



Hospital-based neurologic care

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Introduction

The evolution of the United States healthcare system has posed numerous challenges to neurology practices around the country that particularly impact the hospital setting. Traditional inpatient models based on limited coverage provided by predominantly outpatient-based providers have become nearly untenable in a clinical and regulatory environment increasingly focused on short hospital stays, cost-effectiveness, electronic documentation, and quality metrics. In many instances, neurologists recognize both a widening knowledge gap and severely limited availability that requires medicine hospitalists to take the lead in managing complicated inpatients without expert guidance. This article addresses the role of the burgeoning subspecialty of hospital neurology in which neurohospitalists take primary responsibility for providing neurologic expertise in the hospital. This is a critical issue many private practices and academic departments are facing as neurohospitalist programs proliferate across the country (Likosky and Amin 2005; Freeman et al 2008; Josephson et al 2008; Likosky 2009; Barrett and Freeman 2010; Likosky et al 2010; Freeman and Josephson 2011; Likosky and Aragon 2015).

The neurohospitalist model has 2 main theoretical advantages over more traditional inpatient care models: (1) expertise in managing acute neurologic disorders and navigating an increasingly complex healthcare system, and (2) availability to patients, staff, and trainees in the absence of extensive commitments in outpatient or laboratory settings. Neurohospitalists represent a group of neurologists ideally situated to effectively and efficiently care for hospitalized patients, lead interdisciplinary care teams, work with hospital administration to improve the value of neurologic care, and train housestaff and medical students. Multiple factors internal and external to clinical neurology have provided an opportunity that could be truly transformative - not only changing the way hospital-based neurologic care is provided, but allowing neurologists to expand and enrich outpatient clinics, research laboratories, and neurologic education.

Overview

Escalating economic pressures, a complex regulatory environment, and an ever-expanding scientific knowledge base are threatening to make traditional models for hospital-based neurologic care untenable. Similar to medical hospitalists nearly 20 years ago, neurohospitalists are an emerging group of inpatient subspecialists that have rapidly evolved as a way to bridge the widening gap between increasingly focused outpatient neurologists and the demands of inpatient care for acute neurologic disease. In this article, the author reviews advantages and disadvantages of novel models for hospital-based neurologic care and their potential impact on the future practice of neurology.

Key points

- The evolution of the U.S. healthcare system has posed numerous challenges to neurology practices around the country that particularly impact hospitalized patients in a clinical and regulatory environment increasingly focused on short hospital stays, cost-effectiveness, electronic documentation, and quality metrics.
- Neurohospitalists represent a burgeoning subspecialty group of neurologists ideally situated to effectively and efficiently care for hospitalized patients, lead interdisciplinary care teams, work with hospital administration to improve the value of neurologic care, and train housestaff and medical students.
- A sea of change is underway in the provision of neurologic care, which will have a substantial impact on current and future neurologists.

The current hospital model

Is the current hospital model untenable in the modern era of neurologic care?

The definition of a typical or traditional model for inpatient neurologic care differs widely, but for the most part, there is variation around several themes.

A typical private practice model has usually meant caring for inpatients while working around a densely packed office schedule. For the most part, services are consultative in nature, although a few straightforward primary inpatients are not uncommon. Nurse practitioners or other affiliate providers are increasingly employed. Inpatient service is usually rotated among practice partners and frequently shared between multiple practices to lessen the burden of inpatient responsibilities on any single neurologist. This rotation can be weekly, daily, or even patient-by-patient.

A typical academic model has been driven by housestaff. Primary inpatient services are common and often segregated by patient population, such as general neurology, vascular neurology, and [epilepsy](#) monitoring. An attending neurologist, 1 or 2 neurology residents, and a variety of fellows, medical residents, and medical students usually staff each service. In addition, there may be a similarly staffed consult service that covers the emergency department and inpatients on other services (medicine, surgery, etc.) and a neurology resident located in the hospital to cover nights.

These models have several significant deficiencies with regard to patient care, physician satisfaction, hospital efficiency, and neurology training. First, the inpatient knowledge gap recognized by increasingly specialized, almost exclusively outpatient providers, continues to widen. A corollary is that neurologists removed from their area of expertise while in the hospital lose the opportunity to practice more effectively in their preferred clinical setting. Thus, the quality of both inpatient and outpatient care suffers. Second, responsibilities for inpatient service are widely distributed among providers, with none taking ownership of any problems that may arise. Third, extensive time demands limit the hours available to spend on hospital floors. Fourth, the financial burden associated with caring for hospitalized patients can be overwhelming for both community and academic practices. Finally, all of these deficiencies can negatively impact training future neurologists.

Definition of neurohospitalist

In general, neurohospitalists define themselves as much by where they practice as what they practice. A generally accepted definition of neurohospitalist is “an inpatient neurological subspecialist with a minimum or absence of outpatient responsibilities.” A survey of self-reported neurohospitalists in 2010 indicated that about a quarter spent some time in outpatient clinic and about 20% had some non-clinical responsibilities, but that the vast majority of time was spent in the hospital directly caring for inpatients ([Likosky et al 2010](#)). The majority of neurohospitalists are fellowship-trained, with about half of that training in vascular neurology, and the median time most have been in practice is about 6 years.

Changing neurologic care in the hospital

Care models using neurohospitalists are spreading at an extremely rapid pace, and the number of neurohospitalists in the U.S. is growing just as rapidly. The change is similar to that in internal medicine 20 years ago, during which time hospital medicine has been the fastest growing medical subspecialty in history. Most data are somewhat subjective, but the trend is clear. For example, in 2006 there was an average of 3 job postings for neurohospitalists in the U.S., which increased markedly to 12 in 2009. This ballooned to over 400 neurohospitalist positions posted on SimplyHired.com in mid-2015; it has declined a bit, but has been steady at over 100 for the past few years.

The change is affecting both community and academic practices. In the 2010 survey, respondents were equally split between academic and private practice settings ([Likosky et al 2010](#)). Two more recent surveys of academic neurology departments indicated that over 40% have an active neurohospitalist program, 60% will definitely have a neurohospitalist program within the next 5 years, and only 10% definitely do not expect to have a neurohospitalist program in 5 years ([Probasco et al 2014](#); [Velez-Ruiz et al 2014](#)). Community practices are moving equally quickly, with several large exclusively neurohospitalist groups in practice throughout the country and many practices hiring neurohospitalists specifically to manage the inpatient facet of their patient care.

Bridging gaps in inpatient neurologic care

As depicted earlier in this article, there are several deficiencies with inpatient neurologic care that have developed over the years, and the main way these deficiencies are being addressed is by a rapid transition to hospital-based neurologic care. The following section details several of the more common and problematic issues and discusses how a neurohospitalist care model may address them.

Knowledge gap and opportunity cost. Similar to hospitalists in internal medicine, pediatrics, and obstetrics-gynecology, a neurohospitalist's expertise is developed and maintained by continuous exposure to the acute care setting. Honing inpatient skills allows neurohospitalists to immediately meet the needs of patients with acute neurologic disorders and efficiently navigate inpatient resources. This includes rapid and accurate localization and diagnosis, awareness of the effectiveness and cost of diagnostic tests, development and implementation of efficacious treatment protocols, and providing effective leadership of the neurology care team. Data supporting this theoretical benefit are starting to emerge in the form of decreased hospital lengths of stay and more efficient patient flow through the hospital for neurologic cases (Freeman et al 2011; Douglas et al 2012; Quimby et al 2017).

During the transition to an outpatient, subspecialty, and/or research career, most neurologists notice an atrophy of inpatient skills. As they spend more time away from the hospital, they become less comfortable caring for complex inpatients. This reluctance tends to create a vicious cycle that leads to even less time spent in the inpatient arena with a resultant accelerated erosion of inpatient skills.

The flip side to this issue is lost opportunity. Not only might a neurologist have to deal with inpatient issues for which they feel ill prepared, but those duties prevent them from attending to other tasks for which they are more suited. For example, a neuromuscular expert cannot be in clinic caring for Alzheimer disease patients or in the electrodiagnostic lab performing nerve conduction studies if he is in the emergency room caring for an acute stroke patient. Both efforts are obviously important, but whereas the latter places a "square peg in a round hole," the former maximizes utilization of expertise, time, equipment, and space. Such practice optimization will be important moving forward as the number of patients with neurologic disease continues to rise.

Time demands and schedule disruption. Splitting time between locations tends to be detrimental to both. For example, rushing to the emergency room to care for an emergent patient causes delays or cancellations for scheduled outpatients. This results in poor patient satisfaction, poor provider satisfaction, and lost revenue. Although in many cases a minor component of practice volume, inpatient consults cause disproportionate disruption to overall work flow due to their urgency and unpredictability.

Practice optimization with regard to time management is equally as important as optimization with regard to skill set, and determining ways to maintain productivity in the face of large fluctuations in workload is paramount for the clinical and financial success of a practice.

Ownership. The term "ownership" is used to convey the importance of having a vested interest in the outcome and function of a clinical service. There are many obvious hurdles to optimizing a service in which every provider has only a small level of responsibility and minor effort commitment. With regard to care inefficiencies, quality variability, poor communication, and personality conflicts, all of which arise daily in any clinical endeavor, human nature is to "just get through it" if one will be off service quickly only to return in the fairly distant future. Practically speaking, a neurologist who spends most of his or her time working in the hospital is motivated to make that time as effective, efficient, and enjoyable as possible. As such, neurohospitalists' goals are aligned with the hospital and the rest of the care team, which is a powerful motivator for improvement.

Financial and staffing challenges. All of the gaps delineated above raise many challenges with regard to staffing and finances. Switching to a neurohospitalist care model can help address them, although it raises some new challenges of its own.

One benefit from a financial and staffing perspective is that a neurohospitalist care model consolidates inpatient effort under fewer providers. This change in mindset causes a budgetary transformation that is very obvious to administrators. Costs that were distributed across a budget and somewhat hidden are pulled out and consolidated into a line item. For example, in many academic practices, neurologists spend 10% effort in the hospital, but this effort is not accounted for in their clinical or the hospital budget; it is essentially service rendered to the hospital for free. It is

obviously only a semantic difference, but the effect on the budget is real. When isolated as a specific expense, it becomes obvious to everyone that inpatient care is associated with real costs and provides an avenue for discussion as to how those costs can be met.

Part of this newly recognized cost is counteracted by more efficient inpatient revenue production by providers more experienced in the hospital setting. Rather than billing for a series of low-level follow-ups, neurohospitalists are more likely to bill appropriately for services rendered. Given the alignment of goals discussed earlier, neurohospitalists are also inclined to grow their service. At the author's institution, inpatient revenue increased approximately 2.5-fold over 4 years during the transition to a neurohospitalist model as a result of a combination of increased patient encounters and increased complexity for each individual encounter.

Increased revenue is helpful, but in most cases it is not sufficient to fund the financial gap associated with neurohospitalists. Fortunately, the system-wide benefits to effective neurologic care are increasingly being recognized by hospitals. Financially most important is support for higher-revenue care, such as neurologic and cardiac surgeries, but increased radiology usage, faster throughput through emergency rooms and intensive care units, and decreased overall length of stay are all contributors. This has led many hospitals to subsidize neurohospitalists by a mechanism similar to that employed for medicine hospitalists, and overall, it appears that this is essentially the only way to make inpatient neurologic care feasible in the long run no matter what care model is ultimately used.

The financial relationship between hospitals and neurohospitalists continues to evolve. Much like the prior problem of the costs for inpatient neurologic care being "hidden" in the budget, the benefit to the hospital is "hidden" within hospital metrics such as length of stay and utilization rate. This makes it very difficult to demonstrate benefit to hospital administrators and can lead to negative interactions if not managed proactively. Anecdotally, many neurohospitalists have only discovered their actual worth to a hospital when they have considered decreasing or eliminating services in the face of financial difficulties.

Overlap with other subspecialties

There is significant overlap between neurohospitalists and other neurologic subspecialties. Most obvious are [stroke](#) and neurocritical care, but [epilepsy](#) and essentially every other subspecialty overlap to some extent. As mentioned earlier, about half of neurohospitalists are vascular trained. Neurointensivist care could logically be considered a subset of neurohospitalists, but for clinical, practical, and historical purposes are a separate group of providers.

As discussed earlier, a neurohospitalist is defined primarily by where they practice rather than what they practice. One potential benefit to the more overarching term "neurohospitalist" is to raise awareness for hospital neurology needs and consolidate the voice with which hospital-based neurologists speak to their hospitals and the healthcare community at large.

Impact on neurology or neurohospitalist training

The neurohospitalist model is causing a fundamental change in inpatient neurology education. By virtue of focusing purely or primarily on inpatient care, hospitalists are more intimately familiar with inpatient care systems, as well as teaching challenges and opportunities in the inpatient setting. The educational benefits of neurohospitalists include greater expertise, greater availability, and more emphasis on quality and cost-effective care.

Several surveys indicate that the majority of academic neurology departments have an active neurohospitalist program in one form or another or will have one within the next few years ([Probasco et al 2014](#); [Velez-Ruiz et al 2014](#)). There are many theoretical advantages of this model for residency training, but whether or not they will actually be realized is not yet clear. Certainly, training programs must now demonstrate competency in their residents and not merely show available opportunities and exposure, and neurohospitalists are ideally situated to assist in that task by directly supervising and evaluating residents' performance ([Peltier 2004](#); [Bell 2009](#); [Schuh et al 2009](#)).

The internal medicine hospitalist literature has provided some evidence that housestaff learned more effectively when on teams lead by hospitalists. In a study performed at UCSF, internal medicine hospitalists were rated more highly for teaching effectiveness, knowledge of relevant subject matter, discussion of pathophysiology, emphasis on cost-effectiveness, and provision of appropriate and effective feedback ([Hauer and Wachter 2001](#); [Hauer et al 2004](#)). These findings were confirmed by a systematic review of available data on the effect of internal medicine hospitalist attending physicians on trainees' educational experiences performed more than a decade after the introduction of this

model (Natarajan et al 2009). Although these data are from the internal medicine literature, these findings will likely hold true for education in neurology as well as the neurohospitalist model is implemented in different academic institutions. So far, there is only one study evaluating the impact of neurohospitalists on resident education, but it was overwhelmingly positive, apparently transforming a poorly evaluated night float rotation into the most valuable rotation in the program (Greene 2013).

Neurohospitalist fellowship training is offered at several institutions across the country, and there has been extensive early debate about whether or not fellowship accreditation ought to be pursued. On the one hand is the argument for standardization and legitimacy that accredited training would provide to a nascent subspecialty. On the other is the argument that there is no specific clinical need for additional training to become a neurohospitalist because most residency programs still provide intense inpatient experience. In addition, other established fellowships can provide training to fill in expertise or marketability gaps (vascular, electrophysiology, neurocritical care, etc.). At this point, a neurohospitalist fellowship is usually pursued by neurologists seeking either an academic inpatient experience or additional supervision during their transition to independent inpatient neurologist.

Potential downsides

There are several potential downsides to this type of care model. Some are practical, such as coverage concerns or loss of flexibility, and some are clinical, such as loss of understanding about the continuum and course of neurologic disease.

To address the clinical concern first, this care model introduces an inherent discontinuity of care impacting care of the individual patient and group of patients. From an individual standpoint, it is perhaps better to have a single physician care for them throughout the course of their illness, so as to minimize confusion, repetition, and missteps. Of course, this is a practical impossibility. Instead, one could argue that there has always been a level of discontinuity in modern medical care and that addressing the issue specifically with targeted communication between the inpatient and outpatient settings is a more effective way of overcoming the hurdle. As all specialties of medicine have evolved, this discontinuity has become more obvious and has spawned an entire area of study in effective transitions of care (Starmer et al 2014a; Starmer et al 2014b). Several articles suggest this hurdle can be overcome by targeted discharge strategies implemented by neurohospitalists, including institution of specific discharge clinics (Rennke and Ranji 2015; Shah et al 2016).

Answering the question from the standpoint of individual providers becomes more difficult. There is something to be said for understanding the entire course of the disease process in order to be able to provide the most competent and effective care to patients. Focus only on the inpatient care of neurologic disease will by definition decrease neurohospitalists' understanding of both the patients and their disease. This is a problem that frequently arises in other specialties, for instance, an emergency room physician wanting to admit a patient with Parkinson disease who is delirious or falling frequently, whereas their outpatient neurologist recognizes these problems as usually best managed in the home setting. Much as the issue from the patient's point of view, the "cat is out of the bag" insofar as the transition to neurohospitalist care is already underway. The only solution would seem to be developing effective communication strategies between inpatient and outpatient neurologists.

Staffing issues are also a potential problem. What happens if the neurohospitalist gets sick? Unlike the situation in an outpatient clinic, patients cannot be rescheduled. In addition, if there is no redundancy with inpatient providers, the discontinuity between inpatient and outpatient care may mean that there is no one with sufficient expertise to fill in the gap. This loss of flexibility creates a new staffing challenge because providers are no longer interchangeable. In this vein, it is helpful for practices to have some providers comfortable in each setting. In the author's academic program, there are several younger faculty members who are not so far removed from residency as to feel a wide competency gap in inpatient neurology. These neurologists are encouraged to perform extra duty, such as telemedicine or weekend call, with some regularity so as to maintain a pool of providers who could be called on to provide inpatient coverage in an emergency. This plan is feasible in a large academic practice, but collaboration between groups may be required in a smaller community setting. Regardless, plans for emergency coverage should be developed prior to the emergency arising.

The converse situation can also occur in that having a provider available at a moment's notice for hospital coverage results, by default, in unproductive times if patient flow is slow. In fact, the balance between too much staffing and not enough is a difficult one to strike. This is a complicated issue beyond the scope of this article, but effective use of

advanced practice providers and teleneurology are important strategies to consider.

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**References especially recommended by the author or editor for general reading.

Other topics to consider

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