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Imaging is indispensable to advancing modern biomedical research, particularly in the field of neuroradiology. Neuroradiologists, imaging physicists, and technologists form the backbone of imaging-based investigations, contributing essential expertise in protocol design, image acquisition, and image interpretation of highly complex studies (Figure). These contributions are fundamental to achieving the goals of clinical and translational research in the neurosciences, oncology, and many other areas of medical care and innovation.

Neuroradiologists play a central role in facilitating the numerous imaging components that address specific research objectives. Neuroradiologists are essential in designing imaging protocols, coordinating scheduling, interfacing with informatics tools, performing image analysis and quantification, interpreting intricate findings, as well as identifying incidental findings in patients that require follow-up. Imaging physicists and technologists complement these efforts by configuring and operating advanced imaging systems, contributing to participant safety through screening and monitoring, assuring quality, and precisely executing research protocols. Despite the critical nature of these contributions, neuroradiologists, imaging physicists, and technologists are often overlooked, undercredited, and insufficiently funded, often to the detriment of the research study. This lack of recognition of the significant involvement of neuroradiologists, physicists, and technologists hinders research participation and academic career advancement. Authorship on publications and inclusion in grant budgets are essential for career advancement and promoting excellence in interdisciplinary collaborative research.

The American Society of Neuroradiology (ASNR) Section Chiefs Group and Research Committee propose a structured framework to ensure equity and recognition of neuroradiologists, physicists, and technologists in imaging research. This framework seeks to foster a culture of transparency, fairness, and excellence while advancing the role of neuroradiology in scientific discovery.

Role of Neuroradiology in Imaging Research

Patient benefit is the primary focus of imaging studies in clinical practice, and they are performed according to standard-of-care protocols. These protocols are developed by neuroradiologists in collaboration with imaging physicists and technologists and in consultation with referring providers. They are designed to address specific clinical questions and/or provide data for surgical or treatment planning, to minimize risk, and to ensure the highest level of care for patients.

Research imaging, by contrast, often deviates from routine clinical standards to achieve distinct scientific objectives. The additional steps might include phantom data validation, sequence testing on humans, manual postprocessing, creating interfaces with research software, and imaging data archiving. Such research imaging studies require dedicated expertise, resources, and funding to maintain the integrity of the research data and process. For clinical trials, it is also critical to preserve the high standards of patient care expected in clinical practice.

There is also wide variability in the logistics required for research imaging. These studies may be performed on dedicated research scanners outside clinical ordering and PACS interfaces or in specific scheduling slots on clinical or translational scanners, integrated with clinical surveillance time points. Integrating research protocols with standard-of-care clinical imaging may require discrete order sets to ensure patient scheduling at an appropriate site, correct protocol being run when the subject is imaged, correct billing, modification to scheduling templates, and coordination of data transfer. Most important, the modification of a clinical protocol to "fit" a requested research paradigm demands approval by a neuroradiologist to guarantee that a protocol is not modified to the point that it is nondiagnostic for the intended clinical purpose.

Subject safety is paramount, and neuroradiologists' contributions to the safety aspects of imaging research can be valuable and critical. Overlooking this contribution is hazardous for subjects and researchers. Safety factors range from the radiation dosage for CT or angiography studies, contrast allergies, MRI implant screening, minimizing MRI injuries, and directing care if an MRI injury (eg, thermal burns) occurs. Also, it is important to ensure the safety education of nonradiology members on a research team who might not be aware of standard CT and MRI safety precautions. The MRI safety screening of subjects continues to become more complex secondary to the increasing array of metallic implants, accentuating the importance of thorough and updated MRI safety screening procedures that are performed accurately.

Ensuring Appropriate Support for Neuroradiologists and Imaging Physicists

The level of involvement of neuroradiologists and physicists in research imaging varies widely depending on the specific study or research protocol. For example, in consortium studies in which protocols are predefined and interpretations are centralized, neuroradiologists may have limited direct involvement. In such cases, research budgets should focus on compensating imaging physicists and technologists for the technical implementation and execution of these protocols. Radiologists' time and expertise may be

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needed for protocol review and safety reads, which require budgeted compensation.

In studies in which neuroradiologists are actively involved, adequate funding must be allocated for their participation. Ideally, the neuroradiologist must be involved at the time of study protocol development and grant submission so that all aspects of imaging are considered. The neuroradiologist's contribution would include designing imaging protocols, adapting protocols for a specific patient population (eg, implanted devices), contributing to advanced imaging methodologies, providing safety reviews, research interpretations, or quantitative measurements of lesions (eg, brain tumor measurements for cancer centers). Interpreting research studies often demands additional work from neuroradiologists beyond standard clinical reporting, including separate research measurements, distinct reports, and/or interaction with software that is not used for routine clinical care. Time and effort may vary depending on the number and quality of the images, if reviews are blinded to the research interest or intervention, the number and scope of prior comparisons for longitudinal examinations, and the required comparison with outside prior examinations without reports. In neuro-oncology research, for example, neuroradiologists assess longitudinal MRI studies to determine the radiographic response in patients with gliomas participating in clinical trials. Tasks include identifying measurable-versus-nonmeasurable disease, monitoring nontarget lesions, and performing serial 2D or 3D measurements of target lesions per the Response Assessment in Neuro-Oncology (RANO) guidelines, in addition to completing the imaging response paperwork required for the clinical trial.

Institutional review boards (IRBs) or departmental research imaging workflows should actively involve neuroradiologists in reviewing research protocols that include neuroimaging, ensuring that the imaging components are scientifically sound, aligned with the goals of the study, ethically appropriate, adhere to appropriate participant screening and contraindications, have provisions to address abnormal findings on imaging, and describe processes related to imaging data. IRBs are often voluntary, and neuroradiologists should consider volunteering while acknowledging the time required for these services.

Each neuroradiology section or radiology department should establish guidelines and protocols for how a neuroradiologist may be involved in multidisciplinary research, what compensation would be expected, and how such participation would contribute the neuroradiologist's academic effort. Such policies would help individual neuroradiologists negotiate appropriate support or co-authorship on research publications. There should be transparent fee schedules and associated lead times for these contributions, which may include a study initiation fee, cost per study, or percentage of effort for salary depending on the complexity and demands of the study.

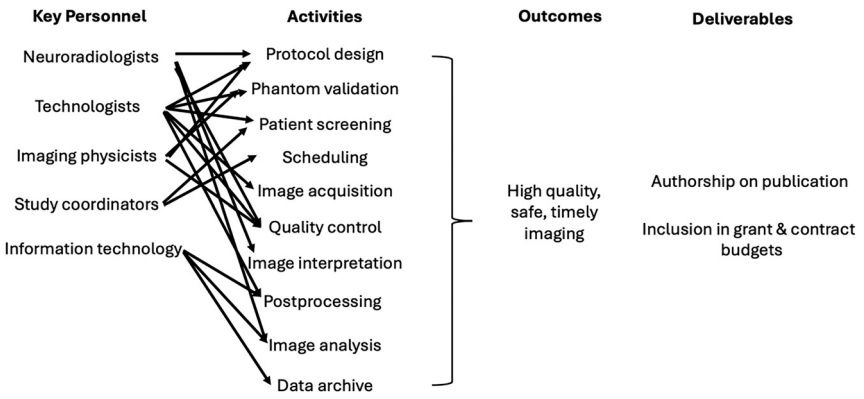

FIGURE. Supporting imaging research: a framework for equity and excellence in neuroradiology.

Strategies for Evaluating Research Proposals

A well-defined intake process (Table) is recommended to evaluate proposed research projects so that needed logistic resources (modalities, procedure areas,

Research study considerations: questions to ask before you commit

What is the nature of the study, imaging, or procedures?
Subject enrollment start date/end date?
Study end point?
Expected number of subjects and number of scans per subject?
Will scans performed be clinical standard of care or research?
For combined clinical and research scans, is there a mechanism to account for the research component of the scan?
Does the research project involve human subjects and/or animals?
What resources are needed for the study (imaging modalities, procedure areas, recovery areas, and other infrastructure)?
What additional research support is needed: assistance developing an imaging research protocol, regulatory assistance, budgeting assistance, technical support, information technology support, study coordination/recruitment assistance, image analysis or de-identification assistance, data safety monitoring?
For image-guided procedure studies, what infrastructure is needed: nursing, recovery, specimen or lab collections, administration of study drugs?
Are any test scans on human volunteers or phantoms required?
Involvement by the neuroradiologist, imaging physicist, advanced practitioners, technologists, informatics staff, research staff, and nursing; is a specific imaging collaborator requested, or can all the imaging experts of a certain unit be involved?
Is there special training or certification required to participate?
Funding: none, grant, industry?
Opportunity for salary support/dedicated time?
Opportunity for authorship?

recovery areas, and other infrastructure) and personnel (neuroradiologists, imaging physicists, advanced practitioners, technologists, informatics staff, research staff, and nursing) can be identified and the extent of their involvement can be evaluated to ensure that the study can be supported without adversely impacting patient care. Ideally, each radiology department or neuroradiology section has a centralized process for receiving these research proposals that are then distributed to the neuroradiologists on the basis of expertise, existing collaborations with the research team, or with the aim of developing an early career faculty member.

Leadership and Collaboration

Leadership within the neuroradiology community, particularly among Neuroradiology Section Chiefs, is critical to fostering equity in research imaging. Section Chiefs are encouraged to define fee structures for neuroradiologists' contributions, establish expectations for authorship and credit for their faculty, and ensure that all team members—neuroradiologists, physicists, and technologists—receive appropriate recognition for their work. Clear and transparent guidelines promote collegial collaboration and fairness while emphasizing the value of the contributions of neuroradiology to research.

In addition, neuroradiologists should be actively involved in the review process for federal and large-scale research funding. Serving on the study sections of the National Institutes of Health is a valuable way for neuroradiologists to contribute their expertise to the broader scientific community, ensuring that research proposals involving imaging are thoroughly reviewed and appropriately supported. Such involvement further elevates the visibility of the contributions of neuroradiology to the advancement of medical research.

Effective communication among national leaders within the ASNR facilitates the sharing of best practices and ensures the strategic allocation of resources. These collaborative efforts amplify the impact of neuroradiology research and advance patient outcomes on a national and international scale.

Addressing Investigator-Initiated Research Studies with Limited Funding

Investigator-initiated research studies often present unique challenges due to limited initial funding. These research projects are crucial for developing novel approaches but may face challenges in covering all the associated costs, particularly those related to supporting investigators' efforts. In such instances, exceptions may be allowed for the support of neuroradiologists and imaging physicists, provided they are involved as co-investigators or collaborators, with their efforts being appropriately credited, including authorship in any resulting publications. In these instances, it is important for the limited scope of the pilot study to be outlined with specific goals defined. Future grants derived from these pilot studies should allocate funds to compensate these neuroradiologists, imaging physicists, and technologists to ensure the ability to sustain additional investigator-initiated and pilot research efforts.

At times, there, unfortunately, may be situations in which a study cannot be supported for a variety of reasons. There also may be occurrences in which a research study that has imaging components is planned but neuroradiology was not engaged in the planning process. It is not unreasonable to pause such a research study to perform the normal intake process.

Elevating Neuroradiology Research on a National Scale

This framework seeks to balance the advancement of scientific discovery in neuroradiology with the central mission of patient benefit. Neuroradiologists play a crucial role in achieving this balance, providing expertise that ensures that both clinical and research imaging meet the highest standards and ensure participant safety. Proper recognition of their involvement—through compensation, authorship, and academic credit—strengthens the neuroradiology research ecosystem, rewards work done, contributes to personnel satisfaction, and fosters continued innovation.

Through equity, transparency, and collaboration, neuroradiologists can ensure the leadership of the field in imaging-based research. Recognizing the contributions of neuroradiologists and other imaging professionals creates an environment in which scientific discovery thrives, patient outcomes are improved, and the discipline continues to advance. This framework establishes a foundation for promoting excellence in research while ensuring fairness for those who contribute to its success.

Endorsed by the ASNR Research Committee, the ASNR Section Chiefs' Group, and the ASNR Department Chairs' Group for submission to the *American Journal of Neuroradiology (AJNR)*.

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