TUESDAY DECEMBER 3, 2019

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Daily Bulletin

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ALS Treatments Are Elusive, but Hope is on the Horizon

By Richard Dargan

While effective treatments for amyotrophic lateral sclerosis (ALS) remain frustratingly out of reach, recent advances hold promise for unlocking its mysteries, a leading expert said Monday.

Pascuzzi

> ***ALS is a horrible disease, but right now there is reason to be optimistic that we can turn things around.***
>
> **Robert M. Pascuzzi, MD**

"ALS is a horrible disease, but right now there is reason to be optimistic that we can turn things around," said Robert M. Pascuzzi, MD, professor of neurology at the Indiana University School of Medicine in Indianapolis and director of the ALS program at Indiana University Health, during his New Horizons lecture at the Arie Crown Theater. Radiology, he stressed, plays a critical role in the battle against ALS.

Dr. Pascuzzi described how Jean-Martin Charcot, a native of France who is considered the Father of Neurology, first reported the disease in 1874 as a progressive disease of the brain and spinal cord characterized by creeping paralysis and loss of function. Most patients live only two to five years after the appearance of symptoms. The cause is not known for the vast majority of patients.

The disease's rapid, relentless course has generated much public attention, perhaps never more so than in the case of Lou Gehrig, the legendary first baseman for the formidable New York Yankees of the 1920s and '30s.

Gehrig, so well-known for his durability that he was nicknamed "the Iron Horse," experienced a dramatic drop-off in his performance in the spring of 1939. Actions once routine for him, like fielding the ball or running the bases, became difficult. Dr. Pascuzzi described how, after Gehrig's diagnosis at the Mayo Clinic in Minnesota, he enrolled in a clinical trial looking at vitamin E as a possible treatment for the disease. The published study included a sanguine pronouncement on Gehrig's status: "The case may be regarded as definitely arrested and somewhat improved."

"What's interesting is that this publication came out almost to the week of Lou Gehrig's obituary being published," Dr. Pascuzzi said.

A Multifaceted Approach to ALS

Current clinical management of ALS involves treatment of symptoms with

CONTINUED ON PAGE 14A

Imaging is a Powerful Weapon in the War on Alzheimer's Disease

By Lynn Antonopoulos

Researchers and clinicians have worked for decades examining Alzheimer's Disease (AD), yet despite making significant progress in identifying factors that contribute to the development of AD, no one has successfully developed a disease-modifying medication.

New Horizons lecturer Andrew Saykin, PsyD, the Raymond C. Beeler Professor of Radiology and Imaging Services and professor of medical and molecular genetics at Indiana University (IU) School of Medicine, presented a look at AD research with a focus on prevalence, risk factors and biomarkers.

"Continued work in the field is evolving toward precision medicine for AD with the ultimate goal of prevention, therapeutic development and an understanding of the fundamental mechanisms needed to achieve this goal," Dr. Saykin said.

According to an annual report released by the Alzheimer's Association, AD is the sixth leading cause of death in the U.S. affecting nearly 6 million Americans and many more worldwide. "Annual costs are estimated to be nearly $300 billion and all of these figures will skyrocket given the aging population if we don't intervene," Dr. Saykin said.

Saykin

> ***Continued work in the field is evolving toward precision medicine for AD with the ultimate goal of prevention, therapeutic development and an understanding of the fundamental mechanisms needed to achieve this goal***
>
> **Andrew Saykin, PsyD**

After presenting a comprehensive list of known risk factors such as age, family history and genetics including the APOE gene, Dr. Saykin said the story of AD goes back 112 years to Alois Alzheimer who identified the mental deterioration of a woman in her 50s who had what became known as senile plaques in her brain.

Sharing imaging of amyloid beta plaques on molecular PET and tau PET,

CONTINUED ON PAGE 14A

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Tuesday At a Glance

RSNA/AAPM Symposium:

Integrated Diagnostics: Why Does it Matter and How Do We Get There?

10:30 a.m. - Noon | (E451B)

Mitchell D. Schnall, MD, PhD

Schnall

The Path to Integrated Diagnostics

Dr. Schnall will discuss how an integrated diagnostic approach, which combines radiology, pathology and genomics, may lead to improved patient outcomes. Currently the Eugene P. Pendergrass Professor of Radiology and the chair of the Department of Radiology at the Perelman School of Medicine at the University of Pennsylvania in Philadelphia, Dr. Schnall has been a faculty member since 1991, and a full professor since 2002.

Anant Madabhushi, PhD

Madabhushi

Radio-Patho-Genomics: Computationally Integrating Disease Specific Features across Scales

Dr. Madabhushi will discuss the potential of new methods to combine imaging and other data from multiple diagnostic approaches. Dr. Madabhushi is director of the Center for Computational Imaging and Personalized Diagnostics (CCIPD) and F. Alex Nason Professor II, Biomedical Engineering, Case School of Engineering, Case Western Reserve University (CWRU) in Cleveland, Ohio. He is also a research scientist at the Louis Stokes Cleveland Veterans Administration Medical Center.

7:15 - 8:15 a.m.

RSNA Diagnosis Live™ (E451B)

Controversy Session

MR Elastography versus US Elastography of Liver (E350)

Hot Topic Session

Patient-facing Nuclear Medicine Clinics for Prostate Cancer (E450B)

8:30 - 10 a.m.

Educational Courses

BOOST

8:30 a.m. - Noon

Series Courses

10:30 a.m. - Noon

Scientific Paper Sessions

Innovation Theater Presentations

Egypt Presents:

Radiology in Egypt-Case-based Approach (E353C)

BOOST: Anatomy and Treatment Planning (Interactive Session)

10:30 a.m. - 3 p.m.

AI Theater Presentations

11 a.m. – 3 p.m.

3D Printing and Advanced Visualization Theater Presentations

12:15 - 1:15 p.m.

Scientific Poster Discussions

1 - 4 p.m.

RSNA Resident and Fellow Symposium 2019 (E451A)

Annual Oration in Diagnostic Radiology

1:30 - 2:45 p.m. | (Arie Crown Theater)

Sanjiv S. Gambhir, MD, PhD

Gambhir

Next Generation Technologies and Strategies for Precision Health

Dr. Gambhir will discuss the concept of precision health, the practice of monitoring healthy people in order to intercept disease as early as possible, and how a shift toward focus on precision health would affect radiology. He is the Virginia and D.K. Ludwig Professor of Cancer Research and chair of the Department of Radiology at Stanford University School of Medicine.

RSNA Gold Medals Presented Today

1:30 - 2:30 p.m.

BOOST

1:30 - 3 p.m.

Interventional Oncology Series

2:30 - 4 p.m.

Educational Courses

3 - 4 p.m.

Scientific Paper Sessions

3 - 4:15 p.m.

BOOST

4:30 - 5:30 p.m.

BOOST

4:30 - 6 p.m.

Educational Courses

Daily Bulletin

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New NCRP Report Shows Average Medical Radiation Doses in U.S. are Decreasing

By Nick Klenske

Results of a 2019 National Council on Radiation Protection and Measurements (NCRP) report show that the average diagnostic and interventional medical radiation doses are decreasing in the United States (U.S.), according to presenters of a Monday session. The report showed a 15 to 20% reduction in medical radiation doses in the U.S. population from 2006 to 2016.

Along with advancing technology, dose reduction campaigns by radiology organizations including RSNA are contributing factors.

"With the exception of CT scans, most medical imaging doses are stable or decreasing," said Mahadevappa Mahesh, PhD, MS, a professor of radiology and medicine at the Johns Hopkins University School of Medicine.

The 2019 report, entitled, "Medical Radiation Exposure in Patients in the United States" and published by the NCRP in November, analyzed radiation exposure in the U.S. population from 2006 to 2016. It serves as a 10-year update to a 2009 NCRP report that measured medical radiation exposure from the early 1980s to 2006.

Mahesh

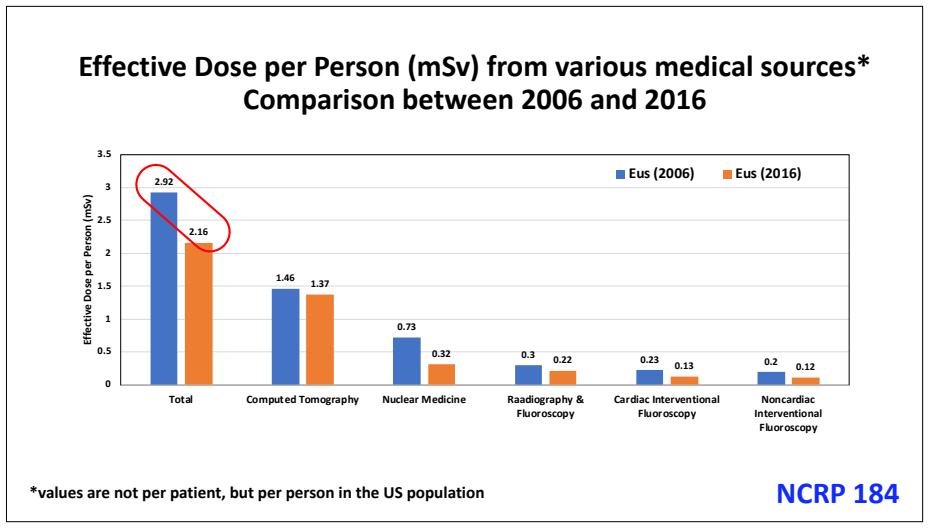
Dr. Mahesh, who presented the 2019 NCRP report during a Monday session, co-chaired the report committee with Fred Mettler Jr., MD, professor emeritus and clinical professor at the Department of Radiology and Nuclear Medicine at the University of New Mexico School of Medicine.

A Dramatic Decrease in Dosage

According to the 2009 NCRP report, medical radiation exposure constituted nearly half of the total radiation exposure of the U.S. population. In fact, the 2009 report showed that medical radiation exposure increased nearly six-fold since the previous NCRP report, published in 1987 – a change that was primarily the result of the significant increase in use of CT scanning.

In contrast, the 2019 report shows a dramatic decrease in average radiation dose per person – by as much as 15 to 20%. Specifically, in nuclear medicine, radiation dose per person was reduced by over 50%, mostly due to a decreasing number of procedures.

"As for CT procedures, while the number of CT scans increased by 20% over the decade between the reports, the overall dose per CT exam declined," Dr. Mahesh said.



Radiology Campaigns Contribute to Dose Reduction

The substantial decrease in radiation dose outlined in the 2019 NCRP report can be attributed to several factors. One important change is the technological advances that have yielded hardware improvements and protocols, leading to higher quality images at lower doses. In addition, radiography's shift away from standard film and increased use of digital receptors has resulted in lower radiation doses for some procedures.

Furthermore, efforts by organizations like the U.S. Food and Drug Administration and such dose reduction campaigns as Image Gently and Image Wisely® – programs developed by RSNA, ACR and other radiology associations – have all increased awareness and understanding of medical radiation dose and dose optimization.

"The 2019 NCRP report demonstrates that medical radiation dose in the United States is on the decline, which is a positive shift from a decade ago when doses were increasing significantly," Dr. Mahesh said. "Clearly, the medical community can continue to leverage the benefits of radiological procedures for patients while reducing dose."

> ***"The NCRP report demonstrates that medical radiation dose in the United States is on the decline, which is a positive shift from a decade ago when doses were increasing significantly."***
>
> **Mahadevappa Mahesh, PhD, MS**

Chest Radiographs Aid Deep Learning Model for Predicting Future Health Care Costs

By Melissa Silverberg

What if one scan could help predict a patient's future health care costs? That's the question Yixin Chen sought to answer through research as an undergraduate studying statistics and computer science at the University of California-Berkeley.

She presented the results of that study, "Prediction of Future Healthcare Expenses from Chest Radiographs Using Deep Learning," during a Monday session. Chen's research captured the RSNA Trainee Research Prize, Medical Student.

Although Chen, who is now pursuing a master's degree in biostatistics at the University of Michigan at Ann Arbor, is not studying to become a doctor, she worked closely with radiologist Jae Ho Sohn, MD, MS, at the UCSF Department of Radiology and Biomedical Imaging, who is a co-author on the study. Dr. Sohn received the Margulis Award at RSNA 2019 for his *Radiology* research, "A Deep Learning Model to Predict a Diagnosis of Alzheimer Disease Using 18F-FDG PET of the Brain."

Realizing that 50% of the total population accounts for about 97% of total U.S. health care expenditures, Chen hypothesized that using big data, deep learning and algorithms could help predict some of those costs.

Chen

"Cost is an important barrier to health care access. Having a reliable cost estimation and reliable prediction of top spenders can be a starting point for developing early interventions to improve health and help people plan accordingly," Chen said.

Chen chose to study the chest radiograph because it contains a depth of information not used by radiologists, including many general health indicators that may be utilized to predict future medical costs. She wanted to design an algorithm to see if it would be possible to predict health care expenses within five years after the chest radiograph is taken and use that data to predict the top 50% of spenders in the future.

Chest Radiographs Improved DL Model's Accuracy

Using 21,872 chest radiographs from 19,524 patients paired with the corresponding patient's total spending over the following five years, Chen built four different machine learning (ML) models with different inputs. The baseline model only used patient demographics such as age, sex, zip code and median income to predict cost. Another model used only chest radiographs to predict costs, while the last two used all variables, but had different designs.

The best regression model in Chen's experiment was able to predict five-year expenditures within a 95% confidence interval. Each of the three models that included the chest radiograph as an input was more accurate than the baseline model that only included demographic data as a predictor for future costs.

"The models can be used to identify high-risk patients, enabling early intervention to reduce risk and cost," Chen said. "It can also be used as an indicator that raises alarm against a seemingly healthy chest radiograph by clinical radiological standards."

Although the study was conducted at one institution, Chen hopes it will be replicated at a larger scale in the future.

"The idea of predicting health care costs from one single chest X-ray might be too simple to be true, but when I think about how radiologists can extract so much information about a patient's health from a chest X-ray, and it makes a lot of sense to estimate how much money that patient is going to spend based on how sick they are," Chen said. "I'm excited to see where this kind of thinking about health care data takes us in the future."

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RSNA 2019 Gold Medals

RSNA's highest honor – the Gold Medal – will be awarded to three individuals during today's plenary session.


Dershaw


Dunnick


Seibert

D. David Dershaw, MD

A pioneer in breast imaging and intervention who was instrumental in developing the concept of the "breast center" now known across the country and the world,
D. David Dershaw, MD, is an emeritus attending radiologist at Memorial Sloan Kettering (MSK) Cancer Center in NY. From 1990 to 2010 he was the director of the Breast Imaging Section, Department of Radiology at MSK.

Dr. Dershaw received his medical degree from Jefferson Medical College in Philadelphia in 1974. After an internship at Beth Israel Hospital in New York, he completed a residency in radiology at The New York Hospital, Cornell University College of Medicine, and a fellowship in diagnostic ultrasound in the Division of Ultrasound and CT at Thomas Jefferson University Hospital in Philadelphia. Since 1981, Dr. Dershaw has served on the faculty of Memorial Sloan Kettering (MSK) Cancer Center. He was named professor of radiology at Weill College of Medicine at Cornell University in 1996.

When he began his career at MSK, Dr. Dershaw managed the output of a single mammography machine — the entirety of the program's breast imaging service. As section chief, he recruited 21 new breast imaging radiologists and trained more than 120 fellows, comprising one of the first and largest fellowship programs of its kind. Dr. Dershaw also designed a program for international fellows, training more than 30 radiologists from 14 countries.

The author of more than 200 peer-reviewed publications, four text books and multiple book chapters, Dr. Dershaw has helped to shape the standard of care for patients with breast disease. His work has included introducing guidelines for image-guided breast biopsy, MR imaging and contrast-enhanced mammography. He has developed algorithms to personalize care for women with breast cancer and to screen women who are at elevated risk. His team planned and built the prototype for the original breast center.

Dr. Dershaw is a celebrated leader, serving as chair of the New York State Breast Cancer Advisory Board for 10 years, president of the Society of Breast Imaging (SBI), and a member of the U.S. Department of Health and Human Services' Breast and Cervical Cancer Early Detection and Control Advisory Committee, as well as serving on multiple radiology committees. He chaired the American College of Radiology committee that developed the accreditation program for stereotactic biopsy.

He has also been a reviewer and editorial board member of several peer-reviewed journals, including *Radiology*, *Journal of Nuclear Medicine*, *American Journal of Roentgenology*, and *The New England Journal of Medicine*.

Dr. Dershaw has testified before the FDA and both houses of Congress as a liaison for the breast imaging community. He has lent his expertise to the development of mammography screening programs in Serbia, Romania and Kuwait. The SBI awarded Dr. Dershaw a gold medal in 2013. He received an honorary Doctor of Science from Trinity College, CT, in 2017.

N. Reed Dunnick, MD

A champion of scientific research in medical imaging, N. Reed Dunnick, MD, served for 26 years as the Fred Jenner Hodges Professor and Chair of the University of Michigan's Department of Radiology, and continues to serve as a faculty member, encouraging new advances in imaging, image-guided therapy and professional development.

Dr. Dunnick received his medical degree from Cornell University Medical College in New York City in 1969, and spent two years working in internal medicine at Strong Memorial Hospital at the University of Rochester in New York. He completed his residency in diagnostic radiology at Stanford University, and served as a staff radiologist for the National Institutes of Health (NIH), where he cultivated an interest in genitourinary tract radiology. He served on the faculty of Duke University for 11 years as a professor of radiology, chief of uroradiology and director of the Division of Diagnostic Imaging. In 1984 Dr. Dunnick received Duke's William F. Barry Jr. Award for Teaching Excellence.

Since 1973, Dr. Dunnick has conducted studies in renal and adrenal imaging, exploring multiple modalities in diagnosis and treatment in a wide array of conditions. He has led initiatives in quality improvement, faculty satisfaction, training and continuing education for medical imaging professionals.

Dr. Dunnick has contributed to more than 300 scientific articles, 62 book chapters and 11 books. He has served on the editorial boards of numerous peer-reviewed journals, including *Radiology*, *American Journal of Roentgenology*, *Academic Radiology*, and *Journal of the American College of Radiology*.

A veteran leader in medical imaging, Dr. Dunnick is a past president of the American Board of Radiology (ABR), the American Roentgen Ray Society (ARRS), the Association of University Radiologists (AUR), Michigan Radiological Society (MRS), the Society of Chairs of Academic Radiology Departments (SCARD), the Society of Computed Body Tomography and Magnetic Resonance (SCBT-MR), and the Society of Uroradiology (SUR). As past president of the Academy for Radiology Research, he delivered testimony before Congress that helped to establish the National Institute of Biomedical Imaging and Bioengineering signed into law by President Clinton in 2000. He is a past president of the RSNA, also serving as liaison for publications and communications, liaison for science, and chair of the Board of Directors. He also served as a member and is a past chair of the R&E Foundation Board of Trustees.

Well recognized for his wide-ranging contributions to radiology, Dr. Dunnick has been awarded gold medals from the Academy of Radiology Research, American College of Radiology, ARRS, AUR, MRS, SCBT-MR and SUR. He holds honorary membership in the American Society for Radiation Oncology, Chinese Society of Radiology, European Society of Radiology, and Japan Radiological Society. He was honored by the Mexican Federation of Radiology and Imaging with the Radiological Merit Award in 2014. He received a Lifetime Service Award from the ABR in 2010, the Innovation and Leadership Award from the Radiology Research Alliance in 2013, and the Visionary Leadership Award from SCARD in 2016.

J. Anthony Seibert, PhD

A champion of patient safety and optimal dose in medical imaging, dedicated to exploring techniques that lower radiation dose without sacrificing image quality,
J. Anthony Seibert, PhD, is a professor of diagnostic imaging physics and associate chair of radiology informatics for the University of California (UC) Davis Health in Sacramento, CA.

Dr. Seibert leads initiatives in X-ray fluorography, CT, digital mammography, projection imaging, interventional radiology, imaging informatics, and the tracking, assessment and reporting of radiation dose through automated registries.

Dr. Seibert received his PhD in radiological sciences from UC Irvine in 1982, with a focus on quantitative digital fluoroscopic imaging. He has served on the faculty of UC Davis since 1983, conducting research in digital imaging and directing education in medical physics for graduate students and radiology residents.

An experienced leader, Dr. Seibert has served as chair and president of the board of trustees of the American Board of Imaging Informatics, president of the American Association of Physicists in Medicine (AAPM), chair of the Society of Imaging Informatics in Medicine (SIIM), and third vice-president of RSNA.

He lends his expertise as a voice for medical physicists, identifying opportunities for collaboration and quality improvement among specialties. He oversees the Health Quality Control program for imaging devices at the UC Davis Medical Center and Primary Care Network, ensuring quality monitoring, tracking and reporting of patient encounters and radiation dose. He chaired the American Board of Radiology (ABR) Diagnostic Radiological Physics Exam Committee and continues to serve as a committee member. He was elected to the ABR as a Trustee for Medical Physics in 2013 and has served on the ABR Board of Governors since 2017.

Dr. Seibert is a co-author of the popular textbook *The Essential Physics of Medical Imaging*. He is also a co-author of RSNA's Physics Teaching File for Radiology Residents, recognized globally as an essential comprehensive training tool, hosted by the State University of New York. Dr. Seibert conducts educational symposiums for AAPM, the International Atomic Energy Agency, and the National Council on Radiation Protection and Measurements.

The author of more than 120 peer-reviewed articles and 200 published abstracts, Dr. Seibert has served as an editorial board member and reviewer for both *Radiology* and *RadioGraphics*. He received the *RadioGraphics* Editor's Recognition Award, with distinction, in 2013.

RSNA Announces Winners of Intracranial Hemorrhage AI Challenge

RSNA announced the official results of its latest artificial intelligence (AI) challenge Monday during a presentation in the RSNA AI Theater.

The RSNA Intracranial Hemorrhage Detection and Classification Challenge required teams to develop algorithms that can identify and classify subtypes of hemorrhages on head CT scans. The data set, which comprises more than 25,000 head CT scans contributed by several research institutions, is the first multiplanar dataset used in an RSNA AI Challenge.

The Machine Learning Steering Subcommittee and the Machine Learning Data Standards Subcommittee worked with volunteer specialists from the American Society of Neuroradiology (ASNR) to label these exams for the presence of five subtypes of intracranial hemorrhage — an effort of unprecedented scope in the radiology community.

"The volunteers who contributed data and who worked on annotating the dataset have created a resource of tremendous value for imaging research," said Charles E. Kahn, Jr., MD, MS, chair of the RSNA Radiology Informatics Committee (RIC) and *Radiology: AI* editor.

The award-winning teams in the RSNA Intracranial Hemorrhage Detection and Classification Challenge are SeuTao, NoBrainer, takuoko, GZ, Keep Digging Gold, BRAINSCAN.AI, Big Head, 賞金で焼肉, Mind Blowers and VinBDI.MedicalImagingTeam.

"The challenge demonstrates the increasing sophistication of the imaging AI research community and the real potential of this technology to improve the efficiency and quality of care in radiology," said Luciano M. Prevedello, MD, MPH, chair of the Machine Learning Steering Subcommittee of the RIC.

The challenge was run on a platform provided by Kaggle, Inc. (a subsidiary of Alphabet, Inc., also the parent company of Google). Kaggle also provided $25,000 in prize money to be shared among the winning entries.

For more information on the challenge, visit *RSNA.org/AI-image-challenge*.

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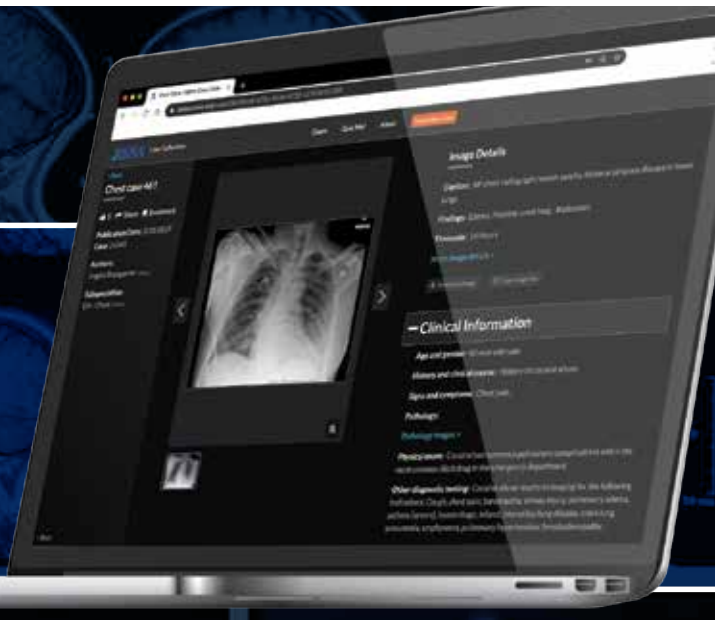

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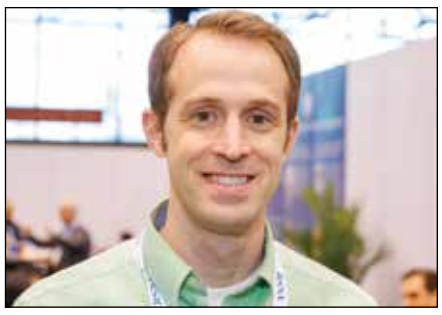
Honorary Memberships were presented Monday to *(left to right)* Bernd Karl-Heinz Dieter Hamm III, MD, Fiona J. Gilbert, MD, MBChB, FRCP, FRCR, and Tarek El-Diasty, MD. Honorary Membership in RSNA recognizes significant achievement in the field of radiology.

RSNA 2019 Attendees LEARN *TOGETHER*

The RSNA annual meeting brings together radiology professionals at all career levels, offering unique learning and networking events. The Residents Lounge is a casual space where trainees can relax with their peers and learn from mentors. Meeting attendees engaged in some friendly competition during the RSNA Diagnostic Live™ Competition and challenged their radiologic knowledge at the Escape Room.

Who or What Inspired You to Pursue Radiology?

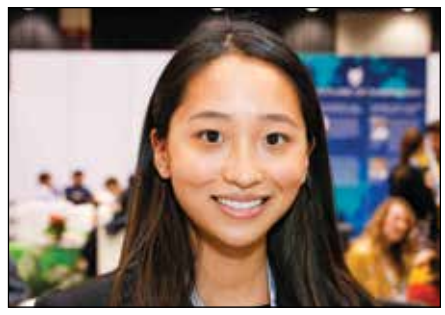
The Daily Bulletin *stopped by the Residents Lounge on Monday to ask doctors the question: "Who or what inspired you to pursue radiology?" Participants were eager to share their reasons for becoming radiologists.*



*"My grandfather and uncle were radiologists and their personal dedication to medicine was inspiring," said **Lane Miner, DO**, fourth-year resident at Penn State University, Hershey, PA.*

***Mariana Raeder, MD**, neuroradiology fellow at the University of Campinas, São Paulo, Brazil, was inspired by, "the state-of-the-art tools that radiology offers patients for diagnosis and treatment."*

***Laura Gregorio, MD**, third-year resident at Louisiana State University, Baton Rouge, was inspired by her wife, Silva Barbeito, MD, who was her radiology attending when she was in medical school in Argentina.*



*"My mentors in medical school introduced me to radiology," said **Elizabeth West, MD**, second-year resident, Columbia University, New York.*

***Emmanuel Magara, MD**, third-year resident at the University of Pennsylvania, Philadelphia, is inspired by, "his mentor, Garry Choy, MD, who brings together the best of radiology and global health."*

*"My mom, who is a medical physicist, always brought me to the reading room, and my medical school mentor, Ilona Schmalfuss, MD — both inspired me to pursue radiology," said **Sarah Thomas, MD**, third-year resident at the University of Pennsylvania, Philadelphia.*

*"When I was younger, one of my family members had breast cancer and I was interested in how radiology set the direction of her treatment," said **Abeer Hameed, MBCHB**, diagnostic radiology fellow at MD Anderson Cancer Center, Houston, TX.*

***Pasant Abouelhoda, MBBCH**, fourth-year resident at Ain Shams University, Cairo, Egypt, was inspired by, "both my parents, who are radiologists."*

RSNA President Valerie P. Jackson, MD, presented Jae Ho Sohn, MD, with the eighth annual Margulis Award for his 2018 *Radiology* article, "A Deep Learning Model to Predict a Diagnosis of Alzheimer Disease by Using 18F-FDG PET of the Brain," at a ceremony Monday at RSNA 2019.

Dr. Sohn, from the Radiology & Biomedical Imaging Department at the University of California in San Francisco (UCSF), co-authored the groundbreaking study that shows the significant potential of artificial intelligence as a diagnostic tool in Alzheimer's disease.

Named for Alexander R. Margulis, MD, a distinguished investigator and inspiring visionary in the science of radiology, this annual award recognizes the best original scientific article published in RSNA's peer-reviewed journal *Radiology*.

Dr. Sohn's study is included in the *Radiology* Editors' Choice 2019 publication available at RSNA 2019.

Emerging Prostate Imaging Method Drives Treatment Changes

By Lynn Antonopoulos

Findings from a retrospective study performed at the University Hospital of Zurich (UHZ) show that 68Ga-PSMA-11 PET (PSMA PET) used in the staging setting for intermediate and high-risk prostate cancer patients could translate to a difference in patient management and may ultimately lead to better outcomes for patients with the disease.

"PSMA PET has been increasingly used over the past decade in Europe to image prostate cancer and is often considered a game changer in detection of recurrent prostate cancer because of its high sensitivity and specificity," according to Daniela A. Ferraro, MD, nuclear medicine research fellow at UHZ.

Dr. Ferraro and her team sought to understand whether the method could be useful during disease staging while also assessing the potential impact of PSMA PET in clinicians' decisions regarding therapeutic approach.

Researchers examined results from 116 patients who underwent staging using PSMA PET/CT or PSMA PET/MRI during a two-year period from 2016 to 2018.

Using a simulated, multidisciplinary tumor board, they looked at clinical and conventional imaging to define treatment options prior to PSMA PET use. They reviewed the cases again, adding information gathered from PSMA PET imaging results to determine treatment.

Compared to clinical staging and conventional imaging, PSMA PET provided new information for 36% of patients with a change in management for 27% of them.

A new therapy modality was selected for 15 patients, while in 17 others, the findings resulted in an adjustment to therapy such as a modification of the radiotherapeutic field.

Ferraro

"We expected PSMA PET would have an impact in disease management but were particularly surprised that it resulted in a management change for more than one fourth of the patients," she said.

In one case, Dr. Ferraro noted a patient with suspected bone metastasis on both CT and bone scan, which would have resulted in treatment with radiotherapy and androgen deprivation therapy. However, upon further assessment using PSMA PET, the patient was positive for cancer in the primary tumor but negative in the suspected metastasis leading to a biopsy that confirmed a degenerative sclerotic benign change.

"The patient was eligible for curative therapy and underwent surgery only. One year later he did not need any additional treatment and is still free from disease," Dr. Ferraro said.

While Dr. Ferraro emphasized the potential for PSMA PET to change disease management, she noted that further investigation will be necessary to determine whether tailor-made therapies using PSMA PET will improve patient outcomes.

She and her team are currently working on a study to determine what benefit the new modality will bring for the patient.

"A change in disease management is only the first step that can lead to a potential better outcome. To find out the real benefit of the method, we need to know how these patients do over time after having their treatment defined using the information from PSMA PET," Dr. Ferraro said.

Tuesday's Physics Quiz

American Association of Physicists in Medicine

Q What system component in an MR scanner is responsible for loud noises that can lead to potential hearing loss?

[Answer on page 13A.]

Novel MRI-Guided Ultrasound Treatment Destroys Prostate Cancer

A novel procedure called MRI-guided transurethral ultrasound ablation (TULSA) effectively treats prostate cancer with minimal side effects, according to a new study presented on Monday. Researchers said the incision-free technique could also be used to treat benign enlargement of the prostate gland.

Raman

"Unlike with other ultrasound systems on the market, you can monitor the ultrasound ablation process in real time and get immediate MRI feedback of the thermal dose and efficacy," said Steven S. Raman, MD, study co-author professor of radiology and urology, and director of Prostate MR Imaging and Interventions and Prostate MR Imaging Research at the University of California at Los Angeles (UCLA).

"It's an outpatient procedure with minimal recovery time."

The multicenter trial enrolled 115 men, median age 65, with localized low or intermediate risk, gland-confined prostate cancer. Clinicians delivered TULSA treatment to the entire gland. Treatment time averaged 51 minutes.

Prostate volume in the study group decreased on average from 39 cubic centimeters pre-treatment to 3.8 cubic centimeters a year after treatment. Overall, clinically significant cancer was eliminated in 80% of the study participants. Seventy-two out of 111 men, or 65%, had no evidence of any cancer at biopsy after one year. Blood levels of prostate-specific antigen (PSA), a marker of prostate cancer, fell by a median of 95%. There were low rates of toxicity and no bowel complications.

"We saw very good results in the patients, with a dramatic reduction of over 90% in prostate volume and low rates of impotence with almost no incontinence," Dr. Raman said.

Low-Dose CT a Safe Alternative for Foreign Body Aspiration Diagnosis in Children

By Mike Bassett

A low-dose CT protocol using a tin filter as the sole diagnostic tool can accurately diagnose foreign body aspiration (FBA) in children while reducing radiation dose and avoiding bronchoscopy.

In her Monday presentation, Lena Gordon Murkes, MD, Karolinska Institutet, Stockholm, Sweden, reported that the use of low-dose CT resulted in lower effective doses, and more accurate diagnoses of suspected FBA, compared to conventional radiographic methods.

According to Dr. Gordon Murkes, dealing with foreign body aspiration is a fairly common problem in many emergency rooms. And that problem is complicated by the fact that FBA is often just suspected — parents might not know for sure whether their children have actually ingested or inhaled a foreign object.

While bronchoscopy will allow a physician to evaluate the airways for a retained foreign body, that procedure requires putting children under general anesthesia, which, while usually safe, can result in complications.

Chest radiographs or fluoroscopy — or both — could also be used in diagnosing FBA in young children. However, these conventional imaging methods are not entirely accurate, Dr. Gordon Murkes said, "So you run the risk of missing the foreign body itself."

CT, on the other hand, is highly accurate. The problem with CT, though, is the possibility of exposing the affected child to a high effective dose of radiation. "But with a tin filter we've managed to minimize the dose so that it is lower than a combination of X-ray and fluoroscopy," she said.

> ***The CT low-dose protocol reduces the radiation dose and decreases the risk of misdiagnoses and negative bronchoscopy outcomes, thereby avoiding operative risks and costs.***
>
> **Lena Gordon Murkes, MD**

For high-contrast exams, low-energy photons aren't needed and only contribute to radiation dose, Dr. Gordon Murkes explained. The tin filter shapes the X-ray spectrum, leaving mostly high-energy photons.

Protocol Decreases Risks for Patients

Dr. Gordon Murkes and her colleagues conducted a retrospective review comparing the diagnostic performance and effective doses of conventional radiographic methods (fluoroscopy and plain radiography) with low-dose CT using a tin filter. They evaluated 136 children, 75 of whom underwent examination with conventional radiographic methods, while the remainder were examined with CT.

Gordon Murkes

Dr. Gordon Murkes and her colleagues determined that low-dose CT examinations resulted in lower effective doses compared to conventional radiographic methods, with median doses of 0.04 mSv and 0.1 mSv, respectively. Both sensitivity and specificity were higher for low-dose CT (100% and 98%) than for conventional imaging methods (33% and 96%), as were positive and negative predicted values (90% and 100% for CT and 60% and 91% for conventional methods, respectively).

"The CT low-dose protocol reduces the radiation dose and decreases the risk of misdiagnoses and negative bronchoscopy outcomes, thereby avoiding operative risks and costs," Dr. Gordon Murkes said.

While the use of CT exams for children has raised concerns about radiation exposure, this is a low-dose exam, fast and "a sure method," Dr. Gordon Murkes said. "Our ENTs (ear, nose, and throat physicians) are extremely pleased with it because they are confident we can tell them if there is a foreign body in the airway and where it is located."

Tuesday's Physics Tip

American Association of Physicists in Medicine

Zooming into an image on a viewing station does not improve resolution of the stored image, but it does make small details larger and brings them into the sensitive region of the human visual system potentially making them "more visible."

AI Helps Predict Risk of Lung Nodules Likely to Become Cancerous

By Richard Dargan

Artificial intelligence (AI) can help predict which small lung nodules will go on to become cancerous, potentially speeding appropriate treatment to patients, according to a study presented Monday.

Mukherjee

Results released in 2011 from the National Lung Screening Trial (NLST), a landmark National Cancer Institute study, showed that CT was better than chest radiographs for lung cancer screening. The trial spurred an expansion of Medicare to cover lung cancer screening for high-risk patients such as longtime smokers. The decision was based on the potential of lung cancer screening to catch cancers earlier, when they are more treatable. However, expansion of CT in this setting also created the challenge of an increase in false positive results.

"As more people were screened, the number of false positives increased, resulting in a lot of unnecessary testing," said study co-author Pritam Mukherjee, PhD, from the Stanford Center for Biomedical Informatics Research (BMIR) at the Stanford University School of Medicine, CA. "Follow-up testing can be expensive and invasive and may expose the patient to more radiation, even though only a very small fraction of biopsies prove to be cancerous."

Machine Learning Model Aids Cancer Prediction

Dr. Mukherjee and colleagues used NLST data to develop a machine learning (ML) algorithm that can mine CT images for prognostic information on the risk of lung nodules becoming cancerous.

They used CT scans from more than 1,000 patients who screened positive with lung nodules more than 4 millimeters (mm) in diameter in the NLST. Of those, 553 subjects were diagnosed with cancer during the study and 585 were never diagnosed with cancer during the study but were demographically similar to the cancer-positive group.

"CT scans have many features that can't be discerned by the naked eye," Dr. Mukherjee said. "By training our model on almost 1,200 patients with CT scans positive for lung nodules, we were able to distinguish between patients who would go on to have cancer and those who wouldn't with reasonably high accuracy."

> ***What differentiates our study is that we're not just interested in the current state of the tumor. We are also trying to see if the patient will develop cancer three or four years down the line.***
>
> **Pritam Mukherjee, PhD**

The researchers built a two-stage machine learning ML model for cancer prediction using CT images from one, two and three screening time points, respectively. The first ML stage, common to all three models, detected nodules and predicted malignancy scores. The second ML stage used the popular algorithm XGBoost to predict cancer probability using the locations and malignancy scores of the patient's lung nodules predicted by the first stage.

"Much CT data has no information on where the lesions are," Dr. Mukherjee said. "We tried to look at the CT scan to find out where the tumor is and try to make judgments based on its appearance."

The results showed it is possible to predict whether a patient with lung nodules larger than 4 mm has or will develop cancer in subsequent years based on screening lung CT scans only. Further, the prediction performance improves if CT imaging data from multiple screening timepoints are incorporated into the model.

"What differentiates our study is that we're not just interested in the current state of the tumor. We are also trying to see if the patient will develop cancer three or four years down the line," Dr. Mukherjee said. "This information could help doctors make treatment decisions."

Dr. Mukherjee said the model may reduce the numbers of false positive screens, resulting in less cost and risk for patients with screen-detected lung cancer. The researchers plan to validate their models on additional data and assess their performance across different centers and groups of patients. They also plan to study the method in combination with genetic and pathological data to further improve diagnosis.

"As more patients are followed up and we have more scans, the technique will get better," Dr. Mukherjee said.

Caricatures for #GivingTuesday

The RSNA R&E Foundation is participating in #GivingTuesday, a global generosity movement unleashing the power of people and organizations to transform their communities and the world.

The movement began in 2012 to encourage people to do good. Over the past seven years, this idea has grown into a global movement that inspires hundreds of people to give back to their communities.

Celebrate #GivingTuesday and seed the future of radiology by making a donation to the Foundation today at *RSNA.org/Donate* or by visiting the R&E Foundation booth in the Connections Center.

Your donation funds grants that empower investigators to discover new advances in medical imaging and support the development of innovative teaching methods.

In 2019, the Foundation funded a record $5 million dollars in education and research grants.

Show your support of the R&E Foundation by letting our artists create a caricature of you. Artists will be next to the RSNA Shop in the Connections Center on Tuesday from 9 a.m. to 5 p.m. The $25 fee for each caricature will benefit the Foundation.

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Mobile App Popular with Patients, Not Physicians

By Mike Bassett

A mobile application that easily enables patients to access their imaging and laboratory results is readily accepted by patients and enables them to better engage with their own health care, according to a study presented Monday.

At the same time, however, the researchers found that physicians are less eager to interact with the technology, said Henrique M. Lee, MD, Hospital Israelita Albert Einstein, São Paulo, Brazil.

According to Dr. Lee, the application was developed by the hospital's innovation group in 2016, which provided physicians an opportunity to analyze patient data as it related to health care informatics.

"The main goal of the project was to describe in a more analytical way how patients and physicians engage with their [the patients'] health care through the mobile app," Dr. Lee said. "And we found out that patients have accepted the app — particularly the functionality that was implemented that allows them to share their exams in a safe, secure way."

The increasing number of shared links reveals that a mobile app is appealing for the patient, who appears to be interested in engaging with his or her own health care.

Henrique M. Lee, MD

Lee

The application generates a digital link to a specific exam and expires after a time stipulated by the patient. Each time a patient shares an exam or lab report, the system reports when it was shared, with whom, if the recipient visualized the report or let the link expire and if the recipient is a physician or not.

Dr. Lee and his colleagues analyzed the extent of patient and physician engagement by analyzing data from the period after the application was launched (from 2016 through 2018).

Physicians Less Likely to Engage with Mobile App

They determined that during that time more than 88,000 patients downloaded the mobile application and that a total of 253,781 outpatient exams were shared from the app (16,071 in 2016, 44,000 in 2017, and 156,163 in 2018).

"The increasing number of shared links reveals that a mobile app is appealing for the patient who appears to be interested in engaging with his or her own health care," Dr. Lee said.

However, of all the shared links, only 40,683 (17%) were accepted by the recipient.

In fact, according to Dr. Lee, while physicians initially appeared to attempt to engage with the functionality as patients began sharing exams with them, the extent to which physicians accessed those exams dropped each year.

"We're still trying to find out what the reasons are for this," Dr. Lee said. One possibility could be that since patients get prompted when a physician accesses their exams or reports, physicians feel pressured to respond to the patient as quickly as possible. "That may cause physicians to try to avoid dealing with this kind of tool," he suggested.

Dr. Lee also noted that there is some evidence that, at least in Brazil, some physicians have yet to fully embrace the transition to a digital world.

For example, when questioned about the app's performance many physicians complained about the fact that they couldn't print exam or lab results.

"This was a problem because the physicians were actually asking for the printed exams," said Dr. Lee, suggesting that while physicians have more access to better technology, it doesn't mean they are engaging with these tools.

"We think the reason is that they believe it doesn't markedly improve their workflow," Dr. Lee said.

The fact that fewer physicians are engaging with the tool means that further analysis is needed regarding the disparity between high patient engagement and low physician acceptance of that digital health tool, Dr. Lee concluded. At the same time, he suggested that the ability to analyze real world data with a mobile application should make the tool more relevant, add value to the user's experience and encourage physicians to engage with it.

View a video interview with Dr. Lee at *RSNA.org/Bulletin*.

Taking the Opportunity: Radiology Begins to Embrace Opportunistic CT

By Nick Klenske

With more than 200 CT exams per 1,000 people performed every year in countries like France, the U.S. and Japan – and a total of 82 million in the U.S. alone – CT exams are an extremely common imaging modality. What is not common, however, is "opportunistic CT" – taking advantage of the secondary analysis of existing CTs to obtain quantitative body composition data without additional testing.

Boutin

But with advances in automated measurements and normative values for bone and muscle health now published in large patient populations, this is beginning to change.

"Opportunistic CT presents an opportunity to add value to existing radiology exams by diagnosing common conditions that have a tremendous public health impact, like osteoporosis and sarcopenia," said Robert Boutin, MD, a radiologist at Stanford University School of Medicine.

Dr. Boutin noted that, according to the International Osteoporosis Foundation, after the age of 50, osteoporotic fractures occur in one out of three women and one of five men.

Although opportunistic CT has promise in improving diagnosis at no additional cost or radiation exposure to the patient, there have been concerns about scanner calibration and measurement interchangeability. Specifically, can similar measurements be obtained on CT scanners made by various manufacturers that are deployed throughout the U.S.?

To help address this gap in knowledge, radiologists and physicists at multiple institutions teamed up to investigate whether or not there is a systematic bias in reported CT numbers, as measured in Hounsfield Units (HU), when comparing the major CT manufacturers, using the American College of Radiology (ACR) phantom as the reference standard. The study analyzed more than 67,000 examinations acquired over seven years.

"CT number measurements between manufacturers have a systematic offset when compared to each other," Dr. Boutin said who discussed the study's results at a Monday session. "Knowledge of these offsets may be useful to harmonize HU values across platforms so as to optimize accuracy in the opportunistic diagnosis of osteoporosis."

Big Data, Big Opportunity

The study retrospectively collected ACR CT accreditation phantom data in a blinded fashion for four CT manufacturers. For each manufacturer, an adult abdomen CT technique was used to analyze the CT number for three materials: water, acrylic (surrogate for trabecular bone) and Teflon (surrogate for cortical bone). Comparisons were made to assess for systematic differences between CT manufacturers using a linear fixed effects regression model.

The paradigm shift of using existing CT scans already obtained for other reasons to opportunistically screen for osteoporosis promises to substantially improve patient care.

Robert Boutin, MD

From this study, researchers noted that the CT number of water ranged from a mean of -0.3 to 2.7 HU, with mean differences between manufacturers that, although small, were highly statistically significant. Likewise, for the trabecular bone surrogate; mean differences in CT numbers across all manufacturers were small but significant. For the cortical bone surrogate, results showed highly significant mean differences in CT numbers across all manufacturers.

Poised for Paradigm Shift

These results show that CT number measurements compared between manufacturers have a systematic offset and these offsets change with the tissue being measured. "CT scanners made by different manufacturers show systematic HU offsets that are highly statistically significant," Dr. Boutin said. "The relatively small offsets relating to trabecular bone HU, however, supports the integrity of CT for the opportunistic diagnosis of osteoporosis."

According to Dr. Boutin, knowledge of these offsets may be used to harmonize HU values across platforms to optimize diagnostic precision. "The paradigm shift of using existing CT scans already obtained for other reasons to opportunistically screen for osteoporosis promises to substantially improve patient care," he added.

Tuesday's Answer

[Question on page 10A.]

A Gradient fields stress the scanner's metal housing as they rise and fall leading to stress and strain on the metal and associated noise.

ALS Treatments Are Elusive, but Hope is on the Horizon

CONTINUED FROM PAGE 1A

medications and physical therapy, along with devices like braces and wheelchairs to help patients function in their everyday lives.

There are two FDA-approved drugs that slow down the disease. Riluzole, a drug that inhibits the release of the neurotransmitter glutamate, prolongs survival by about two to three months. The antioxidant edaravone (Radicava) was approved by the FDA in 2017 based on a study in Japan that found it slowed progression of symptoms in about 30 percent of patients.

However, both treatments have only a mild impact on the disease, Dr. Pascuzzi said.

About 25 different treatments are currently being researched, Dr. Pascuzzi said. Stem cells can be delivered into the spinal canal, although Dr. Pascuzzi believes that such treatment is more likely to slow the disease down than cure it.

Curative investigations focus on C9, a gene that provides instructions for making a protein abundant in nerve cells. Mutations in C9 are the most common cause of familial forms of ALS. In healthy people, the sequence of nucleotides that makes up C9 is relatively short; in people with ALS, it is very long and cluttered with extraneous material.

"How's the poor cell supposed to read all this?" asked Dr. Pascuzzi, presenting

a slide depicting line after line of genetic code. "You need to eliminate the clutter or the cells are going to fail."

One approach currently in clinical trials involves the use of antisense oligonucleotides, small pieces of genetic material that help suppress unwanted DNA from being read. These gene-suppressing fragments have been used successfully in spinal muscular atrophy, a formerly fatal neuron disease of childhood.

Dr. Pascuzzi, who was introduced by his sister, RSNA President Valerie P. Jackson, MD, emphasized that imaging will be central to any progress against the disease.

"Radiology serves an essential role, mainly to make sure that the neurologist isn't missing something else that we could treat better," he said. "We neurologists couldn't exist without what you guys do."

Imaging is a Powerful Weapon in the War on Alzheimer's Disease

CONTINUED FROM PAGE 1A

Dr. Saykin said, "On reflection of the incredible contribution of neuroimaging to this area, it's a transformative development to look at what was only visible before in brain tissue in vivo and potentially years before diagnosis."

Looking at the progress that has been made in the years since AD was first described, Dr. Saykin referred to the Alzheimer's Disease Neuroimaging Initiative (ADNI), a consortium that has been dedicated since the early 2000s to longitudinal studies with multi-modality brain biomarkers including MRI, FDG PET, amyloid PET and tau PET.

Other modalities continue to be studied as the techniques mature into ADNI which, according to Dr. Saykin, is in its fourth phase and has always remained dedicated to open science making all data from studies immediately publicly available.

Molecular Genetics Key to Progress

Researchers have also made progress in molecular genetics, according to Dr. Saykin, identifying three early onset genes (PSEN2, PSEN1 and APP) in the 1990s which are involved in a small but scientifically and clinically important deterministic autosomal dominant form of the disease.

The consortium Dominantly Inherited Alzheimer Network (DIAN), targets the autosomal dominant form of the disease, and research has led to the understanding that changes in biomarkers can be modeled 20 years prior to the onset of AD illness, giving clinicians a long window of therapeutic opportunity.

Dr. Saykin said that large-scale, international studies have identified 25 promising candidate genes related to multiple biological pathways that may be targeted.

Additionally, he referred to "omics" studies and the role of systems biology and bioinformatics in helping identify dysregulated networks in AD.

Research on lifestyle modifications including exercise, diet, cognitive engagement and sleep is very promising. "Protective factors have a real role to play, and large scale studies are looking at the impact of these on the brain."

Dr. Saykin said that ultimately all of this data converges and has to be put into a framework to make sense of it. He emphasized the need for supercomputing to interrogate brain, social and genetic networks and learn as much as possible.

"A broad view that puts all of these elements together is a key to having a better understanding of mechanism of the disease," he said.

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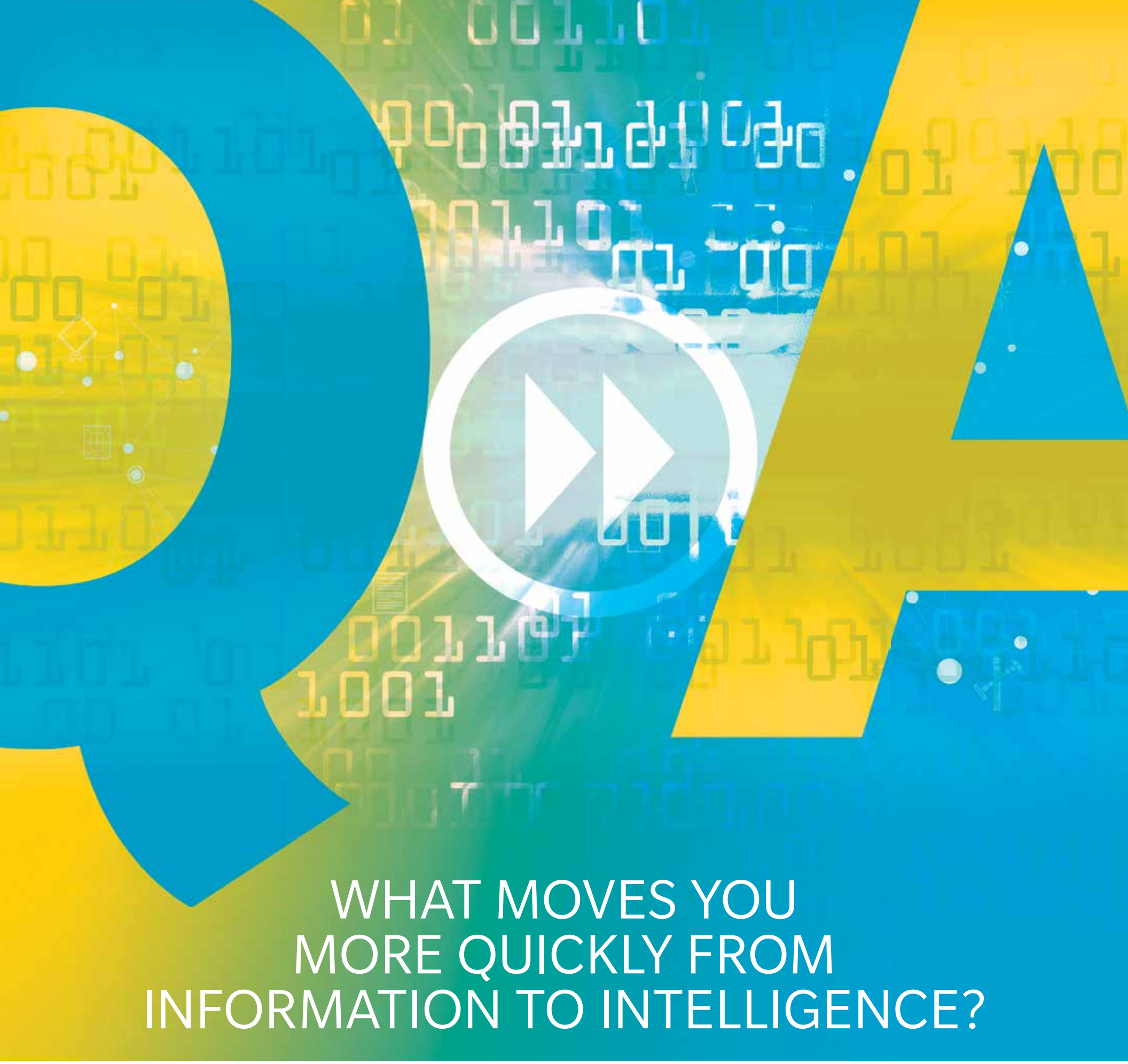

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