Opportunities for Research, Education, and Training at the National Institutes of Health

Aradhana M. Venkatesan, MD, FSIR¹

¹ Section of Abdominal Imaging, Department of Diagnostic Radiology, MD Anderson Cancer Center, Houston, Texas

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Address for correspondence Aradhana M. Venkatesan, MD, FSIR, Section of Abdominal Imaging, Department of Diagnostic Radiology, MD Anderson Cancer Center, 1400 Pressler St., Unit 1473, Pickens Tower, FCT 15.6074, Houston, TX 77030-4009 (e-mail: avenkatesan@mdanderson.org).

Ask many interventionalists their notion of the National Institutes of Health (NIH) and you may encounter perceptions of a hard-core basic science rat-and-test-tube research institute that has little to do with day-to-day interventional radiology (IR) clinical practice, patient-oriented IR clinical research, or education relevant to IR trainees. In fact, there are several opportunities for education, research, and training that are unique to the NIH intramural and extramural programs relevant to both academically oriented and private practice IRs, particularly for those with an interest in device development and clinical trial participation.

National Institutes of Health: The Basics

The NIH, an agency of the U.S. Department of Health and Human Services, is the principal agency of the U.S. government dedicated to biomedical and health-related research.¹ Approximately eighty-three percent of NIH funding supports the Extramural Research Program, which provides biomedical research funding to clinical researchers, scientists, and academic faculty at non-NIH research facilities.² NIH also conducts its own research through its Intramural Research Program (IRP), comprising 27 institutes and centers housed largely on its Bethesda, Maryland, campus. Each of these institutes and centers conducts research on a particular aspect of biomedical science, typically focused on a particular organ or disease entity (e.g., the National Cancer Institute). With 1,200 principal investigators and more than 4,000 postdoctoral fellows in basic, translational, and clinical research, the IRP is the largest biomedical research institution in the world.¹ The NIH Clinical Center, the hospital on the NIH intramural campus, is the nation's largest hospital devoted entirely to clinical research, with its own Radiology and Imaging Sciences Department (RAD) and Center for Interventional Oncology.³ The NIH Center for Interventional Oncology offers opportunities to evaluate image-guided cancer therapies, with an emphasis on interdisciplinary training and

education in interventional oncology, the development of new image-guided methods for personalized drug investigations, image-guided “dose-painting”—that is, tailoring drug delivery based on disease location; the use of “medical GPS” devices for tumor biopsy and treatment; and first-in-human investigations involving new drugs, devices, molecular probes, nanoparticles, and targeted therapies.⁴

Educational Opportunities for IR Trainees

There are several mechanisms for interested IR trainees to engage in clinical and preclinical research education on the NIH campus, whether as medical students or after completion of their medical school training, residency, or IR fellowship.

The NIH Medical Research Scholars Program (MRSP) is a comprehensive, year-long research enrichment program designed to attract creative, research-oriented medical students to the intramural campus.⁵ Fellows accepted into the program spend a year on the Bethesda campus, engaged in a mentored clinical or translational research project that matches their research interests and career goals. An individualized program is developed for fellows in conjunction with a principal investigator in one of the NIH laboratories on selected clinical or translational research projects. Fellows learn about translational research, attend lectures on clinical research, and participate in an interactive, group learning experience with the members of the class and leading NIH physicians and scientists.⁵ For those interested, the option exists to pursue this year of research specifically within the Clinical Center and Interventional Radiology Laboratory of the Department of Radiology and Imaging Sciences, whose focus includes: (1) “smart” drug delivery using novel drug and device combinations; (2) multi-modality image fusion and electromagnetic navigation, and CT-integrated robotics; and (3) the development of an “operating room of the future” combining novel technologies and imaging methods to improve minimally

invasive, image-guided therapies.⁶ As a staff clinician in the Department of Radiology and Imaging Sciences and Center for Interventional Oncology, the author had the opportunity to mentor several outstanding MRSP fellows. Over the course of their fellowships, these individuals developed their research and analytical skills, presented and published work on topics including novel navigational IR techniques and the validation of high-intensity focused ultrasound (HIFU) ablation systems, and are now pursuing their radiology residencies at outstanding programs across the country.

Those more senior trainees who are interested in pursuing a 1- or 2-year IR/IO research experience after completion of residency or IR fellowship may also spend time within the NIH Center for Interventional Oncology, with funding mechanisms including the Imaging Sciences Training Program (ISTP), jointly sponsored by the Department of Radiology and Imaging Sciences in the Clinical Center and the IRP of the National Institutes of Biomedical Imaging and Bioengineering (NIBIB).⁷ Applications, accepted on a rolling basis, provide the opportunity for individuals who intend a research career in imaging and biomedical science to engage in clinical, translational, or basic imaging research available through the Radiology and Imaging Sciences, Nuclear Medicine, Positron Emission Tomography, Interventional Radiology Laboratory and Molecular and Cellular Imaging facilities on the intramural campus.⁷ Depending on their interest, applicants can choose to work in a variety of research areas including interventional, oncological, vascular, metabolic imaging, and computer-aided diagnosis using various imaging techniques. Bench-to-bedside research opportunities also exist in magnetic resonance imaging, magnetic resonance spectroscopy, MR microscopy, positron emission tomography radiochemistry, contrast agent development, cellular and molecular imaging, HIFU, targeted drug delivery, and image processing and visualization algorithms.⁷

Intramural–Extramural Research Opportunities for IRs

In addition to education and training opportunities, funding mechanisms exist specifically to encourage intramural/extramural research collaborations, which are available to interested IR physician researchers.

Bench-to-Bedside Program

The intramural Bench-to-Bedside Program is designed to enable investigators to translate basic scientific findings into therapeutic interventions for patients and to increase understanding of important disease processes.⁸ These projects can involve a combination of intramural and extramural investigators and are meant to involve both basic and clinical researchers. This funding mechanism is meant to support small/pilot research projects (providing up to \$135,000 a year for 2 years), with preference shown for clinical projects that are not entirely preclinical in scope. Meant to highlight the benefits associated with intramural–extramural collaborations, one of the goals of this program is for the extramural community to gain access to the Clinical Center's unique resources. With the introduction of extramural collaborations

in 2006, partnerships at 79 institutions have been funded, 30 of which are Clinical and Translational Science Award sites.⁸

Opportunities for Collaborative Research at the NIH Clinical Center (U01 Funding)

In addition to the Bench-to-Bedside Program, the NIH intramural program is increasing opportunities for extramural researchers interested in working with intramural investigators to use the Clinical Center and its research infrastructure. In August 2012, a grant program was announced to support these partnerships, entitled "Opportunities for Collaborative Research at the NIH Clinical Center" (U01).⁹ Specific NIH Clinical Center research resources highlighted for use in intramural–extramural research partnerships include its metabolic unit, pharmaceutical development capabilities, and research-related radiology imaging services. Project budgets through the U01 mechanism are typically limited to up to \$500,000 a year in direct costs for a period of up to 3 years, with funds designated to support the project-related costs of the extramural principal investigator, the intramural principal investigator/coinvestigator, and the Clinical Center.^{9,10} While the scope of program announcements can vary, recent U01 program announcements pertinent to device research have included funding opportunities to develop new systems of data collection to permit prospective medical device postmarket risk identification, and to develop new methodologies for registry data collection.¹¹

A Stone's Throw Away from the NIH: FDA-Sponsored Clinical Investigator and Regulatory Training for IR Innovators

Also an agency of the DHHS, the Food and Drug Administration (FDA) is responsible for protecting and promoting public health. Its regulation and supervision extends to the oversight of FDA-approved and experimental drugs (under the auspices of the Center for Drug Evaluation and Research, CDER), vaccines, and biologics (under the Center for Biologics Evaluation and Research, CBER) and devices (under the Center for Devices and Radiologic Health, CDRH).¹² FDA oversight including the monitoring of all investigators engaged in clinical trials employing experimental drugs, vaccines/biologics, and devices. For those IR researchers pursuing such trials, it is of paramount importance to be aware of and, ideally, take full advantage of those FDA-sponsored educational opportunities concerning investigator responsibilities and requirements.

Among its educational offerings, the FDA sponsors a 3-day Clinical Investigator Training course, typically held each November in Maryland. This course includes a discussion of nonclinical, early clinical, and phase 3 studies; issues in the design and analysis of trials; safety and ethical considerations; and FDA regulatory requirements related to the performance and evaluation of clinical studies.¹³ Attendees have the opportunity to hear directly from FDA officials about issues critical to successful clinical research, including compliance with the Federal regulations that govern all IR investigators conducting a clinical trial involving an investigative drug, device, or biologic.¹⁴

Online resources are also available to IR clinical investigators engaging in clinical trial research, including guidance documents reflecting current FDA thinking on specific regulatory topics and requirements (maintained on a searchable online database).¹⁵ Guidance documents are available on a variety of topics, from guidance on FDA decisions for investigational device exemption clinical trials to suggested design considerations for pivotal clinical investigations. CDRH maintains its own web page for multimedia education, with useful learning modules pertaining to medical device product regulations, covering both premarket and postmarket topics, which are valuable to both industry members and investigators.¹⁶

Conclusion

The NIH offers several opportunities for education, training, and research pertinent to IR physicians, arguably not as well known as its reputation as a funding agency and intramural campus dedicated to basic and translational research. Nevertheless, these opportunities have proven very valuable for trainee alumni who have participated in NIH intramural research fellowships in IR, and who have progressed to successful careers in both private practice and academic IR. Recently expanded opportunities for intramural–extramural collaboration with the NIH are meant to enhance opportunities for extramural researchers, including IR physicians, to avail themselves of the intramural campus' resources. Finally, regulatory training and educational opportunities offered by the FDA are invaluable resources for IR trainees and practicing IRs alike who are interested or engaged in clinical research and device development to ensure success in their endeavors.

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