**University of Wisconsin**
**School of Medicine**
**And Public Health**

**Department of Medical Physics**

# University of Wisconsin
# Imaging Physics Residency Program

## Residency Program in Imaging Physics

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# Contents



**Abbreviations:**

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|---|---|
| AFCH | American Family Children's Hospital |
| HSLC | Health Sciences Learning Center – home of the UW School of Medicine & Public Health |
| SMPH | UW School of Medicine and Public Health – home of the Departments of Medical Physics, Radiology, and other Basic Science and Clinical departments |
| TAC | The American Center health and wellness center |
| UPMH | UnityPoint - Meriter Hospital |
| UW | University of Wisconsin |
| UWHC | University of Wisconsin Hospitals and Clinics |
| UWHealth | This term describes the totality of clinical facilities at the University of Wisconsin, including those at AFHC, TAC, UWHC, UWMF, and WIMR |
| UWMF | University of Wisconsin Medical Foundation |
| WIMR | Wisconsin Institutes for Medical Research – physical home of the Department of Medical Physics and key classrooms, imaging laboratories, research laboratories, computational resources, *etc*. |

# Introduction

## Program Evolution and History

The UW Imaging Physics Residency program developed from the Radiological Physics Services of the Department of Medical Physics at the University of Wisconsin-Madison. The Department of Medical Physics has a long history of education and training in the application of physics in medicine and biology. Originally, Medical Physics was a section in the Department of Radiology in the UW School of Medicine. The section was founded by Professor John Cameron in 1958, and quickly grew in breadth and status as the number of faculty members and graduate students increased, graduate courses expanded, funded research programs became established, and clinical equipment required greater technical expertise among users. Independent department status was granted to Medical Physics in 1981, and the graduate program, in 1989, was one of the first to be accredited by CAMPEP. The UW-Madison Medical Physics Graduate Program is the largest such program in North America, and resources of this program are fully leveraged by the Imaging Physics Residency Program. The greatest emphasis in the graduate program has been on preparing doctoral students for research careers in academia and industry. In addition, many Ph.D. and M.S. degree graduates, as well as many post-doctoral fellows, have gone on to careers in clinical medical physics in radiation oncology, nuclear medicine, and diagnostic imaging. Preparation for these careers has been through courses, lab work, and experience working side by side with physicists in the clinic.

Since it began in the early 1980's, the Radiological Physics Services (RPS) group within the Department of Medical Physics has participated in imaging physics education and training of graduate students. The RPS provides acceptance testing and quality control testing of imaging equipment, imaging protocol optimization services, radiation safety calculations, radiology resident physics teaching, PACS and DR/CR support services, and other imaging physics services to the UW Hospitals and Clinics (UWHC) as well as to surrounding imaging facilities. RPS faculty members lead the department's "RadLab" courses that focus on evaluating clinical imaging equipment, and they mentor their own graduate students who play a part in clinical testing. Until recently, our model was to accept graduate students into this group for a period of two years, supported by funding generated through the provision of medical physics services. In addition to their course work, the graduate students participated in providing these services under the direction of board-certified faculty. During a two-year period, they obtained valuable work experience in the clinic while completing a M.S. degree in medical physics. This program has a long list of alumni, many of whom are leading medical physics groups throughout the US.

In response to the American Board of Radiology's 2014 initiative, we have made a transition from RPS-based education and training of graduate students to a clinical residency in imaging physics. The expertise and much of the support base for this program has been in place for over six years. The support base began with seed funding from the AAPM and has increased over time to now having ongoing commitments, from sources outside of the Department of Medical Physics, to fully support two full time residents in our program. Our first resident received 21 months of residency education and training, but, unfortunately, left the program before fully completing all requirements in order to join a medical physics group in a hospital in Chicago. (He completed his graduate work and entered the ABR examination process before the ABR 2014 initiative took effect.) Since then, four residents have graduated from our accredited program, with another two currently in our program. The four graduates from our residency program were quickly able to obtain positions within radiology departments at academic institutions, all four as assistant professors, and all involved in clinical medical imaging work.

Current strengths of the program include the leveraging of one of the largest and oldest medical physics graduate programs in North America, an extensive and advanced installed base of medical imaging equipment in a large academic hospital as well as regional clinic environments, and active participation by both medical physics faculty and academic radiology faculty. We have a large group of very highly regarded faculty in both Medical Physics and Radiology who are involved in the residency program or otherwise accessible to the residents. We believe that we can offer many opportunities for clinical physics education, including insightful testing methods, that might not be commonly encountered in other graduate or residency programs. We have developed a substantial resource of didactic materials in medical imaging physics which contains useful information not otherwise available in texts or published papers. We utilize a large library of clinical problems that the resident is asked to consider and solve. We also have a large online library of thousands of references, specifically for the residency program, which the residents can access. Much important imaging equipment has been developed at the University of Wisconsin in addition to testing equipment and testing methods for the evaluation of medical imaging equipment.

## Summary of Program Changes Since Last Review

The model that we originally proposed for our residency training program was to recruit one resident each year into the program that would have a total of two residents concurrently a junior and a senior resident. We initially recruited two residents with the intention to transition to this model. However, we have found that having two residents at the same level has many advantages that, at least for our program, seem to outweigh the advantages of having a senior resident who can help mentor a junior resident. We have found that residents working together at the same level very effectively complement each other and provide a level of comradery that enhances their learning environment. The feedback we have received from residents and mentors has reinforced our assessment of this model, so our intention is to continue to recruit two residents every other year rather than transitioning to the alternate year recruitment of a single resident.

Since our previous review we have added two new rotations: 1) X-ray Imaging Review and Introduction to Methods of Imaging Equipment Evaluation; and 2) Radiation Safety. The first rotation is designed to provide incoming residents with the background information that they need to effectively participate in quality assurance testing of x-ray equipment from the beginning. This introductory training was implemented in response to feedback from one of our early residents who suggested that we provide more instruction on the methods and goals of quality assurance testing prior to working with x-ray equipment for the first time. Another purpose of this rotation is to fill in any background information that residents may not have obtained in their graduate program, to ensure that the two residents are at approximately the same level as they begin the other rotations. Our reasons for creating a new rotation specifically in radiation safety are to leverage the strong Radiation Safety/Health Physics team that we have at our institution, to provide the radiation safety staff with recognition for their efforts in our training our residents, and to provide our residents the opportunity to work closely with health physicists and the radiation safety officer. Many of the radiation safety related activities are already part of several modality specific rotations, but the radiation safety rotation also has unique activities such as participating in radiation safety committee meetings and developing institutional radiation safety policies and training modules.

Other changes include adding new faculty as mentors who have joined our department and replacing those who have left. One of our new faculty mentors is Professor Ivan Rosado-Mendez, PhD. Dr. Rosado-Mendez is an ultrasound physicist with considerable experience providing ultrasound physics support in the clinic. Another new mentor is Jason Timm, MPH, CHP, the radiation safety officer for UW-Madison and UW Hospital and Clinics. Mr. Timm has many years of experience in health physics and as a radiation safety officer. His enthusiasm for teaching residents and willingness to offer participation with his team of health physicists is also a great asset to our program. Unfortunately, a great loss for our program is the passing of our department Chair and colleague, Dr. Edward Jackson, PhD, FAAPM, FACR, who also participated as a mentor in MRI and ultrasound.

Since our last review, we have identified new sources of funding for the residency program, which have enabled it to achieve increased financial stability. The UW Hospital and Clinics provides our residency program with one slot in its medical resident pool, which is likely a unique situation for an imaging physics residency. The University of Wisconsin Departments of Radiology and Medical Physics have entered into an agreement with GE Healthcare to create and provide protocols to be used on all their CT scanners. The great success of this collaboration, the "UW-GE CT Protocol Project", has led to this project providing funding for a second residency position. An advantage of partially funding the residency through the UW-GE CT Protocol Project is that it enables our residents to be involved in this very important aspect of clinical service for diagnostic imaging physicists.

We have also added a new community hospital, with 7 external clinics, to the clinical facilities in which the residents work and in which we provide medical physics services, Including the testing of medical imaging equipment.

## 1. Program Goals and Objectives

1.1 The University of Wisconsin Imaging Physics Residency Program is a 24-month duration program designed for individuals with a M.S. or Ph.D. degree in Medical Physics, preferably from a CAMPEP-accredited program, who seek education and training in clinical medical imaging physics. The overall objective of the program is to provide comprehensive clinical, technical, and professional physics education and training to enable graduates to perform independently as clinical medical imaging physicists. Upon completion of the program, a Certificate of Completion is issued. Graduates are well prepared for ABR board certification and a professional career as a qualified medical physicist in an academic institution, a clinical imaging facility, an imaging physics consulting group, etc. We meet this objective through the following efforts in which the residents are educated and in which they participate:

References below to the clinical rotations in this residency program refer to the contents in Appendix C – Clinical Rotation Summaries.

With reference to the CAMPEP published standards, our mission and objectives include the development in the resident of all the following:

a. *An understanding of the role of patient safety in the clinical practice of medical physics.*

This understanding is provided in the Introductory rotation: X-ray Imaging Review and Introduction to Methods of Imaging Equipment Evaluation and expanded in all subsequent rotations. Patient safety training specifically covers the following topics which are detailed in the applicable rotation descriptions: hazards from radiation, magnetic fields, energy deposition, and medical risks for the actual procedures.

b. *The technical knowledge, skills and competency required for the safe application of the technologies used in the practice of medical physics*.

As part of the education involving equipment testing procedures in all rotations, we describe and demonstrate good safety practices required to protect the physicists and others from harm that could be caused by this testing. This includes radiation safety, electrical and mechanical safety, and safety related to strong magnetic fields. We also teach residents to take care not to damage any clinical equipment, or to change protocols on the equipment without the expressed consent of clinical staff in charge of this equipment.

The residents are taught the need for high-quality equipment testing protocols and methods and providing opportunities for independently carrying out proper equipment test procedures, applying principles of radiation protection as well as electrical and mechanical safety in equipment testing to avoid risks to themselves, others, and the equipment, and learning what can go wrong if inadequate test methods and techniques are used.

*c. An appreciation of the clinical purpose and applications of sophisticated technologies.*

We provide education on the clinical protocols used, and purposes served by the clinical imaging equipment involved in the residency. This includes observation of clinical procedures and discussions with clinicians. This is a part of every rotation.

Residents also attend weekly Radiology Grand Rounds presentations where clinical imaging techniques and examples are presented.

*d. An understanding of the protocols and practices essential to the employment of technologies to detect, diagnose and treat various illnesses and injuries .*

In each rotation we review relevant clinical protocols and how the parameters and methods used in the protocols affects the efficacy of the procedure. This includes image quality necessary for diagnosis and treatment of clinical problems and the safety of the patient, including radiation safety and any other harm from the diagnostic procedure. As an example, our residents are heavily involved in the ongoing refinement and expansion of CT clinical imaging protocols developed at UW-Madison and distributed world-wide by our partner, GE Healthcare.

*e. The ability to deploy new strategies within the clinical environment.*

We involve the residents in the optimization of clinical imaging protocols using the physicist's knowledge of equipment design and imaging science. This includes medical imaging evaluation, protocol development, improvements in imaging technology, and advancing the application of physics principles to solving medical problems in general.

The residents are also involved in the solution of imaging problems and deficiencies encountered in the clinical practice that are brought up by our radiologists or technologist. This in turn may lead to further optimization of clinical imaging protocols.

*f. The ability to critically evaluate research and scholarship in medical physics.*

We provide the residents with access to resource materials relevant to medical imaging, such as textbooks, accreditation manuals, task group reports, testing standards (such as those from the IEC and NEMA), state and federal regulations; and training the resident to be proficient in finding additional information using the internet and other sources. We review much of this material with the resident in each rotation with an eye to using critical analysis to evaluate all these information resources. We require them to provide analysis of the content of these documents, including an assessment of any deficiencies or errors.

Mentors serve as editors and reviewers for scientific journals including Medical Physics, Physics in Medicine and Biology, Radiology, Journal of Computer Assisted Tomography, Cardiothoracic Imaging, Radiation Measurements, and several others. We encourage the residents to volunteer for these activities as well, and to participate in relevant journal clubs. Resident participation is mandatory in the graduate course "MP-900: Journal Club/Seminar" which meets weekly during the academic year.

*g. The communication and interpersonal skills that are necessary to function in a collaborative, multidisciplinary environment.*

The residents interact with their physicist mentors, clinical engineers, clinical managers, and with the radiologists and technologists in clinical practice at the clinical locations where the residency occurs. They also interact with other medical physicists and radiologists while participating at conferences and tele-conferences, at national conferences such as the annual meeting of the AAPM and the RSNA. Registration and travel expenses are covered to these two or similar conferences each year during the residency. The residents are strongly encouraged to present papers at these conferences and to further convert these papers into publications in peer reviewed journals. They are expected to participate in the weekly seminars of our medical physics department and are encouraged to attend the weekly Grand Rounds of the radiology department.

Residents are strongly encouraged to participate in one or more professional committee activities where issues of importance to the practice of diagnostic medical physics are discussed. Examples include AAPM task groups or any of the technical committees of organizations such as the International Society for Magnetic Resonance in Medicine (ISMRM) or the American Institute of Ultrasound in Medicine (AIUM). Recent residents have participated in AAPM's "Diagnostic Demand and Supply Projection Working Group", "Smart Expansion Subcommittee", "Diagnostic Radiology Resident Physics Curriculum Working Group, "Working Group on Entrustable Professional Activities for Medical Physics Residents", "Working Group on Magnetic Resonance Testing and Quality Assurance", and several others.

The resident rotations are mentored by faculty who regularly interact with clinical personnel in their own modality, and opportunities for resident interactions with clinical personnel are emphasized. Residents are required to participate in lectures to physicians as part of the Radiology Residency Program educational courses. Residents have also participated in the design and delivery of in-service training for clinical staff on topics related to radiation safety. The residents recently delivered training on the discontinuation of gonadal shielding at our institution. This was attended by approximately 600 clinical staff members.

The structure of our residency program is specifically set up to facilitate interaction between the residents. The residents occupy office space, directly adjacent to each other. The selection and admissions of residents also helps this interaction. We admit two new residents every two years, so that the two residents in our program are at the same level and are better able to collaborate on their tasks. There are tasks designed to require collaboration between the residents and the faculty. Most of the mentors have offices in the same building and the same floor, very close to the residents' office space. This allows for frequent and close interactions between the medical physics staff and the residents.

*h. The professional attributes and the ethical conduct and actions that are required of medical physicists.*

The development of these skills is part of each rotation. They are also taught and discussed in the course MP 701 *Ethics and Responsible Conduct of Research and in the Practice of Medical Physics*, which is part of the residency curriculum. We instruct the residents with the principles of patient confidentiality and issues related to HIPAA laws and state and federal regulations, and ensure they apply these principles during the residency.

i. *A valuing of career-long continuing education to keep professional knowledge and skills current.*

In our residency program we pride ourselves in providing the residents with a wealth of challenging material and problems to encourage their interest in furthering their knowledge and abilities in clinical medical physics. We emphasize that all the mentors are themselves constantly learning to keep their knowledge and skills current. Some of this occurs through continuing education and attendance at conferences, while some occurs in the process of solving clinical problems presented to them by clinicians. This is a process that the residents are also taught they must participate in to have success in their medical physics careers. We provide them with information on the availability and the requirements for continuing education and experience to serve as a qualified medical physicist in accredited programs.

# 2. Program Structure and Governance

## 2.1 Institutional Accreditation:

The UWHC and UPMH institutions are accredited by the Joint Commission. The Joint Commission "Quality Check" documentation of the accreditation of the UWHC and the UPMH are provided in **Appendix B**. Other clinics cited in this self-study are included as affiliates of UWHC or of UPMH. Various programs within the institutions including Breast Imaging (Mammography, Ultrasound, Stereoscopic Biopsy and MRI), Computed Tomography, and other imaging and interventional modalities are also accredited. Any additional documentation of accreditation will be provided on request.

## 2.2 Clinical and Educational Facilities:

Imaging Physics Residency Program education and training takes place primarily in the UW Hospitals and Clinics (UWHC), Wisconsin Institutes for Medical Research (WIMR), and UW Medical Foundation (UWMF) facilities associated with the University of Wisconsin-Madison School of Medicine and Public Health (SMPH). Training also occurs in a new partner with the UWHealth system , UnityPoint-Meriter Hospital (UPMH). The recently integrated UWHealth system is a nationally recognized regional health system that includes the following facilities:

- UWHC, a large, 500 bed, referral center hospital and associated clinics, located on the UW-Madison campus,
- UWHealth at The American Center (TAC), a 56-bed health and wellness facility located on Madison's east side,
- The American Family Children's Hospital (AFCH), a 111-bed facility adjacent to UWHC and supported by its own extensive medical imaging systems,
- UWMF clinics, with 18 outpatient medical imaging facilities located in and around the city of Madison,
- WIMR Imaging Services, where PET/CT, PET/MR, ultrasound, MRI, and CT facilities devoted both to basic, translational, and clinical research and to standard of care imaging are provided. WIMR is physically connected to UWHC and the University of Wisconsin Health Sciences Learning Center (HSLC), which houses the School of Medicine and Public Health and the Ebling Library,
- UPMH, a 448-bed community hospital in Madison, Wisconsin, which has become a partner of UW Health, and whose radiology department is staffed by UW radiologists, and
- UPMH clinics, with 7 outpatient medical imaging facilities located in and around the city of Madison.

Both UWHC and UPMH received and maintain a Gold Seal of Approval from The Joint Commission. UWHC has several additional advanced certifications (comprehensive stroke, diabetes, palliative care, *etc*.). Imaging facilities at UWHC, UPMH, UWMF, TAC, AFCH, and WIMR are accredited through the American College of Radiology and adhere to all state and federal regulations, including MQSA. UW Hospital is recognized nationally, ranked #1 in Wisconsin by U.S. News & World Report for the past 9 years and listed in the top 100 globally by Newsweek.


Figure 1: Map of primary facilities involved in the Imaging Physics Residency Program (green labels) and other medical campus facilities (blue labels). The UWMF clinics and TAC facilities are within 10 miles from WIMR, UnityPoint - Meriter Hospital and its clinics are within 20 miles from WIMR.

**Residency Program Steering Committee:**

**2.3** The Steering Committee oversees all affairs of the residency program. It is chaired by the program director, who presently is Frank Ranallo. The committee meets two times per year, or more frequently if needed, such as when needed to manage the annual testing of the residents.

**2.4** The Steering Committee consists of all the Medical Physics Program Faculty of the Imaging Physics Residency, including the program director and at least one physician member from the Participating Clinical Faculty (**Table 3**). The chairs of the Medical Physics and Radiology Departments are also members of the Steering Committee.

**2.5** The members of the Steering Committee are appointed by the chair of Medical Physics and the residency program director.

**2.6** The minutes of the Steering Committee for the last two years are contained in **Appendix L.**

The Steering Committee makes recommendations for the appointment of residents after reviewing letters of application, letters of recommendation, and undergraduate and graduate education records. Transcripts are carefully reviewed to ensure adequate undergraduate physics preparation (as defined by CAMPEP standards) and completion of acceptable graduate medical physics education requirements.

**2.7** Annually, the Steering Committee considers the annual reviews submitted by the residents (an example in **Appendix J**) and reviews all exit surveys submitted by graduates of the program. Additionally, any resident may communicate with the Steering Committee by submission of written materials to the program director which are shared with the Steering Committee, or by requesting to interact with the Steering Committee at one of its meetings.

**2.8** The Steering Committee reviews clinical rotation mentor reports on resident progress to assure consistency and fairness of evaluation procedures and makes recommendations to the Program Director to improve the rotation organization and content. Annually, the Steering Committee considers the annual reviews submitted by the residents (an example in **Appendix J**) and reviews all exit surveys submitted by graduates of the program. This is typically done at one of the semi-annual meetings of the Steering Committee. The committee uses such information to make recommendations to improve program content and processes.

**2.9** In conjunction with the above evaluation and discussion (discussed in 2.8), the steering committee annually reviews the educational program with the purpose of improving the program. Examples of such improvements are modification of rotations (content and timing), addition of new rotations, consideration of new mentors, methods of evaluation of the resident's progress and documentation of that progress, addressing any apparent weaknesses of the program demonstration by the residents' progress or by their comments to the mentors or to the steering committee.

**2.10** If a resident does not make acceptable progress towards completing the residency program, the Program Director will meet with the resident and discuss his/her deficiencies. Supplemental materials and guidance will be provided to the resident to make up for the deficiencies. The resident can be encouraged to audit courses to make up for his/her deficits, if appropriate. If, despite all these efforts, the resident shows lack of motivation or inability to follow up, the candidate's performance is reviewed by the Steering Committee. The committee can recommend the resident be placed on probation, with a clear statement of how the resident can end the probationary period or can recommend to the chair of the Department of Medical Physics that the resident be expelled from the program. The resident is informed of the recommendation of the Steering Committee and can appeal the decision by requesting a meeting of the Steering Committee to discuss this recommendation. This meeting will include the normal members of the Steering Committee and the chair of the Department of Medical Physics.

## 2.11 Metrics for Evaluation of Resident Progress and Methods of Tracking this Progress.

All rotations in the residency are thoroughly described in **Appendix C**, including metrics for evaluating the residents' progress and performance.

Residents are monitored throughout the program by the various faculty with whom they work and by the Program Director. Throughout the duration of a rotation, the mentor for that rotation will provide verbal evaluations of the resident, noting any deficiencies or concerns. In this manner, the resident will have frequent feedback during each rotation Additionally a Spreadsheet is maintained in each rotation, for each resident, that is frequently updated, that lists all the required competencies for that rotation. (**Table 2**). At listed dates, the mentor provides an evaluation of how far the resident has progressed on each competency, and these evaluations are reviewed by the resident.

Twice a year the mentor in each clinical rotation provides a written evaluation of each resident by completing an online Qualtrics Survey Evaluation of the resident (**Appendix J**), again noting any deficiencies or concerns. This evaluation is shared with and then discussed with the resident. The program director will have access to these written logs and evaluations to monitor the resident's progress and intervene when needed. Annual meetings are held between the resident and the program director to discuss mutual evaluations and to discuss any issues related to resident education and training. Mentoring is done in these meetings. The resident provides an annual evaluation of the mentors and of the residency program in general, also by completing an online Qualtrics Survey. The evaluations of the faculty by the resident are reviewed by the Program Director and the chair of the Department of Medical Physics. The program director and the chair of the Medical Physics Department will meet annually with each resident to discuss the resident evaluations of the faculty and provide feedback for the resident.

Each resident must keep a log of activities for each clinical modality rotation in a specified folder in the residency's Google Drive. This log details the date of performance, the site where primary activity took place, description of imaging instrument tested (if that is the activity), and a description of the activity. Mentors for each rotation can access this folder to monitor the resident's progress. An example of this log is shown below in **Table 1**.

**Table 1: Elements of activity log used for the CT rotation are shown in this table.**

| Date | Location | Equipment | Activity | Mentor |
|---|---|---|---|---|
| 12/18/2020 | WIMR basement | GE Discovery 710 PET/CT. | Acceptance Test/ ACR Accreditation Tests<br>Testing - Level 1: Observation and Minor Assistance, No Report Writing | Frank Ranallo |
| *etc*. | | | | |

## Table 2: Documentation of Resident's progress for each competency in a rotation.

| | CT | | | | | | |
|---|---|---|---|---|---|---|---|
| | Evaluator | | | | Resident | | |
| Competency | Evaluator's Date of Update | Evaluator's Name | Status | Comments | Resident's Date of Review | Resident's Initials | Comments |
| 1 Understand the principles, design, and recent advances of CT, including all of its major components, such as the x-ray tube, collimator, and detectors, and their functions. | July 12, 2019 | Frank Ranallo | Completed | | July 22, 2019 | XX | |
| 2 Understand the principles of CT image reconstruction, including nonlinear denoising methods. | July 12, 2019 | Frank Ranallo | Completed | | July 22, 2019 | XX | |
| 3 Understand the concepts of dose and image quality (including artifacts) and their relationship in CT. | July 12, 2019 | Frank Ranallo | Completed | | July 22, 2019 | XX | |
| 4 Understand how automatic exposure control systems operate in CT. | July 12, 2019 | Frank Ranallo | Completed | | July 22, 2019 | XX | |
| 5 Understand federal and state regulations applicable to CT systems including operational tolerances and requirement for compliance to these regulations. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 6 Understand the requirements of the Joint Commission, the ACR, and other accreditation bodies for the testing of CT scanners. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 7 Understand the proper methods of performance testing of CT scanners for acceptance testing and quality assurance in light of the requirement of the above accrediting bodies and organizations. Perform these performance tests on CT scanners in compliance with all relevant standards. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 8 Understand how to identify and analyze problems detected in these tests and the corrective actions that can be performed for operational improvements. Understand how to report system deficiencies that do not comply with government regulations and requirement of the joint commission and accrediting bodies. Understand how to report other types of system deficiencies that are detected. Understand how to create an accurate and understandable report for the health care faculty responsible for the CT equipment. Create actual reports of the results of CT system testing. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 9 Have a working knowledge of the accreditation requirements for CT scanners along with the requirements of the Joint Commission and federal regulations, beyond simply the requirements for CT testing. Assist clinical personnel in the process of accreditation of CT scanners and in satisfying the requirements of the Joint Commission and federal regulations. Understand the issues to be addressed in setting up a QC program for CT technologists. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 10 Develop a working knowledge of the requirements of the Joint Commission and the accreditation bodies for personnel requirements for Physicists, Technologists, and Radiologists. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 11 Complete the number of hours of approved continuing medical education (CME) credits as required by the Joint Commission and the accreditation bodies for a Physicist who is testing CT scanners. | July 12, 2019 | Frank Ranallo | In Progress, Less Than 50% Complete | | July 22, 2019 | XX | |
| 12 Understand how to test for the presence of CT image artifacts and to recognize their presence in both phantom and clinical images. Perform analysis of images with possible artifacts including identifying the artifact and its possible causes. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 13 Understand how to analyze CT images with suboptimal quality and provide recommendations for correction or improvement of the imaging process. This includes providing instructions for improving the images of scans already performed by modifications of the reconstruction parameters. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 14 Understand design considerations for a new or remodeled facility including reading room design, radiation shielding requirements, and equipment selection. Participate in these activities in assisting the clinical personnel. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 15 Understand the requirements for reviewing radiations shielding designs for new or remodeled rooms, inspecting the actual construction process, the creation of a radiation shielding report for submission to the health care facility and to the state. Assist in each of these processes. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 16 Understand the processes for obtaining approval to operate CT imaging facilities including state licensing and the legal requirements. Assist in these processes as opportunities allow. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 17 Understand how to calculate estimates of CT doses including CTDI, organ doses, effective doses, and fetal doses. Perform calculations of these doses. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 18 Understand the principles of personnel radiation safety and monitoring both for the clinical personnel and for the persons performing equipment evaluations. Answer radiation safety questions and provide guidance in radiation safety to the clinical staff. Use proper radiation safety techniques while performing medical physics duties. | July 12, 2019 | Frank Ranallo | In Progress, More Than 50% Complete | | July 22, 2019 | XX | |
| 19 Prepare and deliver presentations for clinical staff on CT physics topics of interest such as radiation doses and risks, quality control procedures and technical aspects of CT imaging. | July 12, 2019 | Frank Ranallo | In Progress, Less Than 50% Complete | | July 22, 2019 | XX | |

At the end of the first year of the program, the resident is given an oral examination that is coordinated by the program director and the steering committee. This exam is divided into parts, one for each clinical rotation. The exam in a clinical rotation is given by the mentor(s) in that rotation. A final oral examination, of a format similar to the first exam, is required at the end of the second year . Both exams will be administered in a setting similar to the ABR Part III oral examination.

Written and/or oral examination of the resident is performed by the clinical rotation mentors after the resident completes a given modality rotation. Failure of any of these exams will require the resident to address the deficiencies and be retested. Upon completion of each rotation, the clinical rotation mentor completes an online Qualtrics Survey Evaluation of the resident. The evaluations are reviewed quarterly by the Associate Director and the Program Director and annually by the Steering Committee. The Program Director will meet semi-annually with the resident to evaluate the resident's progress and will provide a written summary of the meeting to the resident. The resident also evaluates the clinical rotation mentor following each rotation (**Appendix J**). The evaluations of the faculty by the resident are reviewed quarterly by the Program Director, Associate Program Director, and the chair of the Department of Medical Physics. The chair of the Medical Physics Department will meet twice a year with each resident, the Program Director, and the Associate Program Director to discuss the resident evaluations of the faculty and provide feedback for the resident.

## 2.12 Location of Residency Program

This residency program is controlled solely by the Medical Physics Department of the University of Wisconsin in Madison, Wisconsin. The Medical Physics office, most faculty offices, and the residents' cubicles are located in Building One of the Wisconsin Institutes for Medical Research, which is adjacent to and connected to the University of Wisconsin Hospital. This is the primary site for all training. There are no affiliated institutions for this program, though some training does take place at facilities affiliated with UW Health that are listed in Section 2.2.

## 2.13 Residency Program Website

This residency has a publicly accessible website as a selection within the website of the University of Wisconsin. The website of the residency program can also be directly accessed using the following URL:

https://www.medphysics.wisc.edu/residency)

The residency website provides general information about the program, admissions information, and a listing of current and previous residents. For previous residents, information on their achievements, employment following completion of the residency program, board certification status, etc. is provided, as required by CAMPEP standards.

### Basic Structure of Residency Program

**2.14** The Imaging Physics Residency Program is a 24-month program administered by the Department of Medical Physics in cooperation with the Department of Radiology in the UW School of Medicine and Public Health (SMPH). We admit two new residents every two years, so that there are always two residents in the program. We do not foresee any circumstances that would reduce the number of residents in our program to zero. As funding allows, we may increase the number of residents in our program.

**2.15** See answer above to 2.14.

**2.16** See answer above to 2.14. There are no affiliated institutions for this program, though some training does take place at facilities affiliated with UW Health, that are listed in Section 2.2.

## 3. Admissions

**3.1** This residency program preferentially admits graduates of CAMPEP-accredited graduate medical physics programs. To be considered for admission an applicant must be from a program that demonstrates a strong foundation in basic physics. This includes an undergraduate or graduate degree in physics, or a degree in an engineering discipline or another of the physical sciences and with coursework that is the equivalent of a minor in physics (i.e., one that includes at least three upper-level undergraduate physics courses that would be required for a physics major).

Our residency program will also consider candidates who either (1) possess a Ph.D. in physics or a related discipline and have completed a CAMPEP-accredited certificate program, or (2) possess a PhD in physics or related discipline and have satisfactorily completed courses equivalent to those in a CAMPEP-accredited certificate program, as determined by the CAMPEP Graduate Education Program Review Committee (GEPRC).

A list of residents that have been admitted to the program is provided in **Appendix D**.

A list of current residents is provided in **Appendix E**.

A list of residents completing the residency program is provided in **Appendix F**.

**3.2** The didactic requirements for entering our residency program shall be completed prior to the beginning of clinical education of our residency program, except for up to two remedial courses, which may be taken without extending the duration of our two year residency program for residents with PhD degree. If our residency program conditionally admits applicants with deficiencies in their academic background, the remedial education of such residents shall consist of specific courses in our own CAMPEP accredited graduate program. Such courses used for remediation must be assessed and approved by CAMPEP.

**3.3 These are the admission standards:**

1. A Ph.D. degree.
2. Study in a CAMPEP-Accredited graduate program, with the degree awarded prior to beginning the residency or possess a Ph.D. in physics or related discipline and have completed a CAMPEP-accredited certificate program.
3. Though we prefer the above qualifications we may also consider an applicant with a master's degree who has studied in a CAMPEP-Accredited graduate program, with the degree awarded prior to beginning the residency. We may also consider an applicant through an "alternate pathway" as described above in 3.2.

The applicant will need to submit all the information required by MP-RAP. This includes the following completed documents:

1. A cover page.
2. The application form.
3. A personal statement.
4. CV.
5. Three references.
6. All undergraduate and graduate academic transcripts.

Admission standards can be found on the residency program website:

https://www.medphysics.wisc.edu/residency)

**3.4** Our program participates in the Medical Physics Residency Application Program (MP-RAP) and in the MedPhys Match program. From MP-RAP, applicants will be referred to the Imaging Physics Residency Program information on the Department of Medical Physics website for basic information on the residency program, descriptions of the program faculty and resources, information on the program rotations and other requirements for completion, financial information (including stipend and benefit specifics), and contact information for the Program Director and the Program Administrator. The admissions standards for our residency program are clearly described on our website, including the method of evaluating the application and informing the applicant of the outcome of their application.

Resident application materials, obtained through the MP-RAP, are reviewed by the Admissions Committee, which identifies top applicants to be invited for an interview. The interview process involves one-on-one interviews with the Program Director and with each of the residency mentors. Following all interviews for a given cycle, the Steering Committee will meet to prepare a prioritized admissions list. The resulting applicant ranking will be submitted to the MedPhys Match process. The residency program will abide by the results of this match. After being informed of the match results, the residency program will promptly email to the matched applicants a confirmation of selection to our residency program, along with the start date. An appointment letter will be attached to this email. This appointment letter states the matriculation date, stipend, and benefit levels, etc. A sample letter is provided in **Appendix I**.

# 4. Program Director

**4.1** The Program Director is appointed by the Chair of the Medical Physics Department, in consultation with the residency program Steering Committee.

**4.2** The Program Director reports to the Chair of the Medical Physics Department. He/she is ultimately responsible for ensuring that the residency program complies with CAMPEP standards and maintaining the high quality of the residency program.

**4.3** The current Program Director is Frank Ranallo, Ph.D., DABR, FAAPM. He has been the director since the inception of the program in 2014. Dr. Ranallo received his Ph.D. in Physics from the University of Wisconsin-Madison in 1993. He obtained board certification in Diagnostic Radiological Physics from the American Board of Radiology in 1994 and was elected a fellow of the AAPM in 2018. He has been associated with the Radiological Physics Services of the Medical Physics Department since its inception, being responsible for x-ray system testing (including that of CT systems), radiology resident physics training, and dealing with many image quality, safety, and radiation exposure questions. Dr. Ranallo is a member of the Radiation Safety Committee of UnityPoint-Meriter Hospital. He has worked with several diagnostic imaging task groups of the American Association of Physicists in Medicine, including those that produced *Instrumentation Requirements of Diagnostic Radiological Physicists, AAPM Report No. 60*, *Quality Control in Diagnostic Radiology, AAPM Report No. 74*, and Performance Evaluation of Computed Tomography Systems, AAPM Report No. 233. Presently he is serving on AAPM Task Groups #150, *Acceptance Testing and Quality Control of Digital Radiographic Imaging Systems*, #233, *Performance Evaluation of Computed Tomography Systems*., and #309, *Imaging - Protocol Management System Design.* He is currently a member of the AAPM Computed Tomography Task Group.

**4.4** The current Program Director, Frank Ranallo, Ph.D., DABR, FAAPM, has been the director of this residency program since the inception of the program in 2014.

**4.5** The Program Director is responsible for recruiting clinical rotation mentors for each of the rotations. This is done in close collaboration with the chair of the Department of Medical Physics and the Steering Committee. As Program Director, Dr. Ranallo also has responsibility for recruiting residents and promoting the residency program: e.g., Participating in Residency Fairs at the AAPM meetings. The Program Director is also responsible for advising the residents, based on the evaluations provided by the mentors of each rotation and on questions from the residents themselves. The program director also monitors the progress of each resident in each rotation and discusses this progress with the rotation mentors and with the residents, as appropriate. The Program Director evaluates the program with an eye to improvements or to remedy any deficiencies. This is typically done in conjunction with the steering committee as described in 2.7 through 2.9 above.

**4.6** The Program Director is responsible for evaluating applicants to determine whether they are fully qualified for a CAMPEP-accredited residency. This selection of qualified residents and their ranking in the match program is done in collaboration with the steering committee. The director works with the graduate program faculty to arrange any remedial education if an otherwise highly qualified applicant does not meet the program requirements.

For all residents, the Program Director is responsible for providing an introductory rotation of the basic physics and instrumentation for medical x-ray imaging systems. This is partially a review of material that should previously been learned, but this review assured that all residents have the proper understand required for the subsequent rotations This review also provides additional material to which the new residents had not been previously exposed and provides actual clinical problems to challenge the residents. Important components of the testing of medical imaging equipment are covered along with various aspects of safety for both the residents and the equipment they are testing.

**4.7** The Program Director is responsible for maintaining the residency's website, assuring its accuracy and completeness, and compliance with CAMEP requirements. This is accomplished by working closely with the Steering Committee and IT specialists in the Department of Medical Physics. This website contains essential information on the residency program such as the type and nature of the training, program and graduate statistics, and important announcements. The Program Director is also responsible for ensuring that all resident statistics, annual reports, and other information required by CAMPEP are reported accurately and in a timely fashion.

**4.8** The Program Director meets quarterly with each resident, providing feedback on their progress, offering constructive advice, and seeking any suggestions for improving the program. Minutes of these meeting are created and maintained, and a copy is provided to the resident. Additionally, each resident is asked to complete an annual review of each rotation and of the residency program in general (an example in **Appendix J**). A record of this annual review is kept and, along with any discussed comments, is provided to the resident. The Program Director reviews the evaluation from a particular resident with that resident particularly in response to any problems brought up. These evaluations are also discussed with the mentors and the steering committee, as appropriate (see 2.7).

# 5. Program Staff

## 5.1 Appointment of Program Staff:

The Imaging Physics Residency Program faculty (Program Staff) are appointed by the Residency Program Director, in collaboration with their respective department chairs, and the Steering Committee.

## 5.2 Number and Description of the Program Staff:

The Department of Medical Physics currently has 23 tenured/tenure-track, 4 clinical track, and 12 active emeritus faculty. In addition, the program has 28 affiliate faculty (from the Departments of Radiology, Human Oncology, BME, Physics, Psychiatry) and two joint executive faculty (Radiology). The medical physics faculty involved in the Imaging Physics Residency Program are a subset of the departmental faculty. Additional residency program faculty, *i.e.*, participating clinical faculty, are recruited from the Department of Radiology and the Radiation Safety Department of the University of Wisconsin. In all cases, Imaging Physics Residency Program faculty are engaged in clinical imaging activities in their areas of expertise.

## 5.3 Ratio of Program Staff to Residents in the Program:

There are a total of 11 Physics Faculty and 7 Participating Clinical Faculty who comprise the Faculty/Program Staff for the residency program. **This results in a ratio of physics faculty to residents in the program of 5.5 : 1, and a ratio of all program staff to residents in the program of 9.5 : 1.**

## 5.4 Certification or Licensing of the Program Staff:

Five of the physics faculty are board certified by the American Board of Radiology , the American Board of Medical Physics, or the American Board of Science in Nuclear Medicine, and all are qualified to provide equipment testing and other services as specified by American College of Radiology accreditation programs. In addition, most program faculty are engaged in the UW Medical Physics Graduate Program as instructors, faculty mentors, and/or research directors, and several are active physics instructors in the UW Radiology Resident education programs. All seven of the clinical faculty are certified by the ABR in Diagnostic Radiology.

## 5.5 Scholarly Activities of the Program Staff:

Faculty members, along with their specialties, are listed in **Table 3**. An inspection of faculty biosketches in **Appendix G** demonstrates that each faculty member is heavily engaged in the education, research, and service efforts of the institution as well as scientific and/or professional organizations, committee work, and other professional medical physics and radiology activities.

**Table 3: Alphabetical List of Imaging Physics Residency Program Faculty**

| Physics Faculty | Area(s) of Expertise | Certification |
|---|---|---|
| Frank Ranallo, Ph.D., FAAPM (Medical Physics and Radiology) – Program Director | Radiography, fluoroscopy, angiography, CT, radiation safety, optimization of imaging protocols | ABR, Diagnostic Radiological Physics |
| John Vetter, Ph.D. (Medical Physics) – Program Associate Director | Radiography, fluoroscopy, angiography, mammography, nuclear medicine, radiation safety | ABR, Diagnostic Radiological Physics |
| Tyler Bradshaw, Ph.D. (Radiology) | Nuclear medicine | American Board of Science in Nuclear Medicine, Physics & Instrumentation |
| Timothy Hall, Ph.D. (Medical Physics) -Chair of Medical Physics | Ultrasound | |
| Walter Peppler, Ph.D. (Medical Physics) | Informatics, PACS, teleradiology | |
| Ivan Rosado-Mendez, PhD (Medical Physics) | Ultrasound | |
| Michael Speidel, Ph.D. (Medical Physics and Medicine) | Radiography, angiography, cardiology | |
| Timothy Szczykutowicz, Ph.D. (Radiology, Medical Physics, BME) | Informatics, CT | ABR, Diagnostic Radiological Physics |
| Jason Timm, MPH ( UW Environmental Health & Safety) | Radiation Safety, Environmental Health and Safety | |
| Karl Vigen, Ph.D. (Radiology) | MR | ABMP, MR Physics |
| James Zagzebski, Ph.D., FAAPM (Medical Physics) | Ultrasound | |

| Participating Clinical Faculty | Area of Expertise | Certification |
|---|---|---|
| Richard Bruce, M.D, (Radiology) | Neuroradiology | ABR, Diagnostic Radiology |
| Thomas Grist, M.D., FACR - Chair of Radiology | Cardiovascular imaging; MRI | ABR, Diagnostic Radiology |
| Jeffrey Kanne, M.D. (Radiology) | Chief, Thoracic Imaging | ABR, Diagnostic Radiology |
| Mark Kliewer, M.D. (Radiology) | Chief, Ultrasound; abdominal imaging and intervention | ABR, Diagnostic Radiology |
| Scott Nagle, M.D., Ph.D. (Radiology) | Thoracic imaging, cardiovascular imaging | ABR, Diagnostic Radiology |
| Lonie Salkowski, M.D. (Radiology) | Breast imaging; anatomy, medical education | ABR, Diagnostic Radiology |
| Gary Wendt, M.D., M.B.A. (Radiology) | Vice Chair, Informatics; neuroradiology; PACS, teleradiology | ABR, Diagnostic Radiology |

Note: All physics faculty are members of the Steering Committee, which also includes one physician representative. The current physician representative is Thomas Grist, MD, FACR, chair of the Department of Radiology.

# 6. Institutional Support

## 6.1 Administrative Support and Resources:

Administrative support for the Residency Program is provided by the Department of Medical Physics. Each resident has access to administrative personnel, and desktop, workstation, database, and web IT support personnel. Each resident also has office space, access to conference rooms and audiovisual resources, copier access, and access to a variety of computational facilities (image processing workstations, compute-node servers, *etc*.). Desktop computers are provided to allow access to the intranet/internet, e-mail, library resources, *etc*., and have any necessary software installed (Office 365, MATLAB, Mathematica, ImageJ, R, SPSS, etc.).

With regard to test equipment, the RPS maintains two Radcal diagnostic X-ray measurement systems (including dosimeters and other electronic test equipment for performing equipment evaluations of all x-ray systems and radiation safety measurements), non-electronic phantoms and equipment for performing equipment evaluations of radiographic, mammographic, fluoroscopic, and angiography systems (including focal spot star patterns and pinhole and slit cameras, HVL filters, collimation test tools, resolution patterns and low contrast phantoms, water/patient equivalent phantoms), a Catphan CT testing phantom, a CTDI Dosimetry phantom, mammography ACR accreditation phantoms and breast tissue equivalent phantoms. RPS also has two Gammex 403 gray scale ultrasound phantoms, a Gammex 404 and a CIRS Model 050 small parts phantom, an ATS Model 539 general purpose phantom, a CIRS Doppler string test object, and a Gammex 425 flow phantom. The Department of Medical Physics maintains a machine shop and electronics laboratory that can be used, as necessary, for the fabrication of custom phantoms, test devices, *etc*. The department also maintains a large laboratory for fabrication of phantoms, and residents have access to a wide variety of research phantoms and have the ability to fabricate novel phantoms for clinically directed projects, if needed. For MRI system testing, the Department of Radiology possesses a number of MRI phantoms, including the large ACR MRI Phantom, a luminance meter for basic MRI operator console luminance testing, and a 3-axis Hall-probe gaussmeter (Metrolab THM 7025, GMW Associates, San Carlos, CA). The Department of Medical Physics has additional MR phantoms, including the ISMRM/NIST MR System Phantom (High Precision Devices, Boulder, CO) and the RSNA QIBA/NIST ADC Diffusion Phantom (High Precision Devices, Boulder, CO).

## 6.2 Financial Support of Program:

The Department of Medical Physics provides percent effort support for the Program Director and the Associate Director, and the department is committed to continuing this support in the future. For fiscal year 2022, the Department of Radiology has requested support from the UWHC for one resident position per year. A second source of funding is the UW-GE CT Protocol Project of the Medical Physics and Radiology Departments which is supporting one resident position per year. A third source of funding for the residency program is revenue from services provided by the RPS to the UWHC, UWMF, and UPMH. Letters of these institutional commitments can be found in **Appendix A**.

Office space, IT, equipment, and administrative support for these program leaders are also provided by the department and the RPS.

## 6.3 Financial Support of Residents

The Imaging Physics Residency Program stipend rates for the residents are based on the Graduate Medical Education (GME) rates of the UW SMPH. Currently, those rates are $60,090 for PG1 residents

and $62,126 for PG2 residents. The SMPH GME rates are based on the Council of Teaching Hospitals survey and are adjusted annually. Each resident is also provided with health and dental benefits.

Residents are formally informed of this support and benefits in an appointment letter that is sent to the matched applicants. An example is provided in **Appendix I.** This information can also be found on our website.

Residents in the Imaging Physics Residency Program are expected to present and publish results of clinically directed projects completed during the program. In support of this effort and to enhance the professional learning of the residents, the program commits to funding travel to at least one scientific / professional meeting per year, *e.g.,* annual meetings of the AAPM, RSNA, SPIE, *etc*. As an example of this productivity for one recent set of residents, please refer to **Table 4** at the end of this section. This is an important part of the residency program, that prepares the residents for a profession in medical physics. This does not interfere with the clinical training of the residents, but if anything, actually helps to enhance it.

Residents are strongly encouraged to participate in one or more professional committee activities where issues of importance to the practice of diagnostic medical physics are discussed. Examples include AAPM task groups or any of the technical committees of organizations such as the International Society for Magnetic Resonance in Medicine (ISMRM) or the American Institute of Ultrasound in Medicine (AIUM).

Faculty mentors are encouraged to nominate their resident for peer review activities, such as reviews of journal articles closely related to their prior research and current areas of interest.

## 6.4 Resident Orientation

Resident orientation activities include introductions to program faculty, tours of facilities in the UWHC and UWMF clinics, the AFCH, and WIMR, an overview of expectations and requirements during years 1 and 2, and review of the support structure for the residency program (program administrative staff, clinical rotation mentors, clinical faculty, etc.). Information on computational support, phantoms and test objects, and HIPAA training requirements is provided. In addition to verbal communication of the orientation materials, the residents will have online access to the *UW-Madison Imaging Physics Residency Program Handbook*, that is on the program website. The actual checklist of the On-Boarding and Orientation Activities for the new residents is provided in **Appendix K.**

## 6.5 Safety Instruction

An introduction to mechanical and electrical safety, including high-voltage safety, and to MR safety is also provided during the orientation and subsequently supplemented by additional training by medical physics mentors during the relevant rotations. Each resident must complete the institutional radiation safety training as part of his/her orientation, and additional radiation safety training is provided in the relevant rotations.

## 6.6 Instruction on Professional, Ethical, :and Patient Confidentiality Issues

Residents will take the UW-Madison Medical Physics Program graduate course, MP 701 Ethics and Responsible Conduct of Research and in the Practice of Medical Physics. The course will be waived for residents who provide transcripts showing evidence of having taken an equivalent graduate course. A complete description of this course is shown in **Table 8**. Additionally, residents will participate in the workshop Leadership offered by the University of Wisconsin Office of Continuing Studies. Residents are also required to take an on-line course and test on the topic of confidentiality of patient information including the Health Insurance Portability and Accountability Act (HIPPA).

**Table 4: Clinically Directed Projects and Publications / Presentations of Residents # 3 and 4:**

| Category | Description | Publications/Presentations |
|---|---|---|
| **CT Protocol Management**<br><br>**Effects of Scan and Reconstruction parameters on Image Quality and Dose.**<br><br>**Method for the Evaluation of Image Quality and Dose in CT** | Projects to ensure all CT protocols being utilized by all UWHealth Imaging facilities achieve sufficient diagnostic image quality at the lowest possible dose. This project also seeks to make image quality homogeneous across the many different scanner models employed throughout these facilities. Also investigated is the source and reduction of repeat scans.<br><br>Another set of projects looks at the specific effects of varying scan and reconstruction settings on the resultant image quality. These settings include kV, scan time, pitch, table speed, AEC (mA modulation), scan field of view, display field of view. These have a number of effects on dose and image quality including image sharpness (MTF), image noise, low contrast detectability, slice sensitivity profile, scan time (motion) and artifacts. | Apparatus for Tomography Repeat Rate/Reject Rate Capture TP Szczykutowicz, BT Viggiano, SD Rose, US Patent App. 16/403,857., 2020.<br><br>A Multi-Institutional Study on Wasted CT Scans for Over 60,000 Patients,.S Rose, B Viggiano, R Bour, C Bartels, T Szczykutowicz, American Journal of Roentgenology 215 (5), 1123-1129, 2020.<br><br>Repeat/Reject imaging in CT: An unnecessary source of patient dose and a tax to radiology resources, T Szczykutowicz, S Rose, ECR 2020 EuroSafe Imaging Poster Exhibition, 2020.<br><br>A Method for Automated Repeat/reject Rate Analysis in CT. S Rose, B Viggiano, T Szczykutowicz, Medical Physics 46 (6), E506-E506, 2019.<br><br>Repeated/rejected events in CT: A study quantifying their frequency and impact on patient dose. S. Rose, B. Viggiano, and T. Szczykutowicz, Scientific Abstract, Radiological Society of North America 105th Annual Meeting, Chicago, Illinois, December 2019 - Oral Presentation.<br><br>An automated informatics-based repeat/reject rate algorithm for CT. S. Rose, B. Viggiano, and T. Szczykutowicz, Scientific Abstract, Radiological Society of North America 105th Annual Meeting, Chicago, Illinois, December 2019 – Poster Presentation. (Selected by the RSNA Science Committee for presentation in the Discovery Theater).<br><br>A method for automated repeat/reject rate analysis in CT. S. Rose, B. Viggiano, and T. Szczykutowicz, American Association of Physicists in Medicine 61st Annual Meeting, San Antonio, Texas, July 2019 – Oral Presentation<br><br>AEC- and Scan Time-Optimized Pediatric Body CT Protocols based on Size-Specific Dose Needs. Lipford, M, Szczykutowicz, T, Scientific Abstract, Radiological Society of North America 105th Annual Meeting, Chicago, Illinois, December 2019 - Oral Presentation.<br><br>An MDCT tutorial: scan coverage, speed, dose output and field of view. Szczykutowicz, T, Lipford, M, Educational Exhibit Presentation, Radiological Society of North America 105th Annual Meeting, Chicago, Illinois, December 2019 (Cum Laude Award).<br><br>Vendor Neutral Method to Create AEC Optimized Pediatric CT Body Protocols Based on Aggregate Clinical Data. Lipford, M, Szczykutowicz, T, American Association of Physicists in Medicine 61st Annual Meeting, San Antonio, Texas, July 2019 - Oral Presentation.<br><br>The Effects of Varying the Display Field of View (Reconstruction Field of View) On MTF. Lipford, M, Rose, S, Ranallo, F, Scientific Abstract, American Association of Physicists in Medicine 61st Annual Meeting, San Antonio, Texas, July 2019<br><br>Pitch Dependence of Slice Sensitivity Profile and Dose-Efficiency in CT. Rose, S, Lipford, M, Ranallo, F, Scientific Abstract, American Association of Physicists in Medicine 61st Annual Meeting, San Antonio, Texas, July 2019 |

# 7. Educational Environment

## 7.1 Mechanisms and Spaces for Open Discussion and Exchange of Knowledge:

Residents are provided office space and computers only a few feet from the program director and most of the physics faculty. There are also two conference rooms in the same areas where discussion between residents and between residents and other faculty and students can occur, and where residents can practice their presentations. Residents spend a very substantial part of the time in the residency with the faculty, allowing for facile communication.

The structure of our residency program is specifically set up to facilitate interaction between the residents. The residents occupy office space, directly adjacent to each other. The selection and admissions of residents also helps this interaction. We admit two new residents every two years, so that the two residents in our program are at the same level and are better able to collaborate on their tasks. There are tasks designed to require collaboration between the residents and the faculty. An example are the creation of shielding calculations and reports. These are produced simultaneously by the residents and a faculty member, with the various approaches discussed among them. The residents are also strongly encouraged to understand testing methods at a deep enough level that they can make recommendations on possible improvements.

Most resident rotations are mentored by faculty who regularly interact with clinical personnel in their own modality, and opportunities for resident interactions with clinical personnel are emphasized. Residents are required to participate in lectures to physicians as part of the Radiology Residency Program educational courses provided by members of RPS. This participation includes attendance at lectures and participation in aspects of the teaching. Physics residents are expected to attend at least four Radiology Grand Rounds seminar presentations each year. They are also invited to journal club presentations of medical physics research groups wherever interests coincide.

## 7.2 Mechanisms and Spaces for Practice of Presentation and Oral Communication Skills:

There are numerous classrooms and conference room in both WIMR and HSLC with full computer and audiovisual capabilities in which the residents can practice their presentations at the UW or at conferences. They are all within minutes of the office space of the residents, with two being only a few feet away. Residents are expected to present one seminar in the Medical Physics Seminar series during their residency program.

## 7.3 Access to professional and educational information:

WIMR Tower 1 (WIMR 1) and WIMR Tower 2 (WIMR 2), as well as the UWHC, are contiguous with the HSLC, which houses the UW School of Medicine and Public Health (SMPH) administrative offices, large and small classrooms, and the Ebling Library. Weekly Medical Physics research seminars and some Radiology Grand Rounds are held in the HSLC facility. Other Grand Rounds, including the UWCCC Grand Rounds, are held in the UWHC.

As with graduate medical physics students and department personnel, all imaging physics residents have access to a vast array of online resources through their desktop computers and/or mobile devices and at a number of UW facilities. Among these are the Ebling Library for the Health Sciences with its extensive on-line and physical journal subscriptions and archives, the UW College of Engineering with its availability of computational software, DoIT (UW-Madison's Department of Information Technology) software resources, and the Department of Medical Physics software resources.

## 7.4 Access to Clinical and Research Facilities:

As noted in Section 3, resident education and training occurs primarily in the Department of Medical Physics, in imaging suites within the adjacent UWHC and the AFCH, in imaging facilities within The American Center (TAC) Hospital on the East Side of Madison, in UWMF imaging suites in the city of Madison, in imaging suites within WIMR and in the UPMH and its associated clinics.

Imaging physics residents have office space among the faculty, post-docs, and graduate students in WIMR Tower 1 (WIMR 1), which opened in 2008 and houses the Department of Medical Physics. This interdisciplinary research tower is connected to UWHC and has its own CT, MRI, ultrasound, PET/CT, and PET/MR imaging facilities, which are used both for standard of care and in basic, translational, and clinical research performed by Radiology and Medical Physics faculty. WIMR 1 also houses the UW Carbone Cancer Center (UWCCC), the McPherson Eye Research Institute, the Department of Medical Physics Medical Radiation Research Center (and its Accredited Dosimetry Calibration Laboratory, ADCL), the Small Animal Imaging Facility, a PETtrace cyclotron and associated radiochemistry and radiation detection research space, a GMP Radiopharmaceutical Production Facility (which opened in 2016), and the Image Analysis Core (IMAC). WIMR Tower 2, which opened in 2014, is immediately adjacent to WIMR 1 and houses 10,000 $ft^2$ of additional shared Radiology and Medical Physics office space, a second IMAC facility, the McArdle Laboratory for Cancer Research, the Cardiovascular Research Center, and the Department of Cell and Regenerative Biology. Most medical physics graduate classes meet in WIMR 1 or WIMR 2.

Including imaging systems located in all facilities to which the residents have access (UWHC, UWMF, AFCH, TAC, WIMR, UPMH), the installed base currently includes the following systems: 18 CT scanners, 61 radiographic CR/DR systems, 24 angiography systems, 64 fluoroscopy systems, 21 mobile radiography CR/DR units, 15 mammography systems, 2 stereotactic biopsy mammography systems, 5 bone densitometry systems, 2 dental units, 25 ultrasound units, 16 MR systems, 6 gamma camera /SPECT systems, 3 PET/CT systems, and 1 PET/MR system.

## 7.5 Resident Feedback on Residency Program Including Quality of Instruction, Effectiveness of Mentors and of the Program in General, and Recommendations for Improvement; Protection from Retribution:

The resident provides an annual evaluation of the mentors, and of the residency program in general, by completing an online Qualtrics Survey (an example in **Appendix J**). This survey also asks for any recommendations that the resident has for improvements in the program. These evaluations are reviewed by the Program Director and the Chair of the Department of Medical Physics. The Program director and the Chair of the Medical Physics Department meet annually with each resident to discuss the resident evaluations of the faculty and provide feedback for the resident.

The Program Director and the Steering Committee review all exit surveys submitted by graduates of the program and use such information to make recommendations to improve program content and processes. Additionally, any resident may communicate with the Steering Committee by submission of written materials to the program director which are shared with the Steering Committee, or by requesting to interact with the Steering Committee at one of its meetings.

The UW SMPH Policy 90.01: Grievance Policy for Graduate Programs in the School of Medicine and Public Health addresses protection of the residents from retribution and as an additional method for addressing grievances. Residents also have access to the School of Medicine and Public Health's Ombudsperson as a neutral, independent, and confidential resource for addressing any issues that may arise.

## 7.6 Feedback from Program Graduates:

Exit surveys submitted by graduates of the program. Both verbal and written feedback is also sought from past graduates of the residency program, considering their current experience and professional positions. Communication is maintained with past graduates so that our program remains informed on their professional progress. The program director and the steering committee use such information to make recommendations to improve program content and processes.

## 7.7 Action on Feedback from Residents:

Annually, the Steering Committee considers the annual reviews submitted by the residents and any exit surveys. In a meeting of the Steering Committee, the mentors consider actions to address concerns raised and make recommendations to improve program content and processes. The Program Director then works with the mentors to put the actions determined in this meeting into effect.

## 7.8 Recording of Resident Activities:

Each resident must keep a log of activities for each clinical modality rotation in a specified folder in the residency's Google Drive. This log details the date of performance, the site where primary activity took place, description of imaging instrument tested (if that is the activity), and a description of the activity. Mentors for each rotation can access this folder to monitor the resident's progress. An example of this log is shown in **Table 1** in Section 2.11.

# 8. Residency Curriculum

## 8.1 Training Schedule:

### 8.1.1 Duration and Timing of Each Clinical Rotation

**Table 5** lists each rotation module with the approximate percent of time spent in each. **Table 7** (pages 31-33) matches each element of the CAMPEP imaging physics residency program standards with the rotation(s) in which the topic is addressed. Approximately thirty-three percent of each resident's time will be spent on two or more clinical projects of particular importance to actual clinical practice, with each project reviewed and approved by the Steering Committee.

The overview listing of all rotations along with the approximate time spent in each is given below in **Table 5**. Approximate timing of each rotation is shown in **Table 6**. Additionally, there are detailed descriptions of each rotation contained in **Appendix C**. In each description, the competency goals are described, the method of evaluation is presented, reference materials are provided, and the duration of the rotation is defined. Common basic requirements across all 11 rotations are provided below.

**Table 5: Overview of the Imaging Physics Residency Program Rotations**

| Imaging Physics Residency Fundamental Rotations (1-9) and Additional Topics | Approx. Percent of Residency |
|---|---|
| 1. X-ray Imaging Review and Introduction to Methods of Image Equipment Evaluation | 4 |
| 2. Radiography, including digital (CR/DR) imaging systems | 8 |
| 3. Fluoroscopy, including image intensifiers and digital systems | 5 |
| 4. Angiography, including interventional and cardiology applications | 4 |
| 5. Mammography, including tomosynthesis and stereotactic breast biopsy systems | 5 |
| 6. Computed Tomography (CT) | 8 |
| 7. Magnetic Resonance Imaging (MRI) | 8 |
| 8. Ultrasound | 6 |
| 9. Nuclear medicine, including PET/CT (overview, not an area of specialization) | 5 |
| 10. Informatics, including PACS, computer networks, and teleradiology | 5 |
| 11. Radiation Safety | 4 |
| Ethics, leadership, and professionalism | 5 |
| Extended experience in two or more of the above modalities (following Steering Committee approval), including clinical projects | 33 |
| Total | 100 |

**Table 6: Sample Training Plan – First Year Rotation Schedule:**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Intro to Imaging Systems** | **Radio-graphy** | **Fluoro** | **Angio** | **Mammo-graphy** | **CT** | **MRI** | **Ultra-sound** | **Nuclear Medi-cine** | **Radia-tion Safety** | **PACS, Infor-matics** |
| **1** | **X** | | | | | | | | | | |
| **2** | | **X** | | | | | | | | | **X** |
| **3** | | x | | | | | | | | **X** | x |
| **4** | | x | **X** | | | | | | | x | x |
| **5** | | x | x | **X** | **X** | **X** | | | | x | x |
| **6** | | x | x | x | x | x | **X** | | | x | x |
| **7** | | x | x | x | x | x | x | **X** | **X** | x | x |
| **8** | | x | x | x | x | x | x | x | x | x | x |
| **9** | | x | x | x | x | x | x | x | x | x | x |
| **10** | | x | x | x | x | x | x | x | x | x | x |
| **11** | | x | x | x | x | x | x | x | x | x | x |
| **12** | | x | x | x | x | x | x | x | x | x | x |

*Includes review and assessment of imaging physics fundamentals using the *Essential Physics of Medical Imaging, Third Edition* by Bushburg, *et al.* and other relevant materials.

**X**: Initial clinical introduction to modality

x: Continuing testing and involvement with modality

Notes:

1) The specific timings of some of these rotations will change year-to-year depending on availability of equipment and personnel. The total time allocated to each rotation, however, will remain constant.

2) Continuing education and training and further testing experience as imaging systems are scheduled for acceptance testing and/or annual system performance testing will be provided in the second year, along with clinically directed projects, *etc*.

In the clinical facilities that are part of the residency program, testing is required throughout the year. To maximize the amount of testing in which the residents can participate, the testing for each rotation continues throughout the residency from a point after a specific rotation has begun.

In addition to the log of clinically directed project activities discussed in Section 8.1.4, a log of activities for each clinical modality rotation is maintained by the resident in a separate folder in his/her activity log and shared with the clinical rotation mentor for the modality. Each week, the clinical rotation mentor reviews and signs off on completed activities, noting any deficiencies or concerns. In this manner, the resident has frequent feedback during the rotation. The activity records are also be shared with the Associate Director to allow his/her review at least twice during each rotation.

The log of activities details the description of the task, date of performance, site where primary activity took place, model and description of imaging instrument tested, and role the resident played. A column is provided for the mentor to indicate his/her approval for successful completion of a particular activity (column 6, "Mentor Eval").

Competencies that involve the testing and evaluation imaging systems, analysis of the test data, and the creation of test reports are evaluated at three successive levels of completion. Each level of completion is documented by the mentor:

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participation in the testing and in data collection under the supervision of the preceptor and assistance in report writing,

(3) Performing testing tasks without significant oversight, and the creation of an entire report with only review by the preceptor.

### 8.1.2 Clinical Rotation Objectives

**Appendix C** provides detailed outlines for each scheduled rotation. The specific training objectives are presented in the competencies section. Each rotation has a description of the methods that are used to assess progress. At the beginning of each rotation, the clinical rotation mentor and resident meets to discuss the objectives, assess the degree of familiarity the resident has with the rotation topic, and agree on any additional didactic material that may be required prior to initial work with the imaging device(s) at hand. In most cases, prerequisites for the rotation will have been met, and the initial meetings are a review and extension of graduate level knowledge. The mentor also helps the resident become familiar with clinical conferences pertaining to the rotation. For example, ultrasound rotation periods are enhanced through attendance at the bimonthly sonographer meetings in the city of Madison, reading room collaborations with physician interpreters, and, where appropriate, direct observations of clinical scan procedures.

Each rotation module also contains a reading list to supplement the testing and report experience.

In addition to the modules listed above, each resident is required to attend at least three meetings of the Radiation Safety Committee.

### 8.1.3 Educational and Training in Expectations for Each Modality:

In addition to the basic medical imaging systems operation and the methods of testing them, also included is the understanding of state and federal regulations and testing requirements (including testing frequency), any Joint Commission requirements, and any accreditation program requirements, *e.g.*, ACR.

Residents learn proper interpretation and reporting of test results. This comprises the creation of an accurate and understandable test report, including recommendations for improvements in image quality and safety as well as documentation of any deficiencies involving state and federal regulations and testing requirements, any Joint Commission requirements, and/or any accreditation program requirements.

Residents must demonstrate the ability to interpret reports for clinical staff and answer questions about the reports from the clinical staff.

Residents also must demonstrate an ability to understand clinical problems encountered in each medical imaging modality, along with problem solving methods.

### 8.1.4 Optional Research Opportunities Which do not Compromise Clinical Training

Clinically directed research projects are an important part of the residency program. Faculty in Medical Physics and Radiology are encouraged to submit proposals for projects that are directly related to the clinical practice of medical physics but outside the scope of clinical rotations. A web-based application procedure is available for such proposals which are evaluated by the program director for relevance to the overall objectives of the program, training value, and to make sure that they do not compromise clinical training. If approved, the opportunities are presented to the residents who may accept or decline them based on their interests and individual training objectives. Some examples of potential projects are mentioned in the rotation descriptions. Examples of completed by previous residents are listed in Table 4.

## 8.2 Elements of Clinical Training:

Minimum requirements of clinical training are described below for completing a residency in imaging physics. For tests to be conducted, the number of systems to be tested to demonstrate competency is left to the discretion of the Program Director, and the clinical rotation mentor, except for systems where accrediting agencies define the minimum number of systems that must be tested for an individual to be considered a qualified medical physicist, *e.g.,* MQSA. In these cases, the minimum number of systems to be tested shall be at least the number specified by the accrediting/regulatory agency. For topics that define quantities that may be measured or computed, the resident should perform actual measurements or computations to demonstrate familiarity with the quantities and their uses.

The following topics, listed in their order of appearance in the CAMPEP Standard for Residency Training, are covered as part of this Imaging Physics Residency. (**Table 7**). Please refer to the individual modules in **Appendix C** for details of each module.

**Table 7: Mapping of CAMPEP Residency Program Standards to UW Imaging Physics Residency Rotations**

*System performance evaluations and quality control, safety, and compliance tests, including vendor recommendations*

| Training Topic | Rotation(s) in Appendix C |
|---|---|
| Radiography | Radiography |
| Computed Radiography | Radiography, Mammography |
| Fluoroscopy | Fluoroscopy, Angiography |
| Interventional/angiography | Angiography |
| Mammography | Mammography |
| Stereotactic breast biopsy | Mammography |
| Computed Tomography | Computed Tomography |
| Magnetic Resonance | Magnetic Resonance Imaging |
| Ultrasound | Ultrasound |
| Image Processors/printers | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography |

***Safety evaluations***

| Training Topic | Rotation(s) in Appendix C |
|---|---|
| Entrance exposure estimates | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Radiation Safety |
| Organ dose estimates | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Computed tomography dose index (CTDI) and dose length product (DLP) | Computed Tomography, Radiation Safety |
| Mean glandular dose | Mammography, Radiation Safety |
| Effective dose | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Risk estimates | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Personnel exposure estimates and reduction | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Fetal dose | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Contrast agents | Fluoroscopy, Angiography, Computed Tomography, Magnetic Resonance Imaging, Ultrasound |
| Protocol optimization | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Magnetic Resonance Imaging |
| MRI hazards | Magnetic Resonance Imaging |
| Organ/fetal dose with MIRD system | Nuclear Medicine |
| Radiopharmaceutical applications and risks | Nuclear Medicine |
| Shielding design | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Magnetic Resonance Imaging, Radiation Safety |
| Personnel shielding/monitoring | Radiology, Fluoroscopy, Angiography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Calibration and survey instruments | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Radiation surveys | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |
| Safety/policies | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Magnetic Resonance Imaging, Ultrasound, Radiation Safety |
| Compliance audits | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Ultrasound, Radiation Safety |
| Dose limits | Radiology, Fluoroscopy, Angiography, Mammography, Computed Tomography, Nuclear Medicine, Radiation Safety |

## Informatics

| Training Topic | Rotation in Appendix C |
|---|---|
| Picture archiving and communication systems (PACS) and radiology information systems (RIS) | Informatics |
| Digital imaging and communication systems (DICOM) standards | Informatics |
| Information acquisition from PACS/images | Informatics |
| Informatics variations among modalities | Informatics |
| Dose reporting | Informatics |
| Use of Integrating the Healthcare Enterprise (IHE) radiology profiles | Informatics |
| Open source software resources | Informatics |
| Quality/maintenance of imaging workstations | Informatics |
| Evaluation of viewing conditions | Informatics |
| Image registration, fusion, segmentation, processing | Informatics |
| Computer-aided detection (CAD) and computer-aided diagnosis (CADx) systems | Informatics |

## 8.3 Summaries of Elements of Clinical Training of Each Rotation:

Please refer to the individual modules in **Appendix C** for a detailed description of each module.

## 8.4 Processes for Creating and Modifying Training Objectives:

Specific rotations emerged out of the lists of tasks that are performed by clinical imaging physicists at UWHealth as well as from the CAMPEP residency standards. As new imaging techniques come online, rotations will be adapted, or new rotations will be implemented to accommodate the need.

Evaluations of the current rotation schedule and content occur annually during regular meetings of the Steering Committee. Input from current residents and, whenever possible, from previous residents, are important when considering modifications to the program.

## 8.5 Facilities used by the Residents Including Location, Availability, and Capacity:

As listed in Section 3, "Program Structure and Governance", imaging facilities in UWHC, AFCH, TAC, WIMR, the imaging clinics of the UWMF, UPMC and its clinics are employed in this residency. Each year, a Memorandum of Understanding (MOU) between the Department of Medical Physics RPS and the UWHC is executed. The MOU defines the services to be provided by the RPS to the UWHC, AFCH, TAC, and UWMF and the compensation to the RPS for such services. Beginning with the 2016-17 version of the MOU, explicit inclusion of imaging physics resident education and training has been included. There is an addition agreement between the Department of Medical Physics RPS and the UPMH, which also explicitly includes the participation of the residents in testing,

Clinical facilities are made available for testing, research, and teaching outside the hours of clinical operations, and during clinic hours when permitted by the clinical workload or required for time-sensitive physics activities such as acceptance testing, troubleshooting or tests following major repairs. The extensive research facilities in WIMR can be scheduled for research projects and educational purposes. A PACS workstation is also available in WIMR for viewing and analyzing clinical and research images.

## 8.6 Ethics and Professionalism Curriculum

Residents will take the UW-Madison Medical Physics Program graduate course, MP 701 *Ethics and Responsible Conduct of Research and in the Practice of Medical Physics*. The course will be waived for residents who provide transcripts showing evidence of having taken an equivalent graduate course. Additionally, residents will participate in the workshop *Leadership* offered by the University of Wisconsin Office of Continuing Studies. The topics covered in the class as given in **Table 8** below.

**Table 8: Specific Topics in Ethics and Professionalism Addressed During the Residency**

| Professionalism and Ethics | How covered | Comments |
|---|---|---|
| Professionalism | MP701 *Ethics and the Responsible Conduct of Research and Practice of Medical Physics*. Professionalism is a constant topic throughout the MP701 course. | |
| Definition of a profession and professionalism | Each clinical rotation/module | |
| Elements of a profession | Each clinical rotation/module | |
| Definition of a professional | Each clinical rotation/module | |
| Elements of professionalism | MP701, discussed in each lecture | |
| How is professionalism judged? | MP701, discussed in each lecture | |
| Do's and don'ts of professionalism | MP701, discussed in each lecture | |
| Physician's charter and applicability to physicists | MP701, Class 8, Ethics in a medical setting | |
| Leadership | MP701, The importance of ethics and leaderships is discussed in class 1 and classes throughout the semester.<br>Elements of leadership in Medical Physics is discussed during each clinical rotation, both during introductory discussions and during hands on clinical work and summaries of reports. | |
| Vision and charisma | | |
| Qualities of leaders | | |
| Rules of leadership | | |
| Causes of leadership failure | | |
| Ethics | MP 701 | |
| Ethics of a profession | MP701, Class 1 and 7<br>From the first-class discussion, we aim to illuminate the role the resident will have in society and the importance of ethics in daily life. | |
| Ethics of an individual | MP701, Classes 1 and 5<br>The class on human subjects (class 5) specifically discusses issues of ethics in individuals. | |
| Interactions with colleagues and co-workers | MP701, Classes 1-3 and 8 | |

| | | |
|---|---|---|
| | Interaction with colleagues is analyzed from different angles, including authorship and negotiation of decisions that affect patients as well as professional societies. | |
| Interactions with patients and the public | MP701, Classes 1, 3, 5-6 on clinical research and human subjects.<br>This topic is analyzed from the point of view of a resident interacting with patients, and addresses COI as well as an issue for confidentiality and trust. | |
| Confidentiality | MP701, Classes 1-6 and 8<br>In depth discussion with relationship to human subjects but also as an important aspect of being a professional, including reviewing papers, and using social media. | |
| Peer review | MP701, Classes 2 and 3<br>What defines a peer review, when it is applied, and how it affects our gaining of knowledge is covered mainly in classes 2 and 3, but also throughout the course. | |
| Negotiation skills | MP701, Classes 1, 3 and 4<br>The class on law and ethics (class 4) provides particular insight on contracts. | |
| Relationships with employers | MP701, Classes 1, 4, and 8 | |
| Conflicts of interest | MP701, Class 3 is devoted to COI | |
| Ethics in research | MP701, Ethics in research is discussed throughout the course | |
| Use of animals in research | MP701, Class 7. A key practical aspect is the point by point analysis of what an IACUC does and case studies of IACUC protocols to see how they are filled out. | |
| Use of humans in research | MP701, Classes 5 and 6. Both classes are devoted to clinical research, providing historical background as well as practical information. | |
| Relationships with vendors | MP701, Class 3 | This topic is covered in depth in class 3, which focuses on COI. |
| Publication ethics | MP701, Classes 2 and 3 | Class 2 analyzes in depth the issues in data reporting, while class 3 further discusses how COI affects publications. |
| Ethics in graduate and resident education | MP701, Classes 1 and 8 | Class 1 analyzes the role of mentor and mentees, while class 8 provides insight on resident life. |
| Selected case studies | MP701, discussed in each lecture | In every class different case studies and ethical questions are presented for discussion. |

# Summary

**Current Strengths:**

Current strengths of the program include the leveraging of one of the largest and oldest medical physics graduate programs in North America, an extensive and advanced installed base of medical imaging equipment in a large academic hospital as well as regional clinic environments, and active participation by both medical physics faculty and academic radiology faculty. We have a group of very highly regarded faculty in both Medical Physics and Radiology. We believe that we can offer many opportunities for clinical physics education, including insightful testing methods, that might not be commonly encountered in other graduate or residency programs. We have developed a substantial resource of didactic materials in medical imaging physics which contains useful information not otherwise available in texts or published papers. We utilize a large library of clinical problems that the resident is asked to consider and solve. We also have a large online library of thousands of references, specifically for the residency program, which the residents can access. Much important imaging equipment has been developed at the University of Wisconsin in addition to testing equipment and testing methods for the evaluation of medical imaging equipment.

**Future Goals:**

Further development in the content of each rotation, particularly of the newest rotations: X-ray Imaging Review and Introduction to Methods of Image Equipment Evaluation; and Radiation Safety. This will involve the increased involvement of the newer faculty along with more established faculty. We will continue to pursue the development of better methods of evaluating medical imaging equipment and the creation of better testing equipment.

# Appendix A - Letters of Invitation and Institutional Commitment

## Letter from Chair, Medical Physics

Department of Medical Physics
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

March 24, 2021

Nesrin Dogan, PhD
Chair, Residency Education Program Review Committee
Commission on Accreditation of Medical Physics Education Programs, Inc.
University of Miami
Radiation Oncology Department
1475 NW 12th Ave, Suite 1500 (D-31)
Miami, FL 33136

Dear Dr. Dogan,

As acting chair of the Department of Medical Physics, I would like to invite the Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP) to review the Department of Medical Physics Imaging Physics Residency Program for the approval of another 5-year certification of our program.

The Program Director for the Imaging Physics Residency Program is Frank Ranallo, PhD, DABR, FAAPM, DABR and the Associate Director is John Vetter, PhD, DABR. The Department of Medical Physics provides administrative and financial support for the program and is committed to continue such support.

We look forward to the feedback of the self-study reviewers. The input from such reviews will undoubtedly allow us to further strengthen the program.

Sincerely,

Timothy J Hall, PhD
Professor and Interim Chair, Department of Medical Physics
Director, Medical Physics Graduate Program
Director, UW Radiological Sciences Training Program
tjhall@wisc.edu

## Letter from Chair, Radiology

DEPARTMENT OF
RADIOLOGY
University of Wisconsin
School of Medicine and Public Health

March 26, 2016

Timothy J Hall, PhD
Professor and Interim Chair
Department of Medical Physics
University of Wisconsin School of Medicine & Public Health
1111 Highland Avenue, 1016 WIMR
Madison, Wisconsin 53705

Dear Tim:

I am writing to express my enthusiastic support for the Imaging Physics Residency Program, which was accredited by the Commission on the Accreditation of Medical Physics Education Programs, Inc. (CAMPEP) four and a half years ago. I have been associated with this residency, and supported it, from its inception, and am very pleased with its evolution over time. I am pleased to lend support for this program from the Department of Radiology. This support builds on our long-standing collaboration on research and education programs here at the University of Wisconsin School of Medicine and Public Health and is in the form of commitments for financial support, faculty mentorship, and access to medical imaging equipment in the UW Hospital and Clinics (UWHC) and associated UWHealth facilities.

In terms of financial support, I have requested support for one imaging physics resident per year in our most recent budget request from the Department of Radiology to the UWHC. With regard to Department of Radiology faculty mentorship, I am very supportive of the participation of Department of Radiology faculty as mentors and faculty members in this residency program.

The Departments of Radiology and Medical Physics have a very long history of successful collaborations in research, education, and patient care. I am very excited to aid in the continued development of the Department of Medical Physics Imaging Physics Residency Program as an accredited program committed to the education and training of the next generation of leaders in the field of clinical imaging physics. One important component of this collaboration has been the great success of the UW-GE CT protocol project. This is a cooperative effort between the Department of Radiology and Medical Physics with GE Healthcare to provide GE with protocols that are delivered with their CT scanners installed around the world. This project additionally provides the residents with significant additional opportunities to participate in some very important clinical work.

Please let me know if there are additional opportunities to support the renewal of the CAMPEP accreditation for the next five years. I am happy to continue our support of the program over period of the next five-year accreditation.

Sincerely,

Thomas M. Grist, MD, FACR
John H. Juhl Professor of Radiology,
Medical Physics and Bioengineering
Chair, Department of Radiology

| | | |
|---|---|---|
| Clinical Science Center, MC 3252 | **Thomas M. Grist, MD, FACR** | Office: 608-265-8231 |
| 600 Highland Avenue, E3/366 | John H. Juhl Professor of Radiology, | FAX: 608-263-0876 |
| Madison, WI 53792-3252 | Medical Physics and Bioengineering | tgrist@uwhealth.org |
| www.radiology.wisc.edu | Chair, Department of Radiology | |

**Letter from Senior Associate Dean, SMPH**

University of Wisconsin
SCHOOL OF MEDICINE
AND PUBLIC HEALTH

Administration

April 12, 2016

Nesrin Dogan, PhD
Chair, Residency Education Program Review Committee
Commission on Accreditation of Medical Physics Education Programs, Inc.
University of Miami
Radiation Oncology Department
1475 NW 12th Ave, Suite 1500(D-31)
Miami, FL 33136

Dear Dr. Dogan,

I am writing this letter to invite the Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP) to evaluate for initial accreditation the Department of Medical Physics Imaging Physics Residency Program. The Department of Medical Physics is one of 10 basic science departments and 17 clinical departments in the University of Wisconsin School of Medicine and Public Health, and is home to the largest, and one of the first, medical physics graduate education programs accredited by CAMPEP. The formal development and implementation of an Imaging Physics Residency is an exciting addition to the medical physics education and training programs provided by this department.

We understand the request for program evaluation is voluntary and agree to abide by the decision of the CAMPEP Board of Directors as specified in the *Standards for Accreditation of Residency Education Programs in Medical Physics*.

Sincerely,

Richard L. Morse

Senior Associate Dean
Office of Basic Research, Biotechnology
and Graduate Studies

Office of the Dean
608/263-4910
Fax 608/265-3286

Health Sciences Learning Center
750 Highland Avenue
Madison, WI 53705-2221

General Information 608/263-4900
Fax 608/262-2327
www.med.wisc.edu

**Letter from Project Administrator, UW-GE Protocol Project**

Department of Radiology
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

March 22, 2021

Nesrin Dogan, PhD
Chair, Residency Education Program Review Committee
Commission on Accreditation of Medical Physics Education Programs, Inc.
University of Miami
Radiation Oncology Department
1475 NW 12th Ave, Suite 1500 (D-31)
Miami, FL 33136

Dear Dr. Dogan:

At the University of Wisconsin–Madison, the Departments of Radiology and Medical Physics have been working together with UW Health CT Technologists to develop and improve the CT imaging protocols used at UW Health. This effort has the goal of reducing patient dose, while enabling the acquisition of more clinically useful images and reducing the frequency of repeat scans. In this effort the UW has partnered with GE Healthcare in providing GE with protocols that are delivered with their CT scanners installed around the world.

As the UW Project Administrator of the UW GE CT Protocol Partnership project, I am happy to announce that the success of this project has allowed us to continue ongoing financial support for the UW Imaging Physics Residency Program in the Medical Physics Department. The UW Imaging Physics Residency Program is a two-year training program that prepares post-graduate Medical Physicists to perform independently as clinical medical imaging physicists.

In support of this two-year Residency Program, the UW GE CT Protocol Project will be funding a new incoming Medical Physicist resident for the upcoming FY22 fiscal year starting July 1, 2021 at a cost of approximately $88,315 (base salary plus fringe).

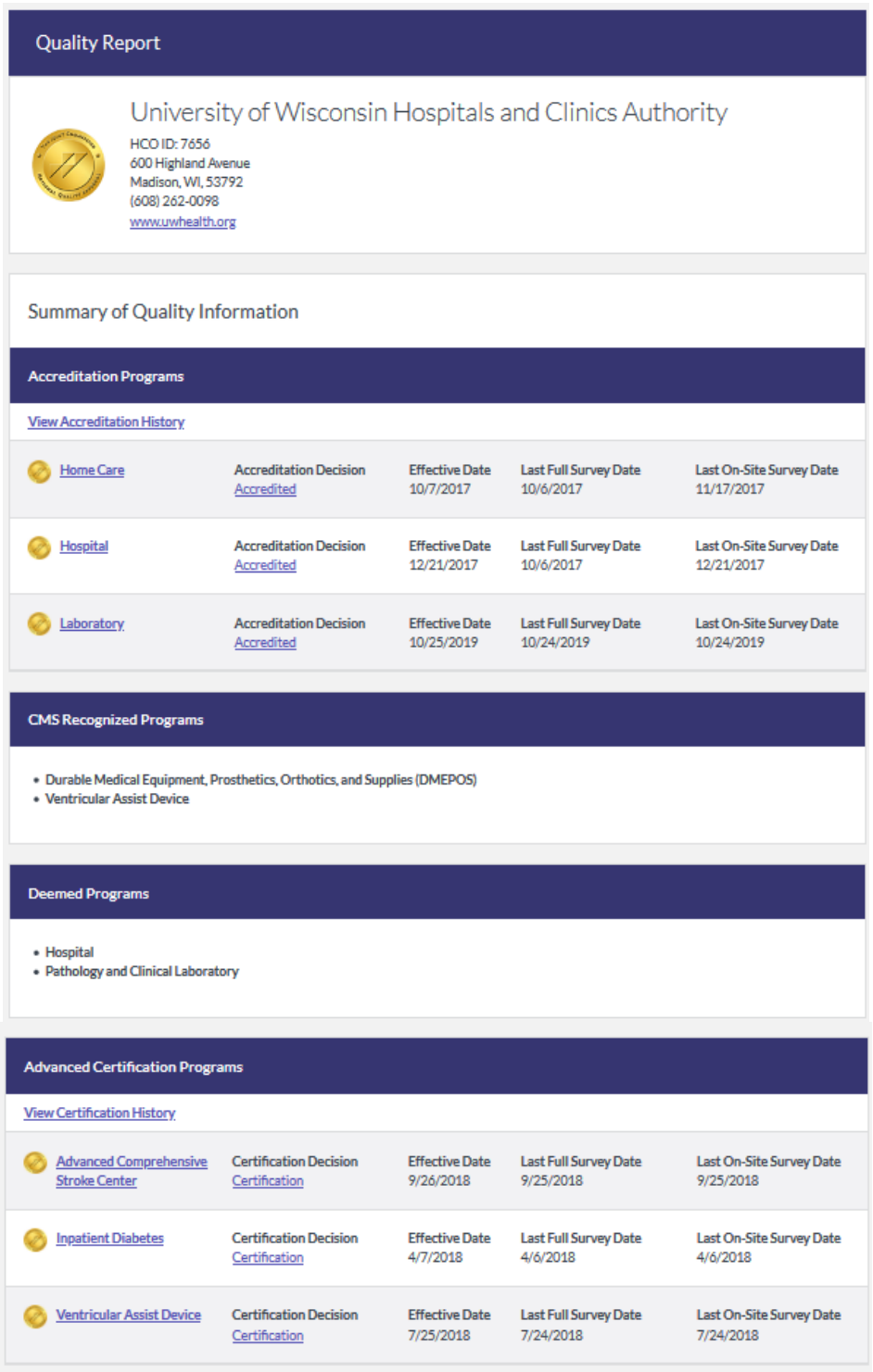
Sincerely,

Lisa Aumann, MBA
Project Administrator

Department of Radiology
University of Wisconsin School of Medicine and Public Health Clinical Science Center 600 Highland Ave Madison, Wisconsin 53792-3252
608/265-8231 Fax: 608/263-0876 E-mail: jdoe@uwhealth.org www.radiology.wisc.edu

# Appendix B - Documentation of Institutional Accreditation

The Joint Commission "Quality Check" documentation of the accreditation of the UWHC and the UPMH are provided below. Other clinics cited in this self-study are included as DBA affiliates of UWHC or of UPMH. Any additional documentation of accreditation will be provided on request.



Quality Report

University of Wisconsin Hospitals and Clinics Authority

HCO ID: 7656
600 Highland Avenue
Madison, WI, 53792
(608) 262-0098
www.uwhealth.org

Summary of Quality Information

**Accreditation Programs**

View Accreditation History

| | | | | |
|---|---|---|---|---|
| Home Care | Accreditation Decision: Accredited | Effective Date: 10/7/2017 | Last Full Survey Date: 10/6/2017 | Last On-Site Survey Date: 11/17/2017 |
| Hospital | Accreditation Decision: Accredited | Effective Date: 12/21/2017 | Last Full Survey Date: 10/6/2017 | Last On-Site Survey Date: 12/21/2017 |
| Laboratory | Accreditation Decision: Accredited | Effective Date: 10/25/2019 | Last Full Survey Date: 10/24/2019 | Last On-Site Survey Date: 10/24/2019 |

**CMS Recognized Programs**

- Durable Medical Equipment, Prosthetics, Orthotics, and Supplies (DMEPOS)
- Ventricular Assist Device

**Deemed Programs**

- Hospital
- Pathology and Clinical Laboratory

**Advanced Certification Programs**

View Certification History

| | | | | |
|---|---|---|---|---|
| Advanced Comprehensive Stroke Center | Certification Decision: Certification | Effective Date: 9/26/2018 | Last Full Survey Date: 9/25/2018 | Last On-Site Survey Date: 9/25/2018 |
| Inpatient Diabetes | Certification Decision: Certification | Effective Date: 4/7/2018 | Last Full Survey Date: 4/6/2018 | Last On-Site Survey Date: 4/6/2018 |
| Ventricular Assist Device | Certification Decision: Certification | Effective Date: 7/25/2018 | Last Full Survey Date: 7/24/2018 | Last On-Site Survey Date: 7/24/2018 |

## Quality Report

# Meriter Hospital, Inc.

DBA: UnityPoint Health - Meriter
HCO ID: 7653
202 South Park Street
Madison, WI, 53715-1596
(608) 417-6000
www.unitypoint.org

## Summary of Quality Information

### Accreditation Programs

View Accreditation History

| | Accreditation Decision | Effective Date | Last Full Survey Date | Last On-Site Survey Date |
|---|---|---|---|---|
| Hospital | Accredited | 10/11/2018 | 7/27/2018 | 3/21/2019 |

### Deemed Programs

- Hospital

### Advanced Certification Programs

View Certification History

| | Certification Decision | Effective Date | Last Full Survey Date | Last On-Site Survey Date |
|---|---|---|---|---|
| Primary Stroke Center | Certification | 8/8/2019 | 8/7/2019 | 8/7/2019 |

# Appendix C – Clinical Rotation Summaries

## Rotation Title: X-ray Imaging Review and Introduction to Methods of Image Equipment Evaluation

**Preceptor/Mentor**: **Frank Ranallo, PhD, DABR, FAAPM**

**Recommended References**:

*The Essential Physics of Medical Imaging –4th Edition*, Bushberg JT, *et. al.*, 2020, Chapters 1-4, 6-7, 11, 21.

*Diagnostic Radiology Physics, IAEA,* Dance DR*, et al.,* 2014, Chapters 1-7, 16.

*Physics of Radiology - 2nd Edition*, Wolbarst AB, 2005, Chapters 1-10, 14-22, 24-40.

*Imaging Systems for Medical Diagnostics –4th Edition*, Oppelt A (ed)., 2005, Chapters 1-11, 16-19, 21.

## *1. Training Objectives and Experiences*

### Objectives

This rotation ensures that the residents have the requisite knowledge and understanding of the basic x-ray imaging principles needed for the following four rotations involving imaging with x-rays. It also introduces to them to the method of imaging equipment evaluation. The rotation occurs during the first month of the residency. It involves (1) instruction, (2) quizzing, (3) discussion between mentor and resident of concepts and methods of both the technology and its evaluation, and (4) presenting the residents with actual clinical physics problems encountered in medical imaging for them to analyze and solve.

### Detailed List of Competencies:

Demonstrate an understanding of the following basic concepts:

1. The basic physics of radiation and the atom.
2. Interactions of radiation with matter.
3. Radiation Quantities and Units
4. Image quality, including contrast, noise, sharpness, and artifacts.
5. Production and control of x-rays: interaction of electrons with matter, x-ray production, x-ray tubes, x-ray generators, filtration, collimation.
6. Patient attenuation of x-rays, anti-scatter grids and AEC systems.
7. Image receptors – CR and DR.
8. Image artifacts and methods of prevention
9. Mammography.
10. Fluoroscopy, Angiography, and Digital Subtraction Angiography.
11. Computed Tomography.
12. Instrumentation used in the evaluation of medical imaging systems.
13. Principles of the evaluation of medical imaging systems.

## *2. Evaluation of Progress in the Rotation*

Performance evaluation will be based on the following elements:

- Initial oral examination.
- Participation in lectures and discussion sessions on the topics of the competencies.
- Directed study on the topics of the competencies.
- Presentation of solutions to presented clinical problems.
- Final oral examination.

## *3. Didactic Requirements*

The rotation occurs during the first month of the residency. It involves (1) instruction, (2) quizzing, (3) discussion between mentor and resident of concepts and methods of both the technology and its evaluation, and (4) presenting the residents with actual clinical physics problems encountered in medical imaging for them to analyze and solve.

## *4. Work Assignments, Reports and Examinations*

See part 2 above.

## *5. Mentor Evaluations of Resident's Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See parts 1, 2 and 3 above.

## *7. Training Schedule*

Beginning in the first month of the residency, the duration of this rotation is dependent on the previous training and experience of the resident.

Optional research and development opportunities could include preparation and presentation of related educational materials.

## Rotation Title: Radiography

**Preceptor/Mentor**: **John Vetter, PhD, DABR, Frank Ranallo, PhD, DABR, FAAPM**

**Recommended References**:

*The Essential Physics of Medical Imaging –4th Edition*, Bushberg JT, *et. al.*, 2020, Chapters 1-4, 6-7.

*Diagnostic Radiology Physics, IAEA, Dance DR, et al.,* 2014, Chapters 1 – 7, 10, 16.

*Physics of Radiology - 2nd Edition*, Wolbarst AB, 2005, Chapters 1-10, 14-22, 24-34, 36-37.

*Imaging Systems for Medical Diagnostics –4th Edition*, Oppelt A (ed)., 2005, Chapters 1-7, 10, 16-19, 21.

*Specifications, Performance Evaluation, and Quality Assurance of Radiographic and Fluoroscopic systems in the Digital Era*, Goldman LW and Yester MV (ed), AAPM Monograph No. 30.

*Practical Digital Imaging and PACS*, Seibert JA, et. al. (ed), AAPM Monograph No. 25.

*Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment*, Seibert JA, *et al.* (ed), AAPM Monograph No. 20.

*Advances in Digital Radiography*, Categorical Course in Diagnostic Radiology Physics, Samei, E (ed), RSNA.

*Ongoing Quality Control in Digital Radiography*: Report of AAPM Imaging Physics Task Group 151, AAPM Report #151.

*Acceptance Testing and Quality Control of Photostimulable Storage Phosphor Imaging Systems*, AAPM Report #93.

*Quality Control in Diagnostic Radiology*, AAPM Report #74.

*Code of Federal Regulations, Title 21, Chapter 1, Subchapter J, Part 1020.*

*Wisconsin Chapter DHS 157 – Radiation protection, and other state radiation protection regulations.*

## *1. Training Objectives and Experiences*

### Objectives

This rotation provides training to enable the resident to develop expertise in providing comprehensive physics support for radiographic imaging, including physics surveys, facility design, equipment selection and radiation safety for patients and staff.

### Detailed List of Competencies:

1. Understand the process of x-ray generation and the proper testing methods and data analysis for testing involving evaluation of the x-ray tube, collimator, cassette tray, and generator. Perform accurate testing and analysis of these components.

2. Understand the physics and technology of various image receptors: screen-film, CR, and DR and of the exposure indicators for digital image receptors. Understand the proper testing methods and data analysis for the testing of these image receptors. Perform accurate testing and analysis of these image receptors including evaluation of the exposure indicators and the processor for CR.
3. Understand how to test for the presence of image artifacts due to the imaging system or to the image receptor. Understand the proper testing methods and data analysis for the detection of image artifacts. Perform accurate testing and analysis to identify image artifacts and to determine their causes.
4. Understand the design and function of anti-scatter grids and the proper testing methods and data analysis for evaluating grid. Perform accurate testing and test analysis of grids.
5. Understand the physics and technology of automatic exposure control (AEC) systems. Understand the proper testing methods and data analysis for the testing of these systems. Perform accurate testing and analysis of AEC systems.
6. Understand federal and state regulations applicable to radiographic systems including operational tolerances and requirements for compliance with these regulations.
7. Understand how each of the previous six competencies is properly combined into a complete system test. Understand how to identify and analyze problems detected in these tests and the corrective actions that can be performed for operational improvements. Understand how to report system deficiencies that do not comply with government regulations. Understand how to report other types of system deficiencies that are detected. Understand how to create an accurate and understandable report for the health care faculty responsible for the radiographic equipment. Create actual reports of the results of system testing.
8. Understand design considerations for a new or remodeled facility including reading room design, radiation shielding requirements, and equipment selection. Participate in these activities with other clinical personnel.
9. Understand the requirements for reviewing radiation shielding designs for new or remodeled rooms, inspections during the actual construction process, and the creation of a radiation shielding report for submission to the health care facility and to the state. Assist in each of these processes.
10. Understand the processes for obtaining approval to operate radiographic imaging facilities and modalities including state licensing and the legal requirements. Assist in these processes as opportunities arise.
11. Understand how to calculate estimates of entrance exposures, organ doses, effective doses, and fetal doses. Perform calculations of these exposures/doses.
12. Understand the principles of personnel radiation safety and monitoring both for the clinical personnel and for the persons performing equipment evaluations. Answer radiation safety questions and provide guidance in radiation safety to the clinical staff. Use proper radiation safety techniques while performing medical physics duties.

## *2. Evaluation of Progress in the Rotation*

Competencies 1 and 2 involve achieving an understanding of the basic technical and physics principles of radiography. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident. The preceptor will document in the competency spreadsheet for the rotation, the resident's progress toward satisfying each of these competencies. They should be satisfied during first part of the radiography rotation.

Competencies 3 through 7 involve the testing and evaluation of actual radiographic systems, analysis of the test data, and the creation of test reports. These competencies are evaluated at three successive levels of completion. Each level of completion will be documented by the preceptor:

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participation in the testing and in data collection under the supervision of the preceptor and assistance in report writing,

(3) Performing testing tasks without significant oversight, and the creation of an entire report with only review by the preceptor.

Levels 1 and 2 should be satisfied by the completion of the radiography rotation. Level 3 must be completed before the end of the residency. The resident will normally participate in the testing of at least 4 radiographic systems at level 2 and at least 4 radiographic systems at level 3.

Competencies 8 through 12 involve activities beyond simply testing radiographic systems and creating reports. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident, and/or satisfactory completion of its stated activities, as appropriate. The preceptor will determine the date on which the resident has satisfied each of these competencies. Many may be satisfied during the radiography rotation, but they must be satisfied by the end of the residency.

For each competency, the completion of the competency is documented, signed, and dated by the resident and preceptor upon its completion. Additionally, the completion of each of the first two levels of completion of competencies 7 and 8 is also documented, signed, and dated by the resident and preceptor upon its completion.

Materials produced during the rotation, such as final test reports and any presentations, will be assessed for completion and accuracy and graded as "complete" or "incomplete".

## *3. Didactic Requirements*

The rotation begins during the second month of the residency and may last throughout its duration. It primarily involves hands-on instruction and experience with equipment testing, planning and problem solving involving radiographic imaging technology and its applications.

## *4. Work Assignments, Reports and Examinations*

See part 2 above. Written reports documenting physics surveys, shielding designs, and the results of investigations involving issues with image quality, radiation dose, etc. are expected of the resident.

## *5. Mentor Evaluations of Resident's Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Parts 2 and 4 above.

## *7. Training Schedule*

**Duration: 8 Weeks.** Starting in the second month of the residency and extending throughout the residency.

≈ 200 hours – Physics Surveys and Report Generation.

≈ 100 hours – Study: technical considerations of radiographic imaging, modality testing, dose considerations, exposure and patient dose calculations, facility design considerations, components of image quality, image quality vs. patient dose.

≈ 20 hours – Presentation of in-service training for clinical staff, Radiology Resident physics training, attendance of Radiology Grand Rounds and Medical Physics Seminars, other interactions with clinical staff.

Optional research and development opportunities could include designing and assessing new testing methods and phantoms for performance evaluation of x-ray imaging equipment.

## Rotation Title: Fluoroscopy

**Preceptor/Mentor**: **John Vetter, PhD, DABR, Frank Ranallo, PhD, DABR, FAAPM**

**Recommended References**:

*The Essential Physics of Medical Imaging –4th Edition*, Bushberg JT, *et. al.*, 2020, Chapters 4, 9, 21.

*Diagnostic Radiology Physics, IAEA, Dance DR, et al.,* 2014, Chapters 4, 8, 24.

*Physics of Radiology - 2nd Edition*, Wolbarst AB, 2005, Chapters 18-22, 35-37, 58-59.

*Imaging Systems for Medical Diagnostics –4th Edition*, Oppelt A (ed)., 2005, Chapters 2, 12.

*Specifications, Performance Evaluation, and Quality Assurance of Radiographic and Fluoroscopic systems in the Digital Era*, Goldman LW and Yester MV (ed), AAPM Monograph No. 30.

*Practical Digital Imaging and PACS*, Seibert JA, *et al*. (ed), AAPM Monograph No. 25.

*Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment*, Seibert JA, *et al.* (ed), AAPM Monograph No. 20.

*Advances in Digital Radiography*, Categorical Course in Diagnostic Radiology Physics, Samei, E (ed), RSNA.

*Ongoing Quality Control in Digital Radiography*: Report of AAPM Imaging Physics Task Group 151, AAPM Report #151.

*Acceptance Testing and Quality Control of Photostimulable Storage Phosphor Imaging Systems*, AAPM Report #93.

*Quality Control in Diagnostic Radiology*, AAPM Report #74.

*Code of Federal Regulations, Title 21, Chapter 1, Subchapter J, Part 1020*

*Wisconsin Chapter DHS 157 – Radiation protection, and other state radiation protection regulations*

## *1. Training Objectives and Experiences*

### Objectives

This rotation provides training to enable the resident to develop expertise in providing comprehensive physics support for fluoroscopic imaging, including physics surveys, facility design, equipment selection and radiation safety for patients and staff.

### Detailed List of Competencies:

Understanding the instrumentation of fluoroscopy systems and the methods of evaluation of these systems is built upon the competencies listed in the radiographic imaging section. Therefore, these competencies are also need for this rotation. These competencies most importantly include:

a. Understand the process of x-ray generation and the proper testing methods and data analysis for testing involving evaluation of the x-ray tube, collimator, and generator. Perform accurate testing and analysis of these components.

b. Understand the physics and technology of various image receptors: screen-film, CR, and DR and of the exposure indicators for digital image receptors. Understand the proper testing methods and data analysis for the testing of these image receptors. Perform accurate testing and analysis of these components.

The competencies specific to this rotation:

1. Understand the equipment technology and physics of fluoroscopic systems, beyond those of radiographic systems. This includes the production of real time images and the technology required to accomplish this: Image intensifiers and TV cameras as image receptors and digital flat panel detectors, with the ability to properly produce multiple images per second at fluoroscopic and acquisition dose rates; technology dealing with patient motion and image noise reduction.
2. Understand how to test for the accuracy of fluoro image receptor size, fluoro collimator adjustments, image/ x-ray field congruence, and fluoro image distortions. Perform accurate testing when indicated.
3. Understand how to test for the presence of image artifacts due to the imaging system or to the image receptor. Understand the differences in test methods and in the causes of artifacts occurring during fluoroscopic operation and those occurring during spot film or digital image acquisition. Understand the proper testing methods and data analysis for the detection of image artifacts. Perform accurate testing and analysis to identify image artifacts and to determine their causes.
4. Understand the design and function of anti-scatter grids and the proper testing methods and data analysis for evaluating grid. Understand the difference in grid use for fluoroscopic imaging and spot film or digital image acquisition. Understand how to remove the grid from the fluoroscopic system and when this is appropriate. Perform accurate testing and test analysis of grids when indicated.
5. Understand the physics and technology of automatic exposure rate control (AERC) systems for fluoroscopic operation and automatic exposure control (AEC) systems for spot film or digital imaging acquisition. Understand the proper testing methods and data analysis for the testing of these systems. Perform accurate testing and analysis of these systems.
6. Understand how to properly measure high contrast resolution and sharpness uniformity over the images. Perform accurate testing and analysis of this function.
7. Understand how to properly measure low contrast detectability over different exposure rate conditions. Perform accurate testing and analysis of this function.
8. Understand how to properly measure the x-ray fluoro entrance exposure rates with different phantoms during x-ray fluoroscopy and to how to properly measure the maximum fluoroscopy x-ray entrance exposure rate according to government regulations. Perform accurate testing and analysis of these functions.
9. Understand federal and state regulations applicable to fluoroscopic systems including operational tolerances and requirements for compliance with these regulations.
10. Understand how each of the previous items is properly combined into a complete system test. Understand how to identify and analyze problems detected in these tests and the corrective actions that can be performed for operational improvements. Understand how to report system deficiencies that do not comply with government regulations. Understand how to report other types of system deficiencies that are detected. Understand how to create an accurate and understandable report for the health care faculty responsible for the radiographic equipment. Create actual reports of the results of system testing.
11. Understand design considerations for a new or remodeled facility including reading room design, radiation shielding requirements, and equipment selection. Participate in these activities with other clinical personnel.

12. Understand the requirements for reviewing radiation shielding designs for new or remodeled rooms, inspecting shielding installation during the actual construction process, and the creation of a radiation shielding report for submission to the health care facility and to the state. Assist in each of these processes.
13. Understand the processes for obtaining approval to operate radiographic and fluoroscopic imaging facilities and modalities including state licensing and the legal requirements. Assist in these processes as opportunities allow.
14. Understand how to calculate estimates of entrance exposures, organ doses, effective doses, and fetal doses. Perform calculations of these exposures/doses.
15. Understand the principles of personnel radiation safety and monitoring both for the clinical personnel and for the persons performing equipment evaluations. Answer radiation safety questions and provide guidance in radiation safety to the clinical staff. Use proper radiation safety techniques while performing medical physics duties.

## *2. Evaluation of Progress in the Rotation*

Competency 1 involves achieving an understanding of the basic technical and physics principles of fluoroscopy. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident. The preceptor will document in the ELN the date on which the resident has satisfied each of these competencies. They should be satisfied during the first part of the fluoroscopy rotation.

Competencies 2 through 10 involve the testing and evaluation of actual fluoroscopic systems, analysis of the test data, and the creation of test reports. These competencies are evaluated at three successive levels of completion. Each level of completion will be documented by the preceptor (for an example see **Table 2**):

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participation in the testing and in data collection under the supervision of the preceptor and assistance in report writing,

(3) Performing testing tasks without significant oversight, and the creation of an entire report with only review by the preceptor.

Levels 1 and 2 should be satisfied by the completion of the fluoroscopy rotation. Level 3 must be completed before the end of the residency. The resident will normally participate in the testing of at least 4 fluoroscopic systems at level 2 and at least 3 fluoroscopic systems at level 3.

Competencies 11 through 15 involve activities beyond simply testing fluoroscopic systems and creating reports. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident, and/or satisfactory completion of its stated activities, as appropriate. The preceptor will determine the date on which the resident has satisfied each of these competencies. Many may be satisfied during the fluoroscopy rotation, but they must be satisfied by the end of the residency.

For each competency, the completion of the competency is documented, signed, and dated by the resident and preceptor upon its completion. Additionally, the completion of each of the first two levels of completion of competencies 7 and 8 is also documented, signed, and dated by the resident and preceptor upon its completion.

Materials produced during the rotation, such as final test reports and any presentations, will be assessed for completion and accuracy and graded as “complete” or “incomplete”.

## *3. Didactic Requirements*

The rotation begins during the second month of the residency and may last throughout its duration. It primarily involves hands-on instruction and experience with equipment testing, planning and problem solving involving radiographic imaging technology and its applications.

## *4. Work Assignments, Reports and Examinations*

See part 2 above. Written reports documenting physics surveys, shielding designs, and the results of investigations involving issues with image quality, radiation dose, etc. are expected of the resident.

## *5. Mentor Evaluations of Resident’s Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Parts 2 and 4 above.

## *7. Training Schedule*

**Duration: 5 Weeks.** Starting in the second month of the residency and extending throughout the residency.

≈ 120 hours – Physics Surveys and Report Generation

≈ 60 hours – Study: technical considerations of radiographic imaging, modality testing, dose considerations, exposure and patient dose calculations, facility design considerations, components of image quality, image quality *vs*. patient dose

≈ 20 hours – Presentation of in-service training for clinical staff, Radiology Resident physics training; attendance of Radiology Grand Rounds and Medical Physics Seminars; interactions with clinical staff.

Optional research and development opportunities could include designing and assessing new testing methods and phantoms for performance evaluation of fluoroscopic imaging equipment.

## Rotation Title: Angiography and Interventional Radiology

**Preceptor/Mentor**: **Michael Speidel, PhD, John Vetter, PhD, DABR, Frank Ranallo, PhD, DABR, FAAPM**

**Recommended References**:

*The Essential Physics of Medical Imaging –4th Edition*, Bushberg JT, *et. al.*, 2020, Chapters 4, 9, 21.

*Diagnostic Radiology Physics, IAEA, Dance DR, et al.,* 2014, Chapters 4, 8, 24.

*Physics of Radiology - 2nd Edition*, Wolbarst AB, 2005, Chapters 18-22, 35-37, 58-59.

*Imaging Systems for Medical Diagnostics –4th Edition*, Oppelt A (ed)., 2005, Chapters 2, 12.

*Specifications, Performance Evaluation, and Quality Assurance of Radiographic and Fluoroscopic systems in the Digital Era*, Goldman LW and Yester MV (ed), AAPM Monograph No. 30.

*Practical Digital Imaging and PACS*, Seibert JA, *et al*. (ed), AAPM Monograph No. 25.

*Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment*, Seibert JA, *et al.* (ed), AAPM Monograph No. 20.

*Radiation Dose Management for Fluoroscopically-Guided Interventional Medical Procedures,* NCRP Report No. 168, 2013.

*Accuracy and calibration of integrated radiation output indicators in diagnostic radiology,* AAPM Report 190, 2015.

A Guide for Establishing a Credentialing and Privileging Program for Users of Fluoroscopic Equipment in Healthcare Organizations, AAPM Report 124, 2012

Cardiac Catheterization Equipment Performance, AAPM Report 70, 2001

*Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment*, Seibert JA, et. al. (ed), AAPM Monograph No. 20.

*Advances in Digital Radiography*, Categorical Course in Diagnostic Radiology Physics, Samei, E (ed), RSNA.

*Ongoing Quality Control in Digital Radiography*: Report of AAPM Imaging Physics Task Group 151, AAPM Report #151.

*Quality Control in Diagnostic Radiology*, AAPM Report #74.

*Code of Federal Regulations, Title 21, Chapter 1, Subchapter J, Part 1020*

*Wisconsin Chapter DHS 157 – Radiation protection, and other state radiation protection regulations*

## *1. Training Objectives and Experiences*

### Objectives

This rotation focuses on x-ray fluoroscopic equipment dedicated to interventional procedures, found primarily in interventional cardiology ("cath lab") and interventional radiology ("IR") settings. These x-ray systems are designed specifically for contrast-enhanced angiography and fluoroscopic guidance of catheter-based devices.

**Detailed List of Competencies:**

For each competency, the completion of the competency is documented, signed, and dated by the resident and preceptor upon its completion. Milestones and materials produced during the rotation, such as final test reports, presentations, and writeups will be assessed for completion and accuracy and graded as "complete" or "incomplete".

1. Understand the technical and physics principles of x-ray image generation in radiography and fluoroscopy. In particular,
    a. Understand the process of x-ray generation, including x-ray tube, collimator, and high voltage generator.
    b. Understand the physics and technology of various image receptors, including indirect versus direct conversion methods, and flat panel versus image intensifier detectors.
    c. Understand the operating principles of an automatic exposure control (AEC) and how the behavior of this system varies by imaging mode (e.g., fluoro vs. cine vs. DSA) and detector mode.

    Milestones and deliverables:

        i. Initial oral examination
        ii. Directed study on the principles of x-ray imaging.
        iii. Hands-on training on an interventional system
        iv. Final oral examination
2. Apply the equipment testing competencies learned in the fluoroscopic rotation to x-ray equipment designed specifically for the interventional setting:
    a. Understand how to test for image/ x-ray field congruence, image distortions, and image artifacts. Perform accurate testing when indicated.
    b. Understand how to remove the anti-scatter grid from the system and when this is appropriate. Perform accurate testing of grids when indicated.
    c. Understand how to properly measure high contrast resolution and sharpness uniformity over the images. Perform accurate testing and analysis of this function.
    d. Understand how to properly measure low contrast detectability over different exposure rate conditions. Perform accurate testing and analysis of this function.
    e. Understand how to properly measure the maximum fluoroscopy entrance exposure rate and half value layer according to government regulations. Perform accurate testing and analysis of these functions.
    f. Understand how AEC behavior varies by imaging modes (e.g., fluoro vs. cine vs. DSA) and detector modes. Perform testing in different imaging modes.
    g. Understand federal and state regulations applicable to fluoroscopic systems including operational tolerances and requirement for compliance to these regulations.
    h. Understand how each of the previous items is properly combined into a complete system test. Understand how to identify and analyze problems and determine corrective actions.
    i. Understand how to report system deficiencies. Create an accurate and understandable report for the health care faculty responsible for the radiographic equipment.

Milestones and deliverables:

i. At least 2 tests at level 1

ii. At least 2 tests at level 2

iii. At least 2 tests at level 3, including completed reports.

iv. Documented review of federal and state regulations

3. Understand differences in the design of an x-ray angiographic system versus a general fluoroscopic system, and how these systems are tailored to different clinical applications. Specifically,

   a. Understand mechanical architectures and their advantages and disadvantages. E.g., floor-mounted versus ceiling-hung C-arms, detector size, single-plane versus bi-plane, typical uses of biplane imaging.

   b. Know the appropriate performance specifications of an angiographic x-ray tube (power level, filtration) and image receptor (frame rates, detector element size) for different clinical applications.

   c. Understand all 2D imaging modes: fluoro, cine, digital subtraction angiography (DSA), rotational angiography. Understand all available 3D rotational modes, including rotational angiography, C-arm CT, and 3D DSA.

   d. Understand how AEC behavior and image processing varies by imaging mode (fluoro, cine, DSA). Know appropriate detector exposure rates for each mode.

   e. Understand the operating principles of a contrast agent power injector.

   Milestones and deliverables:

   i. Hands-on training / demonstration on an interventional bi-plane system

   ii. Initial clinical observation session followed by oral examination.

   iii. 3 clinical observations in each of the 6 operational areas, documented by writeup (template will be provided)

4. Understand and apply principles of radiation safety for both the patient and staff.

   a. Understand the technology used to monitor patient dose during a procedure. Interpret dose information provided by an angiographic system and know typical threshold doses for radiation-induced effects. Calculate estimates of entrance exposures, organ doses, effective doses, and fetal doses.

   b. Understand the principles of personnel radiation safety and monitoring both for the clinical personnel and for the persons performing equipment evaluations. Answer radiation safety questions and provide guidance in radiation safety to the clinical staff.

   c. Understand the components of a program for managing patient and personnel dose information.

Milestones and deliverables:

i. Attendance of at least 1 lecture on radiation safety, delivered by preceptor, followed by oral examination on content.

ii. Preparation of 1 PowerPoint on radiation safety for patient and staff during fluoroscopically guided procedures, and 1 PowerPoint on the components of a radiation safety program in the cardiac cath lab.

iii. Documented review of patient dose information from at least 5 cases in the cath lab.

5. Understand and participate in activities associated with the purchase and installation of an x-ray angiographic system in a new or remodeled facility. If the opportunity to participate in an actual purchase & installation does not arise during the residency, these competencies will be gained through review of existing facilities.

   a. Objectively compare different x-ray angiographic equipment and review their appropriateness for a given clinical application. Communicate a recommendation to the manager(s) responsible for equipment purchases.

   b. Understand design considerations for room layout, including review of radiation shielding requirements and creation of a radiation shielding report to the health care facility and to the state. Assist in these activities.

   c. Inspect the actual construction process and understand the processes for obtaining approval to operate fluoroscopic imaging facilities including state licensing and the legal requirements. Assist in these processes as opportunities allow.

   Milestones and deliverables:

   i. Prepare spreadsheet comparing 3 different x-ray system options for a cardiac cath lab.

   ii. Attend weekly meetings on purchasing, planning, and construction of a new cath lab.

   iii. Perform shielding calculations and prepare shielding report.

## *2. Evaluation of Progress in the Rotation*

The rotation competencies are divided into 5 general areas, as described below. The previous section titled “Detailed List of Competencies” provides a breakdown of each competency area, including milestones and deliverables for each.

**Competency Area 1** involves demonstrating an understanding of the basic technical and physics principles of x-ray projection imaging, as well as features specific to fluoroscopic / angiographic x-ray systems. It should be completed during first part of the rotation. An initial oral exam will be conducted to evaluate the resident’s baseline knowledge. This will be followed by guided study and hands-on training. After an appropriate period, competencies will be evaluated by the preceptor by a final oral examination of the resident. The preceptor will document in the ELN the date on which the resident has satisfied this competency.

**Competency Area 2** involves the testing and evaluation of fluoroscopic / angiographic systems, analysis of the test data, and the creation of test reports. These competencies are evaluated at three successive levels of completion which will be documented by the preceptor:

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participation in the testing and in data collection under the supervision of the preceptor and assistance in report writing, and

(3) Performing testing tasks without significant oversight, and the creation of an entire report with only review by the preceptor.

Levels 1 and 2 may be satisfied through completion of the fluoroscopy rotation. Level 3 must be completed by testing equipment designed for interventional procedures. The resident will normally participate in the testing of at least 2 fluoroscopic systems at level 2 and at least 2 fluoroscopic systems at level 3. This competency must be completed before the end of the residency.

**Competency Area 3** involves learning the unique features of an x-ray angiographic system and gaining in-depth knowledge of the application of angiographic systems. Residents will study the design of angiographic systems used for

(1) cardiology,

(2) electrophysiology,

(3) pediatric cardiology,

(4) peripheral vascular,

(5) interventional radiology, and

(6) neuro-interventional radiology.

The resident will learn the use of the angiographic system in each setting through observation of clinical procedures and hands-on instruction with the preceptor. In initial clinical observations, the preceptor will be present, and the resident's knowledge will be evaluated through oral examination. After the resident has gained sufficient competency, additional observation sessions will be performed by the resident alone. The resident will normally observe at least 3 procedures in each of 6 different clinical settings by the end of residency. Each observation session will be documented with a short writeup. that follows a template provided by the preceptor.

**Competency Area 4** involves learning and applying radiation safety principles in the interventional setting. Residents will study the components of a radiation safety program for protection of patient and staff. The resident will attend lectures on radiation safety (delivered by the preceptor) and then prepare PowerPoint presentations on these topics. Experience in the interpretation of patient dose reports will be gained through analysis of a series of cases from a cath lab. Written reports with dose calculations will be reviewed by the preceptor to document competency.

**Competency Area 5** involves learning the process of purchasing, planning, and installing an x-ray angiographic system. The residents and preceptor will meet hospital managers to discuss clinical needs and, as opportunities arise, attend meetings on the planning of room construction. Residents will participate in room layout and shielding calculations. Meeting activities and shielding reports will be documented by the preceptor.

## *3. Didactic Requirements*

The didactic activities of this rotation are detailed in section 2 above for each competency area.

## *4. Work Assignments, Reports and Examinations*

Materials produced during the rotation, such as final test reports and any presentations, will be assessed for completion and accuracy and graded as “complete” or “incomplete”.

## *5. Mentor Evaluations of Resident’s Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Part 2 above.

## *7. Training Schedule*

**Duration: 5 Weeks**

≈ 100 hours – Physics surveys and report generation

≈ 40 hours – Study: technical considerations of angiographic imaging, staff and patient dose considerations, components of image quality, image quality vs. patient dose

≈ 40 hours – Study: clinical considerations of angiographic imaging, observation of clinical procedures in Radiology and Cardiology, patient dose calculations, facility design considerations

≈ 20 hours – Presentation of training for clinical staff, Radiology residents, and Cardiology fellows, other interactions with staff and hospital managers.

Optional research and development opportunities could include assessing software solutions for the monitoring and evaluation of patient entrance exposures during angiographic and interventional procedures.

## Rotation Title: Mammography

**Preceptor/Mentor**: **John Vetter, PhD, DABR, Frank Ranallo, PhD, DABR, FAAPM**

**Recommended References**:

*ACR Mammography Quality Control Manual*, 1999

*ACR Stereotactic Breast Biopsy Quality Control Manual*, 1999

HOLOGIC Dimensions Quality Control Manuals

GE Pristina Quality Control Manuals

Siemens Inspiration Quality Control Manual

MQSA Policy Guidance Help System

Barco QA Web Manual

McKesson MQSA Quality Control Manual

CareStream 5850 Quality Control Manual

*The Essential Physics of Medical Imaging 3rd ed*, Bushberg, *et al*., Chapter 8

*Code of Federal Regulations, Title 21, Chapter 1, Subchapter J, Part 1020*

*Wisconsin Chapter DHS 157 – Radiation protection, and other state radiation protection regulations*

## *1. Training Objectives and Experiences*

### Objectives

This rotation provides the resident with the training and experience needed to pursue certification as a qualified medical physicist under the Mammography Quality Standards Act, and the American College of Radiology Mammography and Breast Biopsy Accreditation programs. Training in full-field digital mammography, tomosynthesis, and breast biopsy systems is provided.

### Detailed List of Competencies:

1. Understand technical requirements for different breast x-ray imaging modalities including film-screen, full-field digital, tomosynthesis, stereotactic biopsy, and contrast enhanced mammography.
2. Identify common artifacts in mammographic imaging and corrective action (if any) required.
3. Perform Annual MQSA and/or ACR Physics Survey on available units including full-field digital, tomosynthesis and stereotactic breast biopsy units, independently and without errors.
4. Perform reading room and workstation evaluation including monitor calibration.
5. Perform a Technologist's QC program review.
6. Complete sufficient training to meet the initial training and experience requirements under MQSA. This includes a minimum of 20 contact hours of facility survey training including a minimum of 8 hours related to full-field digital mammography and 8 hours on digital tomosynthesis, with participation in a minimum of 10 physics surveys of mammography units and one complete facility survey.

7. Identify requirements for physics involvement resulting from repairs, upgrades and other changes to mammographic equipment and facilities, including lists of tests to be performed, by whom and at what time as well as any requirements for review of test results.
8. Obtain a working knowledge of requirements and recommendations related to accreditation and MQSA regulation of the mammography modalities.
9. Obtain a working knowledge of personnel requirements for Physicists, Technologists and Radiologists related to accreditation and MQSA certification.
10. Understand design considerations for a new or remodeled facility including reading room design, radiation shielding requirements and equipment selection.
11. Understand the processes for obtaining approval to operate mammographic imaging facilities and modalities including state licensing, accreditation, and MQSA certification for each modality.
12. Complete at least 15 hours of approved continuing medical education (CME) credits in mammography, including 3 credits related to stereotactic breast imaging.
13. Demonstrate the ability to measure and calculate skin dose, average glandular dose and effective dose related to mammographic x-ray imaging modalities and make meaningful comparisons to other sources of radiation exposure and risks.
14. Prepare and deliver presentations for clinical staff on mammography physics topics of interest such as radiation doses and risks, quality control procedures and technical aspects of x-ray mammographic imaging.

## *2. Evaluation of Progress in the Rotation*

Competencies 1 and 2 involve achieving an understanding of basic technical and physics principles of mammography, radiation safety, ACR recommendations, and MQSA regulations. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident. The preceptor will document in the ELN the date on which the resident has satisfied each of these competencies. They should be satisfied early in the mammography rotation.

Competencies 3- 6 involve the testing and evaluation of mammography systems, analysis of the test data, and the creation of test reports. These competencies are evaluated at three successive levels of completion. Each level of completion will be documented by the preceptor:

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participating in the testing and data collection with the preceptor and assisting in report writing,

(3) Performing testing with oversight by preceptor and creating reports to be reviewed by the preceptor.

Competencies 7-14 involve activities beyond simply testing mammography systems and creating reports. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident, and/or satisfactory completion of the stated activities, as appropriate. The preceptor will determine the date on which the resident has satisfied each of these competencies. They may be satisfied during the mammography rotation, but they must be satisfied by the end of the residency program.

## *3. Didactic Requirements*

The didactic activities of this rotation are detailed in section 2 above for each competency area.

## *4. Work Assignments, Reports and Examinations*

Materials produced during the rotation, such as final test reports and any presentations, will be assessed for completion and accuracy and graded as “complete” or “incomplete”.

## *5. Mentor Evaluations of Resident’s Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Part 2 above.

## *7. Training Schedule*

**Duration: 5 Weeks**

≈ 100 hours – Physics Surveys and Report Generation

≈ 60 hours – Study: Mammography Quality Standards Act (MQSA) regulations, accreditation requirements, technical considerations of mammographic imaging, dose considerations, modality testing, facility design considerations,

≈ 30 hours – Mammography Continuing Medical Education (CME) completion

≈ 10 hours – Presentation of in-service training for clinical staff, Radiology Resident physics training, attendance of Radiology Grand Rounds and Medical Physics Seminars, other interactions with clinical staff.

Optional research and development opportunities could include assessing prototype mammography and tomography phantoms.

## Rotation Title: Computed Tomography (CT)

**Preceptor/Mentor**: **Frank Ranallo, PhD, DABR, FAAPM, Timothy Szczykutowicz, PhD, DABR**

**Recommended References**:

*The Essential Physics of Medical Imaging – 3rd Edition*, Bushberg JT, *et al.*, Chapters 10, 11.

*Computed Tomography*, 2nd Edition, Hsieh J.

*Computed Tomography*, 3rd Edition, Kalendar W.

*ACR Quality Computed Tomography Quality Control Manual*, 2012.

Other materials from the ACR regarding ACR accreditation of CT scanners.

Catphan® 500 and 600 Manual, The Phantom Laboratory.

MDCT Physics – The Basics, Mahesh M.

MDCT – From Protocols to Practice, Kalra MK, *et al.*, (ed).

*Multislice CT – Principles and Protocols*, Knollmann FK, Coakley FV (ed)

*Imaging Systems for Medical Diagnostics* – 4th Edition, Oppelt A (ed).

Use of Water Equivalent Diameter for Calculating Patient Size and Size-Specific Dose Estimates (SSDE) in CT: Report of AAPM Task Group 220, AAPM Report #220.

*Size-Specific Dose Estimates (SSDE) in Pediatric and Adult Body CT Examinations*, AAPM Report #204.

*Comprehensive Methodology for the Evaluation of Radiation Dose in X-Ray Computed Tomography*: Report of AAPM Task Group 111: The Future of CT Dosimetry, AAPM Report #111.

*The Measurement, Reporting, and Management of Radiation Dose in CT*, AAPM Report #96.

*Specification, Acceptance Testing and Quality Control of Diagnostic X-ray Imaging Equipment*, Seibert JA, *et al*. (ed), AAPM Monograph No. 20.

Operator and Technical manuals for various CT scanners.

*Code of Federal Regulations, Title 21, Chapter 1, Subchapter J, Part 1020*

*Wisconsin Chapter DHS 157 – Radiation protection, and other state radiation protection regulations*

## *1. Training Objectives and Experiences*

### Objectives

This rotation provides the resident with the training and experience needed to serve as a qualified medical physicist providing physics services to facilities accredited by the American College of Radiology CT Accreditation program, and meeting standards of the Joint Commission related to CT services.

### Detailed List of Competencies:

1. Understand the principles, design, and recent advances of CT, including all its major components, such as the x-ray tube, collimator, and detectors, and their functions.
2. Understand the principles of CT image reconstruction, including nonlinear denoising methods.
3. Understand the concepts of dose and image quality (including artifacts) and their relationship in CT.
4. Understand how automatic exposure control systems operate in CT.
5. Understand federal and state regulations applicable to CT systems including operational tolerances and requirement for compliance to these regulations.
6. Understand the requirements of the Joint Commission, the ACR, and other accreditation bodies for the testing of CT scanners.
7. Understand the proper methods of performance testing of CT scanners for acceptance testing and quality assurance considering the requirement of the above accrediting bodies and organizations. Perform these performance tests on CT scanners in compliance with all relevant standards.
8. Understand how to identify and analyze problems detected in these tests and the corrective actions that can be performed for operational improvements. Understand how to report system deficiencies that do not comply with government regulations and requirement of the joint commission and accrediting bodies. Understand how to report other types of system deficiencies that are detected. Understand how to create an accurate and understandable report for the health care faculty responsible for the CT equipment. Create actual reports of the results of CT system testing.
9. Have a working knowledge of the accreditation requirements for CT scanners along with the requirements of the Joint Commission and federal regulations, beyond simply the requirements for CT testing. Assist clinical personnel in the process of accreditation of CT scanners and in satisfying the requirements of the Joint Commission and federal regulations. Understand the issues to be addressed in setting up a QC program for CT technologists.
10. Develop a working knowledge of the requirements of the Joint Commission and the accreditation bodies for personnel requirements for Physicists, Technologists, and Radiologists.
11. Complete the number of hours of approved continuing medical education (CME) credits as required by the Joint Commission and the accreditation bodies for a Physicist who is testing CT scanners.
12. Understand how to test for the presence of CT image artifacts and to recognize their presence in both phantom and clinical images. Perform analysis of images with possible artifacts including identifying the artifact and its possible causes.

13. Understand how to analyze CT images with suboptimal quality and provide recommendations for correction or improvement of the imaging process. This includes providing instructions for improving the images of scans already performed by modifications of the reconstruction parameters.
14. Understand design considerations for a new or remodeled facility including reading room design, radiation shielding requirements, and equipment selection. Participate in these activities in assisting the clinical personnel.
15. Understand the requirements for reviewing radiations shielding designs for new or remodeled rooms, inspecting the actual construction process, the creation of a radiation shielding report for submission to the health care facility and to the state. Assist in each of these processes.
16. Understand the processes for obtaining approval to operate CT imaging facilities including state licensing and the legal requirements. Assist in these processes as opportunities allow.
17. Understand how to calculate estimates of CT doses including CTDI, organ doses, effective doses, and fetal doses. Perform calculations of these doses.
18. Understand the principles of personnel radiation safety and monitoring both for the clinical personnel and for the persons performing equipment evaluations. Answer radiation safety questions and provide guidance in radiation safety to the clinical staff. Use proper radiation safety techniques while performing medical physics duties.
19. Prepare and deliver presentations for clinical staff on CT physics topics of interest such as radiation doses and risks, quality control procedures and technical aspects of CT imaging.

## *2. Evaluation of Progress in the Rotation*

Competencies 1 through 6 involve achieving a basic understanding of the basic technical and physics principles of computed tomography. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident. The preceptor will document in the ELN the date on which the resident has satisfied each of these competencies. They should be satisfied during first part of the CT rotation.

Competencies 7 and 8 involve the testing and evaluation of actual CT systems, analysis of the test data, and the creation of test reports. These competencies are evaluated at three successive levels of completion. Each level of completion will be documented by the preceptor (for an example see **Table 2**):

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participation in the testing and in data collection under the supervision of the preceptor and assistance in report writing,

(3) Performing testing tasks without significant oversight, and the creation of an entire report with only review by the preceptor.

Levels 1 and 2 should be satisfied by the completion of the CT rotation. Level 3 must be completed before the end of the residency. The resident will normally participate in the testing of at least 4 CT systems at level 2 and at least 3 CT systems at level 3.

Competencies 9 through 19 involve activities beyond simply testing CT systems and creating reports. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident, and/or satisfactory completion of its stated activities, as appropriate. The preceptor will determine the date on which the resident has satisfied each of these competencies. Many may be satisfied during the CT rotation, but they must be satisfied by the end of the residency.

For each competency, the completion of the competency is documented, signed, and dated by the resident and preceptor upon its completion. Additionally, the completion of each of the first two levels of completion of competencies 7 and 8 is also documented, signed, and dated by the resident and preceptor upon its completion.

## *3. Didactic Requirements*

The didactic activities of this rotation are detailed in section 2 above for each competency area.

## *4. Work Assignments, Reports and Examinations*

Materials produced during the rotation, such as final test reports and any presentations, will be assessed for completion and accuracy and graded as "complete" or "incomplete".

## *5. Mentor Evaluations of Resident's Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Part 2 above.

## *7. Training Schedule*

**Duration: 8 Weeks**

≈ 200 hours – Physics Surveys and Report Generation

≈ 160 hours – Study: technical considerations of radiographic imaging, modality testing, dose considerations, exposure and patient dose calculations, facility design considerations, components of image quality, image quality vs. patient dose

≈ 20 hours – Presentation of in-service training for clinical staff, Radiology Resident physics training, attendance of Radiology Grand Rounds and Medical Physics Seminars, other interactions with clinical staff.

Numerous optional research and development opportunities in CT exist related to the Wisconsin CT Protocol Development Project and other ongoing research projects in the UW Medical Physics and Radiology Departments.

## Rotation Title: Magnetic Resonance Imaging (MRI)

**Preceptor/Mentor**: **Karl K. Vigen, PhD, DABMP**

**Recommended References**:

Basic MRI Physics (as needed):

D Nishimura, *Principles of Magnetic Resonance Imaging* (available from lulu.com).

Series of MRI Physics review articles from *Journal of Magnetic Resonance Imaging* (in packet).

*The Essential Physics of Medical Imaging*, 3rd ed., Bushberg *et al*., Chapters 12-13

MRI Safety:

Current GE Scanner User's Manual Safety Section (in packet, and available at this link).

Shellock and Crues, *MRI Safety* (available for purchase).

*ACR Guidance Document on MR Safe Practices: 2013*, J Magn Reson Imag 37:501-530, 2013.

*www.mrisafety.com* - Frank Shellock's website, which serves as the most common source of information on the safety of implanted active or passive devices as well as information on other potential sources of MR safety concerns.

MRI QA/QC/Acceptance Testing:

AAPM Report 100 *Acceptance Testing and Quality Assurance Procedures for Magnetic Resonance Imaging Facilities*, Jackson E, Bronskill M, *et al*., 2010 (in packet).

*2015 ACR MRI Quality Control Manual* (available from acr.org).

Additional documentation related to the ACR MRI Accreditation Program (routinely updated at acr.org).

## *1. Training Objectives and Experiences*

### Objectives

This rotation provides the resident with the training and experience needed to provide physics support to facilities providing Magnetic Resonance Imaging services.

### Detailed List of Competencies:

1. Demonstrate knowledge of basic MRI physics and common clinical MR acquisition sequences and techniques.
2. Demonstrate understanding of MRI system hardware basics.
3. Demonstrate understanding of all aspects of MRI safety.
4. Demonstrate ability to operate an MRI system without supervision. Training will be provided through the MRI Research Laboratory's process for MRI system operation, under the supervision of the Research Program Manager for MRI, *i.e*., lead research MRI technologist.

5. Understand of the implementation of a robust MR acceptance testing program and quality control program, including detection of common failure modes, based on AAPM and ACR recommendations.
6. Demonstrate understanding of common MRI artifacts and potential remedies.
7. Demonstrate knowledge of ACR MR Accreditation Program and Joint Commission accreditation requirements.
8. Complete 10 hours/year of MRI-related CME.
9. Develop one (1) successful protocol modification session with a medical physicist and radiologist.
10. Provide significant assistance in two (2) annual system performance tests, based on ACR MR accreditation program requirements.
11. Complete two (2) independent annual surveys of MRI scanners, based on ACR MR accreditation program requirements.
12. Develop and present a QC program for technologists based on ACR MR accreditation program requirements.

## *2. Evaluation of Progress in the Rotation*

Checklist of items listed for each competency, signed, and dated by the resident and preceptor upon successful completion of each item.

Significant assistance in two written survey reports, and two independently produced written survey reports over two years. Because only a limited number of surveys may be available based on the number of MRI units and the timing of the surveys, the resident will likely be asked to perform these outside of the initial MRI rotation.

## *3. Didactic Requirements*

The didactic activities of this rotation are detailed in sections 1 and 2 above for each competency area.

## *4. Work Assignments, Reports and Examinations*

Materials produced during the rotation, such as final test reports and any presentations, will be assessed for completion and accuracy and graded as “complete” or “incomplete”.

## *5. Mentor Evaluations of Resident’s Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Parts 1 and 2 above.

## *7. Training Schedule*

**Duration: 8 weeks**

≈ 100 hours - Annual MRI Physics surveys; acceptance testing (as available); checks of weekly technologist QC.

≈ 120 hours - Additional as-needed MRI clinical support; MRI protocol development with radiologists, attendance at Dept. of Radiology MRI Safety Committee meetings; attend conference calls and discussions with MRI vendor service personnel.

≈ 60 hours - Study: ACR MRI Quality Control Manual; MRI Safety; and topics related to references listed below; attendance at MRI Physics lectures, as needed.

≈ 10 hours - MRI Continuing Medical Education (CME).

≈ 30 hours - Attendance at Medical Physics Seminars; Radiology Grand Rounds with MRI topics.

Optional research and development opportunities may be available under the direction of faculty mentors within the extensive MRI research programs in the UW Medical Physics and Radiology Departments.

## Rotation Title: Ultrasound

**Preceptor/Mentor**: **James Zagzebski, PhD, Ivan Rosado-Mendez, PhD, Timothy Hall, PhD**

**Recommended References**:


*Essentials of Ultrasound Physics*, JA Zagzebski, Elsevier, Chapters 1-5

*Ultrasound Accreditation Program Requirements*, American College of Radiology, available at http://www.acr.org/Quality-Safety/Accreditation/Ultrasound

AIUM Routine Quality Assurance of Clinical Ultrasound Equipment, Ed.2, (2020). American Institute of Ultrasound in Medicine, 14750Sweitzer Ln, Suite 100, Laurl, MD.

Methods and Effects of Transducer Degradation on Image Quality and the Clinical Efficacy of Diagnostic Sonography, J Diagnostic Medical Sonography, 19: 3-13, 2003.

IEC61391-1 Pulse-echo scanners - Techniques for calibrating spatial measurement systems and measurement of point-spread function response.

IEC 61391-2 Ed.1.0: Pulse- echo scanners – Techniques for measurement of maximum depth of visualization and the displayed dynamic range.

Hangiandriou *et al*., Four-year experience with a clinical ultrasound quality control program. Ultrasound Med & Biol. 2011, 37(8):1350-1357.

Browne, J. A review of Doppler ultrasound quality assurance protocols and test devices. Physica Medica 30 (7): 742-751, 2014.

Hall, T., *et al*., RSNA/QIBA: Shear wave speed as a biomarker for liver fibrosis staging. IEEE International Ultrasonics Symposium, 397-400, 2013.

*The Essential Physics of Medical Imaging*, Bushberg, *et al*. Chapters 14-15.


## *1. Training Objectives and Experiences*

### Objectives

This rotation provides the resident with the training and experience needed to provide physics support to facilities providing Ultrasound Imaging services.

### Detailed List of Competencies:

1. Demonstrate understanding of basic ultrasound physics, including propagation, attenuation, reflection and scattering in tissue;
2. Demonstrate understanding of the operation of clinical ultrasound scanners, including, the pulse-echo principle, types of transducers, beam-forming, formation of A-line signals, construction of B-mode images, frame rate limitations, common image artifacts, bioeffects, Doppler and color flow, strain imaging and shear wave imaging;
3. Demonstrate knowledge of the characteristics of phantoms from major manufacturers and how phantom properties might affect performance measurements;

4. Demonstrate ability to independently scan phantoms and test objects on at least 2 different manufacturer's scanners (choose from GE Logiq 8, Logiq E9 or Logiq E10; Siemens Acuson Sequoia; Supersonic Imagine Aixplorer); mount and select available transducers on the scanner, including 3-D transducers; optimize control settings to generate acceptable images; save images to PACS; activate B-mode, harmonics, PW Doppler, and color flow modes; where available activate and demonstrate special operating modes, including strain imaging and shear wave imaging;
5. Understand the implementation of a robust acceptance testing and quality control program for ultrasound systems based on AAPM, AIUM, and ACR recommendations;
6. Independently perform annual ACR Physics surveys on ultrasound scanners in UWHC-Radiology, the UW Breast Center, WIMR, or American Family Children's Hospital, including qualitative assessments of PACS workstation/imaging system monitor fidelity; author test reports for the clinical facilities;
7. Assess safety factors and identify artifacts on ultrasound images that are caused by transducer flaws, such as cracked lens material, dead transducer elements, cable flaws, and inadequate focusing/TGC settings; understand how acquisition features, such as spatial compounding, and processing such as speckle smoothing, can conceal flaws;
8. Evaluate Doppler mode on US systems using flow phantom; tests strain and/or shear wave velocity imaging using phantoms;
9. Demonstrate knowledge of personnel requirements for Physicists and lead Technologists related to ACR and AIUM laboratory accreditation tests;

## *2. Evaluation of Progress in the Rotation*

Competencies 1, 2, 3, 4, 5 involve achieving an understanding of basic technical and physics principles of diagnostic ultrasound, IEC, ACR and AAPM quality control recommendations, and AIUM as well as ACR standards for clinical laboratory accreditation. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident, including one that involves a hands-on lab. The preceptor will document in the ELN the date on which the resident has satisfied each of these competencies. They should be satisfied during the first part of the US rotation.

For competencies 6, and 7, the resident shall provide significant assistance in four written survey reports, and independently author four additional survey reports over two years. Because only a limited number of surveys may be available based on the number of ultrasound units and the timing of the surveys, the resident will likely be asked to perform these, outside of the initial ultrasound rotation.

Competencies 6 and 7 involve the testing and evaluation of actual US systems, analysis of the test data, and the creation of test reports. These competencies are evaluated at three successive levels of completion. Each level of completion will be documented by the preceptor (for an example see **Table 2**):

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participation in the testing and in data collection under the supervision of the preceptor and assistance in report writing,

(3) Performing testing tasks without significant oversight, and the creation of an entire report with only review by the preceptor.

Competencies 8 and 9 involve activities beyond simply testing US systems and creating reports. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident, and/or satisfactory completion of its stated activities, as appropriate. The preceptor will determine the date on which the resident has satisfied each of these competencies. They may be satisfied during the US rotation, but they must be satisfied by the end of the residency.

## *3. Didactic Requirements*

The didactic activities of this rotation are detailed in sections 1 and 2 above for each competency area.

## *4. Work Assignments, Reports and Examinations*

Materials produced during the rotation, such as final test reports and any presentations, will be assessed for completion and accuracy and graded as “complete” or “incomplete”.

## *5. Mentor Evaluations of Resident’s Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Parts 1 and 2 above.

## *7. Training Schedule*

**Duration: 7 weeks**

≈ 140 hours – Physics Surveys and Report Generation

≈ 120 hours – Study: technical considerations of ultrasound imaging, modality testing, safety issues, components of image quality, image quality metrics

≈ 20 hours – Presentation of in-service training for clinical staff, Radiology Resident physics training, attendance of Radiology Grand Rounds and Medical Physics Seminars, other interactions with clinical staff.

Optional research and development opportunities may be available for topics including image quality testing, phantom development and evaluation, ultrasound probe testing, and others.

## Rotation Title: Nuclear Medicine

**Preceptor/Mentor**: **Tyler Bradshaw, PhD, ABSNM, John Vetter, PhD, DABR**

**Recommended References**:

*NEMA NU 1-2012 Performance measurements of Scintillation Cameras.* NEMA, Rosslyn, Virginia 2013

*The Selection, Use, Calibration, and Quality Assurance of Radionuclide Calibrators Used in Nuclear Medicine.* AAPM Report 181, 2012

*PET and PET/CT Shielding Requirements.* AAPM Report 108, 2006

*GE Optima NM/CT 640 Systems Test Manual*

*GE Discovery IQ NEMA Test Procedures and Detector Performance Test Manual*

*Physics in Nuclear Medicine,* Cherry SR, Sorenson JA, Phelps ME., Grune & Stratton, Orlando, 2003

Christian PE, Bernier D, Langan JK, *Nuclear Medicine and PET Technology and Techniques,* Mosby, St. Louis, 2004

*Radiation Safety in Nuclear Medicine*, Lombardi, MH, CRC Press, Boca Raton, 2007

*The Essential Physics of Medical Imaging, 3rd ed.*, Bushberg, *et al*., Chapters 15-19

## *1. Training Objectives and Experiences*

### Objectives

This rotation provides the resident with the training and experience needed to provide quality assurance and other physics services at Nuclear Medicine Imaging facilities.

### Detailed List of Competencies:

1. Understand the physical and technical requirements of nuclear imaging systems including planar, single photon emission computed tomography (SPECT) and positron emission tomography (PET) systems.
2. Perform annual physics surveys and calibration procedures on SPECT and PET imaging systems and dose calibrators.
3. Understand principles and practices related to the safe handling of radioactive materials and the performance of imaging and therapy procedures. Perform review of radiation safety policies and practices within the radiopharmacy and SPECT and PET/CT imaging suites.
4. Perform radiation surveys of imaging suites, patient treatment rooms and radiopharmacies.
5. Know emergency procedures relevant to the nuclear medicine department. Know the procedures and regulations regarding the containment and cleanup of radioactive material spills.
6. Understand and be able to discuss recommendations regarding the administration of radiopharmaceuticals to pregnant and possibly pregnant patients, and patients who are nursing mothers.

7. Understand and review staff radiation monitoring policies, procedures, and dose reports. Discuss procedures involved with investigations into personnel dose readings that are above the threshold for investigation.
8. Understand design considerations for a new or remodeled facility including imaging room designs, radiopharmacy design considerations, radiation shielding requirements and equipment selection. Perform a radiation shielding design for a PET/CT facility.
9. Understand and perform estimates of organ doses from any administered radiopharmaceutical using the MIRD method.
10. Be familiar with ACR requirements for accreditation of nuclear medicine and PET facilities and Joint Commission accreditation requirements related to nuclear imaging.
11. Be familiar with the administration of a broad scope radioactive material license, the activities of the radiation safety committee overseeing the license, and the associated federal and state regulations.
12. Prepare and deliver presentations for clinical staff on nuclear medicine physics topics of interest such as the health effects of radiation exposure, radiation doses and risks from various procedures, quality control procedures and technical aspects of nuclear imaging.

## *2. Evaluation of Progress in the Rotation*

Written survey reports produced independently by the resident and reviewed by the preceptor with evaluations. The preceptor provides guidance in the production of accurate reports and suggestions for improvement of the submitted reports. A list of all survey reports in which the resident has participated is kept along with a record of the degree of resident participation:

(1) Observation of the testing procedures performed by the preceptor with attention to learning the proper methods of testing and analysis,

(2) Participation in the testing and in data collection under supervision of the preceptor and assistance in report writing,

(3) Performing testing tasks without significant oversight and the creation of an entire report with only review by the preceptor.

Checklist of items listed under each competency, signed, and dated by the resident and preceptor upon demonstrated completion of each item.

## *3. Didactic Requirements*

The didactic activities of this rotation are detailed in sections 1 and 2 above for each competency area.

## *4. Work Assignments, Reports and Examinations*

Materials produced in conjunction with activities undertaken to achieve competencies. Examples include: Presentations for clinical staff, CME certificates, reports or correspondence related to dose calculations, etc. These materials will be reviewed by the preceptor with suggestions for improvements where appropriate.

## *5. Mentor Evaluations of Resident's Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Parts 1 and 2 above.

## *7. Training Schedule*

**Duration: 5 weeks**

≈ 50 hours – Acceptance and Annual tests of gamma cameras, PET scanners, Dose Calibrators, and bone density scanners, including report generation.

≈ 60 hours – Study technical considerations of nuclear medicine imaging, modality testing, dose considerations, exposure and patient dose calculations, facility design and shielding considerations, components of image quality, image quality *vs*. patient dose and imaging time, characteristics, and selection of radionuclides.

≈ 40 hours – Participation in radiation dose surveys, observation of technologists' daily and weekly quality control activities, preparation of radiopharmaceuticals, and other routine tasks in the nuclear medicine department.

≈ 50 hours – Presentation of in-service training for nuclear medicine staff, Radiology Resident physics training, participation in radiation safety committee meetings, attendance at Radiology Grand Rounds and Medical Physics Seminars.

Optional research and development opportunities may be available under the direction of faculty and scientific staff in the nuclear medicine and molecular imaging research programs in the UW Medical Physics and Radiology Departments.

## Rotation Title: Informatics

**Preceptor/Mentor**: **Walter Peppler, PhD, John Garrett, PhD, Gary Wendt, MD, MBA**

**Recommended References**:

*Digital Imaging and Communications in Medicine (DICOM),* Oleg Pianykh, Springer-Verlag Berlin Heidelberg, 2008.

*The Essential Physics of Medical Imaging: Third edition*, Bushberg, *et al*. Chapter 5.

http://medical.nema.org

http://dcm4che.org

http://www.dclunie.com

http://dicom.offis.de/dcmtk

http://support.dcmtk.org/docs

http://www.ihe.net

http://www.rsna.org/ihe

http://www.dvtk.org/index.php

http://rsbweb.nih.gov/ij

https://www.virtualbox.org

http://www.dicomlibrary.com

http://www.dicomtags.com/

http://pacsdisplay.org/

## *1. Training Objectives and Experiences*

### Objectives

This rotation provides the resident with the training and experience needed to understand and work with information technologies present in medical imaging facilities.

### Detailed List of Competencies:

1. Demonstrate ability to find pertinent information within the DICOM standard publication; including SOP classes, transfer syntaxes, IOD modules and definitions, and value representations (VR).
2. Demonstrate understanding of DICOM conformance statement, including supported SOP classes.
3. Demonstrate a familiarity with Integrating the Healthcare Enterprise (IHE) initiative and relevant domains, including radiology and mammography.
4. Demonstrate ability to connect new or replacement modalities to the UWHealth PACS system. This will include configuring the modality and the PACS system as well as solving configuration problems.

5. Demonstrate ability to test monitor conformance to DICOM Grayscale Display Function. This testing will also be performed in the mammography rotation, but the resident will be expected to install and test open source software for testing workstations outside of mammography.
6. Demonstrate ability to interpret HL7 messages. This will include a familiarity with the UWHealth Cloverleaf HL7 interface engine and a basic understanding of the various threads and their purpose.
7. Demonstrate ability to use open source DICOM toolkits, including command line implementation of dcm4che tools (DICOM send, DICOM move, etc.)
8. Demonstrate ability to use open source utilities for clinical trial processing and anonymization, such as DICOM Editor, RSNA's CTP, and Dcm4chee.
9. Demonstrate knowledge of radiation dose reporting systems including internal and external (e.g., ACR Triad).
10. Demonstrate understanding of advanced applications (3D modeling, image fusion, CAD, etc.) and the ability to support the clinical use of those applications.

## *2. Evaluation of Progress in the Rotation*

Competencies 1, 2, and 3 involve achieving an understanding DICOM and Integrating the Healthcare Enterprise (IHE). Competencies 9 and 10 similarly involve an understanding of dose reporting and advanced imaging functionality. The evaluation of these competencies will be determined by the preceptor by oral examination of the resident. The preceptor will document in the ELN notebook the date on which the resident has satisfied each of these competencies.

Competency 4 will be evaluated as follows. New and replacement modalities are constantly being added to the UWHealth PACS system. The resident will be expected to: 1) observe the configuration and validation testing of approximately 5 modalities performed by the preceptor with attention to learning the proper methods, 2) participate in the configuration and validation testing under supervision of the preceptor, and 3) perform configuration and validation testing without significant oversight.

No formal reports are required when configuring a new system. The resident will be required to keep a record of all systems they were involved with in the ELN notebook. The preceptor will confirm the successful implementation of the systems that the resident completes with minimal oversight. If any deficiencies are noted, additional installations will be assigned.

Modality connectivity problems frequently arise significantly after the initial configuration. These may be due to software updates or may just be recognized as an issue at a later date. Since these problems are not scheduled or planned, the resident will be expected to participate throughout the residency period when available. It will be the resident's responsibility to ensure that they accumulate 3-4 such experiences. Some problems are critical, and the resident will be evaluated by the preceptor on whether they were able to actively participate in the solution. Other problems are more long term and may require intervention by the equipment vendor; including backend configuration or software patches. The resident will be expected to take the lead role on at least one such situation; continuing to follow up to make sure the problem is adequately resolved. The final step of which is generally to confirm with the end user that a satisfactory solution has been achieved (or in some cases that it cannot be resolved). The preceptor will ask the end user for a report of satisfactory or unsatisfactory communication skills and overall handling of the issue.

Competency 5 will be evaluated as follows. The resident will install and configure open source display calibration software on a non-clinical workstation. The resident will be expected to work with the preceptor to test a clinical reading station. Finally, the resident will be expected to test 3 or more clinical reading stations with minimal or no supervision. The completion of these tasks will be entered in the ELN by the resident and confirmed by the preceptor.

## *3. Didactic Requirements*

The resident will be expected to assist the instructor with the hands on lab portion of the informatics course offered by the department. This consists of 2-3 hours of lab participation demonstrating open source DICOM and HL7 tools and applications. Competencies 6, 7, and 8 will be evaluated during these laboratories. The preceptor will evaluate the resident's ability to perform the assigned functions on a satisfactory/unsatisfactory basis.

## *4. Work Assignments, Reports and Examinations*

Materials produced in conjunction with activities undertaken to achieve competencies. Examples include: Presentations for clinical staff, CME certificates, reports or correspondence related to dose calculations, etc. These materials will be reviewed by the preceptor with suggestions for improvements where appropriate.

## *5. Mentor Evaluations of Resident's Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Parts 1, 2 and 3 above.

## *7. Training Schedule*

**Duration: 3 weeks**

≈ 30 hours – Course MP 671, includes didactic and hands on participation.

≈ 50 hours – Setup, configuration, and installation of new modalities onto PACS system.

≈ 20 hours – Solving connectivity issues on an ongoing basis, as needed.

≈ 20 hours – PACS workstation display calibration, setup, and testing

Optional research and development opportunities may be available under the direction of faculty and scientific staff in the informatics research programs in the UW Medical Physics and Radiology Departments.

## Rotation Title: Radiation Safety

**Preceptor/Mentor**: **John Vetter, PhD, DABR, Jason Timm, MHP, MPH, CHP**

**Recommended References**:

*Structural Shielding Design for Medical X-Ray Imaging Facilities,* NCRP Report No. 147, 2005.

*PET and PET/CT Shielding Requirements.* AAPM Report 108, 2006

*Radiation Dose Management for Fluoroscopically-Guided Interventional Medical Procedures,* NCRP Report No. 168, 2013.

*Accuracy and calibration of integrated radiation output indicators in diagnostic radiology,* AAPM Report 190, 2015.

*A Guide for Establishing a Credentialing and Privileging Program for Users of Fluoroscopic Equipment in Healthcare Organizations*, AAPM Report 124, 2012

*Radiation Protection,* Wisconsin Department of Health Services Chapter DHS 157.

*Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII – Phase 2,* Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, National Research Council, National Academy of Sciences, 2006.

*Radiation Safety in Nuclear Medicine, Lombardi, MH, CRC Press, Boca Raton, 2007*

*UW Health Policies and Procedures related to radiation safety.*

## *1. Training Objectives and Experiences*

### Objectives

This rotation focuses on the radiation safety aspects of the use of x-rays and radioactive materials for diagnostic and screening purposes in the clinical setting. Many of the activities and competencies are described in modality specific rotations, and not reproduced here. These activities generally include room shielding designs, inspections and surveys, patient dosimetry monitoring and calculations, radiation safety presentations and consultations. Unique to this rotation are participation in University of Wisconsin, UW Health and Meriter-Unity Point Health radiation safety committees, and participation in activities carried out by the team of health physicists under the direction of the Radiation Safety Officer, Jason Timm. These activities generally include managing the personnel dosimetry program, x-ray device and radioactivity material licenses, the radioactive waste program, and providing training and dosimetry support for clinical and research radiation use. Lists of activities and topics for each of these sections are as follows:

Medical Physics Team (John Vetter and other Medical Physics mentors)

- Radiation Shielding design and verification: CT, Rad/Fluoro, PET/CT, bone mineral scanners, nuclear pharmacies, radionuclide therapy suites.
- Patient dose estimates (peak skin dose, fetal radiation dose, other patient dose estimates, human subject radiation dose estimates).
- Radiation Safety in Fluoroscopy.
- Radiation Safety in CT.
- Radiation safety training (provided by Medical Physis) for clinical staff and physicians.

Radiation Safety Team (Jason Timm and other Health Physicists)

- Personnel dosimetry (shadow Bindu/UW Asst. RSO): Dose records review, high dose investigations, new technology evaluations. Evaluation of personnel protective equipment.
- Nuclear Medicine: audits, surveys, and therapies (I-131 thyroid ablation, I-131 CLR, I-131 MIBG)
- Radiology therapies (IR: Y-90 Therasphere).
- Radiation and Human Oncology: audits, surveys, and participation in therapies (Ra-223 Xofigo, Ir-192 HDR, Sr-90 BetaCath).
- Veterinary Medicine Radiology: Lg. animal Tc-99m equine bone scans, feline I-131 hyperthyroidism.
- Participation in Radiation Safety related Committees: Policy development and review, Authorized PI, AU and AMP approval processes.
- Radiation safety training (provided by ORS) for staff, physicians.
- Radioactive material licensing and inspections.
- Radioactive waste program.
- Spills and emergencies.

**Detailed List of Competencies:**

1. Describe radiation biology and public health principles that form the basis of recommendations, policies, and regulations on limits to radiation exposure for patients, radiation workers and the general public.
2. Use an understanding of good radiation safety practices to instruct and counsel operators of x-ray producing equipment and personnel handling radioactive sources to promote best practices in radiation safety.
3. Demonstrate knowledge of limits on exposure to ionizing radiation and the scientific and governing bodies that produce those limits.
4. Use knowledge of radiation safety principles to assist in the development of institutional policies related to the use of radiation.
5. Develop educational materials for patients, staff and physicians related to radiation safety.
6. Use methods described by NCRP, AAPM and other organizations to calculate appropriate radiation shielding designed to limit exposure to acceptable levels.
7. Use knowledge of regulations and accreditation standards to inspect laboratories and clinical services using ionizing radiation, and audit radiation safety practices of license holders, x-ray device operators and users of radioactive materials.
8. Use knowledge of radiation dosimetry and dosimeters to effectively measure levels of radiation exposure in surveys of imaging suites, radiopharmacies, laboratories, and other areas where radiation is used, and to evaluate levels of activity in radiation emergencies.

## *2. Evaluation of Progress in the Rotation*

Evaluation of competency in activities performed with the Radiation Safety Team will primarily consist of checklists documenting participation in committee meetings, audits and inspections, and observation of cleanup and survey activities. In addition, dependent on available opportunities, a report documenting the results and recommendations of at least one of each of the following activities will be produced by the resident: an inspection and audit of a laboratory or clinical service, a survey of radiation levels, an investigation of a high dose incident on a personnel radiation monitor, and response to a radiation emergency.

## *3. Didactic Requirements*

The resident will be expected to complete a number of radiation safety training courses available in the "Learn at UW" on-line training program, related to their activities involving handling of radioactive materials, operation x-ray machines, and work within controlled areas. The preceptor will evaluate the resident's ability to perform the assigned functions on a satisfactory/unsatisfactory basis.

## *4. Work Assignments, Reports and Examinations*

Materials produced in conjunction with activities undertaken to achieve competencies. Examples include: Presentations for clinical staff, CME certificates, reports or correspondence related to dose calculations, etc. These materials will be reviewed by the preceptor with suggestions for improvements where appropriate.

## *5. Mentor Evaluations of Resident's Progress in Completion of the Rotation*

Progress is documented in the spreadsheet set up for this rotation for each resident. The spreadsheet is updated by the mentor throughout the duration of the rotation. Snapshots of the spreadsheet taken periodically, provide a permanent record of progress through the rotation.

## *6. Performance and Behavioral Expectations*

See Parts 1, 2 and 3 above.

## *7. Training Schedule*

**Duration: 5 Weeks**. Beginning in the third month of the residency and extending throughout the remainder of the residency program.

≈ 50 hours – Radiation Safety activities, shielding design, surveys, and report generation.

≈ 50 hours – Study: technical considerations and regulatory requirements related to radiation safety.

≈ 50 hours – Attendance at Radiation Safety Committee meetings, planning meetings for construction of new facilities, meetings with managers and other staff regarding the development and implementation of radiation related policies and procedures.

≈ 50 hours – Preparation and Presentation of training for clinical staff, Radiology residents, and Cardiology fellows, and other faculty, trainees, and staff with the use of radiation in clinical settings.

# Appendix D – List of Residents Admitted

Please provide a reverse chronological list of residency program admissions for the past 5 years.

| Ref # | Start Year | Graduate Degrees | Dates | Institution | CAMPEP accreditation | | |
|---|---|---|---|---|---|---|---|
| | | | | | Graduate | Certificate | Not Accredited |
| 1 | 2020 | PhD - Medical Physics | 2020 | University at Buffalo SUNY | X | | |
| 2 | 2020 | PhD - Medical Physics | 2019 | UTHealth Graduate School | X | | |
| 3 | 2018 | PhD - Medical Physics | 2018 | University of Chicago | X | | |
| 4 | 2018 | Biomedical Engineering | 2018 | Wake Forest University | | | X |
| 5 | 2016 | PhD - Medical Physics | 2016 | University of Wisconsin -Madison | X | | |
| 6 | 2016 | PhD - Medical Physics | 2016 | University of Wisconsin -Madison | X | | |
| 7 | 2014 | PhD - Medical Physics | 2006 | University of Wisconsin -Madison | X | | |

Resident #4's degree was not from a CAMPEP-accredited program. Following is a list of where the required didactic courses were taken:

| Res # | Course | Institution |
|---|---|---|
| 4 | Radiological physics and dosimetry | Wake Forest University |
| | Radiation protection and safety | Wake Forest University |
| | Fundamentals of medical imaging | Wake Forest University |
| | Radiobiology | Wake Forest University |
| | Anatomy and physiology | Wake Forest University |
| | Radiation therapy physics | Wake Forest University |

## Appendix E – List of Current Residents

Please provide an alphabetical list of current residents in your program.

| Resident | Supervisor | Year Entered | Funding Sources |
|---|---|---|---|
| Jordan Krebs | Frank Ranallo, Ph.D.<br>John Vetter Ph.D. | 2020 | RPS – Department of Medical Physics<br>UWHC<br>UW-GE CT Protocol Project |
| Joseph Meier | Frank Ranallo, Ph.D.<br>John Vetter Ph.D. | 2020 | RPS – Department of Medical Physics<br>UWHC<br>UW-GE CT Protocol Project |

## Appendix F – Residency Program Graduates

Please provide a reverse chronological list of residency program graduates for the past 10 years.

| *Name* | *Time in Program (dates)* | *Supervisor* | *Current Occupation* | *Board Certification* |
|---|---|---|---|---|
| **Sean Rose** | 7/1/2018 - 6/30/2020 | Frank Ranallo, Ph.D.<br>John Vetter, Ph.D. | Assistant Professor, University of Texas at Houston Medical School | In Process |
| **Megan Lipford** | 7/1/2018 - 6/30/2020 | Frank Ranallo, Ph.D.<br>John Vetter, Ph.D. | Assistant Professor, Imaging Physicist, Department of Radiology, Wake Forest Baptist Health | In Process |
| **Christina Brunnquell** | 7/1/2016 - 6/30/2018 | Frank Ranallo, Ph.D.<br>John Vetter, Ph.D. | Assistant Professor, Medical Physics, University of Washington | ABR-Diagnostic Medical Physics |
| **Zhimin Li** | 4/1/2016 - 3/30/2018 | Frank Ranallo, Ph.D.<br>John Vetter, Ph.D. | Diagnostic Medical Physicist, Northwestern Memorial Hospital | ABR-Diagnostic Medical Physics |

# Appendix G - Faculty and Staff Biographical Sketches and Primary Clinical Interests

## Alphabetical List of Faculty/Staff

| Name | Primary Clinical Interest |
|---|---|
| Bradshaw, Tyler, Ph.D. | Nuclear medicine physics |
| Richard Bruce, MD | Neuro Imaging and informatics |
| Grist, Thomas MD FACR / Chair, Radiology | Cardiovascular imaging, MRI |
| Hall, Timothy, PhD | Ultrasound physics |
| Kanne, Jeffrey, MD | Thoracic imaging |
| Kliewer, Mark, MD | Abdominal imaging and intervention |
| Nagle, Scott, MD, PhD | Thoracic imaging, cardiovascular imaging |
| Peppler, Walter, PhD | Informatics, PACS, teleradiology |
| Ranallo, Frank, PhD, DABR, FAAPM / Program Director) | Physics of radiography, fluoroscopy, angiography, and CT; radiation safety, optimization of imaging protocols |
| Rosado-Mendez, Ivan, M | Ultrasound physics |
| Salkowski, Lonie, MD | Breast imaging; anatomy, medical education |
| Spiedel, Michael, PhD | Physics of radiography and angiography |
| Szczykutowicz, Timothy, PhD | CT physics |
| Timm, Jason D. | Environmental and Radiation Safety |
| Vetter, John, PhD, DABR / Associate Program Director | Physics of radiography, fluoroscopy, angiography, mammography, and nuclear medicine; radiation safety |
| Vigen, Karl, PhD, DABMP | MRI physics |
| Wendt, Gary, MD, MBA | Vice Chair, Informatics; neuroradiology; PACS, teleradiology |
| Zagzebski, James PhD, FAAPM | Ultrasound physics |

## Bradshaw, Tyler, J

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin-Madison | PhD | 2015 | Medical Physics |
| University of Utah | BS | 2010 | Physics |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of Wisconsin-Madison | 01/2015-01/2016 | Postdoctoral |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison, Radiology | 08/2019-Present | Associate Scientist |
| University of Wisconsin-Madison, Radiology | 01/2016-08/2019 | Assistant Scientist |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| | | |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Science in Nuclear Medicine | Physics and Instrumentation | 2017 | 2021 |

**ACADEMIC SUPERVISION**

N/A

**ROLES IN PROGRAM**

Principal mentor for the Nuclear Medicine rotation

**CLINICAL RESPONSIBILITIES**

Oversee nuclear medicine physics quality assurance program at University of Wisconsin and at UW Health.

**SCHOLARLY ACTIVITIES**

Member of Society of Nuclear Medicine and Molecular Imaging (SNMMI) Artificial Intelligence Task Force; served as intern on the SNMMI Physics, Instrumentation, and Data Science Council; have provided CE credited webinar and seminars through the SNMMI.

**RESEARCH INTERESTS**

Machine learning in nuclear medicine; quantitative PET imaging and analysis

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 26 | 21 |
| Book chapters & conference proceedings | 0 | 0 |
| Published abstracts | 58 | 46 |
| Presentations at national & international conferences | 18 | 13 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| R01GM987654 (Co-I) | Improved techniques for substitute CT generation from MRI datasets | 2018-2022 | 15% salary support |
| GE Healthcare | Molecular Imaging Research Support | 2016-2022 | Project-dependent |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

Wallis J, Klein R, **Bradshaw TJ**, et al. PIDSC Remote Viewing Guidelines Document. *J Nucl Med Technol [In Press]*.

Fowler AM , Kumar M, Henze-Bancroft L, Salem K, Johnson JM, Karow J, Perlman SB, **Bradshaw TJ**, et al. Glucose uptake of primary invasive breast cancer measured using simultaneous time-of-flight breast PET/MRI: a method comparison study with prone PET/CT. *Radiology: Imaging Cancer [In Press]*

Tzeng S, Zhu J, Weisman A, **Bradshaw TJ**, and Robert Jeraj. Spatial process decomposition for quantitative imaging biomarkers using multiple images of varying shapes. *Statistics in Medicine. 40(5):1243; 2021*

Weisman AJ, Kim J, Lee I, McCarten K, Kessel S, Schwartz C, Kelly K, Jeraj R, Cho S, and **Bradshaw TJ**. Automated quantification of baseline imaging PET metrics on FDG PET/CT images of pediatric Hodgkin lymphoma patients. *EJNMMI Physics. 7(1):76; 2020.*

Weisman AJ, Kieler M, Perlman S, Hutchings M, Jeraj R, Kostakoglu L, and **Bradshaw TJ**. Comparison of 11 automated PET segmentation methods in lymphoma. *Phys Med Biol. 65(23):5019; 2020*.

Weisman AJ, **Bradshaw TJ**, Namias M, and Jeraj R. Impact of scanner harmonization on PET-based treatment response assessment in metastatic melanoma. *Phys Med Biol.* 65(22):5003; 2020.

Weisman AJ, Kieler M, Perlman S, Hutchings M, Jeraj R, Kostakoglu L, and **Bradshaw TJ**. Convolutional Neural Networks for Automated PET/CT Detection of Diseased Lymph Node Burden in Patients With Lymphoma. *Radiology: Artificial Intelligence.* 2(5):e200016; 2020

Kogan R, Leenders K, et al. Factors affecting the harmonization of disease-related metabolic brain pattern expression quantification in [18F]FDG-PET (PETMETPAT). *Alzheimers Dement.* 11:472-482; 2019

Im HJ, Solayappan M, **Bradshaw TJ**, et al. Multi-level Otsu Method to Define Metabolic Tumor Volume in Positron Emission Tomography. *Am J Nucl Med Mol Imaging.* 8(6): 373-386*;* 2019

Lin C, Harmon S, **Bradshaw TJ**, et al. Response-to-repeatability of quantitative imaging features for longitudinal response assessment. *Phys Med Biol.* 64(2): 025019; 2019

**Bradshaw TJ**, Zhao G, et al. Feasibility of deep learning-based PET/MR attenuation correction in the pelvis using only diagnostic MR images. *Tomography*. 4(3): 138-147; 2018.

Perk T, **Bradshaw TJ**, et al. Automated Classification of Benign and Malignant Lesions on $^{18}$F-NaF PET/CT Images Using Machine Learning. *Phys Med Biol.* 63: 225019; 2018

Perk T, Chen S, Harmon S, Lin C, **Bradshaw TJ**, et al. Statistically Optimized Regional Thresholding Method (SORT) for Bone Lesion Detection in PET/CT Imaging. *Phys Med Biol.* 63: 225018; 2018.

Liu F, Jang H, Zhao G, **Bradshaw TJ**, and McMillan AB. A deep learning approach for $^{18}$F-FDG PET attenuation correction. *ENJMMI Physics*. 5(24); 2018.

Jang H, Liu F, **Bradshaw TJ**, and McMillan A. Technical Note: Deep learning based MRAC using rapid ultra-short echo time imaging. *Medical Physics.* 45(8): 3697-3704; 2018.

Namias M, **Bradshaw TJ**, et al. A novel approach for quantitative harmonization in PET. *Phys Med Biol*. 4(63): 095019; 2018.

Jang H, Liu F, **Bradshaw TJ**, et al. Rapid dual echo ramped hybrid encoding MR-based attenuation correction (dRHE-MRAC). *Magn Reson Med*. 79(6): 2912-22; 2018.

Liu F, Jang H, **Bradshaw TJ**, et al. Deep learning MR-based attenuation correction (deepMRAC) for PET/MR. *Radiology*. 286(2):676-84; 2018.

Im HJ, **Bradshaw TJ**, Solaiyappan M, and Cho SY. Current Methods to Define Metabolic Tumor Volume in Positron Emission Tomography: Which One is Better? *Nucl Med Mol Imaging*. 52(1):5-15; 2018.

Lin C, **Bradshaw TJ**, et al. Repeatability of Quantitative 18F-NaF PET: A Multicenter Study. *J Nucl Med*. 57:1872-1879; 2016. [*2017 Alavi-Mandell Publication Award*]

**Bradshaw TJ**, Voorbach MJ, et al. Image quality of $^{89}$Zr PET imaging in the Siemens microPET Focus 220 preclinical scanner. *Molecular Imaging and Biology*. 18:377-385; 2016.

## Bruce, Richard J

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Oklahoma State University | BS | 1998 | CHEMICAL ENGINEERING |
| University of Texas Southwestern Medical School | MD | 2003 | MEDICAL DOCTOR |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of Texas Southwestern Medical School | 2003 – 2004 | Internship in Internal Medicine |
| University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin | 2004 – 2008 | Residency in Radiology |
| University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin | 2008 – 2009 | Fellowship in Neuroradiology |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| Department of Radiology, University of Wisconsin | 2009 – Present | *Assistant Professor of Neuroradiology (CHS)* |
| Department of Radiology, University of Wisconsin | 2009 – Present | *Medical Director of Radiology Informatics* |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| | | |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Radiology | Diagnostic Radiology Board Certification | 2008 | |
| American Board of Radiology | Neuroradiology Certificate of Additional Qualification | 2010 | |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

**ROLES IN PROGRAM**

*UW Radiology Computer Support Oversight Committee 2011-2014 Chair*
*UW Radiology Quality Improvement and Safety Committee 2011-Present Member*
*UW Radiology Improvement Group Committee 2009-2011 Member*
*UW Radiology Peer Review and Quality Improvement Committee 2008-2009 Member*
*UW Radiology Graduation Committee 2007-2011 Co-chair*
*Member, UW Health Radiology Client Area Steering Committee (2018-Present).*
*Member, Research Compute Infrastructure (RCI) Steering Committee (2018-Present).*
*Member, Clinical Resources Information Systems and Processes (CRISP) Steering Committee (2015-2018).*
*Member, UW Health Physician Informatics Champions (2015-Present).*
*Co-Chair, UW Health/SMPH/Campus Collaborative Security Committee (2015-2017).*
*Member, UW Hospital and Clinics Medical Records Committee (2009-2017).*
*Member, UW Hospital and Clinics Pharmacy and Therapeutics Committee (2009-2017).*
*Member, UW Hospital and Clinics Medical Board (2007-2009).*
*Member, UW Hospital and Clinics House Staff Association Radiology Representative (2005-2008).*
*Member, UW Hospital and Clinics GME Oversight Committee house staff representative (2005-2007).*

**CLINICAL RESPONSIBILITIES**

Clinical Teaching

2009 – Present Clinical instruction in neuroradiology of residents and fellows.
2010 – Present Radiology Professional Development Lecture Series

Co-Director, lecture and assist lecture content coordination for yearly 13 lecture series.
2016 – Present Imaging Informatics Leadership Program

Program Director

2018 – Present National Imaging Informatics Curriculum

Small Group Leader

**SCHOLARLY ACTIVITIES**

*Member, Christian Medical and Dental Association (CMDA)*

*Member, Society of Imaging Informatics in Medicine (SIIM)*

*Member, Radiological Society of North America (RSNA)*

*Member, American Society of Neuroradiology (ASHNR)*

*Member, American College of Radiology (ACR)*

**RESEARCH INTERESTS**

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 18 | 6 |
| Book chapters & conference proceedings | 1 | |
| Published abstracts | | |
| Presentations at national & international conferences | 45 | 7 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| | CT and MRI Spine Machine Learning Data Set Assembly | 2018 – Present | $75,000 |
| | Representative Radiology Data Set Assembly | 2018 – Present | $50,000 |
| | An Autopsy Tissue Study for Quantification of Gadolinium Levels and Histopathological Changes from Subjects Who Received A Gadolinium-Based Contrast Agent | 2018 – Present | $28,160 |
| | Collaborative Cancer Research Award – Development of a curated repository for machine learning with GBM imaging data, radiation treatment plan data, and metadata | 2018 – Present | $62,500 |
| | Development of a Head and Neck Cancer SPORE Radiology Research PACS | 2017 – Present | $50,000 |
| McKesson / Epic | McKesson / Epic FHIR Integration | 12/2016 – 3/2017 | $19,428 |
| McKesson | McKesson Next Generation Viewer | 2016 – Present | $40,040 |
| GE | GE Protocol Manager Project | 3/2017 – Present | |
| NIH | NIH Clinical and Translational Science Award (CTSA) Biomedical Informatics Core | 7/2014 – Present | |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

1. **Bruce R**, Wentland AL, Haemel AK, Garrett RW, Sadowski DR, Djamali A, Sadowski EA. Incidence of Nephrogenic Systemic Fibrosis Using Gadobenate Dimeglumine in 1423 Patients With Renal Insufficiency Compared With Gadodiamide. Invest Radiol. 2016 Feb 16.
2. Kinner S, Schubert T, **Bruce RJ**, Rebsamen S, Diamond CA, Reeder SB, Rowley HA. Deep brain nuclei T1 shortening after gadobenate dimeglumine in children: influence of radiation and chemotherapy. AJNR Am J Neuroradiol. 2018 Jan;39(1):24-30.
3. Szczykutowicz TP, Brunnquell CL, Avey GD, Bartels C, Belden DS, **Bruce RJ**, Field AS, Peppler WW, Wasmund P, Wendt G. A General Framework for Monitoring Image Acquisition Workflow in the Radiology Environment: Timeliness for Acute Stroke CT Imaging. J Digit Imaging. 2018 Feb 5.
4. Falomo E, Strigel RM, **Bruce RJ**, Munoz del Rio A, Adejumo C, Kelcz F. Incidence and outcomes of incidental breast lesions detected on cross-sectional imaging examinations. The Breast Journal. 2018 Sep;24(5):743-748.
5. German M, Lutz M, Pickhardt P, **Bruce RJ**, Said A. Statin Use is Protective Against Hepatocellular Carcinoma in Patients With Nonalcoholic Fatty Liver Disease: A Case-control Study. Journal of Clinical Gastroenterology. 2019 Sep.
6. Vey BL, Cook TS, Nagy P, **Bruce RJ**, Filice RW, Wang KC, Safdar NM. A Survey of Imaging Informatics Fellowships and Their Curricula: Current State Assessment. Journal of Digital Imaging. 2019 Feb;32(1):91-96.

## Garrett, John, W.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Middlebury College | BA | 2011 | Physics |
| University of WI-Madison | MS | 2013 | Medical Physics |
| University of WI-Madison | PhD | 2017 | Medical Physics |
| | | | |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of WI-Madison | 06/2017-05/2018 | Assistant Scientist |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of WI-Madison, Department of Radiology | 05/2018-current | Assistant Professor |
| University of WI-Madison, Department of Radiology | 05/2018-current | Director of Imaging Informatics |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.: 8*

**ROLES IN PROGRAM**

I have been working on a variety of informatics and IT related projects for the department including: Access to clinical systems, facilitating and fostering collaborations with industrial partners including GE, Change Healthcare, Healthmyne, Epic, and Philips, collaborating with others around campus to develop policies regarding data sharing and establish UW Radiology as a leader in this area, acting as a liaison between and champion for UW Radiology and other entities such as UW Health IS and SMPH ICTR, and working to deploy provide education for new computing infrastructure such as the NVIDIA DGX system.

**SCHOLARLY ACTIVITIES**

Associate Editor for Medical Physics. Reviewer for the following journals: Medical Physics, Physics in Medicine and Biology, IEEE Trans Med Im, American Journal of Neuroradiology, Journal of Medical Imaging, Computers in Biology and Medicine, and Optics Express.

**RESEARCH INTERESTS**

Image reconstruction, Image processing, Cone-Beam CT Imaging, Digital Breast Tomosynthesis, Imaging Informatics, Data science, Artificial Intelligence, Natural Language Processing

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 17 | 11 |
| Book chapters & conference proceedings | 21 | 7 |
| Published abstracts | 31 | 16 |
| Presentations at national & international conferences | 15 | 5 |

| RESEARCH FUNDING SUPPORT | | | |
|---|---|---|---|
| **Source of Funding** | **Title of Research Grant** | **Dates of Support** | **Funding Amount** |
| NLM | Can machines be trusted? Robustification of deep learning for medical imaging | 07/02/2020 – 03/31/2024 | $318,155 |
| NIH | Development and Deployment of Artificial Intelligence (AI) Driven Methods to Enable Chest X-ray Radiography as an Alternative Diagnostic Method for COVID-19 Pneumonia | 07/21/2020 – 07/20/21 | $347,688 |
| NIH | ONE STOP SHOP IMAGING FOR ACUTE ISCHEMIC STROKE TREATMENT | Dates: 09/30/15-07/20/21 | $1,069,153 |
| NIH | MULTI-CONTRAST X-RAY BREAST IMAGING | 01/01/16-06/30/21 | $402,142 |
| WI Partnership Program | Alternative Means to Diagnose COVID-19 Pneumonia | 07/21/2020 – 07/20/21 | $150,000 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**

*Last 5 years.*


Dayan, I., Roth, H., et al. “Federated Learning used for predicting outcomes in SARS-COV-2 patients”. Nature Medicine. In revision

Voter, Andrew, Meram, E., Garrett, J., and Yu, John-Paul. “Diagnostic accuracy and failure mode analysis of a deep learning algorithm for the detection of intracranial hemorrhage.” JACR, 2021. https://doi.org/10.1016/j.jacr.2021.03.005. Accepted for publication.

Voter, A., Larson, M., Garrett, J., and Yu, J.-P. “Diagnostic accuracy and failure mode analysis of a deep learning algorithm for the detection of cervical spine fractures”. American Journal of Neuroradiology. Accepted for publication.

Eisenmenger, L., Capel, K., Ahmed, A., Niemann, D., Garrett, J., et al. “Comparison of Sequential MDCTP And CBCTP Maps in 39 Subjects with AIS Due to a Large Artery Occlusion” Under review, JNIS, 2020.

Zhang, R., Tie, X., Qi, Z.,Bevins, N., Zhang, C, Griner, D, Song, T, Nadig, J, Schiebler, M, Garrett, J., et al. “Diagnosis of COVID-19 Pneumonia using Chest Radiography: Value of Artificial Intelligence.” Radiology 2021 298:2, E88-E97 DOI: 10.1148/radiol.20202029446.

Zhang, R., Fowler, A., Wilke, L., Kelcz, F., Garrett, J., Chen, G.-H., Li, K. “Fast Acquisition with Seamless Stage Translation (FASST) for a human-compatible trimodal x-ray breast imaging system”. Accepted for publication. Med. Phys., 2020 47: 4356-4362. https://doi.org/10.1002/mp.14297

Li, Y., Garrett, J., Li, K., Strother, C., Chen, G.-H. “An enhanced SMART-RECON Algorithm for Time-Resolved Cone-beam CT Imaging”. IEEE Transactions on Medical Imaging. doi: 10.1109/TMI.2019.2960720.

Garrett, J., Li, Y., Li, K., Wu, Y., Johnson, K., Schafer, S., and Chen, G.-H. “Quantification of Temporal Resolution Improvement Factor in SMART-RECON Based Time-Resolved C-arm Cone Beam CT Angiography (TR-CBCTA)” Physics in Medicine and Biology. 2018; 63(19).

Garrett, J., Li, Y., Li, K., and Chen, G.-H. “Reduced anatomical clutter in digital breast tomosynthesis with statistical iterative reconstruction. Med. Phys. 2018, 45: 2009-2022.

Li, Y., Garrett, J., Li, K., Wu, Y., Johnson, K., Schafer, S., Strother, C., and Chen, G.-H. “Time-Resolved C-arm Cone Beam CT Angiography (TR-CBCTA) imaging from a single short-scan C-arm cone beam CT acquisition with intra-arterial contrast injection” Physics in Medicine and Biology. 2018; 63 075001.

Cruz-Bastida, J. P., Gomez-Cardona, D., Garrett, J., Szczykutowicz, T., Chen, G.-H., and Li, K. “Modified ideal observer model (MIOM) for high contrast and high spatial resolution CT imaging tasks.” Medical Physics. 2017; 44 (9): 4496-4505.

## Grist, Thomas, M

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Marquette University | B.S. | 1981 | Biomedical Engineering |
| Medical College of Wisconsin | M.D. | 1985 | Doctorate of Medicine |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| Duke University Medical Center | 7/1/1987<br>6/30/1991 | Diagnostic Radiology |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| UWSMPH, Department of Radiology and Medical Physics | 2002 --present | Professor (Tenure) |
| UWSMPH – Department of Biomedical Engineering | 2002 --present | Professor (Tenure) |
| UWSMPH, Department of Radiology | 2005 --present | John H. Juhl Professor and Chairman |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| UWSMPH | 1991 – 1996 | Assistant Professor |
| UWSMPH | 1996 – 2002 | Associate Professor |
| UWSMPH | 2003 - 2005 | Robert Turrell Professor, Imaging Sciences |
| UWSMPH | 2005 – present | John H. Juhl Professor and Chair, Department of Radiology |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| State of Wisconsin | Medicine and Surgery | 1987 | 2021 |
| American Board of Radiology | Diagnostic Radiology | 1991 | 2022 |

**ACADEMIC SUPERVISION**

Current supervisor for 0 PhD student; past supervisor for 21 PhD students and 1 MS students, 30 post clinical and doctoral fellows

| ROLES IN PROGRAM |
|---|
| Member of Program Steering Committee |
| **CLINICAL RESPONSIBILITIES** |
| Cardiovascular Imaging, Diagnostic Imaging |
| **SCHOLARLY ACTIVITIES** |
| National and International lecturer. Authored 4 books, 16 book chapters and over 175 peer-reviewed publications |
| **RESEARCH INTERESTS** |
| Magnetic Resonance Imaging |
| **RESEARCH SUMMARY** |

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 177 | 10 |
| Book chapters & conference proceedings | 16 | 0 |
| Published abstracts | 278 | 5 |
| Presentations at national & international conferences | 332 | 40 |

| RESEARCH FUNDING SUPPORT | | | |
|---|---|---|---|
| **Source of Funding** | **Title of Research Grant** | **Dates of Support** | **Funding Amount** |
| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
| GE Healthcare | UW Strategic Partnership | 7/13/2012 – | |
| 7/12/2022 | 34,000,000 | | |

## Hall, Timothy J.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin – Madison | PhD | 1983 | Physics |
| University of Wisconsin – Madison | MS | 1985 | Medical Physics |
| University of Michigan - Flint | BS | 1988 | Medical Physics |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of Kansas Medical Center | 1988 | Postgraduate, Quantitative Ultrasound |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin – Madison, Medical Physics | 2020-Present | Interim Chair |
| University of Wisconsin – Madison, Medical Physics | 2003-Present | Professor |
| University of Kansas Medical Center, Dept. of Radiology | 2000-2002 | Professor |
| University of Kansas Medical Center, Dept. of Moleculaand Integrative Physiology | December 1999 | Associate Professor |
| University of Kansas Medical Center, Division of Imageand Science Technology | August 1999 | Director |
| University of Kansas Medical Center, Dept. of Radiology | 1995-2000 | Associate Professor |
| University of Kansas Medical Center, Dept. of Radiology | 1991-1995 | Assistant Professor |

**ACADEMIC SUPERVISION**

**Master's and PhD. Theses Directed**

2001 – 2002 Jingfeng Jiang MS, Electrical and Computer Engineering
2003 – 2008 Lee M Kiessel PhD, Medical Physics
2003 – 2010 Amy M Sommer PhD Candidate, Medical Physics
2004 – 2010 Ted G Fisher PhD, Medical Physics
2005 – 2007 Aishwarya Sreenivasan MS, Biomedical Engineering2
005 – 2012 Kibo Nam PhD, Electrical Engineering
2008 – 2011 Janelle Anderson MS, Biomedical Engineering
2008 – 2013 Matthew Bayer PhD, Medical Physics
2009 – 2014 Ivan M Rosado-Mendez PhD, Medical Physics
2010 – 2017 Haidy Gerges Nasief PhD, Medical Physics
2010 – 2018 Lindsey Carlson PhD, Biomedical Engineering
2012 – 2018 Quinton W Guerrero PhD, Medical Physics
2015 – 2019 Andrew Santoso PhD, Medical Physics
2017 Present Hayley Whitson PhD Candidate, Medical Physics
2020 Present Alexandra Christensen PhD Candidate, Medical Physics

## ROLES IN PROGRAM

**Didactic Teaching**

MP701 – Ethics and RCR in the Practice of Medical Physics – Discussion, 2-hours, 21 Graduate Students (2018)
MP619 – Microscopy of Life – Lecture, 1-hour/year, 25 Graduate Students (2012 – Present)

MP775 – Advanced Ultrasound Physics – Lecture, 45-hours/semester, 2-5 Graduate Students (2008 – 2013)

**Non didactic Teaching**

MP699 – Independent Study – Discussion, 45-hours/semester, 3 Graduates (2007 – Present)
BME399 – Independent Study – Discussion, 45-hours/semester, 1 Graduate (2007)

BME699 – Independent Study – Discussion, 45-hours/semester, 1 Graduate (2006 – Present)

**Department**

2020 – Present Interim Chair, Medical Physics Department, UWSMPH

2016 – 2019 Vice-Chair for the Faculty, Medical Physics Department, UWSMPH
2015 – Present Manager, Medical Physics Machine Shop

**UWSMPH/Hospital**

2012 – 2016 UWCCC Education
Committee2011 – 2016 UWCCC Pilot
Grant Review

## SCHOLARLY ACTIVITIES

**Professional Society Memberships**

2020 – Present Society of Directors of Academic Medical Physics Programs

2012 – Present Radiological Society of North America's Quantitative Imaging Biomarker Alliance (QIBA)2012 – Present World Federation of Ultrasound in Medicine and Biology

2002 – Present American Institute of Ultrasound in Medicine 1994 – Present American Association of Physicists in Medicine1988 – Present Institute of Electrical and Electronics Engineers1984 – Present American Institute of Physics

1984 – Present Acoustical Society of America

**Reviewer for Scientific Journals**

1. Academic Radiology
2. Current Medical Imaging Reviews
3. IEEE Transactions on Biomedical Engineering
4. IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control
5. IEEE Transactions of Medical Imaging
6. Journal of the Acoustical Society of America
7. Mechanical Engineering & Physics
8. Medical Image Analysis
9. Medical Physics
10. Physics in Medicine and Biology
11. Physiological Measurement
12. Radiology
13. Reproductive Sciences
14. Ultrasonic Imaging
15. Ultrasonics
16. Ultrasound in Medicine and Biology
17. Ultrasound in Obstetrics & Gynecology

## RESEARCH INTERESTS

Ultrasound tissue elasticity imaging phantom development, algorithm development for motion tracking and image formation, fundamental noise properties of elasticity images, system integration, quantitative quasistatic elastography.

| RESEARCH SUMMARY | | |
|---|---|---|
| **Item** | **Total** | **In last 5 years** |
| Peer-reviewed papers in referred journals | 138 | 31 |
| Book chapters & conference proceedings | 9 | 2 |
| Published abstracts | 138 | 31 |

| RESEARCH FUNDING SUPPORT | | | |
|---|---|---|---|
| **Source of Funding** | **Title of Research Grant** | **Dates of Support** | **Funding Amount** |
| Pfizer and Siemens | Imaging Biomarkers for Liver Assessment | 2019-2099 | $1,999,958 |
| NIH/NCI T32 CA0092061978 | UW Radiological Science Training Program | 1978-2024 | $464, 867 per annum |
| NIH/NCI R01 CA195527 | Multi-Parameter Nonlinear Elasticity Mapping ofBreast Masses | 2016-2020 | $2,171,345 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

**Refereed Articles**

Jafarpisheh N, Rosado-Mendez IM, Hall TJ, and Rivaz H. Analytic Global Regularized Backscatter Quantitative Ultrasound IEEE UFFC, accepted, Dec 2020.

Palmeri ML, Milkowski A, (and many more). RSNA/QIBA Shear Wave Speed as a Biomarker for Liver Fibrosis Staging: Elastic and Viscoelastic Phantom Studies. accepted J Ultrasound Med, Dec.2020.

Pinkert MA, Hall TJ, Eliceiri KW, Challenges of conducting quantitative ultrasound with a multimodal optical imaging system, Phys Med Biol, accepted Nov 2020.

Gendin DI, Nayak R, Wang Y, Bayat M, Oberai AA, Hall TJ, Barbone PE, Alizad A, Fatemi M, Repeatability of linear and nonlinear elastic modulus maps from repeat scans in the breast, IEEE Trans Med Imag accepted Oct 2020.

Castañeda-Martinez L, Noguchi KK, Ikonomidou C, Zagzebski JA, Hall TJ, Rosado-Mendez IM. Optimization of Ultrasound Backscatter Spectroscopy to assess neurotoxic effects of anesthesia in the newborn non-human primate brain. Ultrasound Med Biol. accepted Apr 2020

Pinkert MA, Cox BL, Dai B, Hall TJ, Campagnola PJ, Rogers JD, Eliceiri KW. 3D-printed registration phantom for combined ultrasound and optical imaging of biological tissues. Ultrasound Med Biol. accepted Mar 2020.

Pinkert MA, Simmons ZJ, Niemeier RC, Dai B, Woods LB, Hall TJ, Campagnola PJ, Rogers JD, Eliceiri KW. A platform for quantitative multiscale imaging of tissue composition. J Biomed Optic Express, accepted Mar.2020.

Carlson LC, Hall TJ, Rosado-Mendez IM, Mao L, Feltovich H. Quantitative assessment of cervical softening during pregnancy with shear wave elasticity imaging: an in vivo longitudinal study. Interface Focus. 2019 Oct 6;9(5):20190030. doi: 10.1098/rsfs.2019.0030. Epub 2019 Aug 16. PMCID: PMC6710662

Wang Y, Bayer M. Jiang J, Hall TJ. An Improved Region-Growing Motion Tracking Method Using More Prior Information for 3D Ultrasound Elastography. IEEE Trans Ultrasound Ferroelectr Freq Control. 2019 Oct 23. doi: 10.1109/TUFFC.2019.2948984. [Epub ahead of print], PMID: 31647429 .

Santoso AP, Vink JY, Gallos G, Feltovich H, Hall TJ. Quantitative ultrasound detects smooth muscle activity at the cervical internal os in vitro. Ultrasound Med Biol 2020 Jan;46(1):149-155. doi: 10.1016/j.ultrasmedbio.2019.08.020. Epub 2019 Oct 24. PMCID: PMC6879854

Wang Y, Bayer M, Jiang J, Hall TJ. Large-Strain 3-D in Vivo Breast Ultrasound Strain Elastography Using a Multi-compression Strategy and a Whole-Breast Scanning System. Ultrasound Med Biol. 2019 Dec;45(12):3145-3159. doi: 10.1016/j.ultrasmedbio.2019.08.013. Epub2019 Sep 2,1 PMCID: PMC6823158.

Guerrero QW, Rosado-Mendez IM, Santoso AP, Carlson LC, Zea R, Feltovich H, Hall, TJ. Quantitative Ultrasound Parameters Based on the Backscattered Echo Power Signal as Biomarkers of Cervical Remodeling: A Longitudinal Study in the Pregnant Rhesus Macaque.

Ultrasound Med Biol. 2019 Jun 1;45(6):1466-74. PMCID:

**Books and Book Chapters**

Barbone PE, Hall TJ and Oberai AA. “Introduction to Quasistatic Elastography.” in Tissue Elasticity Imaging, Vols. 1 and 2, S. Kaisar Alam and Brian Garra editors, Elsevier, 2017.

Dord J-F, Goenezen S, Oberai AA, Barbone PE, Jiang J, Hall TJ and Pavan T. “Validation of quantitative linear and nonlinear compressionelastography” in Ultrasound Elastography for Biomedical Applications and Medicine, edited by Ivan Z. Nenadic, Matthew W. Urban, James

F. Greenleaf, Jean-Luc Gennisson, Miguel Bernal and Mickael Tanter, John Wiley & Sons, Ltd.

## Kanne, Jeffrey P, MD, FACR

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Northwestern University | BA | 1996 | English Literature |
| Emory University School Medicine | MD | 2000 | Medicine |
| | | | |
| | | | |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| Swedish Hospital Medical Center-Seattle | 6/2000-7/2001 | Internship – Transitional Year |
| University of Washington, Seattle | 7/2001-7/2005 | Residency – Diagnostic Radiology |
| Vancouver General Hospital, Vancouver BC | 7/2005-7/2006 | Fellowship – Thoracic Radiology |
| | | |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of WI School Medicine Public Health, Department of Radiology | 7/2009-7/2015 | Associate Professor |
| University of WI School Medicine Public Health, Department of Radiology | 7/2015- Present | Professor |
| University of WI School Medicine Public Health, Department of Radiology | 7/2009- Present | Vice Chair of Quality and Safety |
| University of WI School Medicine Public Health, Department of Radiology | 7/2013-Present | Chief of Thoracic Imaging |
| | | |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| | | |
| | | |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board Radiology | Diagnostic Radiology | 2005 | |
| NIOSH | B Reader | 2004 | |
| | | | |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

N/A

**ROLES IN PROGRAM**

Mentor Medical Physics residents on clinical and patient safety aspects of medical imaging specifically in the area of thoracic imaging

**CLINICAL RESPONSIBILITIES**

Chief of Thoracic Imaging, UW Hospital/UW School of Medicine and Public Health

**SCHOLARLY ACTIVITIES**

Regular lecturer and national and international courses and conference. Co-director of American College of Radiology HRCT of the Chest and NIOSH B-Reader hands-on courses

**RESEARCH INTERESTS**

Diffuse Lung diseases, occupational lung disease ,and respiratory tract infections

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 131 | 46 |
| **Book chapters** & conference proceedings | 21 | 2 |
| Published abstracts | N/A | |
| Presentations at national & international conferences | 96 | 34 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| | N/A | | |
| | | | |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

**Kanne JP**, Bai H, Bernheim A, Chung M, et al. COVID-19 Imaging: What We Know Now and What Remains Unknown. *Radiology* 2021 Feb 9:204522. doi: 10.1148/radiol.2021204522. Online ahead of print.

Hartung MP, Bickle IC, Gaillard F, **Kanne JP.** How to Create a Great Radiology Report. *Radiographics*. 2020 Oct;40(6):1658-1670. doi: 10.1148/rg.2020200020.

Johnson EM, Martin MD, Sharma R, Meyer CA, **Kanne JP.** Blastomycosis: The Great Pretender. *J Thorac Imaging*. 2020 Sep 25. doi: 10.1097/RTI.0000000000000562.

Sharma R, Meyer CA, Frazier AA, Martin Rother MD, Kusmirek JE, **Kanne JP.** Routes of Transdiaphragmatic Migration from the Abdomen to the Chest. *Radiographics*. 2020 Sep-Oct;40(5):1205-1218. doi: 10.1148/rg.2020200026. Epub 2020 Jul 24.

Goyal N, Chung M, Bernheim A, Keir G, Mei X, Huang M, Li S, **Kanne JP.** Computed Tomography Features of Coronavirus Disease 2019 (COVID-19): A Review for Radiologists. *J Thorac Imaging*. 2020 Jul;35(4):211-218. doi: 10.1097/RTI.0000000000000527.

Simpson S, Kay FU, Abbara S, Bhalla S, Chung JH, Chung M, Henry TS, **Kanne JP**, Kligerman S, Ko JP, Litt H. Radiological Society of North America Expert Consensus Statement on Reporting Chest CT Findings Related to COVID-19. Endorsed by the Society of Thoracic Radiology, the American College of Radiology, and RSNA. *J Thorac Imaging*. 2020 Jul;35(4):219-227.

Rubin GD, Ryerson CJ, Haramati LB, Sverzellati N, **Kanne JP**, Raoof S, Schluger NW, Volpi A, Yim JJ, Martin IBK, Anderson DJ, Kong C, Altes T, Bush A, Desai SR, Goldin J, Goo JM, Humbert M, Inoue Y, Kauczor HU, Luo F, Mazzone PJ, Prokop M, Remy-Jardin M, Richeldi L, Schaefer-Prokop CM, Tomiyama N, Wells AU, Leung AN. The Role of Chest Imaging in Patient Management During the COVID-19 Pandemic: A Multinational Consensus Statement from the Fleischner Society. *Chest*. 2020 Jul;158(1):106-116. doi: 10.1016/j.chest.2020.04.003.

**Kanne JP**, Little BP, Chung JH, Elicker BM, Ketai LH. Essentials for Radiologists on COVID-19: An Update- Radiology Scientific Expert Panel. *Radiology*. 2020 Aug;296(2):E113-E114. doi: 10.1148/radiol.2020200527.

**Kanne JP.** Chest CT Findings in 2019 Novel Coronavirus (2019-nCoV) Infections from Wuhan, China: Key Points for the Radiologist. *Radiology*. 2020 Apr;295(1):16-17. doi: 10.1148/radiol.2020200241.

Cossu A, Martin Rother MD, Kusmirek JE, Meyer CA, **Kanne JP.** Imaging Early Postoperative Complications of Cardiothoracic Surgery. *Radiol Clin North Am*. 2020 Jan;58(1):133-150. doi: 10.1016/j.rcl.2019.08.009.

Henry TS, Kligerman SJ, Raptis CA, Mann H, Sechrist JW, **Kanne JP**. Imaging Findings of Vaping-Associated Lung Injury. *AJR Am J Roentgenol.* 2020 Mar;214(3):498-505. doi: 10.2214/AJR.19.22251.

## Kliewer, Mark A.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Oberlin College | BA | 1975-1979 | Undergraduate |
| Duke University School of Medicine | MD | 1981-1985 | Medical School |
| Duke University | MS | 1996-1998 | Graduate School |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| Duke University | 1981-1985 | MD |
| Duke University | 1996-1998 | Master of Health Science in Biometry (Biostatistics) |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin, Department of Radiology, Madison, WI | 2006-Present | Professor of Radiology and Medical Physics (with Tenure) |
| University of Wisconsin, Department of Radiology, Madison, WI | 2002-Present | Director of Obstetric & Gynecologic Imaging |
| University of Wisconsin, School of Ultrasound, Madison, WI | 2011-Present | Medical Director for The School of Ultrasound |
| University of Wisconsin, Department of Radiology, Abdominal Imaging | 1/2003-11/2006 | Professor of Radiology (with Tenure) |
| University of Wisconsin, Department of Radiology, Abdominal Imaging | 1/2002-1/2003 | Visiting Professor |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| Duke University Medical Center | 2/2001-12/2001 | Clinical Director of Ultrasound |
| Duke University Medical Center | 8/1999-12/2001 | Academic Mentorship Program for Residents Co-Director |
| Duke University Medical Center | 9/1998 – 12/2001 | Departmental Manuscript Editor |
| Duke University Medical Center, Department of Radiology, Abdominal Imaging | 2/1997-12/2001 | Associate Professor with Tenure |
| Duke University Medical Center, Department of Radiology, Ultrasound, and Pediatric Imaging | 12/1996-2/1997 | Associate Professor |
| Duke University Medical Center, Department of Radiology, Ultrasound, and Pediatric Imaging | 7/1991-11/1996 | Assistant Professor |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Radiology | Diagnostic Radiology | 1990 | |
| Certificate of Added Qualifications | Pediatric Radiology | 1995 | |
| North Carolina | Medical License | 1988 | |
| Wisconsin | Medical License | | |

| ACADEMIC SUPERVISION |
|---|
| Past supervisor for 12 PhD students and 1 MS students |
| **ROLES IN PROGRAM** |
| Course lecture for Principles of Ultrasound Physics (1 contact hour);<br>Interact with Medical Physics residents and advise on ultrasound image quality factors as they pertain to medical physics. Director of Clinical Ultrasound Imaging, |
| **CLINICAL RESPONSIBILITIES** |
| Abdominal Imaging.<br>Medical Director of Ultrasound and Obstetrical and Gynecologic Imaging, UW-Madison<br>Medical Director of UW Ultrasound School |
| **SCHOLARLY ACTIVITIES** |
| *Examples: participation in scientific societies and meetings, scientific presentations, continuing education, etc.* |
| **RESEARCH INTERESTS** |
| Advanced techniques in Ultrasound Obstetrical and Gynecologic Imaging Vascular Doppler Imaging |

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 145 | 12 |
| Book chapters & conference proceedings | 11 | 0 |
| Published abstracts | 115 | 12 |
| Presentations at national & international conferences | 141 | 20 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| RSNA | How Informed Consent Affects Patients' Trust and Assessment of Risk: Effects of Message Framing, Denominator Neglect, Anchoring and Rhetoric | 2019-Present | $37,142.00 |
| R21 | Total Uterine Blood-flow Volume: Placental Function | 2015-Present | $275,000.00 |
| National Instituted of Health | Central Neck Dissection in Patients with Clinical Node Negative Thyroid Cancer | 2014-Present | |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

1. **Kliewer MA**, Dyke WB, Birch CW, Bagley AR. Respiratory Fluctuation of Peak Systolic Velocities in the Carotid Doppler Waveforms of Patients with Obstructive Airway Disease: Evidence of Pulsus Paradoxus With Experimental Validation. J Ultrasound Med. 2020 Jul 29. doi: 10.1002/jum.15410. Epub ahead of print. PMID: 32725845.
2. **Kliewer MA**, Lee LJ, Bagley AR. Measurement of the Internal Carotid Artery Cross-Sectional Area: Systematic Differences Depending on Grayscale, Power Doppler, and Color Doppler Techniques. J Ultrasound Med. 2020 Jul. doi:10.1002/jum.15400. PMID: 32706144.
3. **Kliewer MA**, Mao L, Brinkman M, Bruce R, Hinshaw JL. Diurnal Variation of Major Error Rates in the Interpretation of Abdominal/Pelvic CT Studies. Ab Rad. 2020. . doi:10.1007/s00261-020-02807-w.
4. **Kliewer, M.A.**, Lee, L.J. and Bagley, A.R., Measurement of the Internal Carotid Artery Cross-Sectional Area. 2020 July; J Ultrasound Med. doi:10.1002/jum.15400
5. **Kliewer, M.A**., Dyke, W.B., Birch, C.W. and Bagley, A.R., Respiratory Fluctuation of Peak Systolic Velocities in the Carotid Doppler Waveforms of Patients with Obstructive Airway Disease. 2020 July; J Ultrasound in Medicine doi:10.1002/jum.15410
6. **Kliewer M**, Brinkman M, Hinshaw JL. The Back Alleys and Dark Corners of Abdomen and Pelvis CT: The Most Frequent Sites of Missed Findings in the Multiplanar Era. A Case Series and Review of the Literature. Clinical Radiology. November 2, 2020. doi:10.25259/JCIS_184_2020
7. Russell PK, Otitoju F, Vazirani R, Grum, KA, McDermott, JC, Wojtowycz M, Fine J, ***Kliewer M***. Ultrasound surveillance of TIPS: the diagnostic performance of combined Doppler and clinical parameters in a large cohort. Submitted to Radiology.
8. Jiang J, Hobson MA, Musack R, ***Kliewer MA***, Madsen EL, Hall TJ. Ultrasound-based strain imaging for internal organs: initial experience. Submitted to IEEE UFFC.
9. Yi PH, Golden SK, Harringa JB, **Kliewer MA**. Readability of Lumbar Spine MRI Reports: Will Patients Understand? AJR Am J Roentgenol. 2019 Jan 8; American Journal of Roentgenology, 212(3), 602-606. doi:10.2214/AJR.18.20197
10. Schrauben E, Kohn S, Macdonald J, Johnson K, ***Kliewer M***, Frost S, Fleming J, Wieben O, Field A. 4D flow MRI and Ultrasound assessment of cerebrospinal venous flow in MS patients and controls. JCBFM. 2017 April; 37(4):1483-1493.
11. Kramer H, Pickhardt PJ, ***Kliewer MA***, Hernando D, Chen GH, Zagzebski JA, Reeder SB. Accuracy of liver fat quantification by advanced CT, MR and US techniques: Prospective comparison with MR Spectroscopy. AJR. 2017 Jan; 208(1):92-100.
12. Roshan TR, ***Kliewer MA***, Lopes T, Rebsamen SL, O'conner J, Grados MA, Kimball A, Clemens J, Kline AD. Cornelia de Lange syndrome: Correlation of brain MRI findings with behavioral assessment. Am J Med Genet C Semin Med Genet. 2016 May; 278(1):95-103.

## Nagle, Scott K

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Carleton College | BA | 1991 | Physics |
| University of Chicago | PhD | 2000 | Medical Physics |
| University of Chicago | MD | 2002 | MD |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| Stanford University | 2003-2008 | Radiology Residency |
| University of Wisconsin- Madison | 2008-2009 | MRI Fellowship |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| Department of Radiology, University of Wisconsin | 2016-Current | Associate Professor |
| Department of Radiology, University of Wisconsin | 2009-2016 | Assistant Professor |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| | | |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Radiology | Diagnostic Radiology | 2008 | |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

Have served on 7 medical physics graduate students' dissertation committees. Have served as principal PhD advisor to 1 medical physics student.

**ROLES IN PROGRAM**

Clinical resource and mentoring. Having both clinical radiology training and a medical physics PhD will help to provide relevant feedback to trainees, tying clinical needs with basic medical physics concepts and problem-solving.

**CLINICAL RESPONSIBILITIES**

Cardiovascular and thoracic imaging.

**SCHOLARLY ACTIVITIES**

*Examples: participation in scientific societies and meetings, scientific presentations, continuing education, etc.*

**RESEARCH INTERESTS**

Lung MRI

| RESEARCH SUMMARY | | |
|---|---|---|
| **Item** | **Total** | **In last 5 years** |
| Peer-reviewed papers in referred journals | 53 | 25 |
| Book chapters & conference proceedings | 3 | 2 |
| Published abstracts | 137 | 41 |
| Presentations at national & international conferences | 20 | 3 |

**RESEARCH FUNDING SUPPORT**

| **Source of Funding** | **Title of Research Grant** | **Dates of Support** | **Funding Amount** |
|---|---|---|---|
| NIH | MRI Methods for High Resolution Imaging of the Lung | September 2017 – August 2022 | $149,832 |
| Cystic Fibrosis Foundation Therapeutics | Impact of Early Malnutrition on Lung Disease Development in Cystic Fibrosis | September 2017 – August 2020 | $263,167 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

1. **Nagle SK**, Schiebler ML, Repplinger MD, François CJ, Vigen KK, Yarlagadda R, Grist TM, Reeder SB. Contrast enhanced pulmonary magnetic resonance angiography for pulmonary embolism: Building a successful program. Eur J Radiol 2016 Mar;85(3):553-63. PMID:26860667. PMCID:PMC4751592.
2. Hahn AD, Cadman RV, Sorkness RL, Jarjour NN, **Nagle SK**, Fain SB. Redistribution of inhaled hyperpolarized $He^3$ gas during breath-hold differs by asthma severity. J Appl Physiol 2016 Mar 1;120(5):526-36. PMID:26635346. PMCID:PMC4773646.
3. Bhave S, Lingala SG, Newell JD, **Nagle SK**, Jacob M. Blind compressed sensing enables 3D dynamic free breathing MR imaging of lung volumes and diaphragm motion. Invest Radiol 2016 June;51(6):387-99. PMID:26863578.
4. Schiebler ML, Ahuja J, Repplinger, François CJ, Vigen KK, Grist TM, Hamedani AG, Reeder SB, **Nagle SK**. Incidence of actionable findings on contrast enhanced magnetic resonance angiography ordered for pulmonary embolism evaluation. Eur J Radiol. 2016 Aug;85(8):1383-9. PMID:27423676.
5. Zha W, Niles DJ, Kruger SJ, Dardzinski BJ, Cadman RV, Mummy DG, **Nagle SK**, Fain SB. Semiautomated Ventilation Defect Quantification in Exercise-induced Bronchoconstriction Using Hyperpolarized Helium-3 Magnetic Resonance Imaging: A Repeatability Study. Acad Radiol. 2016 Sep;23(9):1104-14. PMID:27263987.
6. Harringa JB, Bracken RL, **Nagle SK**, Schiebler ML, Patterson BW, Svenson JE, Repplinger MD. Anemia is not a risk factor for developing pulmonary embolism. Am J Emerg Med 2017 Jan;35(1):146-149. doi: 10.1016/j.ajem.2016.09.068. PMID:27836322.
7. Bannas P, Bookwalter CA, Ziemlewicz T, Motosugi U, Munoz del Rio A, Potretzke TA, **Nagle SK**, Reeder SB. Combined gadoxetic acid and gadofosveset enhanced liver MRI for detection and characterization of liver metastases. Eur Radiol. 2017 Jan;27(1):32-40. PMID:27137648.
8. Schiebler ML, Hamedani, AG, Runo J, Francois CJ, Repplinger MD, Reeder SB, **Nagle SK**. CE-MRA in the primary diagnosis of pulmonary embolism: Building a team to start a clinically relevant program. Appl Radiol. 2017;46(1):31-36.
9. Harringa JB, Bracken RL, **Nagle SK**, Schiebler ML, Pulia MS, Svenson JE, Repplinger MD. Negative D-dimer testing excludes pulmonary embolism in non-high risk patients in the emergency department. Emerg Radiol. 2017 Jun;24(3):273-280. PMID:28116533.

10. Benson DG, Schiebler ML, Repplinger MD, François CJ, Grist TM, Reeder SB, **Nagle SK**. Contrast-enhanced pulmonary MRA for the primary diagnosis of pulmonary embolism: current state of the art and future directions. Br J Radiol. 2017 Jun;90(1074):20160901. doi: 10.1259/bjr.20160901. Epub 2017 Apr 12. PMID: 28306332. PMCID: 5602179.

11. Benson DG, Schiebler ML, **Nagle SK**, François CJ. Magnetic Resonance Imaging for the Evaluation of Pulmonary Embolism. Top Magn Reson Imaging. 2017 Aug;26(4):145-151. PMID:28777163.

12. Zha W, Kruger SJ, Johnson KM, Cadman RV, Bell LC, Liu F, Hahn AD, Evans MD, **Nagle SK**, Fain SB. Pulmonary Ventilation Imaging in Asthma and Cystic Fibrosis Using Oxygen-Enhanced 3D Radial Ultrashort Echo Time MRI. Journal of Magnetic Resonance Imaging. 2018 May;47(5):1287-1297. PMID: 29086454

13. Zha W, Kruger SJ, Cadman RV, Mummy DG, Evans MD, MS, **Nagle SK,** Denlinger LC, Jarjour NN, Sorkness RL, Fain SB. Regional Heterogeneity of Lobar Ventilation in Asthma Using Hyperpolarized Helium-3 MRI. Academic Radiology Feb;25(2):169-178. PMID: 29174189.

14. Dunican EM, Elicker BM, Gierada DS, **Nagle SK**, Schiebler ML, Newell JD, Raymond WW, Lachowicz-Scroggins ME, DiMaio S, Hoffman EA, Castro M, Fain SB, Jarjour NN, Israel E, Levy BD, Erzurum SC, Wenzel SE, Meyers DA, Bleecker ER, Phillips BR, Mauger DT, Gordon ED, Woodruff PG, Peters MC, Fahy JV. Mucus plugs in patients with asthma linked to eosinophilia and airflow obstruction. Journal of Clinical Investigation. 2018 Mar 1;128(3):997-1009.

15. Repplinger MD, Bracken RL, Patterson BW, Shah MN, Pulia MS, Harringa JB, Schiebler ML, **Nagle SK**. Downstream Imaging Utilization After MR Angiography versus CT Angiography for the Initial Evaluation of Pulmonary Embolism. J Am Coll Radiol. 2018 Dec;15(12):1692-1697. PMID: 29724625

16. Repplinger MD, **Nagle SK**, Harringa JB, Broman AT, Lindholm CR, Francois CJ, Grist TM, Reeder SB, Schiebler ML. Clinical outcomes after magnetic resonance angiography (MRA) versus computed tomographic angiography (CTA) for pulmonary embolism evaluation. Emergency Radiology 2018 Oct;25(5):469-477.PMID: 29749576

17. Jiang W, Ong F, Johnson KM, **Nagle SK**, Hope TA, Lustig M, Larson P. Dynamic 3D image navigators for Motion Robust High Resolution 3D Free-Breathing Pulmonary MRI. Magnetic Resonance in Medicine 2018 Jun;79(6):2954-2967. PMID: 29023975.

18. Knobloch G, Sweetman S, Bartels C, Ravel A, Gimelli G, Jacobson K, Lozonschi L, Kohmoto T, Osaki S, Francois C, **Nagle SK**. Inter- and Intra-Observer Repeatability of Aortic Annulus Measurements on Screening CT for Transcatheter Aortic Valve Replacement (TAVR): Implications for Appropriate Device Sizing. European Journal of Radiology. 2018 Aug;105:209-215. PMID: 30017282

19. Zha W, **Nagle SK**, Cadman RV, Schiebler ML, Fain SB. 3D Isotropic Functional Imaging in Cystic Fibrosis Using Oxygen-enhanced MRI: Comparison with Hyperpolarized Helium-3 MRI. Radiology. 2019 Jan;290(1):229-237. PMID: 30351258

20. Torres L, Kammerman J, Hahn A, Zha W, **Nagle SK**, Johnson K, Sandbo N, Meyer K, Schiebler M, Fain SB. Structure-Function Imaging of Lung Disease Using Ultra-Short Echo Time MRI. Academic Radiology 2019 Mar;26(3):431-441. PMID: 30658930

21. Zha W, Fain SB, Schiebler ML, Evans MD, **Nagle SK**, Liu F. Deep Convolutional Neural Networks With Multiplane Consensus Labeling for Lung Function Quantification Using UTE Proton MRI. J Magn Reson Imaging. 2019 Oct;50(4):1169-1181. PMID: 30945385

22. Knobloch G, Colgan TJ, Schiebler ML, Johnson KM, Li G, Schubert T, Reeder SB, **Nagle SK**. Comparison of gadolinium-enhanced and ferumoxytol-enhanced conventional and UTE-MRA for the depiction of the pulmonary vasculature. Magn Reson Med. 2019 Nov; 82(5):1660-1670. PMID:31228293.

23. Van Straten M, Brody AS, Ernst C, Guillerman RP, Tiddens HAWM, **Nagle SK**. Guidance for computed tomography (CT) imaging of the lungs for patients with cystic fibrosis (CF) in research studies. J Cyst Fibros. 2020 Mar;19(2):176-183.PMID: 31537430.

24. Knobloch G, **Nagle SK**, Colgan T, Schubert T, Johnson KM, Bannas P, Li G, Hinshaw L, Holmes J, Reeder SB. Feasibility and optimization of ultra-short echo time MRI for improved imaging of IVC-filters at 3.0 T. Abdom Radiol (NY). 2021 Jan;46(1):362-372. PMID: 32535691.

## Peppler, Walter W.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin-Madison | BS | 06/1974 | Physics |
| University of Wisconsin-Madison | MS | 06/1976 | Medical Physics |
| University of Wisconsin-Madison | PhD | 05/1981 | Medical Physics |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| UW-Madison, Medical Physics and Radiology | 2019-present | Professor Emeritus |
| UW-Madison, Medical Physics and Radiology | 1997 – 2019 | Professor |
| UW-Madison, Medical Physics and Radiology | 1995-1997 | Clinical Professor |
| UW-Madison, Medical Physics and Radiology | 1986-1995 | Clinical Associate Professor |
| UW-Madison, Medical Physics and Radiology | 1983-1986 | Clinical Assistant Professor |
| UW-Madison, Medical Physics and Radiology | 1981-1983 | Assistant Scientist |
| UW-Madison, Medical Physics and Radiology | 1974-1980 | Research Assistant |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

*11*

**ROLES IN PROGRAM**

*Campus Conflict of Interest Committee 2010-2019*

*Chair of UW Conflict of Interest Committee 2017-2019*

**SCHOLARLY ACTIVITIES**

*American Association of Physicists in Medicine, MEMBER*

**Invited presentations:**

Seminar presentation to the Environmental Remote Sensing Center. Applications of image processing in medicine: DSA, July, 1985. Madison, WI

Patient-specific beam attenuators, at the Chest Imaging Conference, Madison, WI, August, 1987

Spring 1989, "Digital Radiography," Radiography '89, Madison WI.

Seminar presentation. The application of x-ray capillary optics to radiography. The University of California - Irvine, February, 1993.

Oncology Grand Rounds, with Fred Kelcz, University of Wisconsin, Madison, WI, October, 1995.

Colloquium Presentation, “X-ray Capillary Optics for Digital Mammography”, at the University of Twente, The Netherlands, December 1995.

RSNA Tutorial, “Integrating Ultrasound with Multimodality PACS”, Chicago, IL, November, 2003.

Society for Computer Applications in Radiology (SCAR), “Enterprise Image Management - PACS Beyond Radiology”, Vancouver BC, May, 2004.

SPIE Conference on Optics and Photonics, “Mammographic Applications of Capillary Optics”, San Diego, CA, August, 2005.

**RESEARCH INTERESTS**

My area of interest is digital diagnostic imaging and PACS. I have extensive experience in medical imaging research. I have taught hands on workshops at RSNA on the topics of DICOM and HL7 data manipulation. As a Professor Emeritus of Medical Physics and Radiology at the University of Wisconsin-Madison, I am familiar with the current state of the art in PACS, informatics, and digital x-ray imaging including breast tomosynthesis.

| RESEARCH SUMMARY | | |
|---|---|---|
| **Item** | **Total** | **In last 5 years** |
| Peer-reviewed papers in referred journals | 56 | 1 |
| Book chapters & conference proceedings | 11 | 1 |
| Published abstracts | 58 | 0 |
| Presentations at national & international conferences | 7 (RSNA) | 0 |

| RESEARCH FUNDING SUPPORT | | | |
|---|---|---|---|
| **Source of Funding** | **Title of Research Grant** | **Dates of Support** | **Funding Amount** |
| National Institutes of Health | Selective Exposure Radiography | 1983-1985<br>1985-1988 | $322,127<br>$249,000 |
| National Institutes of Health | Research, Development and Evaluation of Minimally Invasive Systems for Detection and Quantitation of Atherosclerotic Lesions in Coronary Arteries in Humans | 1983-1988 | $650,000 |
| National Institutes of Health | A Beam Compensation Method for DSA Quantitation | 1984-1987 | $78,000 |
| National Institutes of Health | DSA Imaging of Coronary Flow Reserve | 1986-1989 | $454,500 |
| National Institutes of Health | Dual-Energy Exercise Ventriculography | 1987-1990 | $450,000 |
| National Institutes of Health | Single-Exposure Dual-Energy Radiography | 1989-1992 | $732,000 |
| National Institutes of Health | X-Ray Optical Mammography and Chest Radiography. | 1992-1995<br>1997-2001 | $896,000<br>$624,000 |
| National Institutes of Health | Capillary Optics for Superior Mammographic Image Quality | 1998-2002 | $622,000 |
| NIH (UW subcontract with Gammex/RMI) | Neonatal Chest Phantom for Computed Radiography Testing | 2005-2006 | $40,000 |
| US Army (UW subcontract) | Direct Digital Mammography using capillary optics. | 1994-1998 | $197,000 |
| US Army (UW subcontract w/ SUNY) | Practical Monochromatic Breast Imaging Using Polycapillary Optics | 2002-2005 | $126,000 |
| US Army (UW subcontract w/ SUNY) | Wide Field Coherent Scatter Mammographic Imaging | 2004-2006 | $35,000 |
| National Cancer Institute, SBIR | Scanning Detector for Selective Exposure Radiography - Phase I | 1985-1986 | $50,000 |
| National Science Foundation | Digitally Controlled X-ray Beam Attenuation Techniques | 1984-1986 | $300,000 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order** *Last 5 years.*

Szczykutowicz TP, Brunnquell CL, Avey GD, Bartels C, Belden DS, Bruce RJ, Field AS, Peppler WW, Wasmund P, Wendt G., A General Framework for Monitoring Image Acquisition Workflow in the Radiology Environment: Timeliness for Acute Stroke CT Imaging. J Digit Imaging. 2018 Apr;31(2):201-209. doi: 10.1007/s10278-018-0055-1. PMID: 29404851

Meyer JD, et. al (in preparation). Effects of recording rate, screen calibration, and room ambient lighting on video fluoroscopic swallow study outcomes.

## Ranallo, Frank N.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin – Madison | PhD | 1993 | Major: Physics, Minor: Computer Science, Mathematics, and Chemistry |
| University of Wisconsin-Madison | MS | 1976 | Physics |
| De Paul University | BS | 1973 | Physics |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin – Madison, Medical Physics and Radiology | 2014-Present | Director of the Imaging Physics Residency Program |
| University of Wisconsin – Madison – Medical Physics and Radiology | 2020-Present | Professor (CHS) |
| University of Wisconsin – Madison – Medical Physics and Radiology | 2005-2020 | Associate Professor (CHS) |
| University of Wisconsin – Madison – Medical Physics and Radiology | 1999-2004 | Assistant Professor (CHS) |
| University of Wisconsin – Madison, Medical Physics | 1998-1999 | Assistant Professor (CHS) |
| University of Wisconsin – Madison, Medical Physics | 1994-1997 | Clinical Assistant Professor |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| Unity Point – Meriter Hospital | 2016-Present | Member of Radiation Safety Committee |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Radiology | Diagnostic Radiological Physics | 1994 | |

**ACADEMIC SUPERVISION**

Ph.D.

Alphonso Rodriguiz, *The Effect of High Resolution Kernals, Iterative Reconstruction, and Acquisition Parameters on Quantitative Computed Tomography Measures of the Lung*, 2016, Co-Advisor: Sean Fain.

David Ellerbusch, *Objective Performance Evaluation Methods for Single and Multislice Computed Tomography Scanners*, 2006,

M.S.

I have taught and directed a total of 31 graduate students in the area of quality assurance in medical imaging from 1984 to the present within the Radiological Physics Services program of the Medical Physics Department. Generally, each student has been with me for two years.

Training of IAEA Fellows

I have been involved in the training programs of several individuals from outside our university and outside the United States. Several of these individuals have been on IAEA Fellowships or support. These have included Ng Kwan-Hoong from Malaysia in 1995, Ngoc Toan Tran from Vietnam (1/15/98 - 5/15/98), Saion Bin Salikin from Malaysia (7/6/98 - 7/17/98), and Alejandro Douglas Blackman from Panama (8/1/99 - 10/1/99). In each case I was responsible for about 25% of the training.

Postgraduate Training of 3 individuals

Outside Training of Professionals

In 1983, 1988, and 1993 I participated in a one-week training course for a visiting individual on the topic of quality assurance in diagnostic radiology. In each case I was the primary instructor.

| ROLES IN PROGRAM |
| --- |
| Director of Imaging Physics Residency Program |
| Mentor in Imaging Physics Residency Program in the following rotations: |
| Physics for Radiology Residents -1986-Present |
| Physics for Radiology Residents - Summer Introductory Course – 2004-Present |
| Medical Physics 662: Rad Lab - Diagnostic Radiology – 1984-Present |
| Medical Physics 567: The Physics of Diagnostic Radiology – 1984-Present |
| Medical Physics 471: Medical Imaging Systems – 2000-Present |
| Guest Lecturer (2 hour demonstration) |
| Medical Physics 265: Introduction to Medical Physics – 1990-Present |
| Guest Lecturer (2-3 hour lecture/lab on diagnostic radiology) |
| Computed Tomography, Mammography, and Quality Assurance in Radiology |
| Guest Lecturer (8 to 12 hours of lectures and labs to the students in the Radiologic Technology School at the UW) |
| **CLINICAL RESPONSIBILITIES** |
| Associate Director of the Radiologic Physics Services – Performing physics services for all of UW Health and UnityPoint-Meriter Hospital (1995 – present) |
| Member of the UnityPoint-Meriter Hospital x-ray radiation safety committee (2015-present) |
| **SCHOLARLY ACTIVITIES** |
| American Association of Physicists in Medicine - Full Membership. |
| American College of Radiology – National Physicist Full Membership |
| The Society of Directors of Academic Medical Physics Programs - Member |
| Radiological Society of North America - Member |
| American Roentgen Ray Society - Member |
| SPIE - Member |
| Current member of AAPM Computed Tomography Subcommittee |
| Current member of AAPM Task Group #150, "Acceptance Testing and Quality Control of Digital Radiographic Imaging Systems" |
| Current member of AAPM Task Group #233, "Performance Evaluation of Computed Tomography Systems" |
| Current member of AAPM Task Group #309 “Imaging Protocol Management System Design” |
| Member of the AAPM Task Group # 151, “Radiographic System Quality Control” (3/2007-12/2015) |
| Member of the Imaging Physics Curricula Subcommittee (3/2012 – 12/2014) |
| Member of the Diagnostic X-ray Imaging Committee of the American Association of Physicists in Medicine (appointed by the Board of Directors of the AAPM) from 1/1993 to 12/1998. |
| Member of AAPM Task Group #12 “Quality Assurance in Diagnostic X-ray Imaging” (1/1992-12/1999). |
| Member of AAPM Task Group #4 “Instrumentation Requirements for Diagnostic Radiology” (1/1995-12/1998). |
| Member of the Radiation Safety Writing Group for the Council on Cardiac Sonography of the American Society of Echocardiography |
| Member of the Diagnostic Radiologic Physics item writing task force for the American Board of Radiology written examination |
| Member of Board of Directors of Medical Physics Publishing, Madison, Wisconsin |
| Publication Reviewer for Medical Physics Publishing. |
| Member of the Radiation Safety Committee, Meriter Hospital, Madison, WI |
| Reviewer and Associate Editor for Medical Physics Journal |
| Member of the Board of Associate Editor of Medical Physics Journal (12/2017 to present) |
| Reviewer for abstracts submitted to the 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, & 2018 AAPM Meetings |
| Reviewer for Abdominal Radiology |
| Reviewer for AJR |
| Reviewer for Radiation Measurements |
| Peer Reviewer for the "H-7 Committee on Quality Assurance in Diagnostic X-Ray" of the Conference of Radiation Control Program Directors (CRCPD). |

**RESEARCH INTERESTS**

Development of improved protocols for CT imaging that optimize image quality and reduce patient dose, dual energy CT for the imaging of gout, metal artifact reduction in the imaging of musculoskeletal CT, the use of iterative noise/dose reduction algorithms in CT, the use of CT in evaluating COPD and asthma, the development of phantoms for quantitative CT, and the design of protocols to test the performance of medical imaging devices.

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 27 | 7 |
| Book chapters & conference proceedings | 6 | 0 |
| Published abstracts | | |
| Presentations at national & international conferences | 42 | 5 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| GE Healthcare | UW CT Protocol Development and Distribution | 2012-Present | $1,000,000 per annum |
| GE Healthcare Investigator Initiated Research Project | Revolution 2.1B External Evaluation | 2019-2020 | $100,000 |
| GE Healthcare Investigator Initiated Research Project | Automatic Exposure Control (AEC) System Design and End User Guidance for the Revolution CT Platform | 2018-2020 | $171,854 |
| GE Healthcare Investigator Initiated Research Project | Sedation Free Pediatric Imaging | 2018-2020 | $261,528 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**

*Last 5 years.*

**PUBLICATIONS IN REFEREED JOURNALS AND EDITED PROCEEDINGS**

AAPM Scientific Report: "Performance Evaluation of Computed Tomography Systems – Summary of AAPM Task Group 233", Samei E, Bakalyar D, Boedeker KL, BradyS, Fan J, Leng S, Myers KJ, Popescu LM, Giraldo JCR, Ranallo F, Solomon J, Vaishnav J, and Wang J, Med Phys.46(11), November 2019.

"CT Protocol Optimization Over the Range of Patient Age and Size and for Different CT Scanner Types: Recommendations and Misconceptions," Ranallo F., Presented at the AAPM 61th Annual Meeting, San Antonio, TX., July 2019.

""Pitch Dependence of Slice Sensitivity Profile and Dose-Efficiency in CT," Rose, S, Lipford M, Ranallo F. Presented at the AAPM 61th Annual Meeting, San Antonio, TX, July 2019.

"The Effects of Varying the Display Field of View (Reconstruction Field of View) on MTF," Lipford M, Rose, S, Ranallo F. Presented at the AAPM 61th Annual Meeting, San Antonio, TX, July 2019.

"Performance Evaluation of Computed Tomography Systems "- The Report of AAPM Task Group 233, Samei E, Bakalyar D, Boedeker KL, BradyS, Fan J, Leng S, Myers KJ, Popescu LM, Giraldo JCR, Ranallo F, Solomon J, Vaishnav J, and Wang J, AAPM Report No. 233, April 2019.

Category: Reports "Technical note: Model-based magnification/minification correction of patient size surrogates extracted from CT localizers," Burton S, Malkus A, Ranallo, F, Szczykutowicz, Med Phys.46(1), January 2019.

"The Current State of CT Dose Management Across Radiology: Well Intentioned but Not Universally Well Executed," Szczykutowicz TP, Bour RK, Ranallo F, Pozniak M,. AJR Am J Roentgenol. 211(2), August 2018.

"Significant Suppression of CT Radiation-Induced DNA Damage in Normal Human Cells by the PrC-210 Radioprotector," Frank Jermusek, Jr., Chelsea Benedict, Emma Dreischmeier, Michael Brand, Michael Uder, Justin J. Jeffery, Frank N. Ranallo and William E. Fahl, Radiation Research, 190(2), August 2018.

"Optimizing CT Scan Protocols: Including the best use of Smart mA," Ranallo F., Presented at the GE User Meeting CT and Nuclear Medicine, Stockholm, Sweden, February 2018.

"Dispelling Myths and Making Adjustments: How the Physicist should Account for Size and Age when Designing CT Protocols," Ranallo F, Presented at the AAPM 59th Annual Meeting, Denver, CO, August 2017.

"The effects of iterative reconstruction and kernel selection on quantitative computed tomography measures of lung density," Rodriguez A, Ranallo FN, Judy PF, Fain SB. Med Phys.44(6), June 2017.

"Improvement in CT image resolution due to the use of focal spot deflection and increased sampling," Rubert N, Szczykutowicz T, Ranallo F. J Appl Clin Med Phys. 17(3), May 2016.

## Rosado-Mendez, Ivan, M

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Instituto Tecnológico y de Estudios Superiores de Monterrey | B.Sc. | 2006 | Engineering physics |
| Universidad Nacional Autónoma de México | M.Sc. | 2009 | Medical Physics |
| University of Wisconsin-Madison | M.Sc. | 2011 | Medical Physics (Imaging track) |
| University of Wisconsin-Madison | Ph.D. | 2014 | Medical Physics (Imaging track) |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of Wisconsin-Madison | 8/24/2014-2/24/2016 | Postdoctoral fellowship, Quantitative Ultrasound Lab. |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison | 2/25/2016-5/31/2017 | Assistant scientist |
| Universidad Nacional Autónoma de México | 6/1/2017-1/31/2021 | Assistant professor |
| University of Wisconsin-Madison | 2/15/2021-current | Assistant professor |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| N/A | N/A | N/A |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| N/A | N/A | N/A | N/A |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

***3 M.S. students (Medical Physics, UNAM, Mexico)***

***Abel Torres Añorve (graduated in 2020), Laura Castañeda Martínez (in process of graduating), Ana Karen Argueta Lozano (to graduate in December 2021).***

**ROLES IN PROGRAM**

***Co-teaching of course MEDPHYS 578 Non-ionizing radiation imaging (ultrasound part), 7 weeks (4hours / week), 23 1-hour virtual lectures, 2-hour office hours per week.***

**CLINICAL RESPONSIBILITIES**

**20% appointment in the Department of Radiology, currently collaborating in research protocols with Dr. Lori Mankowski-Gettle (head of ultrasound, Department of Radiology)**

**SCHOLARLY ACTIVITIES**

***PROFESSIONAL AFFILIATIONS***

*2018 – Present Medical Physics for World Benefit*

*2015 – Present CONACYT Medical Physics Network (Scientist member) 2011 – 2018 IEEE, Ultrasonics, Ferroelectrics, and Frequency Control Society*

*2011 – Present American Institute of Ultrasound in Medicine (AIUM)*

*2008 – Present American Association of Physicists in Medicine (AAPM)*

*2007 – Present Medical Physics Division of the Mexican Physics Society*

***LEADERSHIP***

| | |
|---|---|
| *2020 – Present* | *Member of the AAPM Imaging metrology and Standards Subcommittee* |
| *2020 – Present* | *Member of the AAPM Task Group TG353 – Pulsed Doppler and Color Flow Ultrasound System Performance Assessment using Flow Phantoms* |
| *2020* | *Scientific session organizer at the 2020 AAPM/COMP Annual Meeting (virtual). Session title: Quantitative ultrasound imaging: from the benchtop to a clinical protocol, July 12-16* |
| *2020* | *President of the scientific committee and chief editor of the proceedings of the XVI Mexican Symposium on Medical Physics (virtual), October 26-30* |
| *2020 – Present* | *Co-chair (academia), Pulse-Echo Quantitative Ultrasound Biomarker Committee, AIUM/Quantitative Imaging Biomarker Alliance (QIBA), Radiological Society of North America* |
| *2019* | *Faculty, AAPM Symposium, International Conference on Medical Physics, September 8-11, Santiago, CHL* |
| *2019* | *Co-organizer of the workshop on tissue-equivalent materials, Instituto de Física, UNAM, November 6* |
| *2019* | *Session moderator at the AAPM annual meeting, July 14-18, San Antonio, TX.* |
| *2019 - Present* | *Member of the AAPM ultrasound subcommittee* |

***Academic service***

| | |
|---|---|
| *2020* | *Abstract reviewer, Annual Meeting of the AAPM* |
| *2019* | *Project reviewer– CAP 2020 de la Pontificia Universidad Católica del Perú (PUCP), Peru* |
| *2019* | *Abstract reviewer, Annual Meeting of the AAPM* |
| *2019* | *Abstract reviewer, IEEE Engineering in Medicine and Biology Conference* |
| *2018* | *Abstract reviewer, Annual Meeting of the AAPM* |
| *2018* | *Project reviewer – CAP 2019, Pontificia Universidad Católica del Perú (PUCP), Peru* |
| *2018* | *Project reviewer, Institutional Research Projects. Universidad de Guanajuato* |
| *2017* | *Scientific Committee, Annual Meeting of the Mexican Federation of Medical Physics Organizations* |
| *2016* | *Member of the scientific committee and editor of proceedings, XIV Mexican Symposium of Medical Physics* |
| *2016* | *Project reviewer. Technological Innovation and Research Projects, Universidad LaSalle* |

**RESEARCH INTERESTS**

My research is centered on developing quantitative methods for medical imaging and their clinical translation through standardization, as well as on developing acoustics-based imaging and therapeutic strategies. This is motivated by the need to provide more objective and timely disease detection and diagnosis, as well as to provide personalized treatment to various diseases. In particular, I have worked on Contrast-Enhanced Digital Mammography (CEDM), Ultrasound Backscatter Spectroscopy (UBS) and Shear Wave Elasticity Imaging (SWEI).

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 29 | 20 |
| Book chapters & conference proceedings | 4 | 3 |
| Published abstracts | 90 | 41 |
| Presentations at national & international conferences | 90 | 41 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| CONACYT MEXICO | Quantitative radiological images for a non-invasive characterization of breast cancer | 1/1/221-12/31/2023 | USD$124,000 |
| UNAM PAPIIT | Development of quantitative and functional ultrasound biomarkers for the characterization of the rat uterine cervix | 1/1/2020-12/31/2020 | USD$7,600 |
| UNAM PAPIIT | Development of quantitative imaging biomarkers for medical ultrasound | 1/1/2018-12/31/2019 | USD$15,800 |
| UNAM Physics Institute | Design, fabrication, and characterization of tissue-mimicking materials for medical physics applications | 6/1/2018-12/31/2019 | USD$32,930 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

Indexed journals

1. A. K. Z. Tehrani, M. Amiri, **I. M. Rosado-Mendez**, T. J. Hall, H. Rivaz, "Ultrasound scatterer density classification using convolutional neural networks by exploiting patch statistics," under review in IEEE Trans. Ultrason. Ferroelect. Freq. Contrl., 2021
2. A. Torres-Añorve, M. L. Palmeri, H. Feltovich, T. J. Hall, **I. Rosado-Mendez,** "Shear wave dispersion as a potential biomarker for cervical remodeling during pregnancy: evidence from a non-human primate model," Frontiers in Physics, in press, 2021
3. N. Jafarpisheh, T. J. Hall, H. Rivaz, **I. M. Rosado-Mendez**, "Analytic global regularized backscatter quantitative ultrasound," IEEE Trans. Ultrason. Ferroelect. Freq. Contrl., in press, 2020
4. **I. Rosado-Mendez**, A. Smargiassi, R. Inchingolo, Gino Soldati, M. Muller, L. Demi, "Commentary - Lung Ultrasound for COVID-19 patient management: Please report your settings and MI," Journal of Ultrasound in Medicine, vol. 40, pp. 187-189, 2020
5. L. Castañeda-Martinez, K. Noguchi, J. A. Zagzebski, C. Ikonomidou, T. J. Hall, **I. Rosado-Mendez**, "Optimization of ultrasound backscatter spectroscopy to assess neurotoxic effects of anesthesia in the newborn non-human primate brain," Ultrasound in Medicine and Biology, vol. 46, no. 8, pp. 2044-2056, **2020**
6. L. Carlson, H. Feltovich, **I. M. Rosado-Mendez**, L. Mao, T. Hall, "Quantitative assessment of cervical softening during pregnancy with shear wave elasticity imaging: an *in vivo* longitudinal study," Journal of the Royal Society Interface, vol. 9, no. 5, pp. 20190030, **2019**
7. W. T. Tran, K. Jerzak, F. Lu, J. Klein, S. Tabbarah, A. Lagree, T. Wu, **I. Rosado-Mendez**, E. Law, K. Saednia, A. Sadeghi-Naini, "Personalized breast cancer treatments using artificial intelligence in Radiomics and Pathomics," Journal of Medical Imaging and Radiation Sciences, vol. 50, no. 4 (2), pp. S32-S41, **2019**
8. H. Gerges-Nasief, **I. M. Rosado-Mendez**, J. A. Zagzebski, T. J. Hall, "A quantitative ultrasound-based multi-parameter classifier for breast masses," Ultrasound in Medicine and Biology, vol. 45, no. 7, pp. 1603-1616, **2019**
9. Q. W. Guerrero, H. Feltovich, **I. Rosado-Mendez**, A. P. Santoso, L. C. Carlson, R. Zea, T. J. Hall, "Quantitative ultrasound parameters based on the backscattered echo power signal as biomarkers of cervical remodeling in the pregnant Rhesus macaque: a longitudinal study," Ultrasound in Medicine and Biology, vol. 46, no. 6, pp. 1466-1474, **2019**
10. **I. M. Rosado-Mendez**, K. Noguchi, L. Castañeda-Martinez, G. Kirvassilis, H. Wang, F. Manzella, B. S. Swiney, K. Masuoka, S. Capuano III, K. G. Brunner, K. Crosno, Q. W. Guerrero, H. Whitson, A. Brambrink, H. S. Simmons, A. F. Mejia, J. A. Zagzebski, T. J. Hall, C. Ikonomidou, "Quantitative ultrasound detects apoptotic death induced by anesthesia in the neonatal primate brain," Neurobiology of Disease, vol. 127, pp. 554-562, **2019**
11. Q. W. Guerrero, H. Feltovich, **I. M. Rosado-Mendez,** L. C. Carlson, T. J. Hall, "Quantitative ultrasound biomarkers based on backscattered acoustic power: potential for quantifying remodeling of the human cervix during pregnancy" Ultrasound in Medicine and Biology, vol. 45, no. 2, pp. 429-439, **2019**
12. Z. Vajihi, **I. M. Rosado-Mendez**, T. J. Hall, H. Rivaz, "Low variance estimation of backscatter quantitative ultrasound parameters using dynamic programming," IEEE Trans. Ultrason. Ferroelect. Freq. Contrl., vol. 65, no. 11, pp. 2042-2053, **2018**
13. Q. W. Guerrero, L. Fan, S. Brunke, A. Milkowski, **I. M. Rosado-Mendez**, T. J. Hall, "Power spectrum consistency among systems and transducers," Ultrasound in Medicine and Biology, vol. 44, no. 11, pp. 2358-2370, **2018**
14. **I. M. Rosado-Mendez**, L. C. Carlson, K. M. Woo, A. P. Santoso, Q. W. Guerrero, M. L. Palmeri, H. Feltovich, T. J. Hall, "Quantitative assessment of cervical softening during pregnancy in the Rhesus macaque with shear wave elasticity imaging," Physics in Medicine and Biology, vol. 63, no. 8, pp. 085016, **2018**
15. Q. W. Guerrero, H. Feltovich, **I. M. Rosado-Mendez**, L. C. Carlson, G. Li, T. Hall, "Anisotropy and spatial heterogeneity in quantitative ultrasound parameters: Relevance to study of the human cervix," Ultrasound in Medicine and Biology, vol. 44, no. 7, pp. 1493-1503, **2018**
16. L. C. Carlson, T. J. Hall, **I. M. Rosado-Mendez**, M. L. Palmeri, H. Feltovich, "Detection of changes in cervical softness using shear wave speed in early vs. late pregnancy: an *in vivo* cross-sectional study" Ultrasound in Medicine and Biology, vol. 44, no. 3, pp. 515-521, **2018**
17. Q. W. Guerrero, **I. M. Rosado-Mendez**, L. C. Drehfal, H. Feltovich, T. J. Hall, "Quantifying backscatter anisotropy using the reference phantom method," IEEE Trans. Ultrason. Ferroelect. Freq. Control, vol. 64, no. 7, pp. 1063-1077, **2017**
18. **I. M. Rosado-Mendez**, M. L. Palmeri, L. C. Drehfal, Q. W. Guerrero, H. Simmons, H. Feltovich, T. J. Hall, "Assessment of structural heterogeneity and viscosity in the cervix using shear wave elasticity imaging: initial results from a Rhesus macaque model," Ultrasound in Medicine and Biology, vol. 43, no. 4, pp. 790-808, **2017**

## Salkowski, Lonie R. , MD, MS, PhD, FACR

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Mount Mary College | BS | 1986 | Biology and Chemistry |
| Medical College of Wisconsin | MD | 1991 | Medical Doctor |
| University of Wisconsin | MS | 2013 | Educational Leadership and Policy Analysis |
| University of Wisconsin | PhD | 2017 | Education Curriculum and Instruction |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| St. Luke's Medical Center | 07/1991 – 06/1992 | Transitional Residency |
| St. Luke's Medical Center | 07/1992 – 06/1993 | Nuclear Medicine Residency |
| Medical College of Wisconsin | 07/1993 – 06/1997 | Diagnostic Radiology |
| Medical College of Wisconsin | 07/1997 – 06/1998 | Women's Imaging Fellowship |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| Medical College of Wisconsin | 07/1998 – 07/2005 | Assistant Professor |
| University of Wisconsin-Madison | 08/2005 – 06/2011 | Associate Professor |
| University of Wisconsin-Madison | 07/2011 – Present | Professor |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| University of Wisconsin Hospital and Clinics | 08/2005 – Present | Physician |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Nuclear Medicine | Nuclear Medicine | 1997 and 2007 | Expired |
| American Board of Radiology | Radiology | 1999 | |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

3

**ROLES IN PROGRAM**

Developed an anatomy course focused on radiology anatomy and imaging for medical physics and biomechanical engineering graduate students

Mentor for Medical Physics Doctoral students

CAMPEP- Residency Program in Imaging Physics, Clinical Faculty

**CLINICAL RESPONSIBILITIES**

Breast imaging

Lead Authorized User for the radiation seed localization program in breast.

imaging at UWHC

**SCHOLARLY ACTIVITIES**

RSNA (Radiologic Society of North America), Chair RSNA Education Study Section

AACA (American Association of Clinical Anatomists) Poster and platform presentation judge for annual national meeting

AACA (The American Association of Clinical Anatomists) Member, Financial Affairs Committee (Presidential appointment)

NIH (National Institute of Health) grant study section PAR-18-640: Perception and Cognition Research to Inform Cancer Image Interpretation

AUR Scientific Program Committee

"Mammography II, "Moderator at Scientific Session

Medical Image Perception Society (MIPS) XVII Biennial Meeting, Houston, TX, July 13, 2017

Scientific judging of poster and platform sessions

34th Annual AACA (The American Association of Clinical Anatomists),Minneapolis, MN, July 19, 2017

"Designing an Educational Research Project," ACER/AMSER Essential Skills in Educational Scholarship webinar. April 10, 2018

**RESEARCH INTERESTS**

Exploration and understanding how students learn, and how we may optimize.

learning through innovative teaching methods and technology

The development and use of simulation in education – medical anatomy and

Radiology

Competency training and assessment

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 18 | 9 |
| Book chapters & conference proceedings | 16 | 5 |
| Published abstracts | 0 | 0 |
| Presentations at national & international conferences | 67 | 28 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| UW Fall Research Competition | Screening Mammography Simulation and Training: Assessment of Trainee Performance and Competency Leading to Expertise and Improving Patient Safety | 7/1/19 – 6/30/21 | $65,652 |
| University of Wisconsin Radiology Research and Development Fund | Simulation Training in Screening Mammography: Assessment of Trainee Performance and Competency Leading to Expertise and Improving Patient Safety | March 1, 2019 – February 28, 2021 | $30,225 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

Woods RW, **Salkowski LR**, Elezaby M, Burnside B, Woods, Strigel B, Fowler A. Image-based screening for men at high risk for breast cancer: Benefits and drawbacks. *Clinical Imaging, Mar 2020, Volume 60 (1); P84-89*

Spratt, J.D., **Salkowski, L.R.**, Loukas, M. & Turmezei, T. *Weir and Abrahams' Imaging Atlas of Human Anatomy*, Sixth Edition. – 2020, Elsevier Ltd.

a. Breast and Axilla, Chapter 6

b. Lower Limb, Chapter 11

c. Functional Imaging, Chapter 12

**Salkowski L**, Elezaby M, Fowler A, Burnside B, Woods, Strigel B. Comparison of screening mammography technical recalls from FFDM and digital breast tomosynthesis (DBT). *J Med Imaging (Bellingham). 2019 Jul;6(3):031403. doi: 10.1117/1.JMI.6.3.031403. Epub 2018 Dec 22. PMID: 30603658; PMCID: PMC6303840.*

**Salkowski L**, Elezaby M, Fowler A, Burnside B, Woods R, Strigel B. Comparison of screening mammography technical recalls from FFDM and digital breast tomosynthesis (DBT). Proceeding of SPIE, International Workshop on Breast Imaging (IWBI 2018) Volume 10718, 20:1-9.

**Salkowski LR**, Russ R. Experts and novices engage in different cognitive processing when correlating anatomy and imaging. *Journal of Medical Imaging, May (3) 2018.*

**Salkowski LR**. *Mass with Indistinct Margins.* In: Breast Imaging: Rotations in Radiology, Lee CI, Lehman CD, & Bassett LW, Eds. Publication: 2018. Oxford University Press.

**Salkowski, L.R**. & Moseley, T.W. *Clinical Breast Tomosynthesis*: *A Case-Based Approach.* Publication: July 2017. Thieme Publishers

Pinkert M, **Salkowski L**, Keely P, Hall T, Block W, Eliceiri K. Quantitative multiscale imaging of breast cancer. *Journal of Medical Imaging, Dec 2017*

Strigel RM, Burnside ES, Elezaby M, Fowler AM, Kelcz F, **Salkowski L**, DeMartini WB. "Utility of BI-RADS Assessment Category 4 Subdivisions for Screening Breast MRI." American Journal of Radiology, June 2017; 208:1-8.

Strigel RM, Rollenhagen J, Burnside ES, Elezaby M, Fowler AM, Kelcz F, **Salkowski L**, DeMartini WB. "Screening Breast MRI Outcomes in Routine Clinical Practice: Comparison with BI-RADS Benchmarks." Academic Radiology 2017; 24(4):411-417.

Spratt, J.D., **Salkowski, L.R.**, Loukas, M. & Turmezei, T. *Weir and Abrahams' Imaging Atlas of Human Anatomy*, Fifth Edition. ISBN: 978-0-7234-3826-7. July 2016. Elsevier Ltd.

## Speidel, Michael A.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin-Madison | PhD | 2003 | Medical Physics |
| University of Wisconsin-Madison | MS | 1998 | Medical Physics |
| University of Wisconsin-Madison | BA | 1996 | Physics |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of Wisconsin-Madison | 2003-2006 | Post-doctoral Research Associate in Medical Physics |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison, Department of Medical Physics, Department of Medicine | 2018-Present | Associate Professor |
| University of Wisconsin-Madison, Department of Medical Physics | 2012-2018 | Assistant Professor |
| University of Wisconsin-Madison, Department of Medical Physics | 2007-2012 | Assistant Scientist |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| University of Wisconsin Hospital and Clinics, Clinical Cardiac Catheterization Labs | 2012-Present | Technical Director |

**ACADEMIC SUPERVISION**

**Students Supervised**

Courtney Bateman, 2007-2011, Completed MS, co advised with Dr. Michael Van Lysel
Brad McCabe, 2007-2012, Completed MS, co advised with Dr. Michael Van Lysel
Yinghua Tao, 2Brian B007-2013, Completed PhD, co advised with Dr. Guang-Hong Chen
Michael Tomkowiak, 2006-2014, Completed PhD
Charles Hatt, 2007-2015, Completed PhD, co advised with Dr. Amish Raval
Erick Oberstar, 2011-2021, Completed PhD (co advised with Dr. Charles Mistretta 2011-2017, sole adviser 2018-2021)
David Dunkerley, 2012-2017, Completed PhD
Jordan Slagowski, 2012-2017, Completed PhD
Lindsay Bodart, 2016-Present
Brian Davis, 2018-Present
Erick Oberstar, 2018-Present
Ethan Nikolau, 2018-Present
Joseph Whitehead, 2018-Present

**Classroom Teaching**

MP 567: The physics of Diagnostic Radiology, 2011-2018, Course Instructor, 50 class hours (per semester)
MP 671: The Physics of Medical Imaging with Ionizing Radiation, 2020, Course Instructor, 28 class hours
MP 671: Radiation Detection and Production, 2020-2021, Instructor, 4 class hours
MP 580: The Physics of Medical Imaging with Ionizing Radiation, 2021, Course Instructor, 28 class hours

**ROLES IN PROGRAM**

**Departmental**

Curriculum Development Committee
Department of Medical Physics
Dates: 2012 – 2016

Faculty Senate Representative
Department of Medical Physics, District 88
Dates: 2015-2016 (alternate), 2016 – present (main)

Oral Qualifier Examination Committee
Department of Medical Physics
Dates: 2016 – present

Imaging Physics Residency Program Mentor, Angiography rotation
Department of Medical Physics
Dates: 2016 – present

Imaging Physics Curriculum Redesign Workgroup, Chair
Department of Medical Physics
Dates: 2018 - present

**CLINICAL RESPONSIBILITIES**

Technical Director of the University of Wisconsin Hospital and Clinics Cardiac Catheterization Lab (2012 – present)

Medical physics support for 8 cath labs located in the University of Wisconsin Hospital, American Family Children's Hospital, and Department of Medicine large animal core research lab (2012 - present)

Member of the UW-Madison/UW Health x-ray radiation safety committee (2016-present)

**SCHOLARLY ACTIVITIES**

*Examples: participation in scientific societies and meetings, scientific presentations, continuing education, etc.*

Full member, American Association of Physicists in Medicine (AAPM)

Full member, International Society for Optics and Photonics (SPIE)

Journal Reviewer, Radiation Protection Dosimetry, 2016 – present

Journal Reviewer, Journal of Medical Imaging, 2015

Journal Reviewer, IEEE Transactions on Medical Imaging, 2015 - present

Journal Reviewer, Radiation Measurements, 2014 – present

Abstract Reviewer, AAPM Annual Meeting, 2014 – present

Journal Reviewer, Academic Radiology, 2014 – present

Journal Reviewer, Medical Physics, 2007 – present

**RESEARCH INTERESTS**

**Novel x-ray fluoroscopic systems for interventional cardiology and radiology, 3D visualization of catheter devices and target anatomy, quantitative digital subtraction angiography, reduced radiation dose, scanning-beam digital x-ray (SBDX) technology, 3D catheter tracking with sub-millimeter accuracy using tomosynthesis, 3D vessel analysis, C-arm inverse geometry CT, design of a next-generation SBDX photon counting detector and real-time reconstruction**

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 34 | 13 |
| Book chapters & conference proceedings | 1, 37 | 0, 18 |
| Published abstracts | 42 | 25 |
| Presentations at national & international conferences | 14 | 3 |

| RESEARCH FUNDING SUPPORT | | | |
|---|---|---|---|
| **Source of Funding** | **Title of Research Grant** | **Dates of Support** | **Funding Amount** |
| National Institutes of Health/NHLBI | 4D DSA and 4D Fluoroscopy: Validation of Diagnostic and Therapeutic Capabilities | 2020-2021 | $638,792 |
| National Institutes of Health/NIBIB | Development of Motion-corrected 4D Digital Subtraction Angiography and Quantification of Embolization Related Changes in Hepatic Arterial Blood Flow | 2018-2021 | $606,100 |
| Siemens Healthcare | 4D Digital Subtraction Angiography | 2016-2021 | $332,514 |
| Siemens Healthcare | Real-Time 3D Device Imaging for Fluoroscopically-Guided Interventions | 2016-2021 | $260,630 |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*


Bodart LE, Ciske BR, Le J, Reilly NM, Deano RC, Ewer SM, Tipnis P, Rahko PS, Wagner MG, Raval AN, Speidel MA. Technical and clinical study of x-ray-based surface echo probe tracking using an attached fiducial apparatus. Med Phys. 2021 Feb; (in press)

Ruedinger KL, Schafer S, Speidel MA, Strother CM. 4D-DSA: Development and current neurovascular applications. AJNR Am J Neuroradiol. 2021 Jan;42(2):214-220.

Ruedinger KL, Harvey EC, Schafer S, Speidel MA, Strother CM. Optimizing the quality of 4D-DSA temporal information. AJNR Am J Neuroradiol. 2019 Dec;40(12):2124-2129.

Lamers LJ, Morray BH, Nugent A, Speidel M, Suntharos P, Prieto L. Multicenter assessment of radiation exposure during pediatric cardiac catheterizations using a novel imaging system. J Interventional Cardiology. 2019: 7639754.

Meram E, Harari C, Shaughnessy G, Wagner M, Brace CL, Mistretta CA, Speidel MA, Laeseke PF. Quantitative 4D-Digital Subtraction Angiography to Assess Changes in Hepatic Arterial Flow during Transarterial Embolization: A Feasibility Study in a Swine Model. J Vasc Interv Radiol. 2019 Aug;30(8):1286-1292.

Shaughnessy G, Schafer S, Speidel MA, Strother CM, Mistretta CA. Measuring blood velocity using 4D-DSA: A feasibility study. Med Phys. 45(10):4510-4518, 2018.

Wu Y, Shaughnessy G, Hoffman CA, Oberstar EL, Schafer S, Schubert T, Ruedinger, KL, Davis BJ, Mistretta CA, Strother CM, Speidel MA. Quantification of blood velocity with 4D digital subtraction angiography using the shifted least-squares method. Am J Neuroradiol 39(10):1871-1877, 2018.

Wagner MG, Hatt CR, Dunkerley DAP, Bodart L, Raval AN, Speidel MA. A dynamic model based approach to motion and deformation tracking of prosthetic valves from biplane x-ray images. Med Phys 45(6): 2583-2594, 2018.

Ciske BR, Speidel MA, Raval AN. Improving the cardiac cath-lab interventional eco system. Translational Pediatrics 7(1): 1-4, 2018.

Li Y, Speidel MA, Francois CJ, Chen G-H. Radiation dose reduction in CT myocardial perfusion imaging using SMART-RECON. IEEE Trans Med Imaging 2017 Aug 30.

Dunkerley DAP, Slagowski JM, Funk T, Speidel MA. Dynamic electronic collimation method for 3-D catheter tracking on a scanning-beam digital x-ray system. J Med Imaging 4(2): 023501, 2017.

Slagowski JM, Dunkerley DAP, Hatt CR, Speidel MA. Single-view geometric calibration for C-arm inverse geometry CT. J Med Imaging 4(1): 013506, 2017.

Oberstar EL, Speidel MA, Davis BJ, Strother CM, Mistretta CA. Feasibility of reduced-dose three-dimensional/four-dimensional digital subtraction angiogram using a weighted edge preserving filter. J Med Imaging 4(1): 013501, 2017.

Hatt CR, Speidel MA, Raval AN. Real-time pose estimation of devices from x-ray images: Application to x-ray/echo registration for cardiac interventions. Medical Image Analysis 34: 101-108, 2016.

## Szczyktowicz, Timothy P.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin-Madison | PhD | 2012 | Medical Physics |
| University of Wisconsin-Madison | MSc | 2010 | Medical Physics |
| State University of New York at Buffalo | BSc | 2008 | Physics (major), Math (minor) |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of Wisconsin-Madison | 2013-2014 | Post-doctoral Researcher |
| University of Wisconsin-Madison | 2013-2014 | Clinical Physics Imaging Resident |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison, Department of Radiology | 2019-Present | Associate Professor (CHS) |
| University of Wisconsin-Madison, Departments of Medical Physics, and Biomedical Engineering | 2014-Present | Affiliate Professor |
| University of Wisconsin-Madison, Department of Radiology | 2014-2019 | Assistant Professor (CHS) |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Radiology | Diagnostic Medical Physics | 2016 | |

**ACADEMIC SUPERVISION**

I currently mentor 1 post doc (2 career total), 1 part time research medical physics resident (2 career total), and 4 undergraduates (15 career total)

**ROLES IN PROGRAM**

Mentor in Informatic and CT rotation. Member of Steering Committee

**CLINICAL RESPONSIBILITIES**

CT physicist: PI/co-PI on multiple industrial research and equipment grants with GE Healthcare, Director of Clinical Operations for UW-Madison CT protocol development team (deliver/sell optimized CT protocols to GE Healthcare), 20% Appointment with UW Radiation Oncology supporting CT/x-ray imaging needs, Internal auditor (ISO 9001:2008 trained) representing UW for GE audits of UW-Madison CT protocol development project Provide support local community hospitals in CT.

## SCHOLARLY ACTIVITIES

My work is being incorporated into clinical CT scans being acquired around the globe. Through my relationship with GE Healthcare, for which I am the director of operations, thousands of CT scanners around the globe receive CT protocols developed by the University of Wisconsin Madison.

I created, and shared, a system for disseminating and managing CT protocols. I published on this before any vendor had a solution, and before organizations like the Integrating the Healthcare Enterprise (IHE) or American Association of Physicists in Medicine (AAPM) had profiles or committees established to address this issue. I consult for several companies on protocol management, and I am a leading expert in this area of patient care in medical imaging.

**Positions and Honors**

2007 Society of Physics Students leadership award

2013 2 articles selected as “Editor’s Pick” in the Journal of Medical Physics 40(2)021905, 40(2)021906

2015/6 2 articles selected as cover features for “Radiology Business”

2017 Selected as the “Most influential Faculty Member” by one of my students for their 4 year B.S. career

**Other experience and Professional Memberships**

Member ACR 2017-present

Judge for WARF research competition 2015

Journal reviewer for JACMP 2015-Present

Radiological Society of North America Member 2010-2016

Society of Photographic Instrumentation Engineers 2010-2016

Journal reviewer for Medical Physics 2009-Present

American Association of Medical Physicists 2008-Present

American Physical Society 2006-Present

## RESEARCH INTERESTS

My objective is to understand as much as possible about CT from the basic science enabling image creation to how technologists and physicians interact with CT scanners and images. I respect all facets of CT imaging: from orders being placed by referring providers, CT technologists interacting with patients and equipment, to radiologist interpretation. My background as a CT physicist with expertise in image reconstruction and clinical protocol optimization coupled with my desire to optimize CT work fuels my clinical and research interests.

## RESEARCH SUMMARY

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 36 | 24 |
| Book chapters & conference proceedings | 24 | 6 |
| Presentations at national & international conferences | 60 | 27 |

## RESEARCH FUNDING SUPPORT

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| GE Healthcare | Photon Flux Characterization as a Function of Dose and Body Region | 2020 | |
| GE Healthcare | Clinical and Technical Evaluation of the Rev2.2B Upgrade to the Revolution CT Scanner | 2020 | |
| GE Healthcare | CT Protocol Manager and Intelligent Protocoling Evaluation | 2019 | |
| GE Healthcare | Revolution 2.1B External Evaluation | 2019 | |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

Publications:

- TP Szczykutowicz, B Viggiano, S Rose, P Pickhardt, M Lubner. Monitoring CT contrast enhancement using a new metric: Applications for institution-wide quality control. Under Review 2021
- S Rose, B Viggiano, C Bartels, R Bour, J Kanne, TP Szczykutowicz. Applying a New CT Quality Metric in Radiology: How CT Pulmonary Angiography Repeat Rates Compare Across Institutions. Journal of the American College of Radiology 2021
- B Viggiano, S Rose, TP Szczykutowicz. E_ect of Contrast Agent Administration on Water Equivalent Diameter in CT. Medical Physics 48 (3) 2020
- TP Szczykutowicz, Brian Nett, Lusik Cherkezyan, Myron Pozniak, Jie Tang, Meghan Lubner, Jiang Hsieh. Protocol Optimization considerations for implementing deep learning CT reconstruction. American Journal of Roentgenology June 2021
- S Rose, B Viggiano, R Bour, C Bartels, and TP Szczykutowicz. A multi-institutional study on wasted scans from 60,000 patients in CT. American Journal of Roentgenology November 2020 215(5).
- R Sing, TP Szczykutowicz, F Homayounieh, R Vining, K Kanal, SR Digumarthy, MK Kalra. Radiation Dose for Multiregion CT Protocols: Challenges and Limitations. American Journal of Roentgenology 213 1100-1106 2019
- TP Szczykutowicz and S Rose. First Look: Repeat Rates in CT. Radiology Management Sept/Oct 2019 Issue.
- C Burton, A Malkus, FN Ranallo, and TP Szczykutowicz. Technical note: Model-based magnification/minification correction of patient size surrogates extracted from CT localizers. Medical Physics 45(1) 2019
- M Wagner, L Hinshaw, Y Li, TP Szczykutowicz, P Laesekem CA Mistretta, and FT Lee. Ultra-Low Radiation Dose CT Fluoroscopy for Percutaneous Interventions: A feasibility study. Radiology Published Online January 15th, 2019
- TP Szczykutowicz, R Bour, F Ranallo, and Myron Pozniak. The current state of CT dose management across radiology: Well intentioned but not universally well executed. American Journal of Roentgenology 2018 [Link]
- TP Szczykutowicz, Christina L. Brunnquel, Gregory D. Avey, Carrie Bartels, Daryn S. Belden, Richard J. Bruce, Aaron S. Field, Walter W. Peppler, Peter Wasmund, Gary Wendt. A General Framework for Monitoring Image Acquisition Workflow in the Radiology Environment: Timeliness for Acute Stroke CT imaging. Journal of Digital Imaging 31(2) 2018
- Christina L. Brunnquell, Gregory D. Avey, TP Szczykutowicz. Objective evaluation of CT time efficiency in acute stroke response. Journal of the American College of Radiology 15(6) 7 of 13 2018
- Christiane Burton and TP Szczykutowicz. Evaluation of AAPM reports 204 and 220 using patient data: Estimation of Effective Diameter, Water Equivalent Diameter and ellipticity ratios for Chest, Abdomen, Pelvis and Head CT . JACMP 19(1) 2018

Presentations:

- A general framework for monitoring CT acquisition workow Presented at the EFOMP Symposium at the 2020 ESR Annual Meeting in Vienna (virtual conference due to covid) as part of the tract titled \EF 11 CT protocol management and optimization: management".
- Advanced Computed Tomography characterization techniques: Lessons from medical CT Invited Talk for the ASTM International Conference on Additive Manufacturing (ASTM ICAM 2020). (virtual conference due to covid)
- Diagnostic Imaging and 100 mSv+ Doses WSensakovic, MRehani, MLipford, T Szczykutowicz. Symposium as part of the AAPM Annual Meeting 2020.
- Special Panel: Risks and Benefits of Diagnostic Imaging: Radiation Dose, Clinical Need, and Imaging Utilization. Mahadevappa Mahesh, MS, PhD, FAAPM, FACR, FIOMP Tim Szczykutowicz, PhD, DABR Aaron Sodickson, MD, PhD, FASER Michael Repplinger, MD, PhD. 10-1-2020
- Medical Imaging Advances: Do All Bell-and-Whistle Options Impact Patient Care? Presented at the University of Michigan Department of Nuclear Engineering Colloquium 1-31-2020
- Practice Management Invited Talk given as a part of the \Advances in CT: Technologies, Applications, Operations - CT Practice" Track. RSNA, Chicago Nov. 29, 2018 International Meeting Patient Specific Adaption of Imaging Technique for CT American Association of Physicists in Medicine, San Antonio TX, 2019
- CT Technologies, What's new: Protocol standardization and patient customization International Society of CT, San Diego CA, September 14-15 2018
- Pediatric Topics of Concern to all: How to Correctly Set Automatic Exposure Control International Society of CT, San Diego CA, September 14-15 2018

Books and Book Chapters

- TP Szczykutowicz. \CT Practice Management" in \Computed Tomography: New Approaches, Applications, and Operations". Ehsan Samei and Norbert Pelc editors, Springer 2020. Pages 167-182
- TP Szczykutowicz. The CT Handbook: Optimizing Protocols for Today's Feature Rich-Scanners. Medical Physics Publishing 2020. 580 Pages. ISBN Hardcover 978-0-944838-53-2eBook 978-0-944838-57-0

## Timm, Jason D.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Florida | MPH | 2007 | Environmental Health |
| University of Alabama | BS | 2003 | Applied Sciences |
| Lakeshore Technical College | AS | 1995 | Health Physics |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison, Environmental Health & Safety Department | 2016-Present | Radiation Safety Officer |
| University of Wisconsin-Madison, Environmental Health & Safety Department | 2019-2020 | Interim Environmental Health & Safety Co-Director |
| University of Wisconsin-Madison, Environmental Health & Safety Department | 2015-2016 | Interim Radiation Safety Officer |
| University of Florida, Department of Environmental and Global Health | 2010-2011 | Adjunct Faculty |
| University of Florida, Division of Environmental Health and Safety | 2001-2008 | Health Physicist |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| University of Wisconsin Health Clinics | 2016-Present | Radiation Safety Officer |
| University of Wisconsin Health Clinics | 2015-2016 | Interim Radiation Safety Officer |
| University of Wisconsin Health Clinics | 2014-2016 | Health Physicist/Assistant Radiation Safety Officer |
| Medical College of Wisconsin and Froedtert Hospital, Milwaukee, WI | 2012-2014 | Assistant Radiation Safety Officer |
| The Scripps Research Institute | 2011 | Interim Environmental Health and Safety Director |
| The Scripps Research Institute | 2008-2012 | Radiation Safety Officer |
| Southern Radiological Services | 1997-2000 | Health Physics Consultant |
| Massachusetts General Hospital, Environmental Health and Safety | 1997-2000 | Hazardous Waste Program Manager |
| Massachusetts General Hospital, Environmental Health and Safety | 1996-1997 | Health Physics Technician |

**ROLES IN PROGRAM**

University of Wisconsin – Madison, Department of Medical Physics Residency Program Steering Committee Member

Recently created a new radiation safety rotation within the SPMH Medical Physics Imaging residency program that includes training and in-person learning opportunities for residents.

**SCHOLARLY ACTIVITIES**

**PROFESSIONAL DEVELOPMENT AND TRAINING**

Principal organizer for U.S. DOE's Radiation Emergency Assistance Center/Training Site (REAC/TS)
Emergency Medicine Training, UW-Madison & UW Health
Principal organizer for U.S. DOE's Radiation Emergency Assistance Center/Training Site (REAC/TS)
Emergency Medicine Training, Milwaukee Metro Area
Dade Moeller Radiation Safety Academy, DOT, NRC, and IATA RAM Transportation
Dade Moeller Radiation Safety Academy, Fluoroscopy Safety
Dade Moeller Radiation Safety Academy, X-Ray Safety Awareness
Principal organizer for U.S. DOE/National Nuclear Security Administration and FBI sponsored
National Tabletop Exercise "Operation Science Thunder", Palm Beach Gardens, FL
24-hour U.S. DOE Global Threat Reduction Initiative, Alarm Response Training Class, Oakridge, TN
Attended U.S. DOE/FBI sponsored National Tabletop Exercise "Operation Bearcat Thunder", University of Cincinnati
Principal organizer for Advanced Radiation Response Volunteer Corps Workshop, Orlando, FL
40-hour Laser Safety Officer Training. Laser Institute of America, Orlando, FL
40-hour HAZWOPER Certification, OSHA Standard 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response", including 8-hour annual refresher trainings
40-hour Health Physics in Radiation Emergencies, U.S. DOE's Radiation Emergency Assistance Center/Training Site (REAC/TS), Oakridge Institute for Science and Education, Oakridge, TN
Coordinated Emergency Plan Training and Annual Drill, University of Florida Training Reactor Annual Radiological Disaster Drill, UF Health Emergency Department

**PROFESSIONAL ASSOCIATIONS**

Health Physics Society (Plenary member 1996 to present)
Chair, Ad Hoc Committee on Marketing (2012 to 2014)
Local Arrangements Committee Member, 58th Annual Meeting, Madison, WI
Local Arrangements Committee Chair, 56th Annual Meeting, West Palm Beach
Society Support Committee Member (2005 to 2007)
Health Physics Society, North Central Chapter (Member 2012 to present)
Executive Council Member (2014 to 2017)
Health Physics Society, Florida Chapter (Member 2004 to present)
President-Elect/President/Past President (2009 to 2012)
Secretary (2004 to 2009)
Executive Council Member (2001 to 2004)
Webmaster (2004 to 2018)

**OTHER**

Teaches annual radiation safety course to undergraduate students as an appointed lecturer in the Nuclear Medicine Technology program at UW-La Crosse.

**RESEARCH INTERESTS**

Environmental, health and safety, general safety and health physics in large university, academic medical center and biotechnology environments, university-based radiation safety, creating more efficient and beneficial human-use research protocol review processes, creation of new and more purposeful radiation safety committees to better serve the needs of clinicians and researchers while increasing the level of safety and regulatory compliance.

## Vetter, John R.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin – Madison | PhD | 1990 | Medical Physics |
| University of Wisconsin – Madison | MS | 1983 | Medical Physics |
| University of Wisconsin – Madison | BA | 1981 | Physics |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin - Madison | 2004-Present | Associate Professor (CHS) |
| University of Wisconsin - Madison | 1997-2004 | Assistant Professor (CHS) |
| University of Wisconsin - Madison | 1993-1996 | Clinical Assistant Professor |
| University of Wisconsin - Madison | 1992-1993 | Researcher |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| International Atomic Energy Agency, Manila, Philippines | 2013 | Short Term Consultant (two-week appointment to evaluate residency program) |
| St. Luke's Hospital, Manila, Philippines | 2010 | Short Term Consultant (two-week appointment to provide required instruction on digital mammography to achieve the first ACR Accreditation of a Digital Mammography program in Asia) |
| World Health Organization Western Pacific Region, Manila, Philippines | 2003, 2005 | Short Term Consultant in Diagnostic Radiology Physics (one month appointment) |
| US Army Medical Research and Material Command Breast Cancer Research Program and Prostate Cancer Research Program | 1996-2004 | Physical Imaging Scientific Review Panel Member |
| American Board of Radiology | 1994 | Diplomate of the American Board of Radiology in Diagnostic Radiological Physics |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Radiology | Diagnostic Radiological Physics | 1994 | NA |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

**Students Supervised through the Master's Degree:**

Rick Peters, M.S. James Royal, M.S.
Gene Wollan, M.S. Jeff Harrington, M.S.
Sally Gocker, M.S. Clint Wood, M.S., M.D.
Stacy Aldridge, Ph.D. Carin Flint, M.S.
Jeff Limmer, M.S. Mike Kowalok, Ph.D.
David Ellerbusch, Ph.D. Richard Ross, Ph.D.
Michael Meltsner, M.S. Megan Miller, M.S.
Patrick Martin, M.S. Leah Schubert, Ph.D.
Charles Wallace, M.S. Eibsee Marquez, M.S.
Chris Campen, M.S. Shauheen Soofi, M.S.
Joshua Hubble, M.S.

**Student Supervised through the Ph.D. Degree:**

Mariela Porras-Chaverri, Ph.D. (Tenured Associate Professor, University of Costa Rica)

**Imaging Physics Residents Co-Supervised:**

Kimberly Howell, M.S.
Nicholas Rubert, Ph.D.
Zhimin Li, Ph.D.
Christina Brunnquell, Ph.D.
Megan Lipford, Ph.D.
Sean Rose, PhD
Jordan Krebs, Ph.D. (current)
Joseph Meier, Ph.D. (current)

**ROLES IN PROGRAM**

Director: Radiological Physics Services

Member: Executive Committee Graduate Admissions Committee Advisory Committee, Radiation Calibration Laboratory Steering Committee, Imaging Physics Residency Program, University of Wisconsin-Madison/UW-Health Executive Radiation Safety Committee, Chair: X-ray Safety Committee, Chair Basic Science Administrators (past) Member: SMPH Administrative Policy Development Committee (past) Search Committee, Chair of Medical History & Bioethics (past)

**SCHOLARLY ACTIVITIES**

Memberships: American Association of Physicists in Medicine, Society of Directors of Academic Medical Physics Programs

Manuscript reviewer: Medical Physics, Radiology, Radiation Measurements journals

Member: AAPM Work Group on Periodic Review of Medical Physics Residency Training

Member: AAPM Work Group on Entrustable Professional Activities for Medical Physics Residents

**RESEARCH INTERESTS**

Medical Image Science, Computed Tomography, Mammography, Tomosynthesis, Image Quality and Radiation Safety in Diagnostic Radiology, Diagnostic Radiology Quality Assurance Methods and Test Tools

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 12 | 0 |
| Book chapters & conference proceedings | 1 | 1 |
| Published abstracts | 4 | 0 |
| Presentations at national & international conferences | 4 | 0 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| AAPM/RSNA, University of Wisconsin Hospital | Residency Program in Diagnostic Radiology Physics | 1999-2000, 2014-2015, 2016 | $30,000 annually (AAPM/RSNA), $65,000 annually University of Wisconsin Hospital |
| UW Hospital & Clinics, UW-Madison | Radiological Physics Services | 1992-Present | $320,000/per annum |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

Refereed Articles

Porras-Chaverri MA, Mora P, **Vetter** JR, Highnam R. Determination of Personalized Mean Glandular Dose using Estimates of the Glandular Tissue Distribution in a Clinical Setting. Rev. latinoam. fis. Med. 2015; 1(2):69-72.

Chapters in Books

Quality and Safety in Medical Imaging, Bryan Bednarz and John Vetter, (Chapter 2) in Kanne Quality and Safety in Medical Imaging: The Essentials, 2016.

## Vigen, Karl K.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Gustavus Adolphus College | BA | 1995 | Physics |
| University of Wisconsin-Madison | MS | 1998 | Medical Physics |
| University of Wisconsin-Madison | PhD | 1998 | Medical Physics |
| | | | |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| Stanford University | 02/2001-11/2003 | Postdoctoral Fellow in Radiology (Interventional MRI) |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison, Radiology | 12/2003-06/2010 | Assistant Scientist |
| University of Wisconsin-Madison, Radiology | 07/2010-06/2016 | Associate Scientist |
| University of Wisconsin-Madison, Radiology | 07/2016-Present | Senior Scientist |
| | | |
| | | |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| University of Wisconsin Medical Foundation | 09/2016 | Director of Clinical Physics-MRI |
| | | |
| | | |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| American Board of Medical Physics | MRI Physics | 2013 (Renewed 2018) | 2023 |
| | | | |
| | | | |

**ACADEMIC SUPERVISION**

*Number of present and past Ph.D. and M.S. students whose research you have directly supervised.*

None

**ROLES IN PROGRAM**

*Examples: Courses/Classes taught (with contact hours), membership of program committees (steering committee, admissions committee, student research committees, etc.)*

I am the Mentor for the Magnetic Resonance Imaging (MRI) Rotation; leading and instructing all aspects of this rotation. I provide instruction or supervision for the residents in Annual MRI QC surveys (approximately 6 in the 1st year, and 12 in the 2nd year, about 5 hours of contact time each). I guide training in MRI Safety (approx. 30 contact hrs/year); other clinical MRI activities (at least 30 contact hrs/year).; and other educational sessions (about 20 hours/year).

**CLINICAL RESPONSIBILITIES**

• Department of Radiology-designated MRI Safety Expert (MRSE) (2018-Present). UW Health / UW-Madison MRI Safety Committee Vice-Chair (2020-Present).

• Providing MRI physics support for clinical MRI program, including directing MRI quality assurance /quality control (QA/QC); coordinating the MRI physics portion of the ACR MRI and Breast MRI accreditation programs and requirements of The Joint Commission hospital accreditation requirements; implementing prototype MRI pulse sequences; and consulting on MRI safety-related issues, such as continually developing guidelines for MRI of approved MR-conditional and non-MR-conditional implanted devices (pacemakers/ICDs).

• Translating emerging research methods to clinical use; and providing MRI physics support for clinical and basic science research projects, primarily in the areas of cardiovascular imaging, neuroradiological imaging, and abdominal imaging.

• Coordinating and implementing technical MRI physics components of the UW Intraoperative MRI Program, including MRI-guided DBS implantation, laser ablation procedures, and emerging procedures as needed.

**SCHOLARLY ACTIVITIES**

*Examples: participation in scientific societies and meetings, scientific presentations, continuing education, etc.*

- Regular abstract submission, abstract review, and participation in ISMRM annual meeting.
- Regular attendance at RSNA annual meeting; periodic attendance at meetings incl. SCMR, ISMRM Safety Workshops; iMRI workshops.
- Oral examiner, ABMP (MRI Physics): 2014, 2015, 2018.

**RESEARCH INTERESTS**

Interventional MRI, including neuro and body intraoperative procedures; Cardiac MRI; MR Angiography; MRI Quality Assurance and Quality Control; and MRI Safety.

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 31 | 3 |
| Book chapters & conference proceedings | 81 | 6 |
| Published abstracts | 81 | 6 |
| Presentations at national & international conferences | 10 | 1 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**
*Last 5 years.*

**Vigen KK**, Reeder SB, Hood MN, Steckner M, Leiner T, Dombroski D, Gulani V. JMRI-ISMRM Recommendation: Recommendations for Imaging Patients with Cardiac Implantable Electronic Devices (CIEDs). J Magn Reson Imaging, In Press: Early View (2020).

Schiebler ML, Ahujaa J, Repplinger MD, François CJ, **Vigen KK**, Grist TM, Hamedani AG, Reeder SB, Nagle SK. Incidence of Actionable Findings on Contrast Enhanced Magnetic Resonance Angiography Ordered for Pulmonary Embolism Evaluation. Eur J Radiol, 85, 1383–1389 (2016).

Nagle SK, Schiebler ML, Repplinger MD, François CJ, **Vigen KK**, Yarlagadda R, Grist TM, Reeder SB.

Contrast enhanced pulmonary magnetic resonance angiography for pulmonary embolism: Building a successful program. Eur J Radiol, 85, 553-63 (2016).

**Wendt, Gary J.**

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| Univ of Wisconsin - Madison | BS | 1982 | Electrical and Computer Engineering |
| Univ of Wisconsin - Madison | MBA | 1985 | Business Administration |
| Medical College of WI | MD | 1991 | |
| | | | |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| UW Madison | 1992-1996 | Fellowship, Diagnostic Radiology |
| UW Madison | 1997 | Fellowship, Neuroradiology, |
| | | |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison, Department of Radiology | | Professor |
| | | |

**HOSPITAL and OTHER APPOINTMENTS**

| Hospital, Clinical, Company etc. | Start & End Dates | Position or Title |
|---|---|---|
| UW Hospital | | Vice-chair Informatics |
| UW Hospital | 2006- present | technology assessment committee |
| | | |

**CERTIFICATION, REGISTRATION and LICENSURE**

| Granting Body | Specialty | Year Granted | Year of Next MOC |
|---|---|---|---|
| ABR | Diagnostic Radiology | 1996 | |
| State of WI MD | Medical Doctor | 1992 | |
| ABPM | Clinical Informatics | 2016 | |

**ACADEMIC SUPERVISION**

Director of fellowship program at UW, the Radiology Informatics Fellowship.

**ROLES IN PROGRAM**

A mentor in the Informatic Rotation in the Medical Imaging Residency Program

**CLINICAL RESPONSIBILITIES**

Neuroradiology; Radiology informatics; UW Hospitals Informatics;

**SCHOLARLY ACTIVITIES**

1. SIIM20, Virtual Recordings for Presentation – 4001: Product Improvement Implementation, 4001: Product Improvement Proactive, 4002: E1-DICOM, 5/27/20 2:30 – 4:00 PM
2. SIIM Webinar Enterprise Imaging - Technical, Business, and Clinical Issues of Implementing a Multi-site and Multi-modality/Multi-department PACS, 9/21/2016 1 p.m. – 2 p.m.

**RESEARCH INTERESTS**

I serve as the enterprise director of medical imaging and vice-chair of informatics at the University of Wisconsin-Madison. In that position and as an associate professor of radiology, I focus on topics such as picture archiving and communications systems (PACS), informatics, enterprise imaging, and workflow improvement.

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 33 | 2 |
| Book chapters & conference proceedings | 2 | |
| Published abstracts | 4 | 0 |
| Presentations at national & international conferences | 74 invited<br>42 presentations | 2 |

**RESEARCH FUNDING SUPPORT**

| Source of Funding | Title of Research Grant | Dates of Support | Funding Amount |
|---|---|---|---|
| NIH | Neuropsychological Progression in New Onset Epilepsy | 6/1/00 to present | |
| NIH | Neurobehavioral Features of Mesial Temporal Lobe Epilepsy | 6/1/98 to present | |
| | | | |

**LIST OF SELECTED PUBLICATIONS – Reverse Chronological Order**

*Last 5 years.*

1. Timothy P. Szczykutowicz, Christina L. Brunnquell, Gregory D. Avey, Carrie Bartels, Daryn S. Belden, Richard J. Bruce, Aaron S. Field, Walter W. Peppler, Peter Wasmund, Gary Wendt; A General Framework for Monitoring Image Acquisition Workflow in the Radiology Environment: Timeliness for Acute Stroke CT Imaging, Journal of Digital Imaging, 2/8/2018, 1-9
2. Brunnquell CL, Belden DS, Avey GD, Bruce RJ, Field AS, Wendt G, Peppler WW, Wasmund P, Bartels C, Szczykutowicz TP. Objective evaluation of CT time efficiency in acute stroke response. 2017. Submitted to J Am Coll Radiol.

## Zagzebski, James A.

**EDUCATION**

| Institution Name | Degree | Year Awarded | Field of Study |
|---|---|---|---|
| University of Wisconsin-Madison | PhD | 1972 | Radiological Sciences |
| University of Wisconsin-Madison | MS | 1968 | Physics |
| St. Mary's College, Winona | BA | 1966 | Physics |

**POSTGRADUATE TRAINING**

| Institution Name | Start & End Dates | Nature of Training |
|---|---|---|
| University of Wisconsin-Madison | 1972-1975 | Post-doctoral Research Associate |

**ACADEMIC APPOINTMENTS**

| Institution, Department | Start & End Dates | Position or Rank |
|---|---|---|
| University of Wisconsin-Madison, Department of Medical Physics | 2013-Present | Professor Emeritus; responsible for all ultrasound Quality Control testing at UW Hospitals |
| University of Wisconsin-Madison, Department of Biomedical Engineering | 2008-2013 | Affiliate Appointment |
| University of Wisconsin-Milwaukee, College of Health Sciences | 2007-2015 | Clinical Professor |
| University of Wisconsin-Madison, Department of Medical Physics | 1998-2013 | Chairman |
| University of Wisconsin-Madison, Departments of Medical Physics, Human Oncology, and Radiology | 1986-2013 | Professor |
| University of Wisconsin-Madison, Departments of Medical Physics, Human Oncology, and Radiology | 1981-1986 | Associate Professor |
| University of Wisconsin-Madison, Departments of Human Oncology, and Radiology | 1977-1981 | Assistant Professor |
| University of Wisconsin-Madison, Departments of Human Oncology, and Radiology | 1975-1977 | Adjunct Assistant Professor |

**ACADEMIC SUPERVISION**

Ronald Jutilla MS Degree, 1977
Brian Knipp MS 1996Richard Banjavic, Ph.D. 1979
Michele Burlew MS Degree, 1981
Carmen Mesina MS 1981
Mitchell Goodsitt, Ph.D. 1982
Joel Felmlee MS 1983
Thomas Burke, Ph.D. 1983
Michael Insana, Ph.D. 1983
Farhad Jafari, Ph.D. 1983
Rick Rossman MS in BME, 1986
Scott Weiner MS in BME, ~1987
William Davros, Ph.D. 1987
Timothy Hall, Ph.D. (With EL Madsen) 1988
Evan Boote, Ph.D. 1988
Lin Xin Yao, Ph.D. 1990
Zheng Feng Lu, Ph.D. 1994
Jian Feng Chen, Ph.D. 1994
Thaddeus Wilson, Ph.D. 2000
Yadong Li, Ph.D. 2001
Anthony Gerig, Ph.D 2004
Timothy Stiles (with Ernest Madsen) 2005
Haifeng Tu, Ph.D. 2005
Wu Liu, Ph.D. 2007
JiHad Al Sadah, Ph.D. 2007
Kibo Nam, Ph.D. 2011
Ivan Rosada-Mendez, Ph.D. 2013

**ROLES IN PROGRAM**

**COURSES TAUGHT**

Diagnostic Ultrasound Physics (Medical Physics 575; 1975-2000)

Graduate student course introducing Medical Physics students to medical ultrasound instrumentation. Taught in the fall semester.

Physics for Ultrasound Technologists (1981-2006) UW Hospital course introducing students in the School for Diagnostic Medical Sonography to the physical principles of this modality. Taught in the summer and fall semesters.

Medical Ultrasound Principles and Instrumentation (UW-Milwaukee CL Sci 323; 2007-2015) Undergraduate course introducing students in the School for Diagnostic Medical Sonography to the physical principles and instrumentation of medical ultrasound. Taught in the spring semester.

Medical Physics Ultrasound "Radlab" (Medical Physics 666, current)

Graduate course in which students learn proper methods for Acceptance Testing and Quality Assurance of ultrasound imaging equipment. This course extends, over 1-½ semesters and is taught once a year.

**UNIVERSITY SERVICE: UNIVERSITY OF WISCONSIN**:
Vice Chairperson, Department of Medical Physics, 1987-1998
RARC (Animal Use Committee), 1990-1994
Advisory Board, School of Diagnostic Ultrasonography, 1989-2015
Medical School Admissions Committee, 1992-1995, 1999-2004
University Hospitals Ultrasound Technology Assessment Committee, 1992-1994
Department of Medical Physics Admissions and Awards Committee, 1992-1999
Medical School Graduate Program Council, 1996-1999
Medical School Faculty Equity & Diversity Committee, 1999-2002
Interdisciplinary Council on Information Technology, 2000-2004
Chairperson, Department of Medical Physics, 1998-2013
Medical School Basic Sciences Chair-Caucus, 2000-present
Medical School Basic Sciences Chair's Representative to the UW Medical Foundation, 2001-Jan 2010
UW Medical School Interdisciplinary Research Complex (Project Team and Team Leader for Imaging, 2003 - present)
UW Medical School Tenure Track Professors Promotion Committee-Primary Role, 2005-2008 Chairman, 2007-2008
UW-Medical School Combined Chairs, 1999-present
Faculty Senate, 1986-1988; 2009-2012

## SCHOLARLY ACTIVITIES

**HONORS AND AWARDS:**
William Fry Memorial Lecture Award, American Institute of Ultrasound in Medicine, 2019
J. Clinical Ultrasound, Best Paper Award, 1992
Joseph H. Holmes Basic Science Pioneer Award, American Institute of Ultrasound in Medicine, 1996.
Fellow, American Association of Physicists in Medicine, 1997
Fellow, American Institute of Ultrasound in Medicine, 1992

**PROFESSIONAL SOCIETIES:**
American Association of Physicists in Medicine (AAPM)
American Institute of Ultrasound in Medicine (AIUM)
Institute for Electrical and Electronics Engineers Ultrasonics Society (IEEE)
American College of Radiology (ACR)
Society of Directors of Academic Medical Physics Programs (SDAMPP)

**COMMITTEE MEMBERSHIP:**
--American Association of Physicists in Medicine (AAPM)
General Medical Physics Committee 1980-1989 (Vice Chairman 1986-1989)
Ultrasound Task Force 1986-present (Chairman, 1986-1989)
Ad Hoc Committee on Diversification (1986-1987)
Ultrasound Committee Chairman (1989-1995)
Science Council (1989-1995)
Task Group 353, (2020-present) Pulsed Doppler and Color Flow Ultrasound System Performance Assessment Using Flow Phantoms
--QIBA (Quantitative Imaging Biomarker Alliance) (2017-present)
Volume Blood Flow Committee; co-chair, Quality Assurance and Phantom subcommittee
Pulse Echo Quantitative Ultrasound (PECUS) Committee
--Society of Directors of Academic Medical Physics Programs (SDAMP)
Board Member at Large, 2010-2013
--Commission for Accreditation of Academic Medical Physics Programs (CAMPEP)
Graduate Education Program Review Committee (2013-2019)
--American Institute of Ultrasound in Medicine
Standards Committee, 1976-present (Vice Chairman 1979-1981, Chairman 1981-1983, Chairman 1995-1997)
AIUM/NEMA Safety Standard Task Group, 1978-1982
AIUM/NEMA Performance Standard Task Group (Co-Chairman, 1982-1990)
Manufacturer's Commendation Committee, 1984-1999 (Chairman 1987-1991)
Board of Governors, 1990-1993
Board of Governors, 2006-2009

--American Registry of Diagnostic Medical Sonographers
Physics Exam Committee, 1979-1985
Certification-recertification Committee, 1983-1985 (Chairman, 1983-1985)
Volunteer item writer, 1989-1992
--Centers for Radiological Physics
Ultrasound Task Group, 1976-1984
Program Chairman of 6 regional workshops on ultrasound equipment quality control
--National Council on Radiation Protection
Scientific Committee on Quality Control in Diagnostic Radiology, 1983-1986
--National Institute of Health
Ad hoc reviewer, 1984-present (2-3 Study Sections per year)
Diagnostic Radiology Study Section, 1988-1992
--American College of Radiology
Ultrasound Accreditation Committee
Ultrasound Quality Assurance Committee (Chairman)
--International Commission on Radiation Units and Measurements
Subcommittee on Tissue Substitutes, Phantoms and Computational Modeling in Medical Ultrasound, 1993-1999
--International Electrotechnical Commission (IEC)
U.S. Delegate to IECTC87, working Group 9 on Pulse Echo Imaging Systems.
Principal Author of "Ultrasonic Pulse-Echo Systems: Measurement of System Sensitivity and Dynamic Range." (IEC61391, 2010)
--National Advisory Council for the National Institute of Biomedical Imaging and Bioengineering (NIBIB)
Advisory Board Member, 2003-2007 (Served during the inauguration years of NIBIB)

**EDITORSHIP:**
Associate Editor, Medical Physics, 1991-2001
Associate Editor, Journal of Diagnostic Ultrasound, 1992 – 2020
Regular Manuscript Reviewer for
Journal of Ultrasound in Medicine
Journal of Acoustical Society of America
IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control
Ultrasonic Imaging
Physics in Medicine and Biology

**COMMUNITY SERVICE:**
Medical Physics Foundation
Board of Directors, 1986-1998
President, 1993-1998
Medical Physics Publishing Corporation
Board of Directors, 1996-present
President, 2000-2020

**RESEARCH INTERESTS**

Ultrasound Imaging in Medicine
Ultrasonic Tissue Characterization
Flow Measurement and Visualization Using Ultrasound

**RESEARCH SUMMARY**

| Item | Total | In last 5 years |
|---|---|---|
| Peer-reviewed papers in referred journals | 172 | 11 |
| Book chapters & conference proceedings | 27 | 2 |
| Presentations at national & international conferences | 320 | ~10 |

# Appendix H – Sample Interview Evaluation Form


**Imaging Physics Residency Position**

Applicant Name:

Interview Date:

Interviewer: _____

For the following items, please rate the candidate on a scale from 1 to 5
(1 is the lowest, 5 is the highest or best score)

| | Lowest ..... Highest | | | | |
|---|---|---|---|---|---|
| Communication Skills ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Self-Motivation & Independence ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Perseverance & Tenacity ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Maturity and Sense of Professional Ethics ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Ability to carry out tasks independently and accurately ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Preparation for Residency in Medical Imaging Physics ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Desire and Passion for Residency Program and a Career in Clinical Imaging Physics ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Perceived Ability to Perform as a Clinical Physicist ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| Would you hire this person for an appropriate position? ..... | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |

Comments:

# Appendix I – Sample Offer Letter

Department of Medical Physics
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

April 30, 2020

[redacted]

Dear Dr. [redacted]:

On behalf of the Department of Medical Physics at the University of Wisconsin-Madison I am pleased to offer you an employee-in-training appointment as a Post Graduate Trainee 1.

This is a 100% appointment with an annual salary rate of $[redacted] for the period beginning July 1, 2020 and ending June 30, 2021. At that time, should we be in a position to renew the appointment for an additional period, a rate review will be conducted. Renewal determination will be based upon your training progress, funding availability, program needs and satisfactory performance.

You will be collaborating with Drs. Frank Ranallo and John Vetter, and other program faculty in the Imaging Physics Residency Program.

All UW School of Medicine and Public Health faculty, staff and students are responsible for upholding the highest standards for professional conduct and ethical behavior in pursuing the School's missions of patient care, education, research, and service. Professionalism includes: 1) demonstrating honesty, integrity, inclusivity, accountability, and fairness; 2) treating everyone, including patients and visitors, colleagues, staff, and learners, with kindness, compassion, and respect; and 3) making a commitment to altruism in all interactions. Faculty, staff and students are responsible for personally modeling professional conduct and inspiring and expecting professional behavior by others. The School of Medicine and Public Health expects all faculty, staff and students to abide by these principles of professionalism, and associated laws and university policies, in the performance of their responsibilities.

Important benefit information is available on the Office of Human Resources/Payroll and Benefits Services website at https://hr.wisc.edu/docs/new-employee-packet.pdf. Many University benefits have strict time limits, so please contact Coreen Marklein at (608) 265-4157 or cmarklein@wisc.edu as soon as possible to discuss your benefit options. Failure to do so could result in the loss of important benefits.

Your employment is contingent upon verification of your identity and work authorization within three days of your first day of employment as required by federal law. Please note that Section 1 of the Form I 9 must be completed electronically on or before your date of hire. Also see Nadean Marron nmarron2@wisc.edu in the departmental office within three days to complete the I-9 form. You will be provided the list of acceptable documents and detailed instructions on how to complete the electronic Form I-9

Please note: Applications for individuals seeking J-1 immigration status sponsored by the University may be subject to additional screening activities to ensure compliance with the federal export control regulations. If you have questions about export control regulations, please contact the University's Export Control Office: https://research.wisc.edu/integrity-and-other-requirements/export-control/.

University of Wisconsin-Madison 1111 Highland Avenue, WIMR 1005 Madison, Wisconsin 53705
608/262-2171 Fax: 608/262-2413 www.medphysics.wisc.edu

This offer of employment is conditional pending the results of a criminal background check. If the results are unacceptable, the offer will be withdrawn or, if you have started employment, your employment will be terminated.

Executive Order #54 (EO 54) requires the reporting of child abuse or neglect. As a UW-Madison employee, you are required by EO 54 and campus policy to immediately report child abuse or neglect to Child Protective Services (CPS) or law enforcement if, in the course of employment, you observe or learn of an incident or threat of child abuse or neglect, and you have reasonable cause to believe that child abuse or neglect has occurred or will occur. If the abuse or neglect occurred in a University program, on campus, or involved a University employee, volunteer, or agent, you must also notify the Office of Equity and Diversity. EO 54 does not apply to employees whose job requires them to comply with the mandatory reporter requirements in Wis. Stats. s. 48.981. Employees who learn about child abuse or neglect in a healthcare setting should only report as permitted by HIPAA. For more information, please see the University of Wisconsin – Madison Office of Equity and Diversity website at: https://oed.wisc.edu/child-abuse-and-neglect-reporting/.

All employees, faculty and staff are strongly encouraged to help make the University a drug-free workplace. You can do this by learning about substance abuse (its dangers and warning signs), encouraging others to avoid substance abuse, and getting help if you need it—either for yourself or for someone you are concerned about. Please review the "UW-Madison Compliance with the Drug-Free Schools & Communities Act", which is provided to all employees as part of their orientation to the University community. This document can be found at: https://alcoholanddruginfo.students.wisc.edu/dfsac-act/.

All employees of the UW School of Medicine and Public Health are required to complete the Health Insurance Portability and Accountability Act (HIPAA) privacy/security training. To access the HIPAA training course please click on this link: https://compliance.wisc.edu/hipaa/training/. For any questions regarding the training, please contact: smph-hipaa-admin@med.wisc.edu. Please complete this on or after your start date unless otherwise directed by your department.

UW-Madison is committed to creating and maintaining a campus community that is free from sexual harassment and sexual violence. All employees are required to complete an online prevention education program called "Preventing Sexual Harassment and Sexual Violence at UW-Madison" within 30 days of a UW-Madison appointment. Additional information and a registration link for this training can be found at: https://compliance.wisc.edu/titleix/employee-training/. (If you are currently a student at UW-Madison and have already taken a similar training directed at students, you are not required to take this training.)

New UW School of Medicine and Public Health (SMPH) employees working in UW Hospital, American Family Children's Hospital and UWHC Clinics must annually complete mandatory Safety and Infection Control training. Information regarding this online training will be provided by the UW Health Medical Staff Affairs Office.

Be aware that an influenza (flu) vaccination is required during flu season; only those with waivers are exempt. To learn more, see: https://go.wisc.edu/smph-flu.

TB Skin Tests are required if you have contact with UW research participants and/or patients, you will need to provide documentation of a TB test completed within the past 12 months. This is an annual requirement.

University of Wisconsin-Madison 1111 Highland Avenue, WIMR 1005 Madison, Wisconsin 53705
608/262-2171 Fax: 608/262-2413 www.medphysics.wisc.edu

It is the policy of University of Wisconsin-Madison to provide reasonable accommodations for qualified individuals with disabilities. If you need a reasonable accommodation to perform the essential functions of your position, please contact our Divisional Disability Representative at smph-accommodation@med.wisc.edu. The DDR is the person authorized to receive and maintain confidential medical information in our School. More information can be found at the following website: https://employeedisabilities.wisc.edu/.

A variety of transportation options (parking, vanpools, bus, biking, etc.) are available to UW employees through Transportation Services at http://transportation.wisc.edu. Parking may be available to employees according to parking allocation criteria. The fees are payable by payroll deduction or by cash payment. Employees needing special accommodations should also contact the Transportation Services Office.

UW-Madison prohibits discrimination against applicants, employees, students and visitors to campus who wish to participate in University programs or activities. Information about relevant law, policies, resources and complaint procedures and protected bases is available at: http://www.oed.wisc.edu.

The University of Wisconsin is required to provide all employees with a Notice of the availability of the Health Insurance Marketplace. Beginning in 2014, the federal Affordable Care Act (ACA) requires most everyone to obtain health insurance for themselves and their dependents or pay a penalty when filing their tax returns. The Marketplace (also known as the Exchange) is an option for people to obtain health insurance. Detailed information about the Health Insurance Marketplace and options can be found on at https://www.healthcare.gov/ and the official marketplace notice can be found at the following link from UW System, https://www.wisconsin.edu/ohrwd/aca/.

I look forward to working with you. Please do not hesitate to call me if you have any questions about your appointment.

Sincerely,

Timothy J Hall, PhD
Professor and Interim Chair, Department of Medical Physics
Director, Medical Physics Graduate Program
Director, UW Radiological Sciences Training Program
tjhall@wisc.edu

I have read and accept the terms of this appointment:

Signature:_____ Date:_____

Cc: SMPH Human Resources

# Appendix J – Example of Resident's Evaluation of Residency Program and Example of Faculty's Evaluation of Resident

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

**Imaging Physics Residency Program Evaluation - End Year 1**

Now that you have completed one year in the Imaging Physics Residency Program, the Steering Committee would greatly appreciate your feedback and recommendations regarding program effectiveness. Please complete this survey, which will be reviewed by the Program Director, Associate Director, Department Chair, and Steering Committee.

If there are any concerns you would prefer to share in a confidential manner, please do not hesitate to contact the Director, Associate Director, or Department Chair directly.

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

**Imaging Physics Residency Program Evaluation - End Year 2**

Now that you have completed the Imaging Physics Residency Program, the Steering Committee would greatly appreciate your feedback and recommendations regarding program effectiveness. Please complete this survey, which will be reviewed by the Program Director, Associate Director, Department Chair, and Steering Committee.

If there are any concerns you would prefer to share in a confidential manner, please do not hesitate to contact the Director, Associate Director, or Department Chair directly.

Resident Name

Date (mm/dd/yyyy)

Please rate the following, with 1=poor, 3=average, 5=excellent

1 2 3 4 5

Clarity of expectations for the rotations

Quality of reference materials

Availability of rotation mentors

Professionalism of rotation mentors

Quality of rotations

Communication of rotation competency evaluations

Opportunities for demonstrating increasing independence

Opportunities to participate in clinically-directed projects

Availability and responsiveness of program leadership

Overall quality of the program

Please provide any comments relevant to the 10 items above

Please provide any recommendations for improvement to the program

Please list all publications that were submitted or published based on work performed during your residency

Please list all presentations (oral or poster) that were presented (or have been accepted) based on work performed during your residency

Please tell us about your next appointment, i.e., what type of position, where, etc.?

Please provide your future contact information

Institution

Email address

Mailing address

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Dear Mentor - Thank you for taking time to complete this mid-point evaluation of the residents. Your feedback will be reviewed and shared with the residents as needed. If your rotation with the residents has not been started, please complete the survey as N/ Thank you.

**Clinical Rotation Mentor Name:**

**Resident Name:**

**Evaluation Date (mm/dd/yyyy):**

**Rotation/Module:**

**Evaluation of Technical Skills (0=N/A; 1=poor/needs improvement; 3=average; 5=top 5% residents)**

0 1 2 3 4

Use of Appropriate Procedures

Equipment Operation

Appropriate Knowledge of Safety Issues

**Evaluation of Data Acquisition and Analysis Skills (0=N/A; 1=poor/needs improvement; 3=average; 5=top 5% of residents)**

0 1 2 3 4 5

Data Acquisition

Data Analyses

Report Generation

**Evaluation of Communication Skills (0=N/A; 1=poor/needs improvement; 3=average; 5=top 5% of residents)**

0 1 2 3 4 5

Listening Skills

Oral Communication / Presentation Skills

Quality of Written Reports

**Integrity (0=N/A; 1=poor/needs improvement; 3=average; 5=top 5% of residents)**

0 1 2 3 4 5

Reliability

Complies with Privacy and Confidentiality Policies

Complies with Residency Program Policies / Procedures

**Work Ethic (0=N/A; 1=poor/needs improvement; 3=average; 5=top 5% of residents)**

0 1 2 3 4 5

Arrived for Rotation Assignments On Time

Attended Required / Recommended Seminars, Grand Round, etc.

Completed Tasks By Stated Due Date

**Personal Conduct (0=N/A; 1=poor/needs improvement; 3=average; 5=top 5% of residents)**

0 1 2 3 4 5

Collegiality

Accepts / Acts Upon Constructive Criticism

**Engagement / Commitment to Self-Learning (0=N/A; 1=poor/needs improvement; 3=average; 5=top 5% of residents)**

0 1 2 3 4 5

Actively Seeks Information / Resources

Asks Appropriate Questions

Level of Engagement / Commitment

Quality of Time Management Skills

**Has the Resident Successfully Completed All Requirements of the Rotation, i.e., all Competencies have been Satisfied?**

- Yes
- No

**Please update the Competency Documentation (Google Sheet) spreadsheet for this resident.**

**Please Provide Any Comments:**

This is the end of the survey. Once you click the icon below this will be submitted.

# Appendix K – On-Boarding and Orientation Activities for the New Residents

Department of Medical Physics
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

## Imaging Physics Resident On-Boarding and Orientation Activities

| | Task | Date | Initials |
|---|---|---|---|
| 1 | Appointment Letter provided to Resident, terms explained, and any questions addressed. | | |
| 2 | I-9 Employment Authorization completed. | | |
| 3 | Resident introduced to faculty and administrative staff, shown workspace assignment, and given a tour of relevant areas of WIMR and the UW Hospital. | | |
| 4 | Residency Handbook and initial reference materials provided to the Resident. | | |
| 5 | Workspace and computer provided to resident. | | |
| 6 | HIPAA training completed. | | |
| 7 | Benefits information provided to Resident, Review with Payroll and Benefits Specialist, and payroll and benefits forms submitted. | | |
| 8 | UW Identification Card obtained and computer NetID and facility access requested. | | |
| 9 | Hospital Identification Card obtained. | | |
| 10 | Medical Physics computer network access granted. | | |
| 11 | Radiology & UW Health Computer Systems & PACS access requested. | | |
| 12 | Set up Activity Log and Competency Check list in Google docs. | | |
| 13 | Access to Residency Calendar provided. | | |
| 14 | Radiation safety training completed (on-line and in person sessions with UW Radiation Safety Office). Apply for Personnel Radiation Badge. | | |
| 15 | Mechanical and electrical safety training provided. | | |
| 16 | MRI safety training provided. | | |
| 17 | Approximate rotation schedule worked out for the first year of the residency program. | | |
| 18 | UW Hospital & Clinics safety and infection control training completed. | | |

# Appendix L - Minutes of Steering Committee Meetings

Department of Medical Physics
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

## Minutes for February 25, 2021 Steering Committee Meeting

Attendees: Frank Ranallo, John Vetter, James Zagzebski, John Garrett, Tim Hall. Mike Speidel, Tim Szczkutowitz, Karl Vigen, Tyler Bradshaw, Lonie Salkowski, Jason Timm, Kristina Weaver, Carol Aspinwal

- Approve minutes from Dec 2019 Meeting. – Please send corrections/additions to Frank

- Application for 5 Year renewal of accreditation for the residency program. No visit this year
  - Materials needed from faculty/mentors in the residency program. (Needed by March 12)
    - Bio/CV's -taken care of by Radiology and Medical Physics staff – any remaining I will send to faculty.
    - All faculty should revise/ update their information in Appendix C of the Self Study: "Clinical Rotation Summaries", specifically the following sections: "Recommended References", "Evaluation Scheme", and "List of Competencies". The main mentor of each rotation should take responsibility for this. [Attachment]
  - Ranallo shared what Speidel sent from previous revisions of past residents. Now that we have had some experience with the residents, we can better write these. Remember the residents see these to learn about our expectations. Ranallo will send Speidel's to all for examples of revisions. Speidel commented that he put this together for the last residents and realized it was hard to show how we were evaluating the residents and indicating milestones for them. He would recommend adding to this for current COVID restrictions. Question was asked: Have residents received information with how we are dealing with COVID from others? Ranallo has sent COVID guidelines for UW and Meriter. Ranallo described his adaptations for the first month via WebEx and other labs, at the hospitals. We want to have flexibility.
  - Ranallo indicted that Vetter Timm should add the new rotation to the self-study.
  - This information needs to be newly created for the new rotation: "Radiation Safety" (Vetter)
  - Need letters of support from Hall, UW Protocol Project (who is generously supporting one resident), and Dr. Grist.

- Progress of Residency activity for the first 8 months of the new Residents
  - No Comments on effects of COVID on these activities and the residency in general Karl: We should advocate to have residents vaccinated due to their visits to the hospitals. Weaver said they are on the list to get this, but it might be a few weeks.
  - Ranallo described what they did for the residents with the addition of new rotation for the first month (July) for new residents.

- Ranallo shared how you can get to the Goggle Drive and Box from your "My UW". He then reviewed the Semi-Annual tasks that need to be completed soon:
  - Ongoing: Residents' review of the program –UW *Qualtrics Survey* currently in progress as Meier and Krebs share their thoughts so far.
  - Residents only evaluate those rotations in the programs they have participated in so far.
    - Action on items mentioned by residents will be discussed at next meeting.
  - Ongoing updating of "Activity Documentation" by each resident for each rotation (This resides in shared documents in UW Google *Drive.)* Residents used their own form for the first 7 months. On-going they will use this form.
  - Only rotations that have substantially begun at this point (this includes radiography, informatics, safety, fluoroscopy, mammography) need to do the following:
    - Ongoing: Mentors' review of each resident – UW Qualtrics *Survey.* The mentors should have received links for the Qualtrics survey for evaluation of the residents. This is every six months of only those who have completed rotations with the residents.
    - Ongoing: Updating of "Competency Documentation" by the rotation mentors for each resident (This resides in shared documents in the UW *Google Drive*). Use the presently constructed competencies at this time.

- Reminder: Each rotation has a location to place information and references for that rotation in The UW BOX folder: "Imaging Physics Residency References". Please use this as a means of compiling references for the residents for your rotation (or any other rotation, if appropriate) Discussion included: Should previous residents has access to this? Szczykutowicz has concerns about seeing any PHI once they leave. Szczykutowicz and Speidel said perhaps they should just download what they want before they leave. Weaver added you have to request a separate BOX for anything that has PHI. Discussed what PHI might be needed instead of redacted information. Vigen said they use UW health platform for anything that has PHI. Hall said the box access is tied to an e-mail address. If we are granting outside people access to this, we MUST have a great deal of scrutiny to be open to others. More discussion should happen in June. Ranallo mentioned that he likes to share new forms and updated procedures as we develop them with alumni and former students. Perhaps this information could be shared on a case-by-case basis and more selectively. Garrett suggested Teams for anything that has PHI to share files.

- Updates:
  - Radiography anatomy & procedures – Salkowski: Smilowitz and she met. There is not time to set-up a class for this. Perhaps by Fall 2022. Funding for their time also has to be determined. Hall indicated that DHO has worked out a way to fund this. Salkowski indicate she doesn't have the bandwidth to do a class w/o designated time. Hall said he would talk to Grist.
  - On-line courses/resources possibilities discussion: Ranallo - Can we find any of these for the residents to meet their needs for this? Salkowski: Resources are there but w/o someone guiding them it is difficult. We need to re-visit how to meet the needs of the residents for this.

- Call for Projects for the Residents. Get residents involved and go to the Medical Physics web site for proposals: Update the link to this document on the web site. Projects provide important information for the residency experience and for justification for the Residency program. 30% of the residents' time is designated for research so they do have time for projects. We need to reinforce this with them so they can be very productive. Bradshaw: Have the residents expressed their areas of interest at this time for projects they might like to do? Speidel asked for Ranallo to reinforce that the residents reach out to find projects they would like to do. The end goal is productivity/papers submissions.

- Ranallo mentioned the Residency Calendar & that this works well so that we can see projects, etc. (Provide Link for this)

- Upcoming activities:
  - Review of draft of New self-study for re-accreditation of program
    - Need comments from mentors before submission at the last part of March.
  - Next Steering Committee meeting (June 2021) will include oral exam as noted below. Tentative date will be end of June, July. We may have to consider via WebEx. Szczykutowicz will attend the his ABR Board meeting and gather information about updates to the ABR exam which we can use for our oral exam.
  - First Year Oral Exam – Ranallo with have a call for questions in May 2021
    - Oral Exam planning: June 2021 – also discussed in June Steering Committee meeting to review questions/feedback, determine rubrics, set schedule.

Other topics brought up:

Vigen: Liability Insurance for the residents and other professional aspects of the job/career– Seminar topic re: this? A few people were discussed (Pitsatello? (Ranallo's connection) AAPM liaison to speak?

Zagzebski – Can we have a document listing four areas of where Residency material is stpred? (Google drive, Box, On-line intranet, calendar) Can we define what is where? CAA will make up a document and sent to everyone.

Meeting ended at 2:05PM

Department of Medical Physics
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

# Minutes for May 21, 2020 Steering Committee Meeting

Attendees: Frank Ranallo, John Vetter, James Zagzebski, Tim Hall, Mike Speidel, Tim Szczkutowitz, Karl Vige Tyler Bradshaw, Lonie Salkowski, Carol Aspinwall

Meeting begins at 11:00 am

- Ranallo: Principal topics are the completion of the 2-year residencies of our two residents: Megan Lipford and Sean Rose.
  - The last day for both residents is June 30. All requirements of the residency must be completed by that date.
- Discussion concerning the state of completion of each rotation for each resident. Any competencies remaining to be completed in any rotation. If so, how will this be resolved before graduation.
  - Each mentor will meet with each resident to discuss whether all competencies are completed.
  - Each mentor will also ask each resident whether there are any other needs they have for completing the residency: things they would like to know or to do.
  - We should ask the residents if they are happy with their training (Speidel)
  - We also need to consider if all our competencies are appropriate; we should be able to revise the competencies over time.
  - There does not appear to be any equipment testing that need to be – or will be – done with the residents before the end of the residency.
  - Consensus from all mentors that it appears to them that both residents have completed all the required competencies in every rotation.
- Discussion concerning final oral exam for both residents – each rotation schedules and performs its own oral exam in a specified format with the exam for each resident being performed one right after the other.
  - We do not expect any problems with the oral exams. We will use the same format as for the end of year one exam. All topics covered over the residency are fair game for each rotation.
- After the exam, a mentor from each rotation needs to discuss the exam results with the residents.
  - Suggestion that this could be done immediately after the exam – this is well received by mentor.
- Going forward we need to consider the new incoming residents starting on July 1.
- First discussion about new residents concerns Covid. What we can do remotely and what we will/need to do in person.
  - Discussion of serious risk for Covid. Some mentors are over 65 or may have health conditions that put them at much greater risk than the residents or some other mentors.
  - Follows is a long discussion about Covid, the risks involved in the different rotations, how to mitigate those risks, shortage of masks, how can we obtain medical grade masks, when we can begin testing.
  - No testing will occur the first month.

- Due to the federal, state, and local state of emergencies equipment testing requirement are on hold or delayed. Ranallo has sent this material to all the mentors, in fact to all the faculty.
- Discussion on whether or when this state of emergency will end and how will we know that it has ended.
- Ranallo has created a page of precautions that must be taken when testing equipment with the residents and distributed this to all the mentors.
- Discussion of cleaning of exam rooms, location of cleaning materials, gloves, and masks near these rooms that are readily available.
- Problems with contamination of lead aprons.
- Whenever possible use lead shields instead of putting on lead aprons.
- Need to consider the relative risk of Covid vs. a very small amount of scatter radiation.
- Tim Hall notes that in a call yesterday with Dean, the surgical are readily available but there is still a shortage of N-95 masks.
- Salkowski points out that in some places like mammography the surgical mask are "hidden" in the manager's office so they are not stolen.
- John discussed the cleaning of surfaces this is routinely done by the techs after exams, and also pointed out that you have to be very careful what you use to clean a monitor.
- Discussion on what we will do remotely in the first month(s).
- Zagzebski comments that a discussion of these problems with infection could be another competency in rotations. John points out that this is well covered in the resident orientation.
- Ranallo: if you have any questions about disinfection, due ask the techs about it.
- Ranallo: there is supposed to be a sign on both the outside door and the inside door to a room in which a patient has been examined if there is an infection risk. The signs that say Do Not Enter until a lapsed period of time and/or the room is properly cleaned. The problem in the past is that this sign is sometime not been posted on the inside door that we would normally use to enter and then we enter a room that is supposed to be closed off. So I would recommend looking at both doors for any warning sign or ask the techs, if they are present.
- Speidel: Just look up the state of emergency and there is no end date. So it probably goes on until it is revoked.
- Ranallo has been talking with the resident about what to expect when they arrive. You should call Ranallo with any questions.

- Additional discussion about format of Final oral exams.
  - For each rotation: Part 1 is 4 questions, each with normally 4 subparts. Total length is 20 minutes. Part 2 is 20 minutes with more free form questions from the mentors. After these questions the mentor may wish to give some feedback on the resident's answers in part 1.
  - Both Megan and Sean are finishing the residency end of June. Megan is leaving for a job then. Sean is staying around for a while in a post-doc here.
  - Ranallo suggests a new rotation for the first month, done remotely with Webex in which the residents will be introduced to the program. This rotation would cover a review and discussion of basic physics and equipment for x-ray imaging, methods of testing, and problems that arise. This would be very helpful in preparing them for the first part of the residency and can all be done remotely.

Meeting ended at 11:50 am

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## Minutes for December 11, 2019 Steering Committee Meeting

## Attendees: Frank Ranallo, John Vetter, Tyler Bradshaw, Richard Bruce, John Garre Thomas Grist, Michael Speidel, Lonie Salkowski, Karl Vigen, Carol Aspinwall

**Approve minutes from June Meeting** – Please review and give Frank any feedback (Ranallo)

**Review of Activities Checklist** – FR noted the activities we should be completing and forewarned everyone that the competency Google document and Qualtrics survey would be due by the end of the year. It was suggested that the link to the Google document should be on the Residency web page for access by the mentors. Ranallo will work with Charles on permissions and security. Both the competency log update and snapshot (Google doc) and Qualtrics eval are to be done 3x per year.

**Letter to Dr. Grist re: accomplishments this year:** FR said to send him any accomplishments such as publications or special projects the residents have completed. (teaching, CT projects, other clinical projects.)

**Radiation Safety Rotation** – JV reported that the residents have completed this. Fluoroscopy training would be great to note in the letter to Dr. Grist.

**Call for Projects for the Residents** – More projects are always needed. LS suggested that an announcement be made to the radiology faculty to solicit project ideas. (Ranallo should contact Melissa in Radiology to get on the agenda). Not only should residents be introduced in the fall meeting, but year-round and they should attend radiology and medical physics dept. meeting. Photo on Radiology web site. Discussion continued on CT focus for collaborations and projects. RBruce said he is working on an informatics projects with JV. Projects should be lined up and ready to go. The emphasis with completing projects in year 2. TGrist said residents should be attending more case conferences (besides section meetings) Mentors could coordinate getting residents to these. TGrist suggested a guide at the case conferences so the residents do not feel left out when watching a procedure.

**Residents' review of the program from July 2019** – Individual mentors will be contacted if there are areas of concerns expressed by the residents. Overall, the evaluation of the Residency program by the residents was positive.

**Second Year activity progress**

**Radiography anatomy & procedures** –Still in progress.

**On-line courses/resources (Dr. Garrett and Dr. Salkowski**)- LS brought up the idea of having a file of situations where there are problems on the scans for the residents to review. TGrist said there is a wealth of data so it would be good for residents to have access to case files. It would be good QA to ask them to review, see mistakes. Make QI projects for residents. TGrist said thoracic group might have some QA projects.

**Frank briefly reviewed the next selection of residents process for summer 2020**

Applications Open November 8, 2019

Applications Deadline: December 31, 2019

Open House on February 20 – 21st

Decisions Due in Match System: March 20, 2020

Matches Announced: March 27, 2020

Upcoming activities (Suggested dates in **BOLD**)

December 31, 2019: Mentors be sure to update competency logs by this date.

**January 3 - 15, 2020** Individual review of applications

**January 16 (?)** Application review and invitations issued.

February 20 -21, 2020 Applicants Open House and Interviews

**March 2, 2020**: Ranking meeting

Final Oral Exam - Call for Questions will be in May 2020 (Ranallo)

Oral Exam planning: June 2020 -

Review questions/feedback

Determine rubrics

Set schedule

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**Imaging Physics Residency Program Steering Committee Meeting Minutes**
**Date: May 28, 2019 2:00 PM.**
Attendees: Drs. Ranallo, Vetter, Jackson, Garrett, Speidel, Szczykutowicz, Vigen, Bruce, Zagzebski, Bradshaw; Staff: Amy Martens, Carol Aspinwall.

**Review of previous meeting minutes**. Minutes of the 12/12/2019 meeting were approved as written.

**Review of Director's Activities Checklist and Residents' activities log**: Ranallo shared these two documents and indicated that he would send out reminders for mentors to complete the annual review of residents (in Google documents) and to update individual competencies the residents have acquired. Be sure competency logs are complete by June 30th in advance of the Oral exam.

**Residents' review of the program** from December 2018: Dr. Jackson indicated that overall the review from the residents was very good. Residents indicated they would like more information about testing.

**Mentors' review of the residents** from December 2018: Dr. Ranallo reported that the overall reviews were very positive.

Side note: Ranallo will be posting information at the next AAPM meeting to recruit new residents for the 2020 – 2022 years.

**Radiation Safety Rotation**: Vetter this is a work in progress. Residents have participated in shielding calculations, staff/dose surveys, developing a computer-based training module that has been taken by over 800 staff members at UW Hospital & Clinics, UW Health and Meriter-Unity Point Hospital. Vetter indicated he is continuing to work with Jason Timm. If any mentors have suggestions for topics to add, please let him know. The residents have also been assisting with radiation dose estimates related to the development of clinical trials involving x-ray imaging. As far as the breadth of our Radiation Safety Training, our residents would not be qualified to serve as Radiation Safety Officers (RSOs) based solely on the training received here, but they would have many of the skills needed to serve as assistant RSOs.

**CAMPEP Annual Report** and supplement: Ranallo referred to the document previously sent to everyone and asked for any additions or changes for next year. He has not heard the results of our annual report submission. No news is good news. Our report will be reviewed at the AAPM meeting.

**Call for Projects** for the Residents: Ranallo shared the document to be used to submit proposals. There was some discussion re: the difficulty of finding this on the web site. This should be promoted in other departments as well as Medical Physics as long as projects fall within the required competencies. Ranallo suggested that the residents be consulted first before submitting a project proposal.

**Radiographic anatomy & procedures** Dr. Salkowski sent an e-mail update indicating that she and Dr. Jackson are working on a course for Fall 2020 with an emphasis in physiology and radiographic anatomy. Although residents do come in with some knowledge of anatomy and physiology, we might want to have them take our class or test out of it. The course will be a combination of face-to-face and on-line sessions. Dr. Speidel was considering doing something related to his area (angiography). It was brought up about using PACS as a source of patient images for teaching radiographic anatomy if it can be done without violating HIPAA.

Oral Exam Discussion: began recapping how it was done last year - that the exam was set-up with the same format as the ABR oral exam. Several suggestions were made about questions depth/difficulty, progression of detail required in the answers (broad to fine details), time limits and grading the responses. Conclusion is to be sure each question represents topics listed in the competencies (with the awareness that the residents are at different levels of competencies so questions will need to reflect this). There will be a forty-minute time frame to answer the questions in each rotation. The question format should be a broad question similar to the ABR format, then drill down to details. If time remains, discuss with the resident what is left to complete for that rotation. Exam can be at the convenience of the residents and the examiner but should be completed by July 5th. Four questions should be submitted to Ranallo and Vetter by June 10th. Dr. Szczykutowicz will share rubrics for grading responses.

Next meeting: June 17th: Finalize Oral Exam plans

Oral Exam planning:
Review questions/feedback
Determine rubrics
Set schedule