percent reported using a radiology-specific website to get information."

Despite the emphasis on radiation awareness by the radiology community and press, patients surveyed ranked information regarding exam preparation as most important while getting information about whether an alternative radiation-free exam could be utilized was ranked as least important, the survey showed.

Given that the survey showed that referring physicians are the most common and preferred source for information about imaging exams, this is an important group for educational outreach by the radiology community, he said.

While researchers expected the ordering provider to be the most common source of information for radiology exams, they were surprised that such a small number of patients reported preferring to hear the information from the radiology center

Survey co-lead investigator Jay K. Pahade, MD

conducting the exam (21 percent) or from the providers directly involved in performing or interpreting the exam (9 percent), Dr. Pahade said.

"This is likely related to lack of awareness about radiology and the role of radiologists from most patients," said Dr. Pahade.

The study provides insight into the effectiveness of current pre-exam information delivery, patient and parent/caregiver preferences on receiving information, the importance of specific exam-related information and methods patients currently use to obtain information on their own, Dr. Pahade said.

Results also highlight the need for better awareness and marketing of radiology-specific sites such as the RSNA/ACR patient website, *RadiologyInfo.org*, so patients can obtain accurate pre-exam information, he added.

Dunnick is R&E Foundation Chair

N. Reed Dunnick, MD, is the chair of the RSNA Research & Education (R&E) Foundation Board of Trustees.

Dr. Dunnick is the Fred Jenner Hodges Professor of Radiology at the University of Michigan Health System in Ann Arbor, Mich., where he has been a faculty member since 1992.

A member of the Board of Trustees since 2013, Dr. Dunnick advocates for the Foundation's mission to improve patient care through the financial support of research and education in radiology.

Dr. Dunnick has been an active RSNA member since 1987, serving on the Board of Directors from 2006 to 2014, and as president in 2014. He has also served on the Scientific Program Committee, Research Development Committee, Education Council and the Grants Program Committee.

A recognized leader in the radiology community, Dr. Dunnick is a past president of the American Roentgen Ray Society

N. Reed Dunnick, MD

and the Society of Chairs of Academic Radiology Departments. He has served in leadership roles with a number of other medical societies and organizations, including the American Board of Radiology Foundation and the American College of Radiology, where he served as vice president from 2008 to 2009.

Dr. Dunnick supports the Foundation as a Silver Centennial Pathfinder, Presidents Circle member and Platinum Visionary donor.

The Board of Trustees also appointed Stamatia V. Destounis, MD, Rochester, NY; Umar Mahmood, MD, PhD, Charlestown, Mass.; and Vijay M. Rao, MD, Philadelphia, to the Board.

To learn more about the Foundation and its Inspire-Innovate-Invest Campaign visit the R&E Foundation booth in the Connections Center or *RSNA.org/Foundation*.

Radiation Safety

Answer

[Question on page 9A.]

A Yes. Ultrasonic field parameters and dwell times are selected to provide the best possible imaging study, while keeping acoustic output as low as reasonably achievable.

Q&A courtesy of AAPM.

Dorsal Anterior Insula Connectivity - A Potential Target for Cognitive Improvement in MS Patients

A new study suggests that the dorsal anterior insula may be an attractive target for non-invasive strategies to modulate connectivity in order to improve cognitive function related to multiple sclerosis.

By Lynn Antonopoulos

"THE ROLE OF THE ANTERIOR INSULA as a critical region regulating switching between cognition and behavior is only just beginning to be investigated and understood," said presenter Bernardo Canedo Bizzo, MD, research fellow in radiology, Harvard Medical School/Massachusetts General Hospital (MGH).

He added, "The ability to predict possible cognitive deficits based on our functional neuroanatomic findings has the potential to help guide patient management and patient counseling in the future."

Cognitive impairment is estimated to occur in 40 to 60 percent of MS sufferers. Dr. Bizzo and his team assessed whole-brain, dorsal anterior insula intrinsic functional connectivity using resting state functional MRI (fMRI) in 28 MS patients. In addition, each patient was assessed for cognitive status, degree of disability and cognitive reserve.

They sought to relate dorsal anterior insula instrinsic functional connectivity with measures of cognitive status and reserve. The study provided support for recent findings that relate the insula to a tripartite framework of cognition, emotion and interoception – the sensory system responsible for detecting the body's internal regulation responses.

The researchers performed 3T MRI using the Connectome scanner at MGH Martinos Center for Biomedical Imaging. The scanner maps white matter connections in the brain by tracking the movement of water and produces higher quality images than conventional MRI in a fraction of the time.

The team used the data they collected to look at the relationship of the dorsal anterior insula and its functional connectivity to the cognitive deficit presented by the patient. They found a significant correlation between cognitive reserve and left dorsal anterior insula instrinsic functional connectivity to an occipital cluster in the left hemisphere of the brain which included the cuneus and superior occipital gyrus.

"This combination of advanced hardware with cutting edge computational tools is especially timely and important given the NIH's blueprint for 'The Human Connectome Project: Mapping Structural and Functional Connections in the Brain', as well as the White House Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative," Dr. Bizzo said.

According to Dr. Bizzo, he and his fellow researchers sought to ensure that their methods of analysis did not result in an increased number of false positives associated with some commonly used fMRI methods. After their initial review, they reanalyzed the complete dataset using a more conservative approach. Doing so, they confirmed their initial findings and were able to more precisely define the anatomical regions independently related to cognitive reserve in patients with MS. He said, "On our re-analysis it became clear that the occipital region was, without doubt, a strong predictor of cognitive reserve."

The team plans additional exploration of this topic and will write a review paper on anterior insula function in the hope of raising awareness and generating further research. In addition, they plan to perform a more detailed structural connectivity mapping of the anterior insula specifically in MS using their diffusion spectral imaging dataset.

> *On our re-analysis it became clear that the occipital region was, without doubt, a strong predictor of cognitive reserve.*
>
> Bernardo Canedo Bizzo, MD

Bernardo Canedo Bizzo, MD

Technologists Need Training to Keep up with Pace of CT Angiographic Imaging

By Mike Bassett

TECHNOLOGISTS NEED MORE training and education to keep up with the rapidly changing environment in CT angiographic imaging, said John Leal, BS, RT(R)(CT), a clinical education trainer with the Medical Technology Management Institute, in a Wednesday session.

Technology Continues to Pick Up Speed

As Leal pointed out, scanners have been developed that can acquire 16 cm of data per rotation — enough to cover the head and chest in one gantry rotation — with a rotation time as fast as 0.25 seconds, a temporal resolution as low as 50 milliseconds, and table speeds that enable full-body imaging in three seconds.

"What motivated manufacturers to move in this direction?" Leal asked. "Why this need for speed?"

Machines with this kind of speed and power are built to chase contrast around the body, Leal said. Which means these newer machines are geared toward looking at vascular structures.

So technologists are doing more angiography, "yet we are painfully undereducated in that process," he said.

He compared the problem to handing the keys of a high-powered sports car to a newly licensed driver. "It's like taking driver training and driving a Ferrari at 150 miles per hour to see what happens," he said. "And that's essentially happening to us."

Leal said that he constantly hears from radiologists that their technologists don't understand the disease process they are imaging, and that they don't understand what they are seeing. "Techs take the pictures, process the images, and just send them on," he said. "The problem with that is the radiologists can only see what we show them, which can limit their ability to see the images and diagnose."

A CT technologist's job is to show radiologists the answer to the diagnostic question, Leal pointed out. "Understanding the disease process, and understanding from an angiographic standpoint how blood flows around the body, and how we should design protocols — all of these things have to go together in order for us to properly do our job," he said.

Updated Protocols will Lead to Improved Efficiency

One problem, Leal said, has to do with protocols. "I do a lot of cardiac imaging, and with a lot of our studies we've been using the same kinds of protocols we've been using for years." He added that some of these protocols can be traced back to machines that no longer exist.

"These machines have changed significantly," he pointed out. "So why haven't our protocols changed?"

Leal questioned what he called a cookbook approach to CT scanning. As a consultant, he visits various facilities and observes protocol setups. "I'll ask why they're using that protocol for this particular study, because it doesn't make any sense," Leal said. "And the answer to that will be, 'well, that's what's in the book.'"

"It's another problem we have in the tech world," Leal said, pointing out that technologists will use protocol guides — or "cookbooks" as he refers to them. "We really haven't learned enough about how each individual patient is different and that everyone's cardiac output isn't the same. And this affects how studies come out."

What is needed is more education and training, Leal said, particularly as CT technologists' jobs become more geared toward CT angiography and the equipment they work with becomes more advanced. And hospitals need to provide the time and financial support to attend educational events, he added.

Technologists also have to be partners in imaging with radiologists. "How many radiologists perform CT scans?" he asked. "That's not what they do."

Technologists—particularly those with years of experience, should consider themselves experts at what they do, Leal said. Consequently, they should interact more with radiologists, and get more education and training so they're prepared to make adjustments to protocols and better handle these new CT systems.

"With education, and by working together, we can provide better — and consistent — quality studies, and greater job satisfaction," he concluded.

> *It's like taking driver training and driving a Ferrari at 150 miles per hour to see what happens.*
>
> John Leal, BS, RT(R)(CT)

John Leal, BS, RT(R)(CT)

First RSNA Image Share Validation Seals Awarded

RSNA and The Sequoia Project announced Wednesday the first seven vendors to successfully complete the RSNA Image Share Validation program that rigorously tests the compliance of vendors' systems to accurately and efficiently exchange medical images. The approved vendors include Agfa Healthcare, AMBRA Health (formerly DICOM Grid), GE Healthcare, Lexmark Healthcare, LifeImage, Inc., Mach7 Technologies and Novarad.

"Radiologists should insist that products they purchase have achieved the RSNA Image Share Validation Seal to ensure true interoperability. Anything less is not in the interest of our patients," said David S. Mendelson, MD, vice chair of radiology IT at the Mount Sinai Health System in New York.

Shear Wave Elastography Via Ultrasound Offers a Painless Liver 'Biopsy'

When it comes to assessing and staging fibrosis in chronic liver disease, histopathology is still considered to be the gold standard. But what if ultrasound (US) could do the job just as reliably without subjecting the patient to a painful and inconvenient biopsy?

By Elizabeth Gardner

THE LAHEY CLINIC in Burlington, Mass., is using a US technique, shear wave elastography, to supplement, and in many cases replace, liver biopsy. The clinic uses the technique for about 50 cases per month.

In a poster presentation on Wednesday, radiology resident Pauley Chea, MD, said most healthcare facilities should be able to use shear wave elastography with their existing US equipment, with at most a software upgrade.

"Switching over can happen fairly quickly — it's just a matter of deciding whether it's what a facility needs," he said.

Chronic liver disease, including alcoholic liver disease, fatty liver disease, hepatitis, cirrhosis, cholangitis and hemochromatosis, is responsible for 1.2 percent of deaths per year in the U.S., and cirrhosis alone accounts for 35,000 deaths.

Early detection and staging of fibrosis and inflammation is key in determining prognosis and treatment outcomes, and fibrosis can be reversed if detected and treated early.

The most common causes of fibrosis are hepatitis B and C, alcoholic liver disease and non-alcoholic fatty liver disease. Fibrosis is most commonly confirmed with a biopsy. But biopsies pose their own risks — most
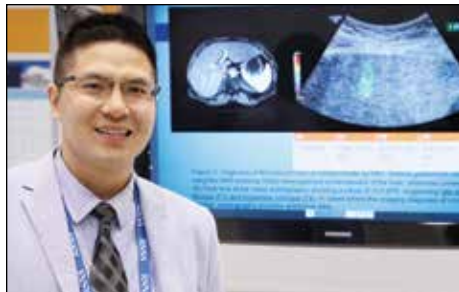
Pauley Chea, MD

commonly bleeding — and may yield inconsistent specimens. The biopsied site may not represent the liver's overall condition if the liver isn't homogeneous. And biopsies may be contraindicated for some patients.

Shear waves are generated in tissues when a directional force (such as US) is applied and causes deformation. Shear waves produce micrometer-level tissue displacement that can be detected by the US probe. Shear waves will propagate faster in stiffer tissues, such as a cirrhotic liver, and therefore increased propagation indicates fibrosis.

Quantified values of liver stiffness are obtained in kilopascals (kPA), a unit of pressure measurement that can be converted to the METAVIR scale (F0 to F4) that is used to grade histopathology specimens. When performed with either complete or limited

abdominal US, shear-wave elastography is non-invasive and quick, samples a larger area than a biopsy, is highly reproducible, has limited dependency on the skill of the operator, and produces quantitative data.

"The beauty is that it's simple to read," Dr. Chea said. "Essentially, you place the probe in a particular position and press a button." The machine averages 10 data points to get an overall measure of stiffness.

Shear-wave elastography may be indicated when liver fibrosis is suspected, as well as hepatitis, non-alcoholic steatohepatitis, primary biliary cholangitis or other liver disease. Because fat and fluid interfere with shear wave propagation,

elastography may be less accurate in obese patients, and in the presence of ascites, steatosis, inflammation, acute hepatitis, and cholestasis.

Dr. Chea predicted that the "painless biopsy" will be particularly useful to measure the effectiveness of treatment over time. Rather than requiring a biopsy every three years, hepatologists can order the scans to monitor response non-invasively, and can also avoid exposing the patient to excess radiation via repeated CT scans, or incurring the greater expense of repeat MRI studies.

The technique also might be used to evaluate blood vessels, focal liver lesions and lung fibrosis.

Cost Assessment Tool Improves Efficiency of MR Enterography

By Richard Dargan

USE OF A COST ASSESSMENT tool helped the Mayo Clinic reduce time and expense associated with an MRI procedure, according to research presented at RSNA 2016.

Time-Driven Activity-Based Costing (TDABC) is a cost accounting methodology developed by two professors at the Harvard Business School to help businesses better understand their costs.

Applied to a healthcare setting, TDABC measures the time and cost of providing patient care services, taking into account personnel and equipment costs per minute. Overhead expenses and profit margins are also factored in to determine the true cost.

"In this era of declining reimbursements, it's particularly important to understand how much a procedure costs and how much you're getting paid," said Stacy Schultz, project manager and former quality improvement specialist at the Mayo Clinic in Rochester, Minn. "TDABC helps by taking every piece of the exam and putting a value on it."

Schultz and her Mayo Clinic colleagues recently employed TDABC to better understand and improve their practice of MR enterography, commonly used to examine the small intestine for signs of Crohn's disease.

Though the imaging portion of the procedure only takes about half an hour, patient preparation can be time-consuming. The exam at the Mayo Clinic once involved eight different care providers and required a patient to spend an average of three hours in the department.

"We picked MR enterography for this study because it was something we knew a lot about," Schultz said. "It's been a frustrating exam for all the staff, with an extensive number of process steps, and prior attempts at improving the process had been disappointing."

Eliminating Delay in MRE Procedures

A multidisciplinary team of patient-care personnel and radiology management staff worked together to analyze the various steps in the procedure and the associated costs and develop new approaches.

For instance, MRE procedures at Mayo once required a nurse to deliver an injec-
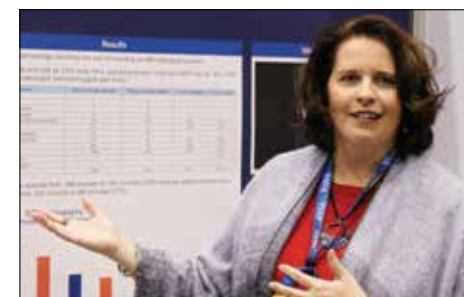
Stacy Schultz

tion of glucagon, a medication that reduces the normal contractions of the intestine that can blur the images on MRI. This step interrupted work flow and had the potential to delay the exam for as long as 25 minutes. The team shifted responsibility for the glucagon injection to the technologist, eliminating the delay.

"The nurses were frustrated at being interrupted from other duties to prepare and perform the injection and technologists were frustrated waiting on the nurses, so this change not only cut time but really helped reduce frustration among staff members," Schultz said.

The organization applied the TDABC methodology to MRE starting in January 2015 and ended the implementation and data collection by October of that year. They were able to gather process observation data from more than 30 exams to validate previous data from over 1,000 patient chart reviews.

Analysis showed that TDABC methodology led to improvements in the daily workflow. In more than 1,000 MRE procedures, the modifications reduced nonvalue-added waste and cost by 13 percent. Staff time was reduced 16 percent, from an average of 198 minutes to 165. Patient process time dropped from an average of 102 minutes to 85, a reduction of 17 percent. Surveys showed a high level of staff satisfaction.

"Everybody loved it," Schultz said. "The nurses and technologists were happy and complaints from radiologists went down."

With the success of this initiative, Mayo Clinic teams are applying the TDABC methodology to other areas within the radiology practice, including ultrasound and MRI of the head.

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Deliver MSK-radiology subspecialty care to your patients with the superior imaging of the SONIMAGE® HS1 compact ultrasound system. The intuitive touchscreen user interface of the HS1 provides rapid and confident MSK evaluation and diagnosis at the point-of-care. With SNV™, Simple Needle Visualization, needles remain clearly visible during ultrasound-guided injections and biopsies. Access the 'Remote Assist' feature for on-site consultation on image optimization and scanning techniques, so you can achieve **better decisions sooner**.

Smile for Ray the robot! Visit Exhibit 1919, South Hall A at RSNA 2016 for our roving robotic photographer to snap and email a digital photo of you.

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