Two hands are definitely better than one — as one researcher learned while mimicking a physical effect often found in his pediatric neurology patients.
An MIR researcher is developing a new approach to produce high-quality X-rays with minimal radiation exposure by adapting the hands-free technology used for the popular Xbox gaming system.

PET/MR imaging, mainly used for research, is now being integrated into clinical care. For one young patient and her family, it keeps tabs on her cancer — now in remission — giving them peace of mind.

Breast imaging specialist Bonnie N. Joe, MD, PhD, looks back fondly on the lessons learned and lifelong friendships formed as a Mallinckrodt Institute of Radiology resident.

ON THE COVER
Samuel I. Achilefu, PhD, the inaugural Michel M. Ter-Pogossian Professor of Radiology and head of MIR’s Optical Radiology Laboratory and its Molecular Imaging Center, is now director of the new Center for Multiple Myeloma Nanotherapy. The center is developing nanomaterials and drugs to treat this disease and other types of cancer. To learn more, turn to page 2. Cover Photo: Robert Boston
New nanotherapy center launched

Researchers at Washington University School of Medicine have been awarded $13.7 million from the National Cancer Institute (NCI) to create new therapies for multiple myeloma, a cancer of immune cells in the bone marrow.

Led by MIR professor Samuel I. Achilefu, PhD, and Gregory M. Lanza, MD, PhD, scientists at the Center for Multiple Myeloma Nanotherapy (CMMN) will work to develop nanomaterials and drugs to treat the disease, which kills most patients within six years of diagnosis. Each year, an estimated 26,850 U.S. residents are diagnosed with multiple myeloma, according to the American Cancer Society.

“Patients with multiple myeloma often respond well to initial treatment,” says Achilefu, the center’s director and the Michel M. Ter-Pogossian Professor of Radiology. “Unfortunately, nearly all relapse. We’re focused on improving patient outcomes by developing and moving promising new therapies from the lab to the clinic.”

Lanza, the Oliver M. Langenberg Distinguished Professor of Science and Practice of Medicine, is the center’s co-director. John F. DiPersio, MD, PhD, the Virginia E. and Sam J. Golman Professor of Medicine, and Michael H. Tomasson, MD, professor of medicine, will help lead critical projects at the center.

The CMMN will focus on three primary projects: developing new drugs and nanodelivery methods, developing a light-based therapy that uses photosensitizing drugs to kill cancer cells, and understanding the molecular basis of these therapies to mediate drug resistance and progression of multiple myeloma.

According to Achilefu, the NCI also has encouraged CMMN researchers — because its technology can be applicable to a variety of tumor types — to explore using the same mechanisms to treat other types of cancer. In fact, the center has already obtained funding from other sources to investigate nanobased therapies in breast, lung, and prostate cancers.

Achilefu has loftier plans. He wants to use the CMMN as a springboard to help create a larger physical center for nanomedicine that will address multiple myeloma and other cancers and non-cancer diseases such as those involving cardiology and neurology. He also wants to attract junior investigators into the program.

Achilefu’s vision, he says, is to create a platform where researchers can ask bold questions about incurable cancers and other diseases. “It’s a place where we are driven to explore new horizons in diseases that are resistant to existing therapies and to ask the basic question: ‘Can we treat patients differently?’”

Leading scientific support services for the center are Koresh I. Shoghi, PhD, associate professor of radiology, who will oversee the Imaging Biomarker Quantification and Standardization Core, and Fred W. Prior, PhD, an adjunct professor of radiology at Washington University and chair of the Department of Biomedical Informatics at the University of Arkansas for Medical Sciences College of Medicine, who will lead the Data Management Core.

The CMMN is one of six Centers of Cancer Nanotechnology Excellence supported by the NCI of the National Institutes of Health (NIH).
Friedman named Loeb Teaching Fellow

Musculoskeletal radiologist Michael V. Friedman, MD, was named a 2015-17 Carol B. and Jerome T. Loeb Teaching Fellow at Washington University School of Medicine.

Friedman, an assistant professor of radiology, serves as radiology coursemaster of the first year anatomy lab and course director of the clinical radiology elective. His interests primarily involve medical student education, with clinical focuses including musculoskeletal ultrasound, emergency imaging, and medical diagnostic coding.

With the fellowship, Friedman plans to focus on the preclinical and clinical years to better prepare students as they transition into their roles as image-ordering and interpreting physicians. The cornerstone of the project will be an interactive workstation simulating the clinical practice of radiology, transitioning students from the traditional observational role to active participation.

In collaboration with fellow members of MIR's musculoskeletal section (Drs. Rubin, Baker, Demertzis, Hillen, Jennings, Long and Stensby), the program is based on the premise that all physicians must have a strong understanding of the different diagnostic imaging modalities available in patient care and the strengths and limitations of each technique.

“Our students enter every field of medicine, and as Dr. Friedman’s project highlights, every physician in every field needs to understand radiology,” says Alison J. Whelan, MD, senior associate dean for education. “This project will impact all of our students and make them more effective at using radiologic imaging in patient care.”

Friedman agrees, adding that all physicians need a working knowledge of medical imaging algorithms, cost-effectiveness, and safe ordering practices.

“This project offers a tremendous opportunity to modernize an interactive learning curriculum for our students,” he says. The Loeb Teaching Fellowship was established in 2004 with a gift from Carol and Jerome Loeb.

Achilefu named Ter-Pogossian Professor

Samuel I. Achilefu, PhD, has been named the inaugural Michel M. Ter-Pogossian Professor of Radiology.

The endowed professorship honors the late Ter-Pogossian, a Washington University School of Medicine researcher from the 1950s and professor and researcher from the 1960s until 1995. Considered a pioneer in positron emission tomography (PET), Ter-Pogossian led the scientific team that designed and built the first PET scanner, imaging technology that showed how organs and tissue are working.

Achilefu, whose lab is housed at Mallinckrodt Institute of Radiology, also is a research member at Siteman Cancer Center. He holds 56 patents, including one for goggles he developed that help surgeons see and remove cancer, and has 7,985 citations in academic publications.

David H. Perlmutter, MD, dean of the School of Medicine and executive vice chancellor for medical affairs, says Achilefu’s work continues a rich tradition of groundbreaking radiology research at Washington University.

“With this professorship named in Dr. Ter-Pogossian’s honor, we are passing the torch to a new pioneer and a new era of discovery,” Perlmutter says. “Like Dr. Ter-Pogossian, Dr. Achilefu’s work has led to technologies that are changing the way we practice medicine.”

Achilefu joined the faculty of the School of Medicine in 2001, after seven years in the Discovery Research Department at Mallinckrodt Medical Inc. in St. Louis. He earned his doctorate in molecular physical and materials chemistry at the University of Nancy, France, in 1991. In 1993, he completed his postdoctoral training at Oxford University in England, where he worked on developing blood substitutes.

Richard L. Wahl, MD, director of Mallinckrodt Institute of Radiology and head of the Department of Radiology, says Ter-Pogossian and Achilefu share many similarities in addition to innovation: entrepreneurialism, excellence at team science, and a focus on mentoring the next generation of scientists.

“This professorship is a fitting tribute to the work and talents of both researchers,” says Wahl.
Wahl elected to National Academy of Medicine

Richard L. Wahl, MD, the Elizabeth E. Mallinckrodt Professor and head of the Department of Radiology at Washington University School of Medicine, has been elected to the National Academy of Medicine, formerly known as the Institute of Medicine. Election to this academy is considered one of the highest honors in the field of health and medicine in the United States.

Wahl, who also serves as director of Mallinckrodt Institute of Radiology, was among the first to combine internally delivered radiation therapy for non-Hodgkin’s lymphoma with techniques that use the immune system and nuclear medicine imaging to inform and precisely target treatments. The combined approach, now FDA-approved, is known as radioimmunotherapy and is recognized as one of the first “precision medicine” approaches for human cancer treatment.

He has been a leader in introducing and using positron emission tomography (PET) to diagnose a broad array of cancers and other diseases. He also is at the forefront of more recent efforts to combine quantitative data from PET scans with computerized tomography (CT) and MRI to form “fusion” images that can help physicians more precisely diagnose and characterize cancers. He and his research group have received research support from the National Institutes of Health (NIH) and other agencies for the past three decades.

Wahl is among 70 new members and 10 international associates whose elections were announced in late 2015. Members are selected based on their professional achievements and commitment to service.

Siegel honored at gala event

The National Atomic Museum Foundation presented its 2016 National Award of Nuclear Science & History to Barry A. Siegel, MD, professor of radiology and director and senior vice chair of MIR’s Division of Nuclear Medicine.

Siegel has been active in nuclear medicine research, with contributions in the diagnosis of pulmonary embolism, detection of thrombosis, and development of oncologic applications for radionuclide tracers. For the last two decades, his research efforts have focused on PET in cancer diagnosis and staging, as well as predicting and monitoring therapy response.

He is a prolific writer and editor and is active in government affairs.

He received the award in March 2016 at the 19th Annual Einstein Gala in Albuquerque, New Mexico. Proceeds from the event help support the museum’s STEM (Science, Technology, Engineering and Math) education and teacher training programs.

ADDITIONAL AWARDS

Dennis M. Balfe, MD, professor of radiology, was recognized with the Medical Staff Association’s Lifetime Achievement Award from Barnes-Jewish Hospital and Washington University School of Medicine.

Robert C. McKinstry, MD, PhD, professor of radiology, was one of three faculty members selected to join this year’s class of AOA (Alpha Omega Alpha) at Washington University School of Medicine, honoring his continued academic and professional achievement.

William D. Middleton, MD, professor of radiology, was honored with a Distinguished Clinician Award at the 2016 Washington University Distinguished Faculty Awards.

Daniel Picus, MD, professor of radiology and director and senior vice chair of MIR’s Division of Diagnostic Radiology, has received the American Medical Association Radiology Current Procedural Terminology Burgess Gordon Memorial Award.

Sally Schwarz, MS, RPh, BCNP, professor of radiology and co-director of the cyclotron facility at MIR, is the recipient of the American Pharmacists Association Captain William Briner Distinguished Service Award.
RSNA 2015

Mallinckrodt alumni now can connect directly with one another using for[MD], a password-protected online community network where alumni can share news, view informative and educational case studies, connect to resources and more! For additional information, visit mir.wustl.edu and select for[MD] under Education.

Mallinckrodt Institute of Radiology faculty and staff joined radiology professionals from around the world at the annual meeting of the Radiological Society of North America (RSNA) in Chicago, November 29-December 4. The event — Innovation is the Key to Our Future — was held at McCormick Place Convention Center and marked the society’s 101st scientific assembly and annual meeting. The event provided six days of education programs for radiologists, radiation oncologists, physicists in medicine, radiologic technologists, and allied health care professionals.
Current and former residents, faculty, and friends renewed acquaintances at RSNA 2015

A Michyla Bowerson  
B Aseem Sharma and Colin Derdeyn  
C Vincent Melnick  
D Jack Jennings and wife Alexandra Georges  
E Barry Siegel and Richard Wahl  
F Noushin Yahyavi, Jack Jennings & Alexandra Georges, Jason Stephenson, Jennifer Demertzis, Susan Holley

Attendees of the Evens Society reception held at the Hyatt Regency of Chicago’s Crystal Ballroom

G Sanjeev Bhalla, Ron Evens, Cooky Menias  
H Sarah Farabi, Sally Schwarz, Arthur Schneider  
I Vincent and Shanna Melnick  
J Hilary Orlowski, Christopher Smith, Sebastian McWilliams  
K Parinaz Massoumzadeh and husband Mehrdad Sehizadeh  
L Naganthan Mani, Ting Tao, Michyla Bowerson, Kris Cummings, Amy Fowler, Nirvikar Dahiya  
M Jason Stephenson, Perry Pickhardt, David Kim

Images photographed by Kim Kania, MIR Visual Media Center
WELCOME TO THE EVENS SOCIETY!

The annual MIR reception at RSNA was held in the Hyatt Regency Crystal Ballroom, where Drs. Wahl and Bhalla announced the formation of the Evens Society for the alumni of MIR. The society is named in honor of Ronald Evens, MD, whose 28 years of service as director of MIR helped the Department of Radiology gain international recognition as one of the finest in the world.

“The goal of the Evens Society is to foster a sense of family and community among the residents, fellows, faculty and alumni of MIR,” says Sanjeev Bhalla, MD. “Through Society activities, members will have the opportunity to meet and network with alumni of MIR, many of whom are national and international leaders in radiology, research and education.”

Another major goal of the Evens Society will be to encourage support of the Department of Radiology to continue building on the educational opportunities for radiology trainees at Washington University School of Medicine.

All full-time faculty within the Department of Radiology will be included as members, and current trainees will be initiated into the Evens Society at the time they complete their clinical and/or research training. Past Department of Radiology faculty and trainees who spent a year within Washington University’s radiology and/or nuclear medicine training programs also will be members.
For two weeks straight, Nico U. Dosenbach, MD, PhD, sported a very pink — almost neon — fiberglass cast on his uninjured right arm for the sake of research. He wore the fingertip-to-upper-arm cast 24/7 during one of the hottest stretches of summer 2015 in St. Louis. Pink is his daughter’s favorite color and Maike, age 2½, had never seen her father otherwise encumbered. He didn’t want to alarm her.

Dosenbach, who conducts research in the Neuroimaging Laboratory (NIL) at Mallinckrodt Institute of Radiology, endured the cast, the heat and the discomfort (it itched) to gain insight into the lives of his patients. Personal perspective aside, Dosenbach also wanted data — and lots of it — about how constraint-induced movement therapy (CIMT) impacts the brain.

Dosenbach, who also is a pediatric neurologist, spends about 20 percent of his time in the neurorehabilitation clinic at St. Louis Children’s Hospital and the remainder conducting research in the NIL.

Many of his young patients have hemiplegia — a type of cerebral palsy that causes paralysis on one side of the body — from strokes that occurred before, during, or shortly after their births. The brain injury can result in a wide range of physical, cognitive and behavioral effects, but is most often diagnosed as an infant becomes mobile and begins to favor one side of the body.

A common treatment for hemiplegia, CIMT (also known as forced-use therapy) immobilizes an individual’s dominant or “good” arm with a cast, forcing the impaired arm into action.
AN “EXPERIMENTAL” TREATMENT

Although CIMT has been shown to improve upper extremity function children with hemiplegia, it’s considered experimental by insurers, who say there’s not enough evidence to support its use. Treatment also includes two or more hours of occupational therapy each weekday, with evening and weekend assignments. Typically, CIMT lasts two or three weeks, but is intense.

“It’s easier to get adults to do the therapy because you tell them: ‘This is important and you should use your other arm.’ It’s more difficult with little kids because they don’t want to do it. You have to make it essentially impossible for them to use their stronger, more dexterous hand or arm to obtain a therapeutic benefit,” says Dosenbach.

RE-FIRING THE BRAIN TO REWIRE IT

Dosenbach’s research interests include forced-use learning and use-driven functional network neuroplasticity, i.e., the brain’s ability to remap and/or create neural pathways. Repetition, as with all learning, helps the brain to develop new neural pathways. As one focuses on a particular task, the affected portion of the brain fires up and, over time, rewires itself. The more frequently pathways are used, the stronger they become. CIMT may help develop new network solutions for controlling the impaired limb.

Dosenbach wanted to gather enough data to measure changes in the brain associated with forced-use therapy. More specifically, he wanted a timeline that identified when neural and anatomic changes occurred within the brain. He discussed the idea with his colleague and Mallinckrodt Institute of Radiology research professor Abraham (Avi) Z. Snyder, MD, PhD, and graduate students Timothy O. Laumann and Adrian W. Gilmore.

“Going back and forth, we came up with this idea (of casting the dominant arm in a healthy adult),” says Dosenbach. “And then Avi said: ‘You should do this to your arm.’ And I replied: ‘You’re right, and I totally will!’”

Above: Children in the neurorehabilitation clinic at St. Louis Children’s Hospital
“IF A STUDY LOOKS AT AN ‘AVERAGE’ OF PEOPLE’S BRAINS, YOU END UP WITH A BLURRED VISION OF EVERYTHING. I DIDN’T WANT THAT. EVERYONE’S BRAIN IS DIFFERENT ANATOMICALLY.”

Above: Diffusion tensor imaging (DTI) showing major white matter tracts of Nico Dosenbach’s brain.
ONE SUBJECT, MORE DATA

With Snyder, Dosenbach applied for and received a $10,000 facilities grant in scan time from Mallinckrodt Institute of Radiology for the pilot research project. The study’s clinical application was approved by Washington University School of Medicine’s institutional review board. Snyder is the principal investigator and Dosenbach is co-investigator.

“Normally we would study 20 to 30 people, but we were interested in seeing specific details in time and in anatomical space,” says Dosenbach. “If a study looks at an ‘average’ of people’s brains, you end up with a blurred vision of everything. I didn’t want that. Everyone’s brain is different anatomically.”

It took a year for Dosenbach to clear his schedule to accommodate the study. His goals were twofold. “On the basic science end, we wanted to capture a deep time course of network plasticity from this intervention in a single healthy person. On the clinical end, I wanted to gain some personal insight into what this therapy is like for the patient.”

62 BRAIN SCANS LATER

In order to detect any alterations resulting from forced-used therapy, the research team that also included occupational therapist Catherine Hoyt-Drazen, OTD, postdoctoral fellow Mario Ortega, PhD, and clinical research coordinator Annie Nguyen, MS, needed to first obtain baseline information on Dosenbach. He underwent a series of standardized motor performance tasks such as using a pegboard, moving blocks from one box to another, finger tapping, handwriting, and figure tracing, and his upper extremity movements were tracked using bilateral, wrist-worn accelerometers.

Dosenbach underwent daily fMRIs for two weeks before he was casted, two weeks while he wore the cast, and almost four weeks after the cast was removed. “I came in at 5:30 every morning,” he says, as scan time costs less in the pre-dawn hours, enabling the researchers to maximize their grant money.

He underwent a total of 62 brains scans, each lasting about an hour. As Dosenbach lay motionless on the MRI table, its computer was noisily acquiring hundreds of images of his brain. “It was like making a movie, with each day being a frame,” he says.

Dosenbach’s work schedule could not accommodate the amount of occupational therapy (OT) that his young patients receive as part of their treatment. He compensated the OT portion of forced-use therapy by doing all the work he routinely does every day with his less dominant and weaker arm — and what he does most is typing on his computer and writing some notes by hand. However, the young researcher, whose wife was then seven months pregnant and none too happy with his decision to immobilize his arm, also had responsibilities at home. “That was my therapy,” he says.
“For many tasks, forced-use therapy is not pure practice, like with a golf swing. You figure out new tricks, like how to open a jar. If you can’t open it one way, you might sit down and clamp the jar with your knees, then it’s easier. So it’s not all pure motor learning. It’s also finding new strategies for things you used to do with two hands, but now do with just one hand. And over time, you get better at it.”

LESSONS LEARNED

Although data from the pilot study has been collected, image processing and analyses is not yet complete. Dosenbach and Snyder intend to use that information to apply for a National Institutes of Health (NIH) grant that will allow them to gain an even greater understanding of use-driven functional network plasticity.

“I learned why the treatment might fail in kids,” says Dosenbach, who admits to “cheating” at least twice out of sheer frustration. “I also decided that the cast is overkill because it is too bulky, heavy and warm. The goal isn’t to make the patients itchy and not have their skin see sunlight; it’s to restrain them from using the dominant hand or arm. So we have to work on other, less obstructive ways to achieve the same results.

“For many tasks, forced-use therapy is not pure practice, like with a golf swing. You figure out new tricks, like how to open a jar. If you can’t open it one way, you might sit down and clamp the jar with your knees, then it’s easier. So it’s not all pure motor learning. It’s also finding new strategies for things you used to do with two hands, but now do with just one hand. Over time, you get better at it.”

Dosenbach’s main problem while he was casted was not going from his dominant right hand to his left hand, but rather going from two hands to one. The grip strength in his casted arm and hand decreased from 124 pounds of force to 90 in just two weeks’ time.

“Across the board, my right arm/hand got worse immediately after it was casted, and began to improve after the cast was removed,” says Dosenbach. “My left hand got stronger with forced use, but not to the degree that my right hand got weaker.”

Although Dosenbach did experience what his patients undergo, it’s still not the same, he says. “The main difference is that my left hand is healthy. It’s way, way harder for my patients because they have decreased use of one arm/hand, and they’re much more frustrated. Forced-use therapy is much more taxing for them.

“The developing brain has great potential for plasticity,” says Dosenbach. “Once we understand it better and develop a better sense of how we can drive or optimize it, we can have better outcomes. That’s a realistic goal.”
Xbox gaming technology may improve X-ray precision. A feasibility study also shows potential for reducing radiation exposure.

Photo Credit: Barone Firenze / Shutterstock.com
With the aim of producing high-quality X-rays with minimal radiation exposure, particularly in children, researchers have developed a new approach to imaging patients. Surprisingly, the new technology isn’t a high-dollar piece of machinery. Rather, it’s based on the Xbox gaming system.

Using proprietary software developed for the Microsoft Kinect™ system, researchers at Washington University School of Medicine have adapted hands-free technology used for the popular Xbox system to aid radiographers when taking X-rays.

The software coupled with the Kinect system can measure thickness of body parts and check for motion, positioning, and the collimated (aligned) X-ray field of view immediately before imaging, says Steven Don, MD, associate professor of radiology at Mallinckrodt Institute of Radiology. Real-time monitoring alerts technologists to factors that could compromise image quality. For example, “movement during an X-ray requires retakes, thereby increasing radiation exposure,” Don says.

A feasibility study was presented at the Radiological Society of North America (RSNA) annual meeting in Chicago this past December.

“The goal is to produce high-quality X-ray images at a low radiation dose without repeating images,” Don says. “It sounds surprising to say that the Xbox gaming system could help us to improve medical imaging, but our study indicates that this is possible.”

The technology could benefit all patients, particularly children because of their sensitivity to radiation and greater variation in body sizes, which can range from premature infants to adult-sized teenagers. Setting appropriate X-ray techniques to minimize radiation exposure depends on the thickness of the body part being imaged. High-quality radiographs are critical in determining diagnoses and treatment plans.

Traditionally, metal calipers were used to measure body-part thickness for X-rays. No longer in use, calipers were “time-consuming, intrusive, and often scary to kids, especially those who are sick or injured,” says Don, a pediatric radiologist who treats patients at St. Louis Children’s Hospital.

“To achieve the best image quality while minimizing radiation exposure, X-ray technique needs to be based on body-part thickness,” Don says. The gaming software has an infrared sensor to measure body-part thickness automatically without patient contact.

“Additionally, we use the optical camera to confirm the patient is properly positioned,” he explains.
AP Chest Radiograph, above left: In the top left image, a region of the chest is highlighted in green (indicating no motion and appropriate centering) including the automatic exposure chambers (three center black boxes). The bottom image is the simultaneous camera display which confirms positioning. The right side of the screenshot shows the chest thickness.

Left Wrist Radiograph, above right: In the top left image, a “skeletonized” patient is shown with each circle representing a joint. The bottom image is the simultaneous camera display that displays the right wrist centered on the detector. Note that the left wrist is highlighted in a red box, indicating that the technologist centered the right wrist rather than the left on the X-ray detector. Occasionally the wrong body part or side is either ordered or taken; the system can help identify these cases. The right side of the screenshot shows the exam that is ordered. The rectangle below is highlighted in red, noting motion and that the left wrist is not centered on the detector.

Originally developed as a motion sensor and voice and facial recognition device for the Xbox gaming system, Microsoft Kinect software allows individuals to play games hands-free without a standard controller. Scientists, computer specialists, and other inventors have since adapted the Xbox technology for nongaming applications.

Don and his colleagues, for example, combined the Microsoft Kinect 1.0 technology with proprietary software to improve X-ray imaging. With help from Washington University’s Office of Technology Management, the team applied for a patent last year. Don developed the technology with William Clayton, a former computer programmer at the School of Medicine, and Robert MacDougall, a clinical medical physicist at Boston Children’s Hospital.

In 2015, Don and his colleagues received funding from Washington University and the Society for Pediatric Radiology to continue research with the updated Microsoft Kinect 2.0 and seek feedback from radiological technologists to improve the software.

While further research and development are needed, the eventual goal is to apply the technology to new X-ray machines as well as retrofitting older equipment.

“Patients, technologists, and radiologists want the best quality X-rays at the lowest dose possible without repeating images,” Don says. “This technology is a tool to help achieve that goal.”
Combined PET/MRI — a relatively new technology available at just a handful of centers across the country — has been used mostly in research. Now that’s changing, and physicians at Mallinckrodt Institute of Radiology are leading the way in using this hybrid imaging tool in clinical care.

Young patient Bella Simmons is one of the first to make use of PET/MRI at Mallinckrodt. Diagnosed with rhabdomyosarcoma (RMS) — a disease in which malignant cancer cells form in muscle tissue — before she even started kindergarten, Bella received expert multispecialty care at Washington University Medical Center and is cancer-free today. Hybrid imaging with PET/MRI was a key component of her tumor surveillance during therapy.
Using PET/MRI to scan pediatric patients has been successful due to collaboration among disciplines. Pediatric radiologist Geetika Khanna, MD, leads the effort, working with other MIR radiologists, nuclear medicine physicists, CCIR (the Center for Clinical Imaging Research, led by director Pamela K. Woodard, MD) staff, pediatric oncologists, and the pediatric anesthesia team. Together, these groups have created a workflow that allows children to be simultaneously scanned using both MRI (detailed images of soft tissue in the body) and PET (use of an injected substance to show radioactivity in the body).

“It’s exciting to see new technology such as PET/MRI benefit the youngest of our patients,” says Woodard. “At Mallinckrodt, our goal is to pursue and provide the best in imaging at the lowest radiation dose possible.”

It truly is a collaborative effort. After imaging is complete, the radiologists and nuclear medicine physicians read the MRI and PET scans respectively. Then the two specialists sit down together to compare notes before sending their findings to Bella’s oncologist.

Another benefit of PET/MRI is that by eliminating the need for a CT scan, the radiation dose to the child can be decreased by up to 40 percent. For younger children, it also means having to undergo anesthesia just once instead of twice. However, the latter isn’t an issue for Bella.

“Even at the young age of 8 years, Bella does an amazing job of holding still for her PET/MR scans without sedation,” says Khanna, who since February has been interim chief of Mallinckrodt’s pediatric radiology section. Khanna anticipates that the technology eventually will have a significant impact in the care of all pediatric oncology patients.

“Bella’s tumor had already seen an aggressive treatment regimen when it relapsed in her head and neck, so we knew that sorting out new cancer from old scar was going to be a challenge,” says pediatric oncologist Frederick S. Huang, MD. “The availability of a PET/MRI machine allowed us to deliver and monitor a new plan of chemotherapy, surgery, and radiotherapy with confidence.”

**BELLA’S STORY**

Bella was nearly 4 years old when her parents took her to an urgent care facility for a mass that had developed under her right ear. At the time, the Simmons lived in Fort Campbell, Kentucky, where her father, Dexter, a U.S. Army captain, was stationed. Bella was treated for an ear infection, but antibiotics proved to be of no help.

That routine trip morphed into something for which no parent is truly prepared. Her pediatrician wasn’t sure what was happening, but thinking that perhaps there was a malformation in Bella’s ear, sent her to Vanderbilt University in Nashville, Tennessee. While Bella’s blood work looked good, the otolaryngologist there ordered an ultrasound that showed something else. An MRI and biopsy soon followed.

After several weeks of imaging to form a diagnosis of RMS, Bella started treatment in early 2012. She and her mother, Orshi, spent three weeks in Nashville while Bella underwent three chemotherapy sessions. At that point it was determined that she also needed proton therapy (more precise, since the tumor was close to Bella’s brain), so the duo moved to MD Anderson Cancer Center in Houston for six weeks so that Bella could receive that and chemotherapy simultaneously. They then returned to Vanderbilt.

All told, Bella endured more than a year of treatment and participated in a clinical trial studying the chemotherapy drug vincristine. It was rough; while Orshi remained with Bella, who was weak, tired, and vomiting, she was separated from her husband and older daughter.

The upside was that the tumor rapidly began to shrink, although subsequent scans showed it never disappeared completely. Surgery was not recommended at that time, and 11 months later the tumor came back — this time growing much more quickly.

By then the family had moved to Fort Leonard Wood, Missouri, and the largest nearby town
—Springfield, Missouri — didn’t have an RMS specialist. Their previous physician recommended St. Louis Children’s Hospital and pediatric oncologist Frederick S. Huang, MD.

“Our previous pediatric oncologist had been so compassionate that I had a hard time trusting the ‘new guy,’” says Orshi. “But Dr. Huang is really knowledgeable and very patient-oriented. We have become friends with him and the staff — they love us and we love them.”

Bella resumed an aggressive chemotherapy campaign, one that left her feeling constantly sick and led to several emergency room admissions. To further complicate matters, it was at this time that Orshi was diagnosed with breast cancer. With her family living in Europe and her husband working, there was really no one available to help except her older daughter, Anna, just 12 at the time.

Orshi underwent a double mastectomy and is now cancer free. Bella and the family were advised that she should have surgery to remove the remaining tumor.

Seven-year-old Bella underwent the 12-hour surgery, followed by another round of radiation and a weekly, less aggressive chemotherapy regimen. After that, she initially traveled to St. Louis every three months to be scanned. She has done very well overall, although she has a mild form of Bell’s palsy — a paralysis or weakness on one side of the face — that is only noticeable when she talks or smiles.

Bella does smile — a lot — on her monthly follow-up visits to Children’s and the Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of Medicine. “Bella likes all the staff; she jokes with them,” says Orshi. “She’s very personable — a people person.”

Bella has had four PET/MR scans since the technology became available for clinical use. This technology, so valuable in diagnosing what is going on in the body, is well-suited for monitoring cancer over time. At her most recent appointment, in April 2016, Bella’s scans were clear.

“The results speak for themselves,” says Huang, associate professor of pediatrics. “Bella is a happy and vibrant young girl who remains free of rhabdomyosarcoma one year after completing all of her therapies!”

That’s great news for Bella, who recently turned 9, and this summer will be traveling to Hungary to visit her maternal grandparents.

The annual incidence of rhabdomyosarcoma in the United States is 4.5 cases per 1 million children younger than 14 years. About 350 new cases of the cancer are diagnosed each year, and that number has held steady for the last few decades.
ALUMNI SPOTLIGHT  
by Kristin Baird Rattini

BONNIE N. JOE, MD, PhD, is a professor in residence and chief of breast imaging in the Department of Radiology and Biomedical Imaging at the University of California, San Francisco (UCSF). The connections she forged during her residency at Mallinckrodt Institute of Radiology remain strong and have brought her back to campus not only to teach — but to learn as well.

What attracted you to radiology?
As I was considering specialties while at the University of Pittsburgh School of Medicine, I had an opportunity to do research making volumetric measures of brain tumors with Carolyn Meltzer, a neuroradiologist on faculty. She was a great role model who introduced me to the specialty. I decided then that radiology was for me; it seemed to encapsulate my desire to combine technology and patient care.

Why did you choose Mallinckrodt for your training?
I wanted to do research and be in academics. When first visiting, I was struck by the Mallinckrodt “tower” being in the center of the hospital. It visually makes the point of how important radiology is to the medical center and embodies our specialty’s central role; radiologists are often the first physicians to make the diagnosis which then drives appropriate next steps in care.

Which faculty at Mallinckrodt made the greatest impression upon you?
That’s the beauty of training at MIR; I was able to learn from the likes of Stuart Sagel and Lou Gilula. Watching Barry Siegel systematically analyze what looked like random dots on film to uncover a patient’s story was always impressive. Dennis Balfe never said “no” to add-on study requests. The unsnipped emphasis on patient care modeled by so many of the MIR faculty has definitely become a part of my own practice and what I try to teach. Ty Bae taught me to embrace new ideas and explore; under his guidance, I received an RSNA Research Fellow Grant to study breast MR in cancer patients during my MR fellowship year. During that year, Vamsi Narra taught me how to scan and troubleshoot MR images — a skill set I still use today. Bob McKinstry was always available for practical advice. “Cooky” Menias and Sanjeev Bhalla helped me survive residency. Although not one of the faculty, Shelly Meese imparted a great pearl of wisdom that I have since imparted to others: During a period of extreme maternal guilt about leaving my child in day care for long hours, Shelly (a fellow working mom) simply reassured me that “a happy mom is a good mom!”

What are your major areas of research?
Most of my current research relates to working on ways to better detect breast cancer early and to reduce false-positive biopsies. We also have a well-established program evaluating tumor response to therapies with MR. A new area we’re working on is molecular breast imaging. The concept of being able to image specific receptor targets with PET is exciting.

Tell us about your current position.
I’ve been chief of our breast imaging service since 2008. I’m proud of transitioning our group off film to digital mammography and ramping up our breast MRI program. Most of my clinical days are spent on breast imaging work: reading mammograms, performing biopsies and diagnostic imaging. On research days I try to preserve time to focus on my own research, but I also spend time...
mentoring faculty and trainees and doing administrative work to keep our clinical services running smoothly.

I work with a great group of dedicated and shared breast-imaging faculty. I really like that our practice group is multidisciplinary; we have frequent interactions with surgery, oncology, and other clinical colleagues. Everyone understands the importance of translational research and integrating that into our clinical enterprise.

It’s also critically important to spend “face-time” with patients. Everyone in our clinical section is behind this; we’re not a group to hide in a dark room reading images. We’re happy to be front and center with our patients so they know a radiologist is caring for them.

**How did your Mallinckrodt ties serve you well as you took on a leadership role?**

When my chair asked me to take responsibility for our breast imaging services, it was a time of transition. I needed to learn and gain some perspective on how to revamp the practice at UCSF. I visited Mallinckrodt for a week to see how an excellent clinical practice was run. Barbara Monsees, a recognized national leader in the field and chief of MIR’s breast imaging section at the time, was highly supportive. I learned about equipment and room layout and most importantly, workflow. I am so grateful for her generosity and continued mentorship.

**You returned to Mallinckrodt a year ago?**

Kate Appleton, current chief of breast imaging, invited me for grand rounds. I did a talk on screening from a historical perspective — how we have decades of experience showing the beneficial effects of early breast cancer detection to save lives. I felt extremely welcomed and loved meeting the residents and fellows. It was very nostalgic to return to the same auditorium where I’d spent so many days as a resident listening to faculty speak.

**What are your interests beyond radiology?**

These days, life revolves around the kids’ activities. My daughter, 16, plays the oboe and loves ballet and contemporary dance. My son, 12, is a French horn player and enjoys swimming. When I accepted the position at UCSF, it was driven by the desire to be near extended family in the Bay Area who have been a great support network as we juggle the challenges of a two-physician family. While in St. Louis my husband and I were avid ballroom dancers —something we both hope to be able to revisit one day.
IN MEMORY

Mokhtar H. Gado, MD, professor emeritus of radiology, died April 28, 2016. For decades a leading clinician and researcher at MIR, Gado was noted for his work with neurological diseases and had conducted extensive research involving magnetic resonance imaging (MRI) of the brain and spine. Many remember his engaging teaching style, deep knowledge of his field, brilliant mind and kind spirit. Gado joined MIR in 1970 and was appointed chief of the neuroradiology section the following year. He served in that role until 1991, when he relinquished his administrative duties to devote more of his time to research and teaching. He remained active as a professor of radiology until 2013, when he was named an emeritus professor. Memorial contributions may be made to the MIR Neuroradiology Education Fund, Department of Radiology, Washington University Office of Medical Alumni and Development, Campus Box 1247, Attn. Kristen Williamson, 7425 Forsyth Blvd, Ste. 2100, St. Louis, MO 63105.

Margaret “Peggy” Jost died unexpectedly November 12, 2015, while traveling with her husband, former MIR director and chair R. Gilbert Jost, MD. Jost began her graduate studies at Yale Medical School. After marrying in 1967 and then moving to St. Louis, she earned a master’s degree in biomedical engineering from Washington University where she worked in various medical research laboratories. Devoted to her family and friends, Jost was well-known to MIR faculty and staff.

Robert C. McKnight, MD, a cardiac radiologist at Barnes-Jewish Hospital for many years before he retired in 2003, died November 29, 2015. A 1961 graduate of Washington University School of Medicine and a longtime MIR faculty member, McKnight was a dedicated physician and educator.

APPOINTMENTS/ PROMOTIONS

Hongyu An, PhD  
Associate Professor of Radiology  

Mario Castro, MPH, MD  
Professor of Radiology (primary appointment in the Department of Medicine)

Delphine L. Chen, MD  
Associate Professor of Radiology

Paul K. Commean, BEE  
Assistant Professor of Physical Therapy (secondary appointment)

Joseph P. Culver, PhD  
Professor of Radiology  
Professor of Physics (secondary appointment)

Jennifer Lee Demertzis, MD  
Associate Professor of Radiology

Manu S. Goyal, MD  
Assistant Professor of Radiology

Deanna Greene, PhD  
Assistant Professor of Radiology (primary appointment in the Department of Psychiatry)

Jack W. Jennings, MD, PhD  
Assistant Professor of Radiology

Akash Pravin Kansagara, MD  
Assistant Professor of Radiology

James E. Kelly, MD  
Assistant Professor of Radiology

Yongjian Liu, PhD  
Investigator (track change)

Michael W. Penney, MD  
Associate Professor of Radiology

Nael E.A. Saad, MD  
Associate Professor of Radiology  
Associate Professor of Surgery (secondary appointment)

Vijay Sharma, PhD  
Professor of Radiology

Elizabeth F. Sheybani, MD  
Assistant Professor of Radiology

James D. Stensby, MD  
Assistant Professor of Radiology

Yi Su, PhD  
Assistant Professor of Radiology

LECTURES

Mikhail Y. Berezin, PhD, assistant professor of radiology, presented “Optical Contrast Agents in Imaging, Diagnostics and Therapy” at the first Sultan Qaboos University (SQU) International Chemistry Conference, “Recent Trends in Drug Development,” in Muscat, Oman, November 10-12, 2015.

Geetika Khanna, MD, associate professor of radiology, presented “Whole Body MRI in Children” as part of the SPR Pediatric Body MRI course (Imaging of Child Abuse) at the second annual meeting of the Society of Emergency Radiology in New Delhi, India, November 2015.

Robert C. McKinstry, MD, PhD, professor of radiology, presented “Application of the mMR to Pediatrics and the Neurosciences” at the inaugural PET/MR (Molecular MR) Symposium at the Hong Kong Sanatorium & Hospital, December 15, 2015.

David E. Reichert, PhD, associate professor of radiology, presented “Applications of Microfluidics to Radiometal-based Radiopharmaceuticals” as part of the Recent Advances in Microfluidics for Radiochemical Synthesis symposium at Bench to Bedside: Chemistry of Health Care program area at the 2015 Pacificchem meeting in Honolulu, December 15-20, 2015.

Marilyn J. Siegel, MD, professor of radiology, presented on multiple topics at the 61st Argentine Congress of Radiology–4th International Course on Radio-pathological Correlation (AIRP) in Buenos Aires, September 10-12, 2015. She also spoke on “Tumor Response Assessment in Adults: Clinical Trials” at the SCBT-MR 38th Annual Course, October 7-11, 2015, in Toronto, and on “Radiation Risks in Pregnancy” and “Pediatric and Adolescent Acute Abdomen, December 6-10, 2015 in Orlando at the National Diagnostic Imaging Symposium.
A lifelong interest in space exploration has one member of the Mallinckrodt Institute of Radiology (MIR) community following a unique trajectory.

An abdominal imaging fellow by day, David Lerner, MD, spends much of his free time thinking about space exploration and how his chosen field of radiology can be incorporated and streamlined to benefit that effort.

He recently presented “Imaging and Intervention in Space: Utilization of Radiology for Future Exploration Class Missions” as a Grounds Rounds lecture to NASA medical staff and engineers at Johnson Space Center, Houston.

Lerner graduated first in his economics class at Rutgers University (summa cum laude) before earning a medical degree at the University of Kansas (KU) School of Medicine. After completing a radiology residency at the University of Missouri–Kansas City (UMKC), he joined the abdominal fellowship program at MIR in July 2015.

His interest in space and NASA (National Aeronautics and Space Administration) dates back to childhood; an introduction to a family friend who worked for the aerospace agency allowed him an entrée into that organization’s inner world. He credits the recent resurgence of interest in space exploration to visionaries like Elon Musk who are privatizing space travel and to NASA-produced advances in technology that make longer and more distant trips possible.

“There’s always been interest in deeper space exploration, but now technology is at a level where things can really start to be done,” says Lerner. For him, that includes thinking about how to translate proven medical interventions from earth to space.

Lerner’s research is focused on the use of diagnostic imaging and interventional radiology in space, which earned him the Radiological Society of North America (RSNA) group’s Roentgen Resident/Fellow Research Award in 2015.

Although prospective astronauts undergo thorough medical screening, it’s inevitable that medical issues will arise during long-term exploration missions of two to three years’ duration. Lerner and other like-minded scientists attempt to estimate the most likely scenarios that might arise.

Microgravity puts astronauts at an increased risk for certain types of pathologies, he says. One effect of weightlessness is that bodily fluids don’t flow as easily, increasing the risk of surgical emergencies, and operating in space is not an option for many reasons, one of which being that a person’s organs would actually float. Fortunately, Lerner says many of the emergencies that would be treated surgically on earth can be treated symptomatically in space.

For example, if a kidney becomes dilated and infected from an obstruction like a stone (pyonephrosis), a person can rapidly develop sepsis and die. While physicians in space cannot operate to remove a kidney stone, they can use interventional radiology (IR) to place a drain into the patient to relieve infection and prevent death. IR can be used to treat symptoms in many emergencies, says Lerner, and it carries a low risk of complication.

Other issues to consider are physical space needs and the cost of the medical equipment.

“These missions need medical equipment to cover all contingencies, but space in the mission crafts is at a premium; anything sent up requires a decrease in or reorganizing of other necessities, such as computers or food,” says Lerner. “More importantly, it takes thousands of dollars to send even a single pound of equipment into space.”

For these reasons, Lerner and colleagues aim to maximize ability while minimizing weight and volume.

These are complicated issues, but for Lerner, thinking about them is pure fun. “I really have a good time doing this research. I’m happy to be able to contribute to the bigger picture of helping space exploration to go forward.”
FYI

CUBAN CONNECTION
Mallinckrodt physicians connect with Latin American counterparts

Fernando Gutierrez was 13 years old when his family left Cuba in August 1961. It was just months after the unsuccessful U.S.-sponsored Bay of Pigs invasion and a little more than a year before the Cuban missile crisis, a military stalemate that extended a diplomatic and economic embargo between the two countries that would persevere for more than 50 years.

At the time, Gutierrez — who relocated with his five siblings and parents to Omaha, Nebraska — expected that life in Cuba would soon normalize and that he would return home in a year or two. But relations between the two countries worsened and Cuba remained frozen in a 1960s time warp due to its inability to import American products, including newer medical technology.

Fast forward 55 years later and Gutierrez, now a physician and a professor of radiology at Mallinckrodt Institute of Radiology, returned to his homeland in January 2016 leading a delegation of nine Washington University School of Medicine physicians.

They attended a three-day pulmonary medicine conference in what may be the first such event open to U.S. doctors since the two countries severed their ties decades earlier. “Radiology is, after all, an important component of pulmonary medicine,” says Gutierrez, a cardiothoracic radiologist. A return trip to Cuba has been on the MIR physician’s bucket list since he left the country.
Gutierrez’ return to Cuba began as a personal invitation to lecture at Hermanos Ameijeiras, the largest tertiary care hospital in Havana. The invitation came from a Cuban pulmonary physician he met at a meeting in Mexico four years ago. Gutierrez declined the initial and subsequent offers but remained in contact with the pulmonologist.

When diplomatic relations improved and the U.S. embassy in Cuba reopened in July 2015, Gutierrez changed his mind and decided to return to his homeland and bring along some colleagues from Mallinckrodt and other departments at the medical school. “I called my friend and said, ‘Why don’t we have a symposium?’” His friend, who was in charge of pulmonary medicine at Hermanos Ameijeiras, agreed.

The meeting caught the attention of the Cuban Society of Pulmonary Medicine, which suggested the symposium be part of their annual meeting in Havana. So the symposium segued into an even larger event and Gutierrez, in turn, sent an invitation to see who among his Washington University colleagues would be interested in attending.

Mallinckrodt professor and chief of cardiothoracic imaging, Sanjeev Bhalla, MD, and assistant professor Andy Bierhals, MD, MPH, quickly agreed. Six other physician volunteers came from the cardiology, pulmonary medicine, and cardiothoracic surgery divisions.

Gutierrez officially attended the conference as a member of La Asociación Latino Americana de Tórax (the Latin American Thoracic Society). “The society has thousands of members throughout Central and South America,” says Gutierrez, who directs its virtual radiology department.

The other Washington University physicians came as guest lecturers. All wanted to learn how medicine is practiced in the Latin American country with the trade embargo. More importantly, they went to share their medical expertise and cultivate a give-and-take relationship with their Cuban physician peers.

Lecture topics included lung cancer, pulmonary hypertension, and interstitial lung disease. “We talked about the imaging of these diseases and integrated some clinical components with our (Washington University) colleagues from pulmonary medicine and thoracic surgery. I talked about lung cancer screening,” Bierhals says.

Smoking is common in Cuba; as a result, lung cancer also is common. “Cuba has a very robust (medical) system,” continues Bierhals. “They have a lot of amenities that the United States has, but not as much. (For example) they have high-end diagnostics and treatments (such as CT and MRI) but they aren’t as advanced. We can help them expand the applications of existing equipment in a market that has limited resources.”

While Cuba does have a shortage of American-advanced medical products, it produces a large volume of primary care physicians. Consequently, it has a high physician-patient ratio and exports many of its primary care doctors to other countries.

“I’ve always been fascinated by what they have been able to do with what they have at their disposal, politics aside,” adds Gutierrez. “They have excellent infant mortality and maternal statistics.”

The Cuban medical model is based on a physician-run pyramid. “At the base is a very good, general medical care system,” says Gutierrez. Above that layer, in ascending order, are polyclinics (independent clinics that have a variety of medical specialists on staff), secondary medical centers and primary tertiary centers. “I think we can be of help; where we can make a difference is at the top,” he says.

According to Gutierrez, Cuba’s two main hospitals are planning to install the first positron emission tomography (PET) scanners on the island nation of 11 million people. “It will take a couple of years before the scanners are installed,” says Gutierrez, as things move at a slower pace. But this is a potential area where we can help them by providing advice.

“From an organization point of view, I think we also can help them out with their residency program,” continues Gutierrez. “But you have to be reasonable and humble and say, ‘This is how we do it. Do you like it and how do you do it? It’s a two-way street.’”

A follow-up trip is tentatively planned for October 2017.
MIR AROUND THE WORLD

Long recognized as an international leader in patient care, training, and research, Mallinckrodt Institute of Radiology and its faculty often venture out into the world to share knowledge via lectures and reciprocal training opportunities for residents and fellows. From South America to Africa to Asia, MIR faculty have worked with their international colleagues to advance the field of radiology and to provide care for patients in need — truly having a global impact. Recently, MIR has formed a RAD-AID chapter to further its international engagement in radiology.

A LOOK BACK

A Lesotho, 2009
Pediatric radiologist Rebecca L. Hulett, MD, provided training for physicians at Queen Elizabeth Hospital in Maseru.

B A young patient in Lesotho

C Kenya, 2000 & 2001
Former MIR clinical interventional radiology fellow David Jeck, MD, traveled with a multidisciplinary medical team from St. Louis to offer free medical care to patients and training for medical staff at Kenyatta National Hospital.

D A Kenyan pediatric patient

E-F Argentina, 2009
A U.S. Air Force C-17 aircraft took on a used Mallinckrodt scanner (including its 23,000-pound magnet) as part of a payload of humanitarian supplies destined for South America. The scanner was the first donation of an MR scanner by a university to a remote, under-served region.

Images courtesy of Mallinckrodt Institute of Radiology Archives
Mallinckrodt Institute of Radiology, the Department of Radiology at Washington University School of Medicine, is working to strengthen its reputation for excellence — through outstanding resident and fellow education programs, pioneering research, and innovative advances in patient care. Philanthropic resources play an important part in the continued advancement and future work of Mallinckrodt and those who train in its programs.

There are many ways you can make a gift to support Mallinckrodt Institute of Radiology — from joining the Eliot Society with a gift of $1,000 or more to a larger gift opportunity, such as supporting an endowed professorship.

Online donations can be made at gifts.wustl.edu. To ensure that your donation is designated for Mallinckrodt Institute of Radiology, please follow these directions:

• At Designation Options, please choose the fourth box marked “Other”
• Type in Mallinckrodt Institute of Radiology in the space provided

For more information, please contact:

Medical Alumni & Development Programs
Campus Box 1247
7425 Forsyth Blvd., Suite 2100
St. Louis, MO 63105-2161
(314) 935-9691
Left to right: Congratulations to Mallinckrodt Institute of Radiology’s 2016-17 Diagnostic Chief Residents — Richard Tsai, MD, Stephen Currie, MD, and Whitney Manlove, MD