The practice of neuroimaging within a neurology office setting

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Summary

Imaging is an essential tool in the diagnosis and management of neurologic disorders, yet its adoption in the clinical neurology setting is limited. Perceived cost barriers and political pressures have caused undue apprehension for a community of experts that otherwise plays a leadership role in solving complex neurologic puzzles. Some private practice neurologists have integrated advanced imaging services into a comprehensive neuroservices model, demonstrating its plausibility together with a recipe for success. The purpose of this article is to explore the advantages, disadvantages, and considerations for integrating imaging into an outpatient neurology clinic. Clinical and business advantages are weighed against financial, regulatory, and political risks.

Imaging plays a substantial role in health care advances aimed at understanding disease processes, early detection, and finding cost-effective, targeted therapies. The NIH's Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative seeks to "produce a revolutionary new dynamic picture of the brain." Research and clinical management of devastating neurologic conditions such as traumatic brain injury, dementia, multiple sclerosis (MS), cerebrovascular disease, and neuro-oncology are heavily reliant on imaging. Counterintuitively, neurology has had limited involvement in the practice of neuroimaging.

The changing health care landscape—characterized by declining reimbursement, rising costs, enormous documentation requirements, and seemingly endless regulatory and legal concerns—has been particularly troubling for neurologists. With 63% of neurologists in private practice,¹ many are deliberating how to mitigate their risks, improve payer leverage, achieve economy of scale, and maintain autonomy. Mergers and consolidations may transform the neurology landscape into more comprehensive practices. Investment in expensive technology is generally the domain of these larger organizations, which have greater financial stability, management expertise, and volumes of service. As an essential

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diagnostic tool for neurologists, it is reasonable that such centers consider integrating neuroimaging.

Preston² provides an excellent overview of historical, political, and regulatory issues surrounding the role of neurology in neuroimaging. The primary goal for embarking on this initiative should be to improve service to the community through consistently high-quality, appropriate testing, cost-effectiveness, and superior access. The business needs to be sufficiently strong to withstand market variability and the uncertainties of future payer models. Policies and procedures regarding state and federal regulations must be fully understood and operationalized. Finally, there should be due consideration of the local and national political landscape.

Despite complexity and hurdles, 10% of neurologists already perform imaging.¹ A simple Internet search reveals many examples of neurology/neuroimaging centers. Table 1 summarizes some of the incentives and disincentives associated with neurologist-owned imaging.

Financial plan

Determining monetary feasibility is complicated by a breadth of equipment and financing options, and payer model variability and uncertainty. A fictitious MRI purchase analysis is presented to help illustrate the thought process.

Assume each of 8 neurologists in a large group practice can, with the help of nonphysician extenders, accommodate 5 consults and 10 follow-up office visits each day. Given the mix of imaging-intensive subspecialties (eg, TIA, brain tumor, complex headache, MS, and symptomatic back pain patients), 3 to 4 MRIs are ordered per physician daily. They have concluded in-house neuroimaging is warranted to improve clinical decision-making and patient convenience. Assuming no payer restrictions in purchasing or self-referring MRI, could this practice afford an MRI?

The pro forma in table 2 analyzes 2 options using hypothetical 2014 reimbursements from a Midwestern metropolitan area. The average technical component (TC) revenue can be derived from a weighted average of payer fee schedules using practice statistics. The per-scan contribution margin is calculated by subtracting the average variable cost of a scan (e.g., supplies, contrast) from the TC. The product of the contribution margin and the annual billable MRI volume must sufficiently exceed the fixed costs associated with equipment, space rental, and staff. Staffing should initially assume extended hours of operation to maximize capacity, then reduce these costs if warranted by volumes. The calculations indicate that in this payer environment, the approximately 125 scans ordered each week easily justifies a 3T MRI purchase, which requires only 90 patients per week to realize a 5% profit. A small practice with less patient volume could instead consider a scaled-back operation with lower-cost equipment. The pro forma should also consider that once a strong reputation is built, it is reasonable to expect a fair number of additional neuroimaging and non-neuroimaging referrals directly from outside practices.

Cash flow is critical to managing expensive services. Essentials include prompt billing and collections, advance insurance verification, and intelligent overbooking. Manufacturers will help ease startup through deferred payments, extended warranties, low interest rates, and operating (fair market value buyout) leases. Bank loans are typically required to cover upfront costs. The less compelling a group's financial history, the more any lender will demand personal guarantees. A line of credit or cash on hand equal to a few months of payments is warranted to buffer against outstanding accounts receivable.

Table 1 Incentives and disincentives for implementing an MRI center

Incentives	Disincentives
Guarantee neuroimaging expertise	Reimbursement decline
Neuroimagers on the clinic team: improved understanding, communication, patient relation	Payer uncertainty
Appropriateness better understood and controls easier to implement	Local relationships tested
Collaborative diagnosis “on the table”	Risky for small/sole practice
Immediate access to records	Political antagonism
Patient confidence	Need for more neuroimaging training programs
Patient convenience	Unfamiliar business model
Portfolio diversification, group overhead reduction	
Cost-effective bundled care opportunities	
Participation in neuroscience research	

Equipment options

The appropriate MRI platform depends on local needs, demographics, payer constraints, and typical referring diagnoses. The 3T systems leverage advances in diffusion tensor imaging, spectroscopy, susceptibility imaging, and functional MRI, plus higher-resolution imaging, improved angiography, and shorter scan times. Reimbursement is identical to lower field strength MRI services, though there are some offsetting financial advantages in productivity, reputation-induced referrals, and specialty scan reimbursement. Refurbished systems are available at a discount, but upgrades may eventually become costly. Lower field open MRIs are less expensive and offer patient comfort advantages, but it is important to confirm whether local payers have equipment restrictions based on field strength. High-field open MRIs avoid this potential restriction, though the special magnet design comes at a cost premium.

Block leasing is an alternative to full ownership. The lessor acts as the rightful owner during their scheduled time, which must be in explicitly specified blocks for at least 1 year. Lease payments must represent fair market value and cannot be tied to volume. Mobile MRI scanners may be an acceptable variation in sparsely populated geographies where access is limited. These approaches are affordable at much lower monthly volumes, offer a safe startup model, and may open the opportunity for smaller groups to share resources that are otherwise too expensive. Disadvantages include the potential for degradation in the quality of service, payer restrictions regarding split ownerships, and greater regulatory complexity that must be navigated by competent legal advisors.

Other modalities should also be considered in larger and multispecialty practices, including new volumetric CT scanners operating at a very low dose, ultrasound, x-ray/fluoroscopy for arthrography or guided injections, PET/CT, and even PET/MRI for clinical and research functional imaging. The pro forma analysis is similar to the MRI illustration.

Other operational considerations

Office-based imaging improves patient care only insofar as the service blends seamlessly within a solid neurology practice, together providing fast access, superior customer relationships, and diagnostics that are insightful, accurate, and timely. Indeed, the quality of the neuroimaging physicians and operations will influence referrals more than equipment choice. A poor neurology practice will destroy the imaging business. For example, if it takes months instead of days to obtain a neurology consult, the patient may already have been scanned because the primary care physician and patient are too worried to wait.

Table 2 Pro forma comparison of fictitious MRI operations

	New 3T	0.3T Open	Notes
Revenue			
Average global reimbursement	\$450	\$450	Payer mix and bad debt
Professional component	\$90	\$90	
Technical component	\$360	\$360	
Variable expenses			
Medical supplies, contrast	\$11	\$11	
Billing (5% of gross receipts)	\$22	\$22	
Office supplies	\$2	\$2	
Transcription per report	\$6	\$6	
Technical margin per scan	\$319	\$319	
Annual staff expenses			
Technologists (3T: 2 FTE, Open: 1 FTE)	\$150,000	\$75,000	3T: Longer hours
1.0 FTE Technologist assistant	\$50,000		Help speed workflow
Reception, clerical (3T: 2 FTE, Open: 1)	\$60,000	\$30,000	
1.0 FTE Manager, IT support	\$90,000	\$90,000	
Annual fixed expenses			
Equipment operating lease	\$460,555	\$222,778	\$1.8 million vs \$750,000, 5 y FMV
MRI service contract	\$144,000	\$100,000	
Rent	\$105,000	\$105,000	(\$35/sf × 3,000 sf)
Installation cost	\$113,227	\$113,227	(\$500,000, 5 y loan @ 5%)
PACS/RIS	\$98,155	\$98,155	(\$375,000, 5 y FMV @ 5%)
PACS/RIS system maintenance	\$60,000	\$60,000	
Other depreciation	\$7,000	\$7,000	
Utility costs	\$10,000	\$10,000	
Legal, training, accreditation	\$15,000	\$15,000	
Desired revenue			
Total fixed expenses	\$1,362,937	\$926,160	
Desired return on investment	5%	5%	
Desired revenue from operations	\$1,431,084	\$972,468	
Required number of scans			
Per year	4,487	3,049	Revenue/margin
Per week	90	61	

Abbreviations: FTE = full-time equivalent; PACS = picture archiving and communication system; RIS = radiology information system.

Quality is attained by investment in talent, training, and management. Technologists must be specially trained in neuroimaging to ensure consistent image quality, able to identify pathology sufficiently well to alert physicians while the patient is on the table, optimize the scan protocol for the patient's condition, and be able to respond knowledgeably to patient questions, symptoms, and emergencies. The physicians who oversee imaging should have a thorough understanding of the referring diagnosis, allowing them to play an important role in appropriateness verification, physician and staff education, and scan protocolling. Images and expert interpretations must be readily available for the decision-making physician. Notification

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of critical results must be immediate and preferably through direct interaction between the imager and clinician.

Small practices may find it difficult to manage or justify costly expansion into imaging. Merging with other specialists having similar cultures and ancillary referral patterns—including neurologists, neurosurgeons, and orthopedists—overcomes these hurdles, and is a practical alternative to facing the increasing burden of health care regulation alone.

Physician interpretation

Clinical neurologists often find themselves developing care plans based on their interpretation of images rather than relying on the radiology report. Sometimes the report is not available or lacks clinical insight, or simply because neurologists ultimately responsible for treatment decisions place more trust in their own neurology training. That someone else, and not the neurologist, gets paid for the reporting can be a source of frustration. One of the driving forces to integrating imaging into a neurology practice is to improve this disconnect.

Choices for imaging interpretation include employed or contracted general radiologists, neuroradiologists, or fellowship-trained neurologists. Using general radiologists is inconsistent with the goals of a neuroimaging program. The better strategy is to fully embrace neuroscience expertise, starting with staff neuroimagers who bring a combination of neurology and imaging training, fully appreciate the relationship between clinical indications and identified pathology, are expert at on-the-fly protocol optimization based on presenting neurologic conditions, and oversee departmental communication, education, feedback, and outcomes research.

Neurologists with fellowship training in imaging who maintain some clinical practice are a natural fit for a neuroimaging operation. Concern about additional liability for nonradiologist interpretations has not surfaced in our practice, in which neuroimagers and neuroradiologists have interpreted hundreds of thousands of cases for almost 30 years without incident. Non-neurologic studies or incidental findings are forwarded to radiologists for their interpretation, and neuroradiologists participate in a systematic peer review process. The cost of malpractice insurance for imaging neurologists is no different than for diagnostic neuroradiologists.

Both neuroradiologists and fellowship-trained neurologists are in short supply. This has fueled renewed interest in neuroimaging training for neurologists, as well as improved clinical and specialty training for radiologists.^{3,4} Several organizations are working with the Association of University Professors of Neurology, seeking to improve imaging education and remove barriers to training during residency. The American Academy of Neurology (AAN) Imaging Section offers regular education through the Continuum Series and the AAN annual conference. The American Society of Neuroimaging (ASN), formed by neurologists in 1977, comprises neurologists, neuroradiologists, neurosurgeons, and scientists from private practices, industry, and academia interested in a clinical collaborative approach to neuroimaging education and science. Its annual meeting and *Journal of Neuroimaging* have evolved into an important source of neuroimaging training. The United Council of Neurologic Subspecialties

accredits neuroimaging fellowship programs and has certified 140 neuroimaging diplomats since 2008, when the first subspecialty of neuroimaging examination was given.

Payer issues and regulations

Imaging centers must be accredited through the American College of Radiology (ACR), the Intersocietal Accreditation Commission, or the Joint Commission in order to submit claims. Each mandates well-maintained equipment, credentialed technologists, documented policies and procedures based on national guidelines, qualified physician oversight, and logs for training and critical events. Any on-site staff physician may supervise technologists and nurses for contrast injections or sedation. Only general supervision is required for a nurse practitioner to administer contrast. The medical director and reading physicians need to meet standards set forth by the accrediting organization. Radiologists who maintain their continuing medical education credits are automatically certified, while nonradiologists must document competency through training and supervised experience.

Insurance companies are sensitive to rising costs, and suspicious that self-referring groups will fill schedules due to financial pressures rather than clinical need, and often require additional preauthorization. An active relationship with payers is extremely helpful in developing and monitoring appropriateness metrics, and can play a valuable role in driving physician behavior that assures the practice maintains value to the payer. Payer assessment of physician quality and cost is increasingly using grouper software that ties diagnosis and procedure codes to episodes of care.⁵ Physician scores influence financial penalties or incentives, affect reputation, and may result in disqualification. Internal auditing programs should use similar scoring methodologies, and provide education and feedback regarding appropriateness based on ACR and AAN guidelines.

The Stark Law, also known as the In-Office Ancillary Service Exemption (IOASE), governs self-referral. Among a myriad of requirements, the profit distributions to owner physicians cannot be tied to referral volume, and physician services must be provided at the scanner site, minimally 30 hours per week. Patients must be informed that the practice has ownership interest and provided a list of alternative imaging centers. Other potential restrictions exist at the federal, state, and payer level. Antikickback rules enforce fair market payment to any contracted interpreting physicians. The Anti-Kickback Law and Federal False Claims Act protect against direct or indirect means of incentivizing referrals.

Many resources are available to stay apprised of evolving self-referral and imaging issues (table 3), including government updates through Twitter and e-mail. Societies such as the Medical Group Management Association provide timely and complete education surrounding health care regulation. Ultimately, a competent attorney is essential to ensuring compliance with evolving regulations.

National policy trends

Self-referral has been the subject of intense, polarizing national debates. Most recently, a 2012 study by the US Government Accountability Office (GAO) concluded that self-referral increases the cost of medicine by \$109 million per year.⁶ The Centers for Medicare and Medicaid Services subsequently stated it would consider appropriateness controls in the medical review strategy for advanced imaging services.

A follow-up analysis by the American Society of Neuroimaging showed the GAO neglected to recognize the cost-shifting and cost-savings effect of outpatient comprehensive care, thereby propagating a dangerous misperception that masks the positive role neurology can play in health care savings.⁷ The GAO data itself show that while the proportion of self-referred imaging between 2007 and 2010 indeed grew from 19% of the outpatient market to 23%, the total cost of all outpatient imaging was essentially flat. One explanation is that rather than practicing defensive medicine, referring physicians defer to specialists, if available and trusted, to judiciously order the proper tests instead. The self-referring neurology practice will therefore absorb and minimize a community worth of imaging, but as a result will appear to be a

Table 3 Useful resources

	Offerings	Internet addresses
American Academy of Neurology	Practice support, guidelines, continuum education, BRAINS	www.aan.com
American Society of Neuroimaging	Imaging education	www.asnweb.com
Medical Group Management Association	Practice management guidelines, regulatory updates	www.mgma.com
International Society of Magnetic Resonance in Medicine	Clinical and scientific education on MRI	www.ismrm.org
Centers for Medicare and Medicaid Services	Government policy updates: blogs, tweets, and listservs	www.cms.gov , www.cms.gov/Medicare/Fraud-and-Abuse/PhysicianSelfReferral/index.html , www.twitter.com/CMSSgov , www.cms.gov/About-CMS/Agency-Information/Aboutwebsite/Email-Updates-List.html
Radiologic Society of North America	Imaging education, research, vendor relationships	www.rsna.org
American College of Radiology	Accreditation, guidelines	www.acr.org
Intersocietal Accreditation Commission	Accrediting body	www.intersocietal.org
Joint Commission	Accrediting body	www.jointcommision.org
Cave Group Consulting	Episode grouper software	www.cavegroup.com
Aunt Minnie	Imaging business news	www.auntminnie.com
Coalition for Patient Centered Imaging	Represents physician societies dedicated to high-quality imaging	AAN (www.aan.com) and other society web sites
Imaging industry	Equipment advice	Philips, Siemens, GE, Toshiba, Hitachi.com

Abbreviation: BRAIN = Brain Research through Advancing Innovative Neurotechnologies.

higher utilizer (table 4), even though the imaging is appropriate.⁸ The GAO study curiously ignores potential savings achieved by avoiding hospital imaging, which is typically much more expensive and represents 77% of advanced imaging costs.

Nevertheless, President Obama's 2014 budget proposal acknowledged the GAO analysis and "encourages more appropriate use of ancillary services by only allowing providers who meet certain accountability standards to self-refer."⁹ On May 17, 2013, the Congressional Budget Office released its impact study of the President's health care proposals, and associated the line item "Excluding certain services from the In-Office Ancillary Services Exception (IOASE)" with a \$1.8 billion savings over 10 years.¹⁰ Left unchallenged, it is possible that poor policy decisions will be made.

The threat of IOASE repeal cannot be ignored when constructing expansion strategies. However, the Consortium for Patient-Centered Imaging collectively represents a wide range of affected specialties and is actively advocating for more rational reforms. Assuming clear heads prevail, there will likely be continued movement toward implementing decision support systems and invoking financial rewards and penalties associated with episode-of-care metrics.

DISCUSSION

Neurology practices that operate imaging as part of an accessible, comprehensive neuroscience program offer financial and quality value to the community while benefiting from economy of scale that improves the group's viability and sustainability. Compared to many neurologists who are straining to keep up and lose 60% or more of their professional revenue to overhead, these practices can apply ancillary profits to offset clinic costs, operate at a fraction of typical

Table 4 Illustration of how GAO calculations can misrepresent cost-shifting and cost savings due to self-referral of imaging

	Defensive medicine practice			Expert neuroimaging practice			Perceived IOASE-related excess vs peers		
	Cost	PCP-ordered MRIs	MRIs by neurologist unavailable for timely consult	Cost	Neurologist-ordered MRIs	Cost	Actual savings	Excess scans?	Excess cost?
Outpatient scans @	\$500	18	0	\$9,000	10	\$5,000	\$4,000	10	\$5,000
Hospital scans @	\$750	2	0	\$1,500	0	\$—	\$1,500		
Total		20	0	\$10,500	10		\$5,500	10	\$5,000

Calculation bias concludes IOASE causes 10 extra scans and \$5,000 waste, but in actuality the neuroimaging practice saved the community \$5,500. Note that GAO ignores expensive hospital imaging costs due to Part A vs Part B claims shift. Abbreviations: GAO = Government Accountability Office; IOASE = In-Office Ancillary Service Exemption; PCP = primary care physician.

group professional overhead rates, attract better talent, build a more service-oriented infrastructure, participate in research, and generally create a much more exciting climate. Neurologists interested in billing for imaging interpretation can receive training through the ASN or other professional organizations. Small practices may get started in imaging using less expensive equipment options, but should strongly consider merging into larger, more comprehensive and financially viable practices.

Health care reform adds investment risk, necessitating conservative fiscal and contingency planning. The most likely reform will involve appropriateness safeguards, with organizations such as the AAN working closely with payers and government to ensure fair representation of the neurologist's value. Active participation in education and negotiation with payers, societies, local politicians, and media is essential to fair recognition of the neurologist's role in imaging.

Despite a projected shortage of neurologists, they remain among the least paid physicians and lowest residency fill rate. Development of comprehensive neuroscience settings offers an achievable path toward reversing this trend. At a time when imaging is at the heart of important new national brain research initiatives, it would be ill-considered to find neurologists unable to participate at a mainstream level.

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