Mallinckrodt Institute of Radiology

TRAINING PROGRAMS

Washington University School of Medicine
1930s

1931 Mallinckrodt Institute of Radiology officially opens with staff of four radiologists and one physicist.

1933 First residents — Allan B. Phillips and William Y. Burton — are accepted.

1937 First laminograph (developed in 1936 at MIR) used to examine World Series Champion pitcher Paul “Daffy” Dean; considered earliest recorded example of sectional imaging used to assess sports-related musculoskeletal injury.

1940s

1941 Cyclotron constructed on WashU’s undergraduate campus is first dedicated to producing isotopes for medical and biological research.

1942 U.S. government commandeers cyclotron to produce some of world’s first plutonium; in the end, half of Manhattan Project’s plutonium comes from WashU.

1950s

1950 Then director Hugh Wilson appoints radiophysicist and future PET pioneer Michel Ter-Pogossian, forever changing the history of MIR.

1954 First pediatric radiology program established at MIR.

1960s

1963 MIR builds first cyclotron in U.S. on a medical campus and second in the world dedicated to medical research.

1964 Newly appointed MIR director and neuroradiologist Juan Taveras establishes first official subspecialties by dividing faculty into six groups based on local anatomy.

1970s

1970s PET invented by MIR researchers Michael Welch and Michel Ter-Pogossian.

1972 Neuroradiology and Ben Mayes come together to create MIR’s first fellowship.

1974 CT scanner — one of first six in U.S. — acquired by MIR.

1976 One of first five mammography units in U.S. arrives at MIR.
1980s

1983 Along with two colleagues, MIR radiologist Michael Vannier publishes first 3D reconstruction of single CT slices of the human head

1984 MIR researchers develop fluoroestradiol (FES), the first radioactive form of estrogen used as a PET imaging agent for detecting breast cancer

1990s

1990s MIR develops widely adopted criteria for diagnosing pulmonary emboli

1992 MIR works with CTI PET Systems to develop some of the first whole-body PET imaging techniques

2000s

2002 Quadriplegic actor Christopher Reeve’s treatment regimen — designed by WashU faculty with imaging studies performed by MIR — results in some motor function restoration

2004 MIR expands resident total to 72, making it largest program in U.S.

2010s

2010 MIR becomes home to the Human Connectome Project

2015 “Cancer Goggles,” invented by Optical Radiology Lab director Samuel Achilefu, allow doctors to see cancer cells during surgery

2020 Your residency training begins

1992 *Newsweek* publishes “Decade of the Brain,” an article highlighting neurologist and radiology professor Marcus Raichle’s PET research and development of nearly all existing techniques for mapping the brain

2008 Mark Mintun, director of the Center for Clinical Imaging at MIR, uses PET imaging to detect Alzheimer’s disease before clinical symptoms appear
Richard L. Wahl, MD, was named director of MIR in 2014, ushering in a new era of leadership.
Welcome to Mallinckrodt Institute of Radiology

As Mallinckrodt Institute of Radiology’s director and a graduate of the residency and fellowship programs, I know firsthand why MIR is the best available training experience to launch your career in radiology.

Most of you know about our diverse and interesting caseloads, exceptionally advanced imaging equipment, unique opportunities for clinical and laboratory research, and world-renowned radiologists. We also provide exclusive service to nationally ranked Barnes-Jewish and St. Louis Children’s hospitals, as well as a chance to collaborate with other specialists from Washington University School of Medicine, one of the top 10 medical schools in the country. And if that’s not enough, there’s our modern, “future-focused” medical campus that is surrounded by some of the most vibrant, thriving — and affordable — communities in the U.S.

Please accept my invitation to explore our programs, tour our facilities, and meet our faculty and trainees. Once you do, you’ll understand why MIR is the premier destination in radiology training.

Richard L. Wahl, MD
Elizabeth E. Mallinckrodt Professor of Radiology
Director, Mallinckrodt Institute of Radiology
Head, Department of Radiology
Washington University School of Medicine
After more than a decade at the helm of one of the most respected radiology programs across the globe, Jennifer Gould, MD, knows a thing or two about what makes for a successful residency. As with all Mallinckrodt Institute of Radiology program directors, Gould’s accomplishments in the field of radiology are too numerous to mention, but here are a few highlights:

- Diagnostic Radiology Residency Program Director since 2006
- Volunteer for the American Board of Radiology since 2004, serving as a board examiner for the oral examinations in diagnostic radiology and interventional radiology
- Chair of the Core Exam writing committee for interventional radiology
- Volunteer for the ACGME with roles in writing the Milestones for Diagnostic Radiology and Interventional Radiology, as well as serving on the Advisory Committee for the Interventional Radiology residency

**Education**

2002–2003  Vascular and interventional radiology fellow, Mallinckrodt Institute of Radiology, Washington University

1998–2002  Diagnostic radiology resident, Mallinckrodt Institute of Radiology, Barnes-Jewish Hospital

1997–1998  Internal medicine intern, Barnes-Jewish Hospital

1993–1997  MD, Washington University School of Medicine

1989–1993  BA, Cornell University
Diagnostic Radiology Residency Program

Mallinckrodt Institute of Radiology's Diagnostic Radiology Residency Program consistently ranks among the top three in the country. At MIR, you’ll train alongside globally recognized radiologists who are dedicated to clinical care, education and your personal success. Below are just a few of the reasons our diagnostic radiology residency is a national standout:

Faculty-to-Resident Ratio
Our one-to-one faculty to resident ratio provides unmatched clinical training in interpreting imaging studies and performing image-guided procedures. Face-to-face readout is used on all services so residents get personal feedback on all reviewed cases.

Class Size
With an average class size of 16, residents have flexibility with vacation time, rotations and on-call scheduling.

Hands-On Training
We provide hands-on training to build graduated competence. Residents rotate through three hospitals during training: Barnes-Jewish Hospital, St. Louis Children’s Hospital and Barnes-Jewish West County Hospital, training alongside attending radiologists.

Daily Education
Morning rotation-specific conferences and core training noon lectures expose our residents to an extensive and diverse caseload. Numerous interdisciplinary conferences include the departments of medicine, surgery and pathology, which demonstrate the radiologist’s role in both diagnosis and treatment.

Research & Educational Projects
MIR offers countless opportunities to participate in mentored radiology research that results in national meeting presentations and publication in major journals. First and second year residents are reimbursed for one meeting each academic year, up to a maximum of $1,500. MIR will reimburse third and fourth year residents for more than one meeting each academic year, up to a maximum of $2,000.

Contact
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NRMP Matching Number: 1353420A0
Mallinckrodt Institute of Radiology has an extensive and collaborative research program. Up to three highly motivated individuals interested in a career in academic radiology are admitted to the Research Residency Track each year.

**Combined Training** This specialized track, which combines training in general diagnostic radiology with dedicated time in research, provides up to 48 weeks of full-time research with one or more faculty mentors and a lecture series (Monday Morning Breakfast Seminar) dedicated to educating residents in translational research. Topics include information on obtaining grant funding, where to go for Institutional Review Board submission assistance, patent filing, and how to navigate the Office of Technology Management. The remaining time is spent rotating on clinical services preparing to be a clinical radiologist. Research residents typically complete the first year of clinical training before starting any dedicated research time.

**Unique Support System** Research residents are given guidance toward the selection of a research mentor, as well as information about the multiple laboratories, facilities, infrastructure and pilot support available at Washington University.

**Funding** MIR received $30.1 million in externally sourced research revenue in fiscal year 2018. In addition, our support staff is well-equipped to assist
residents in the submission of grant applications. This past year, three MIR trainees received Radiological Society of North America (RSNA) resident-fellow research awards to fund their research in 2018-2019.

**NIH Training Grant** Research residents have the opportunity to apply internally to participate in a newly funded training program — Training OPPortunities in Translational Imaging Education and Research (TOP-TIER). TOP-TIER's focus is on training clinical scientists in translational imaging, research, innovation and entrepreneurship.

**Facilities and Advanced Equipment** MIR has seven laboratories and nine research support facilities, including the Center for High Performance Computing (CHPC), the East Building MR Facility and the Center for Clinical Imaging Research (CCIR). The MR Facility and CCIR maintain a total of five research-dedicated whole body MRI scanners, including three Siemens 3T Prisms, a 3T Vida, and a simultaneous Siemens PET/MR whole body scanner scheduled to arrive this fall. The latter, a Siemens Vision, will be one of the first installs in the U.S. In addition, four cyclotrons along with an equipped Radiological Chemistry Laboratory supply both research and clinical radiotracers for the university. The Small Animal MR Facility and the Pre-clinical PET/CT Facility contain a new small animal simultaneous acquisition PET/MRI (3T/7T dual boot) scanner, a 12T and two 4.7T small animal MR scanners, and an Inveon PET scanner.

**How to Apply** This track is offered through the NRMP match under a training program number (see below) separate from the diagnostic radiology training program. Interested applicants are encouraged to also apply to the Diagnostic Radiology Residency Program.

**NRMP Matching Number:** 135420A1
Combined Diagnostic Radiology/Nuclear Medicine Residency Track

Mallinckrodt Institute of Radiology has long been recognized for advancing the scope and practice of nuclear medicine, as well as training individuals for careers in academic and private practice nuclear medicine.

Up to two residents from each diagnostic radiology residency class will be accepted for a specialized training track that will enable graduates to obtain dual certification in diagnostic radiology (American Board of Radiology) and nuclear medicine (American Board of Nuclear Medicine). Candidates are selected during or by the end of the second year of residency training and, depending on a resident’s interest, both four and five-year options are available.

**Four Year Training** This option allows 16 months of training in nuclear medicine during a four-year diagnostic radiology residency. In the first three years, residents complete the same rotations as the other diagnostic radiology residents. In the fourth year, residents in the combined track focus on nuclear medicine. The four-year program is best suited for individuals who are interested in practicing clinical nuclear medicine.

**Five Year Training** This option allows for up to 28 months of training in nuclear medicine, with a minimum of 24 months required. This includes completing a four-year diagnostic radiology residency, with year four training focused on nuclear medicine, followed by a one-year nuclear medicine residency/fellowship. Some of the time spent in nuclear medicine is devoted to research in the field. This pathway is most suited for individuals who are interested in practicing academic nuclear medicine.
Name: Abby Erickson, MD
Hometown: Indianapolis, IN

Favorite local spot: Taste. Creative cocktails and small plates, cool vibe. Get the Subtle Hustle punch bowl.

Teachable moment: The first time an attending did not come into the room with me for a central line placement. I surprised myself and finished the procedure without help. We have a lot of autonomy while maintaining safe supervision.

Favorite meal: I Fratellini for an upscale meal with nice ambiance. Ted Drewes has delicious frozen custard.

Favorite outdoor activity: The parks here are surprisingly nice. Everyone knows about Forest Park, but also check out Castlewood State Park.

Biggest surprise: I knew I would enjoy radiology, but I’m surprised by how good of a work-life balance we are able to have in residency.

Why MIR: Large, well-respected program with down-to-earth faculty and residents; will prepare you well for either academic or private practice jobs; good procedural exposure for residents.

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Early Specialization in Interventional Radiology (ESIR)

Up to three residents will be selected from each residency class for ESIR status. ESIR residents focus on interventional radiology during their fourth year of residency training, completing an ICU month, as well as at least eight IR and IR-related rotations.

The balance of the year features diagnostic radiology rotations, including nuclear medicine and breast imaging, to meet training requirements.

ESIR residents easily meet requirements for advanced placement in an independent IR residency. (To learn more about the IR Residency Program, see page 18.)
**Curriculum: Years 1, 2 and 3**

Mallinckrodt Institute of Radiology residents in all programs and tracks spend the first three years rotating through a core curriculum. Our goal is to progressively build competence, turning our residents into well-rounded radiologists, skilled in all areas of diagnostic radiology and confidently prepared to take board exams. Core rotations include:

**Body Computed Tomography** During their first rotation, residents quickly become familiar with normal cross-sectional anatomy of the chest, abdomen and pelvis, and develop an understanding of pathologies seen on CT. In subsequent rotations, they refine their knowledge of diagnoses frequently found on CT and become proficient with advanced CT protocols.

**Body Magnetic Resonance** This busy clinical service covers all aspects of body MRI and body MRI angiography. Residents experience a high-volume body-MRI practice with a mix of thoracic, abdominal, and pelvic MRI and MRA imaging. PET/MRI exposure is a feature of our program.

**Breast** Our breast imaging facility is co-located with a breast surgical practice, providing residents the opportunity to train and work alongside attending radiologists and breast surgeons. Residents learn how to interpret diagnostic and screening mammograms (including tomosynthesis), receive training in breast MRI, and perform sonographic and stereotactic breast biopsies and needle localizations.

**Cardiac** Our cardiac imaging section — one of the largest in the nation — is staffed daily by a cardiac radiologist, and a radiology resident dictates all cases. Residents have access to cath and echo images, and every cardiac CT and MRI is physician monitored. As a result, residents become proficient in protocoling studies and complex post-processing of images.

**Chest** The cardiothoracic imaging rotation covers the review of chest radiographs for Barnes-Jewish Hospital, which includes its medical, surgical, neurosurgical and cardiothoracic intensive care units. With world-class pulmonary and lung transplant programs, and cardiac and thoracic surgery services, this rotation exposes residents to a wide variety of diagnoses, from routine to rare and complex.
Emergency/Trauma First-year residents rotate through the acclaimed Charles F. Knight Emergency Trauma Center at Barnes-Jewish Hospital, a Level 1 Trauma Center. The hospital has more than 80,000 emergency visits annually, including about 13,000 trauma patients. Second-year residents have independent call for both Barnes-Jewish Hospital and St. Louis Children’s Hospital, the latter being the only pediatric hospital in Missouri and Illinois with a Level 1 Pediatric Trauma Center designation. Faculty backup is available to review images from home or come in when needed, and each shift ends with a face-to-face readout with subspecialty attendings.

Gastrointestinal/Genitourinary Residents perform all fluoroscopic exams including swallow studies, barium esophagrams, small bowel studies, barium enemas, hysterosalpingograms and retrograde urethograms. Remote faculty viewing of the fluoro screen in the reading rooms provides opportunities for residents to independently perform GI/GU examinations.

Interventional Working one-on-one with attending radiologists, residents are the primary operators on procedures. Residents gain experience from clinical training and large volume exposure to general body interventional procedures, including percutaneous organ drainage, arterial embolizations, and routine and complex central venous access.

Name: Jimmy Xu, MD
Hometown: The Bronx, NY
Teachable moment: My first week of my first rotation of residency was on GI/GU and I completely flubbed a study. Instead of a reprimand my attending said, “It’s fine. This happens to everyone. Now go and kick butt on the next one.”

Favorite local spot: Milque Toast in McKinley Heights. A neighborhood breakfast and lunch spot that doubles as a community space, concert venue and art gallery.

Favorite outdoor activity: The summer movies on Art Hill are a magical experience. Imagine sitting in the shadow of the neoclassical St. Louis Art Museum on the grassy hill overlooking the beautiful fountains. A bottle of wine and your friends next to you spread out on blankets. And classic movies like Hitchcock’s “To Catch A Thief” playing on a 40-foot screen. It’s quite an evening and completely free.

Why MIR: You become a radiologist by doing radiology. MIR has the volume, which means you not only see the normal bread and butter stuff but also the rare cases, so you become comfortable with the depth and breadth of radiology.
Musculoskeletal In this multi-modality rotation, residents interpret radiographs, ultrasounds, CTs and MRIs of patients with a wide range of bone and joint disorders, including orthopedic, neoplastic, metabolic, rheumatologic and infectious abnormalities. In addition, the musculoskeletal procedure service provides hands-on instruction for performing image-guided diagnostic and therapeutic interventions for a variety of musculoskeletal conditions.

Neuroradiology Beginning with the first rotation, residents read all modalities in neuroradiology and participate in daily lectures and case conferences dedicated to neuroradiology. In addition to performing fluoroscopically-guided spinal procedures and diagnostic cerebral angiography, residents have the opportunity to participate in interpretation of advanced imaging techniques, including diffusion tractography, functional MRI and PET/MRI.

Nuclear Medicine While on service residents benefit from a unique volume of cases, particularly in the areas of cardiac and PET, as well as exposure to pediatric nuclear medicine. The busy service handles a full complement of imaging, including PET/CT, SPECT, SPECT-CT and planar imaging.

OB/GYN Ultrasound Senior residents, in collaboration with OB/GYN faculty and house staff, learn obstetric ultrasound for the first, second and third trimesters. Residents spend time at Barnes-Jewish Hospital and Missouri Baptist Hospital.
Pediatric  Residents learn pediatric imaging from full-time pediatric radiologists at St. Louis Children’s Hospital. To supplement the daytime experience, residents take radiology call at the hospital during night float and senior call experiences.

Rad-Path  All residents have an opportunity to attend the American Institute for Radiologic Pathology, with MIR paying the tuition and providing a stipend to defray costs of travel and lodging. Residents who elect not to attend are provided a four-week rad-path study period at MIR.

Ultrasound  The ultrasound service performs most of the image-guided biopsies and aspirations for Barnes-Jewish Hospital, and nearly every patient who comes through this service is scanned by a resident after the sonographer completes the initial evaluation. Residents learn image interpretation and scanning techniques on this busy, hands-on rotation.

Vascular Ultrasound  Senior residents learn vascular imaging of the extremities and carotid arteries in the vascular surgery section’s ultrasound laboratory.

Barnes-Jewish West County Hospital  Located in west St. Louis County, this 113-bed facility has a busy inpatient and outpatient radiology service staffed by MIR faculty. Residents spend one to two months over their four years of training in this facility, primarily rotating on abdominal imaging, musculoskeletal and cardiothoracic services.
During their final year of training, residents in the diagnostic radiology residency who are not doing an ESIR, research or diagnostic radiology/nuclear medicine track have the option of completing one or more selective rotations.

Options designed by the subspecialty sections include: abdominal radiology, cardiothoracic radiology, musculoskeletal radiology, breast radiology, interventional radiology, pediatric radiology, neuroradiology and nuclear medicine. Interdisciplinary options, such as informatics, oncology and general radiology, also exist.

These “mini-fellowships” vary from six to 12 weeks in length, though longer selectives can be arranged if the schedule allows. Selectives can often be tailored to focus on a resident’s area of interest. Features vary but often include increased autonomy, teaching opportunities, and academic time for research or quality improvement projects. The year is rounded out with time in nuclear medicine and breast imaging to meet requirements, as well as the assigned call and night float opportunities.

Some residents use allotted time in the fourth year to focus on one or more of the following shorter alternatives:

**Global Radiology Rotations** MIR’s local chapter of RAD-AID International helps foster an interest in global health among residents. In 2016, the chapter established a collaboration with the Instituto de Cancerología (INCAN) in Guatemala City, Guatemala. By sharing expertise with doctors at INCAN, the MIR team helped provide the training and tools necessary to improve the medical care patients receive on a daily basis. In addition to an ongoing partnership with INCAN, MIR’s Global Radiology Committee is working to expand opportunities through relationships with facilities in other countries and underserved areas of the local community.

**Research** Opportunities for research abound at MIR. Residents involved in projects that require dedicated blocks of research time are encouraged to pursue a research elective that provides uninterrupted time to work on mentored projects.

**Teaching Elective** Select residents provide radiology-anatomic correlative training for first-year medical students in the medical school’s Gross Anatomy course through lecture and small group teaching at the cadaver.
Washington University Medical Campus

Washington University Medical Campus, which covers 164 acres over 17 city blocks, is located along the eastern edge of Forest Park in St. Louis’ Central West End neighborhood. Many of our partners, including Barnes-Jewish Hospital, St. Louis Children’s Hospital and the Alvin J. Siteman Cancer Center, are located on campus, though our physicians see patients at locations across the St. Louis region. In addition to our hospital partners, our corporate partners include BJC HealthCare, a consortium of health care providers that includes several of our teaching hospitals.

The Campus Renewal Project Currently in phase two, the 10-year Campus Renewal Project will transform the medical school campus experience. Improvements range from the already completed new inpatient towers and expansion of clinical care services to more parking and additional green space.

Rankings

- Washington University School of Medicine is in the top 10 for both research and primary care and consistently listed among the top 10 medical schools in the U.S. since rankings were first published in 1987.
- Barnes-Jewish Hospital is number 12 on the list of “Best Hospitals in the U.S.”
- St. Louis Children's Hospital, the pediatric teaching hospital for WashU, ranked among the “best in the nation” in all 10 “Best Children's Hospital” specialties.

Source: U.S. News & World Report 2017-2018
Interventional Radiology (IR) Residency Program

Interventional radiology as a specialty requires expertise in diagnostic imaging, image-guided procedures and patient care, and the IR training program at Mallinckrodt Institute of Radiology emphasizes all three components. With more than 50,000 image-guided procedures performed each year, there is more than enough volume for all trainees. Countless research opportunities, an active IR outpatient clinic, and busy inpatient admitting and consultation services round out the experience. Graduates leave prepared for careers in academic or private practice IR. Residents work with 14 subspecialty trained faculty, learning a wide range of adult and pediatric procedures including: venous and arterial imaging, angioplasty/stenting, thrombolysis, venous recanalization, IVC filter placement/retrieval, vein ablation, fibroid embolization, trauma interventions, transarterial chemoembolization, radioembolization, tumor ablation, percutaneous organ access (gastrostomy, nephrostomy, biliary, etc), TIPS, balloon-occluded retrograde transvenous obliteration and more.

MIR offers three paths to becoming an interventional radiologist:

- Medical students can apply to the Integrated IR Residency through the NRMP.
- Candidates in a Diagnostic Radiology residency can apply to the Independent IR Residency through the NRMP, a two-year pathway for those who have not completed an ESIR year during their diagnostic radiology residency.
- MIR Diagnostic Radiology residents can apply internally for the Early Specialization in Interventional Radiology (ESIR) track. This is a pathway that the residents complete during the fourth year of their diagnostic radiology residency, which, if successfully completed, means they only have to complete one additional year of an Independent IR residency. (To learn more about ESIR track, see page 10.)
Gretchen Foltz, MD, arrived at MIR in 2013 as an attending, following a diagnostic radiology residency at the University of North Carolina and an IR fellowship at Northwestern University. She brought with her a wealth of knowledge and fresh thinking about the field of IR and IR training. In 2016 she was named director for the then new IR residency program at Mallinckrodt Institute of Radiology, one of the first of its kind. Foltz, who earned her bachelor’s degree in biomedical engineering from the University of Wisconsin-Madison, has active roles in the Society of Interventional Radiology, the Association of Program Directors in IR, and the Accreditation Council for Graduate Medical Education.

Program Director  GRETCHEN FOLTZ, MD

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Integrated IR Residency
NRMP Matching Number: 1353416A0
Integrated IR Residency

This five-year program begins with a yearlong clinical internship for residents, followed by three years of diagnostic radiology training alongside the diagnostic radiology residents and two years of IR training under the thoughtful supervision of the program’s director. The last two years of the IR residency focus on image-guided interventions and invasive diagnostic procedures with additional rotations through the surgical intensive care unit and IR-related areas.

Mallinckrodt Institute of Radiology currently has integrated IR residents in years one through four of their training. In addition, the program matched residents through the 2019 match for a 2020-2021 residency start.

Acceptance  MIR accepts two applicants per year, matched into the program from medical school. Graduates will be eligible to sit for exams and be board-certified in diagnostic and interventional radiology.

Rotations  Residents rotate through three hospitals during training: Barnes-Jewish Hospital, St. Louis Children’s Hospital and Barnes-Jewish West County Hospital, receiving comprehensive exposure to the full scope of diagnostic and interventional radiology.

Conferences  During their first three years, Integrated IR residents will attend all conferences provided by the Diagnostic Radiology (DR) services. During their last two years, IR residents will attend DR conferences when they are rotating on DR services, and IR conferences when they are rotating on IR service. IR specific conferences include:

- Quality and safety every other Monday morning
- IR didactic every Wednesday morning
- Hepatobiliary every Thursday morning
- A mixture of case conference, journal club and interventional oncology every Friday morning
On Call Opportunities

Call duty begins the second year of training. At least three radiology residents share on-call responsibilities in the hospital from 5:00 pm-7:00 am on weekdays, and around the clock on weekends and holidays.

Residents take call for three years with a break in the months preceding the American Board of Radiology Core Examination.

A night float system is used for most overnight call duty, and additional call shifts are scheduled to manage the busy periods in the evenings and during the day on weekends.

A large residency and individual class size keep the volume of call shifts manageable and easily allows for call switches.

Residents cover the emergency department and hospital, providing interpretation for imaging studies performed after hours without on-site attendings.

When needed, on-call faculty and fellows are available for phone consultation and teleradiology image review.

Residents issue preliminary dictations on all studies they review while on call.

Residents have face-to-face readouts in the morning with subspecialty faculty who provide feedback on their interpretations.
Radiology Learning Center

The Radiology Learning Center is a two-level facility designed specifically for use by Mallinckrodt Institute of Radiology residents. The 24-hour center features a small kitchen on the lower level, an upper level lounge, and a computer lab with access to all necessary institutional programs. Access to StatDX™, eAnatomy™, Qevlar and BoardVitals™ is currently available, and additional resources are regularly added based on resident recommendations and board review.

The center’s library of radiology textbooks are reserved specifically for use by trainees in the program. Residents can check these out for rotation self-study and board review. Access to Washington University School of Medicine’s Becker Medical Library, which has a substantial number of relevant radiology textbooks and e-books, is also available to MIR residents.

Conferences

Daily Noon Conference The noon-hour conference, given by a subspecialty-trained faculty radiologist, is designed specifically for resident education. Each conference is recorded and available for review by trainees. Audience response is increasingly used by lecturers to enhance the learning experience.

Teaching Conference Often case-based, the daily teaching conference is given on nearly every rotation, providing residents with additional didactic teaching and the opportunity to practice taking cases in an unknown format. Residents in all years participate. For example, a first-year might identify the findings in a case, followed by a more senior resident synthesizing those findings into a differential diagnosis. A faculty member rounds out the discussion with additional findings, diagnoses and teaching points.

Review Conferences MIR prepares residents for the American Board of Radiology Core Examination and independent practice by hosting its own internal American Board of Radiology core exam review conference series.
John Neil, MD, is senior vice president and chief physician executive for HonorHealth, a $1.6-billion health network headquartered in Scottsdale, Arizona. Prior to joining HonorHealth, Neil spent 16 years in clinical practice as a vascular and interventional radiologist at Scottsdale Medical Imaging Ltd. A self-described “lifelong learner,” he has always embraced administrative roles for providing him with the opportunity to “work with exceptionally smart people, continually learn new things, and develop as a professional and a person.”

Cynthia K. Rigsby, MD, FACR, is a professor of radiology and pediatrics at Northwestern University’s Feinberg School of Medicine and a pediatric radiologist at the Ann & Robert H. Lurie Children’s Hospital of Chicago (formerly Children’s Memorial Hospital). Rigsby serves as vice chair of the medical school’s Department of Radiology and as division head of body imaging.

Sean D. Pierce, MD, is chair of the Department of Radiology at Hackensack University Medical Center in Hackensack, New Jersey, and a partner in the Hackensack Radiology Group. As he serves both the physicians and patients at New Jersey’s largest hospital, Pierce draws on lessons he learned during his residency at MIR.

Global Alumni Network

Mallinckrodt Institute of Radiology boasts the world’s largest network of radiology alumni, many of whom hold leadership positions in clinical care, research and teaching. Our unparalleled network creates a diverse path of career opportunities and professional connections that last a lifetime.
Sandra Ruhs, MD, is the director of the women’s imaging department at Diagnostic Imaging Associates in Des Moines, Iowa. The practice’s mammography department has been named one of the “Breast Imaging Centers of Excellence” through the ACR since July 2013. Ruhs, who was instrumental in launching a new multidisciplinary clinic for women’s health in 2017, relishes radiology’s vantage point across the medical spectrum.

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. The connections she forged during her residency at MIR remain strong and have brought her back to campus not only to teach but to learn as well.

Perry J. Pickhardt, MD, is a professor of radiology and chief of gastrointestinal imaging at the University of Wisconsin School of Medicine and Public Health in Madison, Wisconsin. He began publishing widely during his residency at Mallinckrodt Institute of Radiology and remains a prolific researcher, particularly in the field of virtual colonoscopy.
Subspecialty Training

Subspecialty training at Mallinckrodt Institute of Radiology is highly sought after, extraordinarily competitive and often filled in advance. In addition to receiving intensive training, trainees teach residents and medical students, consult with clinical colleagues, conduct conferences and attend subspecialty meetings. All trainees also have the opportunity to collaborate with section faculty, many of whom hold key positions in professional radiological societies and organizations.

Abdominal Imaging
Breast Imaging
Cardiothoracic Imaging
Independent Interventional Radiology
Musculoskeletal Imaging and Interventions
Neuroradiology
Endovascular Surgical
Neuroradiology
Nuclear Medicine
Pediatric Radiology
Abdominal Imaging

Abdominal fellows have the opportunity to interpret a broad array of imaging of common, uncommon and rare conditions in this high-volume practice. Rotations are primarily through the body CT, 3D CT, body MRI, ultrasound and procedure services. Limited time is spent on the GI/GU service and all fellows have an option to staff emergency radiology cases. A daily average of 30 to 40 MRI, 10 to 20 3D CT, 80 to 100 US, and 100 to 120 CT cases are performed. Fellows complete the program with extensive expertise in all modalities used to image the abdomen and pelvis, as well as confidence using ultrasound and CT to guide percutaneous procedures.

Attendings are devoted to clinical care and training, working side-by-side in the reading rooms with fellows throughout the day. In addition, fellows play a key role in the teaching and supervision of residents and have graduated responsibility and independence as the year progresses. A combination of on-service experience, conferences and didactic lectures provides the focus for learning.

Need to Know

- **Accepted**: Five fellows are accepted into the program per academic year
- **On Call**: Home call one week about once a month; one Saturday half shift per month, on average
- **Research Projects**: Optional
- **Post-training**: About 65% private practice, 35% academic

**Program Director** ANUP SHETTY, MD

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Body Magnetic Resonance Imaging

This fellowship focuses on clinical training involving all aspects of body MRI, including abdominal and pelvic MRI, MR angiography, cardiac MRI, CT, and PET/MRI. We provide hands-on tutoring and mentoring for MRI examinations and protocoling, with a daily average of about 30 to 40 MRI cases and 10 to 20 3D CT cases. Fellows have the option to rotate on the following services: cardiac-MRI service, ultrasound, body CT, ER, ultrasound and CT-guided procedures. All services expose fellows to a wide range of body pathology.

In addition to diagnostic interpretation, our training emphasizes the instrumentation and basic physical principles of MRI as applied to clinical imaging. Most of our faculty is body-MRI trained, which means fellows graduate with extensive knowledge of body MRI protocols and running a body MRI service, as well as the ability to run/troubleshoot MRI scanners.

**Need to Know**

- **Accepted:** Two fellows are accepted into the program per academic year
- **On Call:** Home call one week about once a month; one Saturday half shift per month, on average
- **Research Projects:** Optional
- **Post-training:** About 65% private practice, 35% academic

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Breast Imaging

Our breast imaging section is a high-volume Breast Health Center with a high-risk cancer-screening program. Fellows receive comprehensive training in breast imaging, film interpretation, and breast interventional procedures. More than 45,000 breast imaging studies are performed per year, including 40 breast biopsies and 20 breast needle localizations each week. The program is fully tomosynthesis capable and offers screening and diagnostic exams and image-guided procedures using mammography, tomosynthesis, ultrasound and MRI. Contrast-enhanced digital mammography is also available.

Radiology services are fully integrated with those of breast surgeons and other ancillary staff to provide comprehensive breast health care. Training primarily occurs in the reading rooms and clinics, where fellows work alongside all seven attending faculty.

Need to Know

- **Accepted:** Three fellows are accepted into the program per academic year
- **On Call:** None
- **Research Projects:** Optional
- **Post-training:** About 50% private practice, 50% academic

Program Director  **MICHELLE LEE, MD**

Contact:  
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314.454.7405

NRMP Matching  
Number: 1353R02F0
Cardiothoracic Imaging

MIR has one of the largest thoracic imaging and cardiac radiology services in the country, interpreting about 120,000 chest radiographs, 12,000 chest CTs, 20,000 total CTs (including abdomen and pelvis), 350 cardiac MRs, and 300 cardiac CTs, and performing 250 lung biopsies every year. Fellows attend “boot camp” lectures/workshops and a cardiothoracic imaging conference series, where cardiology faculty, pulmonologists, cardiologists and pulmonary pathologists provide lectures. In addition, our relationship with St. Louis Children’s Hospital means fellows gain a thorough understanding of the manifestations of cardiopulmonary disease from infancy to old age.

Throughout the year, fellows are responsible for presenting in the following conferences under faculty supervision: thoracic oncology, adult congenital heart disease, pediatric congenital heart disease and aortic surgery. In addition, fellows have the opportunity to attend the interstitial lung disease and Stuart S. Sagel thoracic imaging case conferences. MIR’s chest teaching file has more than 5,000 proven cases.

Need to Know

- **Accepted**: Two fellows are accepted into the program per academic year
- **On Call**: Home call two weeks near the end of training
- **Research Projects**: Optional
- **Post-training**: About 50% private practice, 50% academic

Contact:
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sarusalc@wustl.edu
314.362.2927

Program Director  **CYLEN JAVIDAN, MD**
Independent Interventional Radiology Program

The 2018-2019 match will be the inaugural offering of Independent IR residencies available nationwide, and Mallinckrodt Institute of Radiology will be participating. Applicants who are currently in a diagnostic radiology residency can apply for Independent IR pathway during their third year of training. After completion of the four-year diagnostic radiology residency, trainees have to complete either one or two additional years in an Independent Radiology Residency, depending on whether they completed an ESIR pathway during their last year of Diagnostic Radiology training. (To learn more about ESIR, see page 10.)

Each trainee will perform over 1,200 cases during the course of a training year. In addition, trainees will attend the following IR-specific conferences: quality and safety every other Monday morning, IR didactic every Wednesday morning, Hepatobiliary every Thursday morning, and a mixture of case conference, journal club and interventional oncology on Friday morning.

Need to Know

- **Accepted**: Two to four applicants currently in a diagnostic radiology training program are accepted per academic year (ESIR pathway is not required)
- **On Call**: Weekday and weekend call is split with fourth and fifth year Integrated IR residents over the course of the year
- **Research Projects**: Encouraged
- **Post-training**: Graduates are eligible to sit for exams and be board-certified in diagnostic and interventional radiology

Program Director  **GRETCHE N FOLTZ, MD**

Contact:
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314.362.2819
Musculoskeletal Imaging and Interventions

Our busy clinical practice includes staffing at the main medical center, an outpatient orthopedic center with clinics and surgical suites, and community hospitals. Each fellow rotates through the different sites, gaining exposure to a large volume of radiographs, CT, MRI and ultrasound. Fellows perform image-guided procedures on average two days a week and MR arthography on an almost daily basis. The program’s depth of diagnostic musculoskeletal imaging and procedures is exceptional and features a case mix that includes traumatic, rheumatologic, metabolic, sports, oncologic and spine imaging.

Mallinckrodt Institute of Radiology’s number and variety of interventional procedures is unique and includes vertebral augmentation; tumor ablation using radiofrequency ablation, cryoablation and microwave ablation; bone and soft-tissue biopsy; joint injection and aspiration. In addition, there are spine procedures including facet injection, medial branch block, and central epidural and transforaminal steroid injections. Fellows learn through daily case exposure, independent learning, lectures, and instructional hands-on procedural sessions.

Need to Know

- **Accepted**: Five fellows are accepted into the program per academic year
- **On Call**: Home call one week every third month
- **Research Projects**: Encouraged
- **Post-training**: About 65% private practice, 35% academic

**Program Director**  
**JON BAKER, MD**

**Contact:**  
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314.362.2916
Neuroradiology

Thanks to a nationally ranked tertiary medical center, neuroscience institute, and relationship with St. Louis Children’s Hospital, fellows receive unparalleled training in neuroradiology. The one-year, ACGME-accredited program rigorously prepares them by providing high-level training in both adult and pediatric neuroimaging. Fellows read over 75,000 cases and perform more than 2,700 procedures each year, with 100% of cases reviewed by faculty who are known experts in their fields.

In addition to routine clinical imaging studies, fellows are exposed to a wide range of advanced MRI techniques including MR perfusion, functional MRI, spectroscopy, tractography, vessel wall imaging and PET-MRI. The neurointerventional service trains fellows to perform diagnostic catheter angiograms under the direction of three dedicated, radiology-trained neuro-interventionalists. In addition, MIR’s robust database of diagnosed and pathology-proved cases is easily searchable for review, study and research.

Need to Know

- **Accepted:** Nine fellows are accepted into the program per academic year
- **On Call:** Home call weekdays overnight (one night at a time) and weekend call (daytime review followed by home call at completion of hospital duties), split evenly among fellows throughout the year
- **Research Projects:** Optional
- **Post-training:** About 85% private practice, 15% academic

**Program Director**  
MICHELLE MILLER-THOMAS, MD

**Contact:**  
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winklerp@wustl.edu  
314.362.5949

**NRMP Matching Number:** 1783423F0
Endovascular Surgical Neuroradiology

Fellows learn to diagnose and treat a wide range of conditions, including brain aneurysms, arteriovenous malformations, dural arteriovenous fistulas, extra- and intracranial atherosclerotic disease, and ischemic stroke. Our service is closely integrated with the departments of neurological surgery and neurology. More than 1,000 diagnostic angiographies and 300 interventional cases, including 150 aneurysm cases, are performed annually, and our stroke caseload increases every year. Supervised by three full-time attendings, fellows learn hands-on through a high-volume caseload in two biplane neuroangiographic suites with full flat panel and 3D capabilities.

The one-year ACGME-accredited program requires a prerequisite diagnostic neuroradiology fellowship for candidates from diagnostic radiology programs. Applicants from neurosurgery and neurology require a prerequisite year of training in catheter angiography and vascular imaging. Weekly didactic, stroke and vascular conferences, and monthly events include an endovascular acute stroke committee and a morbidity and mortality conference.

Need to Know

- **Accepted:** Two fellows are accepted into the program per academic year
- **On Call:** Home call one week about once a month; callbacks as needed for urgent/emergent procedures
- **Research Projects:** Required
- **Post-training:** About 70% private practice, 30% academic

Program Director  
DEWITTE CROSS III, MD

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winklerp@wustl.edu  
314.362.5949
Nuclear Medicine

The primary goal of this ACGME-accredited fellowship, which provides intensive clinical training in both adult and pediatric nuclear medicine, is to develop superlative nuclear medicine physicians. In addition, the program attracts and trains medical school graduates, with interests in research and education, who are motivated to pursue careers in academic nuclear medicine. Applicants with diagnostic radiology training are preferred; others with a strong research background will be considered.

Fellows gradually assume increasing responsibility in the clinical service while working closely with an attending physician who reviews every case with them. Though diagnostic imaging is our emphasis, extensive experience in radiiodine therapy of hyperthyroidism and additional experience in cancer therapy, primarily treatment of thyroid cancer is provided. Use of parenteral therapies (ZEVALIN®, samarium, Xofigo® and SIR-Spheres®) also is included. Special features of the training program include a nuclear cardiac imaging service, clinical PET/CT and PET/MRI facilities, and a pediatric service.

Need to Know

- **Accepted**: Five fellows are accepted into the program per academic year
- **On Call**: Home call weekly, split evenly among fellows throughout the year
- **Research Projects**: Encouraged
- **Post-training**: About 80% private practice, 20% academic
Pediatric Radiology

Fellows in this ACGME-accredited program are exposed to a variety of classic and complex pediatric pathology. Mallinckrodt Institute of Radiology performs more than 100,000 pediatric imaging studies annually, including about 12,000 ultrasound studies and 8,500 MRI exams. Faculty work with fellows on an individual basis, and interaction with pediatricians from other clinical departments in the reading rooms and in subspecialty conferences enriches the experience. In addition, though they do not read out residents, fellows do oversee them when on call.

All rotations occur at St. Louis Children’s Hospital, one of an elite group of pediatric hospitals verified as a Level 1 Pediatric Trauma Center by the American College of Surgeons (ACS). It’s the only pediatric hospital to receive this designation in Missouri and Illinois. The hospital provides a full range of pediatric services to the St. Louis metropolitan area and a primary service region covering six states. In fact, some patients even travel from abroad for specialty care at St. Louis Children’s.

Need to Know

- **Accepted:** Two fellows are accepted into the program per academic year
- **On Call:** Home call once a week per four-week rotation; in-house Saturday call (7:30 am-5:00 pm), followed by home call the next morning; Sunday call in-house to read out ICU cases, then take calls from home until the following morning; call is always backing up an in-house resident
- **Research Projects:** Required
- **Post-training:** About 70% private practice, 30% academic

**Program Director** REBECCA HULETT, MD

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314.454.6229
Explore St. Louis

Welcome to St. Louis, known as the Gateway to the West. Nestled between the two longest rivers in the country, this historic location is full of vintage buildings, ample cultural attractions and beloved professional sports teams. Yet the diversity and charm of the city’s many unique neighborhoods often come as a pleasant surprise to newcomers. Each boasts its own personality, which means you’ll find a variety of food, fun and experiences wherever you go.

Central West End
Washington University Medical Campus is located in the Central West End, which means uber-charming sidewalk cafés, boutiques and gastro pubs are just a few steps away.

The Grove
Located right next door to the Medical Campus, The Grove boasts a diverse array of bars, nightclubs, restaurants and shops that are known for setting trends instead of following them.

The Hill
You’ll find a traditional collection of authentic Italian bakeries, grocery stores, a gelateria, mom-and-pop trattorias, and a bustling neighborhood bocce court on The Hill.

Tower Grove Park
Dog-walking, bike-riding, stroller-pushing St. Louisans populate this beautiful Victorian-era park, which is surrounded by diverse and thriving neighborhoods that are home to everyone from hipsters and urban cyclists to WashU scientists and veteran brewmasters.

Cherokee Street
Creativity and the entrepreneurial spirit are alive and well on Cherokee Street, as evidenced by blocks of independent specialty shops, design studios, bakeries and more.

Lafayette Square
This neighborhood is a 30-acre oasis of greenery within an urban landscape that caters to a hip, urban clientele in search of one-of-a-kind culinary experiences.

Maplewood
Look for an eclectic mix of trendy and traditional in Maplewood, including deliciously diverse cuisine, craft brewers, an historic bowling alley and a modern pinball lounge.

The Loop
Delmar Boulevard has been designated one of the “Great Streets of America.” This eclectic main drag features multiple music venues, vintage clothing stores, and a wide range of global cuisine.

Clayton
Clayton, host to a variety of must-attend annual events, boasts a number of boutiques, galleries, hotels and restaurants known throughout the region.

Soulard
The city’s oldest neighborhood features red brick townhomes that house restaurants with charming courtyard dining and live music clubs. Soulard is also home to the oldest farmers’ market west of the Mississippi.
Forest Park is almost twice as big as New York’s Central Park. Boasting 1,300 lush acres and five major cultural institutions, the park, located adjacent to the Medical Campus, was rated No. 1 city park in the U.S. by readers of USA Today. Visitors can take in a spectacular vista while on a picnic, tucking into a good book or taking a paddleboat ride. For a more active itinerary, the 6.2-mile dual path provides ample opportunity for running and biking.

**Forest Park Highlights**

**Saint Louis Art Museum** One of the nation’s leading comprehensive art museums, it offers free admission and contains more than 30,000 art works dating from antiquity to the present.

**The Boathouse** Observe wildlife during a paddleboat ride through the lagoons or enjoy a drink and bite to eat on the patio while watching a beautiful sunset over Post-Dispatch Lake.

**The Saint Louis Zoo** Voted “America’s Top Free Attraction” by USA Today, the 90-acre Saint Louis Zoo is home to more than 600 species of animals, many of them rare and endangered. Founded in 1910, the zoo is famed for its world-renowned natural exhibits and an innovative approach to wildlife conservation, research and education.

**Highlands Golf and Tennis Center** The recently updated facility includes a nine-hole golf course, 30-stall driving range, full-service bar and restaurant, and 13 clay tennis courts.

**Missouri History Museum** Originally built as the first national monument to Thomas Jefferson, the always free museum explores the history of St. Louis from its founding in 1764 through present day.

**The Muny** The nation’s oldest and largest outdoor musical theatre features at least seven Broadway-style productions every summer. About 1,500 of the 11,000 seats are free on a first come first served basis.

**The Science Center** This interactive museum features an OMNIMAX® Theater, the James S. McDonnell Planetarium and more than 700 exhibits. General admission is always free.

**Steinberg Skating Rink** Enjoy a hot chocolate at one of the largest outdoor ice skating rinks in the Midwest. Steinberg offers public skating every day it’s open, including holidays.

For more information on Forest Park, visit forestparkforever.org.
Out and About in “The Lou”

**Things to See and Do**

**City Museum** Created from reclaimed architectural and industrial objects, City Museum features a rooftop Ferris wheel, giant slinky, and working shoelace factory among its exhibits.

**Gateway Arch** No visit to St. Louis is complete without a ride to the top of this fabulous structure. At 630-feet high and 630-feet wide at its base, this landmark can be seen for miles from both sides of the Mississippi River.

**Grant’s Farm** The Busch family’s ancestral home now houses more than 100 species of animals, a petting zoo, and the famous Anheuser-Busch Clydesdales.

**The Magic House** Consistently rated one of the top family attractions in the U.S., this children’s museum boasts more than 55,000 square feet of interactive exhibits.

**Missouri Botanical Garden** This world-renowned, 79-acre oasis garden features a Japanese strolling garden, geodesic dome conservatory and sprawling, hands-on children’s garden.

**Urban Chestnut Brewing Company** UCBC is just one of several microbreweries on the St. Louis landscape. Beer aficionados can sip and sample at a number of area locales.

**Music / Arts / Theatre**

**The Fabulous Fox** A spectacular refurbished movie theatre from the 1920s is now a classic performing arts center and special events venue.

**Peabody Opera House** Thanks to a $79 million renovation, this St. Louis institution provides a stunning backdrop to a wide and diverse array of entertainment and special events.

**St. Louis Black Repertory** The largest professional African-American theater company in the U.S., the Black Rep provides platforms for theater, dance and other creative expressions that heighten the social and cultural awareness of its audience.

**The Pageant** Designed to host a wide range of music performances and special events, the Pageant is a 2,000 plus-capacity concert nightclub with an up-close and personal vibe.

**Hollywood Casino Amphitheater** This Live Nation venue boasts 7,000-seats, with lawn seating for another 13,000. And thanks to a state-of-the-art sound system and six video screens, all 20,000 concert goers can experience a front-row view.

**Citygarden** Open year round and within walking distance of the iconic Arch, Citygarden is a vibrant and serene blending of lush plantings and internationally renowned sculptures.

**Sports / Outdoors**

**Cardinals Baseball/Busch Stadium** If a day spent watching the 11-time World Champion Cardinals isn’t enough fun, be sure to include a stop by Ballpark Village, the sports-anchored entertainment district located right next door.

**Blues Hockey / Enterprise Center** Hockey season brings with it a medical phenomenon. Everywhere you look, St. Louisans are bleedin’ blue. Fans of the oldest NHL team never to have won a Stanley Cup will not be deterred.

**Katy Trail** The longest rails-to-trails conversion in the U.S., bikers and walkers enjoy the 240 miles of scenic landscape, much of which is on the Missouri River bluffs.

**Lake of the Ozarks** Located just three hours from St. Louis and offering more than 1,000 miles of shoreline, the lake is a mecca for boaters, hikers, sightseers and anyone looking for a scenic getaway.
With a welcoming Midwest vibe and an attractive cost of living, it’s no wonder why nearly 3 million people are proud to call St. Louis home. Not only is the living easy, it’s affordable. For example, the median home price in St. Louis is $155,000. Compare that to $398,000 in Boston or $750,000 in San Francisco. Apartment life is a bargain as well. Consider that the median rent for a one-bedroom apartment in St. Louis is $717. Then think about spending $2,522 for a one bedroom in Palo Alto, CA, or $2,115 in New York.

Beyond its affordability, there’s a classic, timeless look to local residential architecture that’s impossible not to love. Throw in a nationally recognized food and craft beer scene and you’ll understand why St. Louis has been dubbed a “hidden gem” and one of the “most welcoming” cities in America.

Home Sweet (and Affordable) Home

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<th>City</th>
<th>One BR</th>
<th>Two BR</th>
<th>Home</th>
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<tr>
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<tr>
<td>St. Louis</td>
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All figures represent median rent and home prices, according to ApartmentList.com, Realtor.com and Kiplinger.com, as of July 2018.
26 REASONS TO APPRECIATE THE HIDDEN GEM OF ST. LOUIS
HuffPost, December 2017

ST. LOUIS IS AS WELCOMING AS IT IS BUDGET-FRIENDLY
The New York Times, March 2018

WORLD’S 15 MOST BEAUTIFUL CITY PARKS
Fodor’s Travel, May 2017

30 MOST EXCITING FOOD CITIES IN AMERICA
Zagat, December 2017