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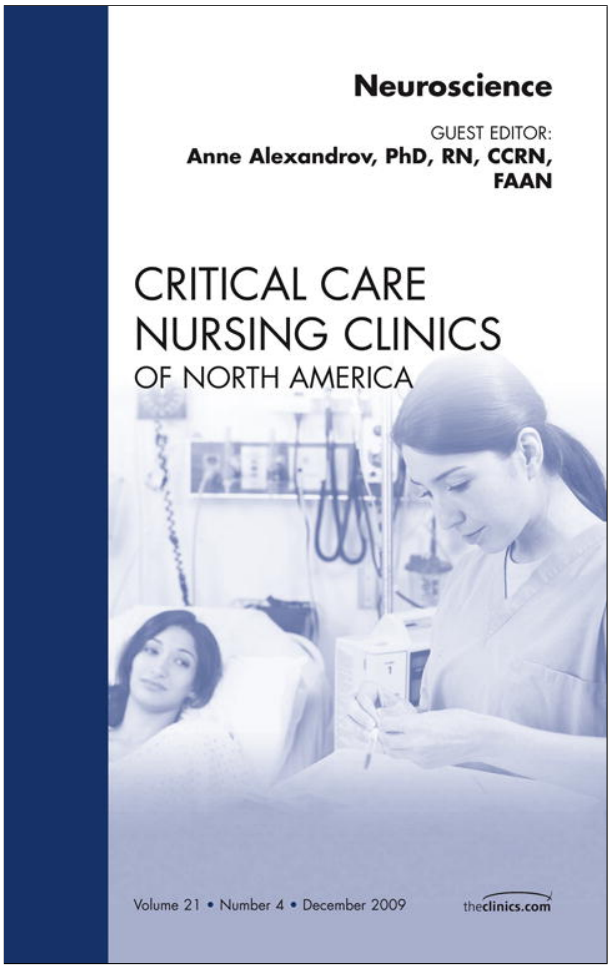

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Postgraduate Fellowship Education and Training for Nurses: The NET SMART Experience

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KEYWORDS

- NET SMART • Post-graduate nurse fellowship programs
- Advanced practice nursing • Neurovascular advanced practice
- Stroke

Graduate nursing education prepares nurses for entry into advanced practice nursing (APN) roles, such as nurse anesthetist, nurse midwife, clinical nurse specialist (CNS), and nurse practitioner (NP). Knowledge and skills acquired through formal graduate education provide a foundation for entry into these new roles yet are insufficient to support the significant degree of specialization often expected within the practice sector. To further development and specialization in practice after graduation, nurses have relied on a variety of strategies, including conference attendance, reading professional publications, and nonstandardized mentoring by physician specialists

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or, in some cases, highly experienced APNs who were originally mentored by physicians. Although these methods are effective, they fail to standardize learning content, vary in their ability to measure knowledge and skill integration, and are often highly dependent on the expertise and individual initiative of mentors and mentees.

The *N*eurovascular *E*ducation and *T*raining in *S*troke *M*anagement and *A*cute *R*eperfusion *T*herapy (NET SMART) APN program offers a first-of-its-kind, academic, postgraduate, fellowship program for APNs that is modeled after physician academic fellowship programs but supported by a flexible Internet-based platform. This article details the rationale, methods, and preliminary results of the NET SMART APN experience, which serves as a unique template for the development of academic postgraduate nursing fellowship programs across a variety of specialty practices.

PRACTICE SPECIALIZATION METHODS

Advanced Practice Nursing Programs

Nurse practitioners

The first NP program was developed at the University of Colorado in 1965 by a nurse, Dr Loretta Ford, and a physician, Dr Henry Silver. The program sought to alleviate shortages of primary care providers in rural and urban areas. The first NP role was that of a pediatric NP, which focused on health promotion and community health issues.[1] Early NP programs were certificate based, with various entry-level requirements; during the 1970s, an increasing number of NP specialties were recognized, and the first NP certification examination was offered by the American Nurses Association in 1977.[2–7]

In the 1980s, education for NPs shifted from certificate programs to graduate nursing education culminating in a master's degree in nursing with NP specialization. By the end of the 1980s, almost 90% of NP programs were master's degree or post–master's degree certificate programs. During the 1990s, the number of NPs grew exponentially, and the NP role also expanded.[2,4,7] The acute care NP specialty was developed in 1990 to respond to the needs of patients and their families during acute illnesses,[7,8] and NPs became more prevalent in the hospital setting in response to health care's increasing fiscal crisis during the late 1990s.[2,7]

Clinical nurse specialists

The first master's degree program for CNSs was developed in 1954 in response to the rapid emergence of clinical specialty knowledge, incorporation of sophisticated technology into clinical practice, and patient and family needs.[7] This initial program was focused on psychiatry, but the CNS role quvickly spread to maternal-child health, oncology, and cardiac and critical care nursing. In the 1970s, master's degree programs emerged for CNSs in critical care.[7,9–12]

Role confusion has surrounded the CNS position for several years. Contributors to this problem include inappropriate titling as a CNS by nurses who are not graduate-prepared specialists and significant role variability. Realignment of the role to ensure increased practice visibility, coupled with solid practice specialty expertise and a focus on health outcomes management in the 1990s, significantly strengthened role performance and perceived value while placing CNSs in a powerful position to improve interdisciplinary practice.[13] Today, there is recognition of the importance of the CNS role to support evidence-based practice assessment and management.

Advanced practice nurses and neuroscience nursing

There is an emerging presence of CNSs and NPs in neuroscience nursing. A 2006 survey of the APN membership of the American Association of Neuroscience Nurses

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revealed that 58.5% of the 282 respondents identified themselves as NPs, whereas 41.5% identified themselves as CNSs.[14] Because there are no graduate APN programs that focus exclusively on entry-level neuroscience education or knowledge, APNs entering this specialty field must bring with them prerequisite knowledge or undergo significant on-the-job training.

Advanced Practice Certification

Professional society generalist and specialty certification serves as a mechanism to ensure safe nursing practice at graduate and undergraduate levels.[15,16] For APNs, graduate academic education is required for licensure or titling in the United States, with many states also requiring professional society certification to support APN titling. The American Nurses Credentialing Center (ANCC) provides APN generalist certification for NPs in adult acute care, adult primary care, family primary care, gerontology primary care, pediatric primary care, and school nursing; ANCC NP specialty certifications include adult psychiatric mental health, diabetes management, and family psychiatric mental health. The ANCC also provides CNS generalist certification in adult health, gerontology, and pediatrics, with specialty certifications that include adult psychiatric mental health, child/adolescent psychiatric mental health, diabetes management, home health, and public/community health. Several other professional nursing organizations also offer APN certification, such as the American Academy of Nurse Practitioners (NP generalist certification), the American Association of Critical-Care Nurses (NP and CNS specialty certification), and the Oncology Nursing Society (CNS specialty certification). No specialty certification exists to support APNs working in the neurosciences or, in particular, advanced neurovascular nursing practice.

Impact of the Advanced Practice Registered Nurse Regulatory Model on Practice Specialization

Uniformity across all US states has been lacking in the definition of APN educational requirements within graduate nursing programs, and licensing and credentialing requirements.[16] Recently, leading professional nursing organizations came together to form the Advanced Practice Registered Nurse (APRN) Consensus Work Group; the group collaborated with the National Council of State Boards of Nursing to develop a framework for requirements supporting APN licensure, graduate APN program accreditation, professional certification, and education for all APRNs.[15] The APRN specialty model (**Fig. 1**) requires that APNs be certified and licensed at the level of one of the four APRN roles (nurse anesthetist, nurse midwife, CNS, or NP) and within at least one of the six populations (family, adult, neonatal, pediatric, women's health, or psychiatry/mental health). Specialization is seen as occurring beyond the scope of the APRN framework, with specialty certification provided by specialist professional nursing organizations.[16]

The APRN regulatory model provides a framework for standardizing APN education within graduate academic nursing programs but precludes provision of education and training in specialty practice in favor of a broad generalist approach. Advantages to the APRN model of generalist education/training include academic content consistency, cross-state portability of APN licensure, a limit on the content depth and time requirements for curriculum completion, and simpler faculty competencies or expertise. APNs who plan to enter specialty practices beyond the scope of the APRN framework, however, require a significant amount of additional education/training to achieve practice competency. Development of postgraduate fellowships across a wide variety of APN specialty practice areas would serve to standardize

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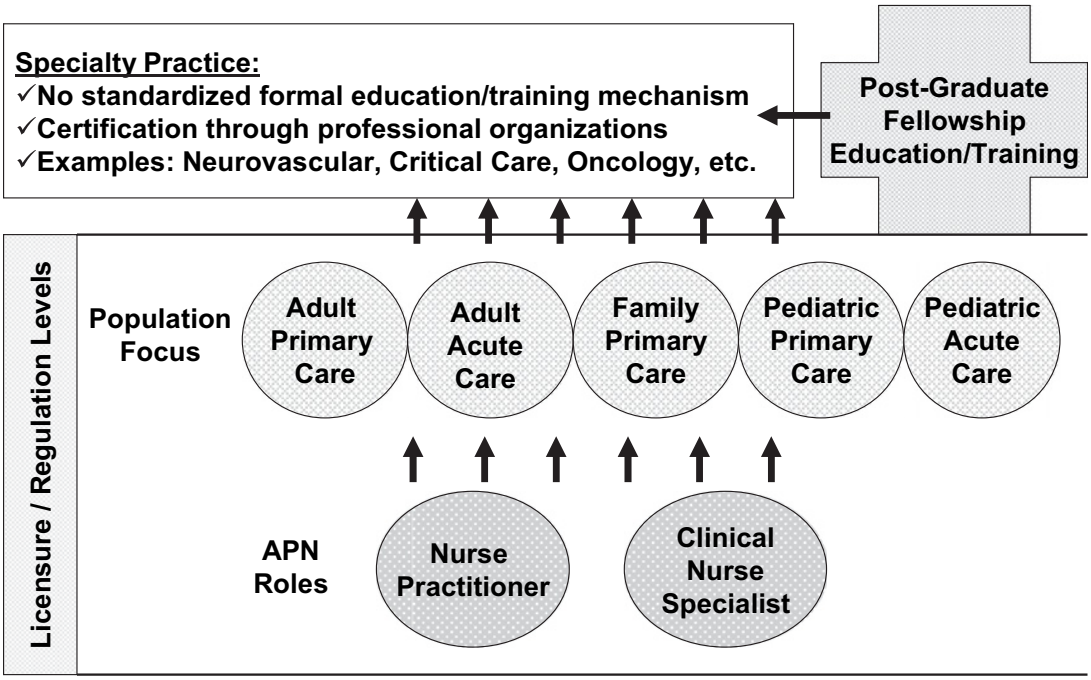

Fig. 1. Positioning of postgraduate fellowship education/training within the APRN regulatory model framework.

preparation of APNs to safely and expertly assume roles in diverse highly specialized practices (see **Fig. 1**).

Physician Specialty Education/Training as a Model for Postgraduate Advanced Practice Nursing Specialty Fellowships

The Accreditation Council for Graduate Medical Education (ACGME) is a nonprofit private council responsible for the accreditation of postgraduate medical training programs (internships, residencies, and fellowships).[17] Accreditation requirements for medical education/training are evaluated against standards addressing the following seven areas:

1. Institution: quality of the sponsoring institution and participating sites
2. Program personnel and resources: quality of the program director, faculty, and other program personnel and resources and medical information access
3. Resident appointments
4. Education program: curricular components, patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, systems-based practice, and residents' scholarly activity
5. Evaluation: methods supporting resident formative evaluation, resident summative evaluation, faculty evaluation, and program evaluation and improvement
6. Duty hours: methods for supervision and fatigue prevention and detection, duty hours, on-call activities, and policies for moonlighting and duty hours exceptions
7. Experimentation and innovation[17]

ACGME physician fellowships typically consist of 1 to 2 years of additional specialty education/training completed after successful attainment of generalist board certification within a specific practice focus (eg, general neurology).[17] Fellowship education/training is not uniformly required to provide care to specific specialty patient populations but may be a requirement stipulated in the bylaws of some practice sites. Physicians who chose this degree of specialization are most commonly employed at

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university-affiliated medical centers that house fellowship education/training programs.

Neurology education/training includes a 4-year residency, of which the first year consists of internal medicine, followed by 3 years of neurology. Neurology postgraduate fellowships may then be entered by interested/eligible candidates in one or more specialty practice areas, including vascular neurology (stroke), interventional neuroradiology, epilepsy, neuromuscular disorders, neurorehabilitation, behavioral neurology, sleep medicine, pain management, neuroimmunology, clinical neurophysiology, or movement disorders. There is typically a 6-month contiguous education/training and validation requirement that supports completion of most physician fellowships, preventing concurrent work outside the selected fellowship program once enrolled.[17]

The seven ACGME fellowship program components provide a model that may be adapted to support APN specialty education/training as follows:

1. Institution: The sponsoring institution and all participating sites must demonstrate that they have access to a large number of patients affected by the diagnosis addressed by the specialty.
2. Program personnel and resources: The program director, faculty, and other program personnel must demonstrate current engagement in the specialty practice at the expert level, in a role that consists of practitioner and researcher elements; resources should include practice facilities that provide high-volume, cutting edge medical/nursing management, with access to advanced patient care technologies, library, and support provided through case- or simulation-based learning methods.
3. Fellowship appointments: APNs must be granted ‘‘fellow’’ status within the program institution, with clearly defined roles and privileges.
4. Education program: Curricular components should be structured in a logical manner that builds on previous learning and encompasses a specialty area of advanced practice knowledge; clinical skills activities that support curricular content must be specified at the direct patient application level to reinforce learning; content should blend medical knowledge, practice-based learning, and improvement with advanced nursing knowledge; mechanisms must be incorporated to promote interpersonal communication skills and professionalism; an understanding of systems-based components in relation to the specialty practice area must be included; and participation in scholarly activities that support knowledge generation, dissemination, and use must be present.
5. Evaluation: Mechanisms for fellow formative and summative evaluation must be established; faculty and program evaluation must be planned for and formally implemented at specified points in time; evaluation data must be aggregated and used for ongoing program improvement; and graduate fellow and faculty outcomes must reflect program mission and values.
6. Duty hours: Specific methods to account for fellow didactic and clinical learning hours must be developed; mechanisms governing local and on-site supervision by qualified practitioner faculty are established; reporting systems for measurement of safe practice are established within local practice sites; and mechanisms governing conduct of fellows during on-site clinical validation must be implemented.
7. Experimentation and innovation: Opportunities for participation in experimental and innovative practice methods must be incorporated into the fellowship experience to foster value and knowledge of evolving scientific and administrative and clinical methods.

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THE ARGUMENT FOR ACUTE NEUROVASCULAR ADVANCED PRACTICE NURSING SPECIALIZATION

Stroke is the third most common cause of death in most countries and the leading cause of adult disability; within the neurosciences, stroke consistently ranks as the top admitting diagnosis in most hospitals worldwide.[18] As a vascular disease, stroke possesses a similar risk factor profile to other cardiovascular diseases and, in the case of ischemic stroke, often similar pathogenic mechanisms. Despite data that support the prevalence of stroke, resources capable of ensuring uniform expertise for APNs in the prevention, diagnosis, and treatment of neurovascular disease are seriously lacking.

The initiation of primary stroke center (PSC) certification by The Joint Commission (TJC) has served as a catalyst for US hospitals to adopt evidence-based acute stroke services and, in several US states, TJC certification is required by law for hospitals that admit acute stroke patients. The PSC movement has significantly increased the numbers of interdisciplinary staff with neurovascular learning needs, but few resources currently exist to support the evolution of stroke practice specialization.

Despite achievement of TJC PSC status in more than 600 US hospitals,[19] national tissue-type plasminogen activator (tPA) treatment rates remain extremely low due to a number of factors, including

1. Failure to engage local communities in the early recognition of stroke warning signs and, when available, use of emergency transport systems for rapid transport to a PSC
2. Inconsistent prehospital care operational standards that may foster long on-scene time or failure to recognize stroke warning signs
3. Transfer of suspected acute stroke patients by emergency medical systems personnel to hospitals that do not offer acute stroke treatment (tPA or intra-arterial rescue)
4. Disorganization within emergency departments (EDs) that precludes early diagnosis and treatment of acute stroke patients
5. Limited numbers of fellowship-trained vascular neurologists combined with apathy toward acute stroke treatment among general neurologists for whom regular trips to an ED may be viewed as disruptive to outpatient office schedules
6. An approach to stroke diagnostic work-up that is tied to finding reasons ''not to treat'' acute stroke patients instead of an aggressive paradigm that finds reasons ''to treat'' acute neurovascular patients
7. Failure to recognize, educate/train, and implement APNs as diagnosticians, process facilitators, and treatment decision makers in acute neurovascular emergency care

THE NET SMART ADVANCED PRACTICE NURSING POSTGRADUATE FELLOWSHIP PROGRAM

Origins of the Program

In the late 1990s to early 2000s, James Grotta, MD, Professor, Chairman of Neurology, and Director of the University of Texas-Houston Stroke Team, became the first US physician to recognize the value of postgraduate neurovascular fellowship education/training for APNs, providing individualized training while significantly expanding the roles and responsibilities of three nurses (Anne Alexandrov, Robin Saiki, and Dawn Meyer). Grotta's efforts resulted in a high rate of diagnostic agreement between

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neurologists and APN fellows, safe tPA treatment delivery, and provision of sound hemodynamic management and secondary prevention.

From this experience, Alexandrov later conducted needs assessments targeting APNs, physicians, and hospital administrators to determine their interest in a standardized, evidence-based, neurovascular, postgraduate APN fellowship and their willingness to expand the role of appropriately educated/trained APNs to include the acute diagnosis and management of stroke. Findings indicated significant interest in this expanded role, coupled with the need for flexible access to learning materials to ensure availability and feasibility of the program. These data, coupled with Health Resources and Services Administration funding, supported the genesis of the NET SMART APN fellowship program, which to date has enrolled more than 70 neurovascular APN fellows.

Overview of the Program

The principle target outcome of the NET SMART program is to develop a critical mass of APNs capable of providing neurovascular clinical practice leadership that results in improved tPA treatment rates and patient and hospital outcomes. To achieve this outcome, a systematic approach to neurovascular education and training was developed using an on-line platform that is accessible 24 hours per day, 7 days per week, and 365 days per year and easily updated based on emerging scientific findings. **Table 1** presents the NET SMART APN curriculum, which consists of 14 modules that progress from primary prevention to emergency systems, acute assessment and diagnosis, reperfusion therapies, evolving treatment methods, neurocritical care, complication avoidance measures, secondary prevention, stroke center leadership, APN role innovation, and entry into rehabilitation. Because NET SMART's mission is closely tied to acute stroke diagnosis and treatment, significant emphasis is placed on acute care management, whereas rehabilitation concepts are introduced but not elaborated on to a significant degree.

Criteria for enrollment into the NET SMART APN fellowship include master's degree preparation as a NP or clinical specialist or current graduate student status within 12 months of program completion. Mechanisms exist to support students enrolled in master's of nursing or doctor of nursing practice programs, including the ability to use NET SMART program time as elective or practice hours with the approval of local faculty. Recently, enrollment was expanded to include master's degree–prepared nurses without an APN role focus (eg, nursing education or administration), although a requirement for at least part-time practice in a related neurovascular role (eg, stroke coordinator or nurse manager) is required.

Enrolled fellows must contract with a local physician supervisor, preferably a neurologist, to provide oversight for clinical skills training and support ongoing learning. In the absence of local neurologist support, fellows may contract with a combination of physician providers, including neurosurgeons, emergency physicians, cardiologists, and radiologists; program faculty also work closely with fellows who do not have local neurologist support to ensure an appropriate learning environment is provided. Fellows also must provide evidence of administrative support for their role, including a willingness to provide data that support process and outcomes measurement during and after program completion, to allow assessment of program metrics.

NET SMART modules are supported by comprehensive testing delivered in a pretest/post-test manner to foster assessment of learning needs and a shift in knowledge. Modular content is deliberately leveled to that of a vascular neurology physician fellowship, with the expectation that APN fellows can articulate findings from all key clinical trials and integrate these findings into practice locally in their

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Table 1
NET SMART curriculum (course content in sequence)

Course Title	Description
Module 1: Introduction to acute stroke	This introductory module reviews stroke typology and pathophysiology, methods for clinical trial design in stroke and evidence quality, findings from pivotal epidemiologic studies in stroke, common risk factors for stroke, and assignment of pathogenic mechanism: I. Introduction of stroke typology II. Introduction to clinical trial design in stroke III. Significant studies in stroke epidemiology IV. Risk factor assessment and incidence V. Determination of stroke pathogenic mechanism
Module 2: Emergency systems for acute stroke patients—prehospital, triage, and emergency department management	This module reviews guideline-based recommendations for stroke systems of care, along with examples from highly successful programs. Mechanisms to engage widespread community involvement in acute stroke prevention, early recognition and emergent transport for treatment are presented: I. Prehospital systems for acute stroke—protocols, algorithms, preferential transport, and communication mechanisms II. Field and departmental triage of stroke emergencies III. Emergency assessment: priorities, quality measures, and practitioner/systems alignment IV. Laboratory diagnostics for treatment decision making V. Innovative telemedicine and prehospital emergency assessment/management approaches VI. Engaging the community in stroke prevention and recognition VII. Legislative efforts for stroke
Module 3: Clinical localization of stroke: Integrated anatomy, physiology, and assessment	This module provides fellows with an understanding of the anatomy and physiology of the central nervous system in relation to signs and symptoms suggestive of acute stroke. Fellows learn how to clinically localize strokes by the presentation of findings suggestive of particular vascular territories in the brain. The module concludes with a review of standardized stroke scales and how these support ongoing neurologic and functional assessment in stroke: I. Vascular territories of the brain II. Anatomy, physiology, and correlated clinical assessment III. Localizing lesions by clinical examination IV. Standardized stroke scales
Module 4: CT imaging in acute stroke	This module reviews the utility of CT in acute stroke. Anatomic correlation on CT and ischemic and hemorrhagic stroke imaging findings are presented: I. Introduction to CT II. Guide to interpretation of CT III. Differentiation of lesions by clinical correlates and imaging vascular distribution IV. Distinguishing hemorrhage from ischemia V. Hypodensities and changes associated with ischemia VI. Imaging priorities in transient ischemic attack

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Table 1
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Course Title	Description
Module 5: MRI imaging in acute stroke	This module reviews the utility of MRI in acute stroke. Fellows learn different MRI sequences (localizer, TI, T2, diffusion-weighted imaging, fluid-attenuated inversion recovery, perfusion-weighted imaging, gradient-recalled echo imaging, and apparent diffusion coefficient) and are introduced to anatomic correlates: I. Introduction to MRI II. Guide to interpretation of MRI III. Differentiation of lesions by clinical correlates and imaging vascular distribution IV. Distinguishing hemorrhage from ischemic changes V. Transient ischemic attack imaging
Module 6: Multimodal angiographic imaging	This module explores multimodal angiography techniques, including the use of CT angiography and CT perfusion, magnetic resonance angiography, and digital subtraction angiography: I. Introduction to multimodal angiographic techniques II. Guide to interpretation of angiography III. Limitations of angiographic approaches
Module 7: Ultrasound (carotid and vertebral duplex, TCD) in acute stroke	This module covers use of ultrasound testing in acute stroke in relation to other imaging modalities and determination of pathogenic mechanism and secondary prevention needs: I. Utility of ultrasound in acute stroke management II. Transcranial Doppler applications in emergent assessment, reperfusion monitoring, and long-term patient management III. Carotid duplex and vertebrobasilar assessment of stroke etiology IV. Ultrasound as a complimentary modality to MRI, CT, and angiography
Module 8: Indications for and administration of reperfusion therapy	This module covers current evidence-based guidelines supporting reperfusion therapy with intravenous tPA and evolving indications and techniques for intra-arterial rescue therapies. Fellows learn indications, dosages, and common pitfalls in administration of thrombolytic treatment for stroke: I. Reperfusion methods and treatment selection II. Reperfusion sequela: prevention and detection of intracranial hemorrhage III. Oropharyngeal edema: airway protection and treatment options IV. Monitoring recanalization and clinical improvement V. Concurrent management of blood pressure
Module 9: Management of intracranial hemorrhage and neurocritical care for stroke	This module covers current and experimental approaches to the management of intracranial hemorrhage while introducing fellows to concepts central to the management of neurocritical care stroke patients: I. Introduction to management of intraparenchymal and subarachnoid hemorrhage II. Common neurocritical care procedures and practices for ischemic and hemorrhagic stroke III. Emerging aggressive management regimes: craniectomy, hypothermia, and hemodynamic augmentation

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Table 1
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Course Title	Description
Module 10: Complications of stroke—prevention, recognition, and management	Major and common complications of ischemic and hemorrhagic strokes are reviewed along with the protocols for monitoring, detection, and treatment to prevent those complications. Special emphasis is paid to aspiration pneumonia, skin breakdown, contractures, deep vein thrombosis, poststroke depression, urinary tract infections, and the newly described reversed Robin Hood syndrome: I. Risk factors for stroke-related complications II. Prevention, from field through hospital management III. Early recognition of complications IV. Medical and nursing management of complications
Module 11: Secondary stroke prevention	Early institution of secondary stroke prevention treatment and discharge on appropriate medications is reviewed. Compliance issues and current indications for the use of specific agents are discussed: I. Physiologic actions and selection of antithrombotic agents II. Statins for secondary prevention III. Glucose control IV. Smoking cessation
Module 12: Stroke units—TJC PSC certification and comprehensive stroke center framework	Content is presented on stroke unit organization, including methods to reconfigure existing space, staffing, and work process. Preparation for TJC certification as a PSC is discussed, and fellows are introduced to a framework for comprehensive stroke center designation: I. Inside the stroke unit: system requirements for optimal organization II. Common stroke unit models for staffing and practice: protocols, pathways and algorithmic care III. Outcomes of stroke unit management: defining successful process and outcome interaction IV. Aligning Brain Attack Coalition and American Stroke Association guidelines with TJC certification processes. V. Assessing readiness for certification and constructing the certification application VI. Promoting staff readiness: educational tools and conducting a mock survey VII. Brain Attack Coalition guidelines as a framework for comprehensive stroke center designation
Module 13: Innovative methods for stroke center operations: use of APNs; stroke center quality improvement: stroke registries and repositories	This course presents content on innovative approaches to quality management of stroke programs, including use of APNs to support a stroke center endeavor, integration of electronic medical record processes into the quality program, and methods to build support through staff ownership of overall program quality: I. Practice models for stroke center APNs: program regulations, credentialing, and APN responsibilities II. Personal practice improvement strategies: measuring quality and initiating research III. Teleradiology and telemedicine systems for APN practice in acute stroke IV. Quality requirements for stroke centers V. Registries, electronic health records, and institution-specific data repositories VI. Engaging interdisciplinary staff in quality and research efforts

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Table 1
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Course Title	Description
Module 14: Neurorehabilitation and recovery	This module covers evaluation of candidates for rehabilitation, early initiation of physical/speech/occupational therapy, and cutting-edge rehabilitation strategies: I. Rehabilitation begins in acute care II. Regulatory and system requirements for rehabilitative placement III. Nursing assessment of readiness and need IV. Collaborative initiation of rehabilitation
On-site clinical preceptorship	The 80-hour clinical preceptorship focuses on validation of content learned during completion of the NET SMART modules. Participants complete several clinical rotations and experiences with expert clinical practitioners and receive ongoing performance feedback

practice sites. To accomplish this, the introductory module incorporates in-depth content on clinical trials design and levels of evidence, whereas later modules build on understanding and application of this introductory material. Module lectures are delivered using Adobe Breeze technology that provides audio lectures along with Microsoft PowerPoint slides and video to enhance learning.

Fig. 2 presents an overview of program progression. Each of the 14 modules is accompanied by clinical skills activities that ensure clinical application of knowledge to practice. Fellows complete activities under the supervision of their local physician supervisors and submit their work for grading to a program coordinator. After completion of modular lecture content and clinical skills activities, the post-test for the module must be passed before advancing to the next module. All modules are externally reviewed by leaders in vascular neurology for content accuracy, relevance, and comprehensiveness.

After successful completion of all 14 modules, fellows advance to an on-site clinical validation session, which is provided at the University of Alabama at Birmingham, Comprehensive Stroke Center. The session consists of 80 hours of supervised clinical time within this fast-paced, high stroke–volume hospital located in the ''stroke belt'' region of the United States. While on site, fellows are provided with beepers to alert them to acute stroke admissions and are expected to round daily in the hospital with the stroke team, including responding to all code stroke events and seeing patients post discharge in the stroke clinic. Specific competencies validated during the experience include

- Ability to accurately interpret neuroimaging (CT, MRI, angiography, and Doppler-based images)
- Ability to clinically localize physical examination findings to discrete neurovascular territories
- Ability to safely recommend prescription of acute stroke treatment (tPA and intra-arterial rescue)
- Ability to provide safe, evidence-based medical and nursing management recommendations for ischemic and hemorrhagic stroke
- Ability to work effectively across several acute stroke settings, including ED, neurocritical care unit, stroke unit, and stroke clinic
- Ability to appropriately work-up and accurately assign stroke pathogenic mechanism

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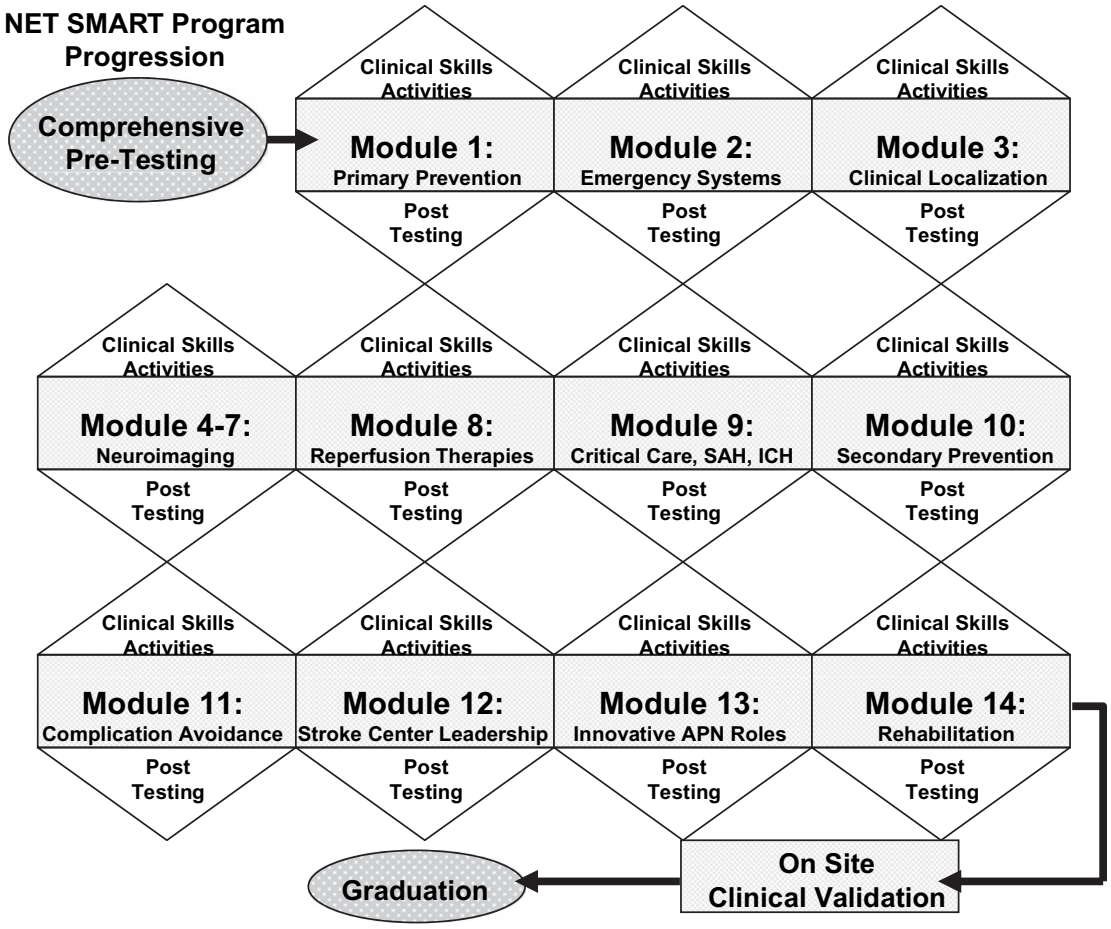

Fig. 2. NET SMART program progression.

- Ability to appropriately recommend prescription of prophylaxis or treatment for secondary prevention of stroke in accordance with pathogenic mechanism and risk factor profile
- Ability to assess needs and recommend prescription of methods for complication avoidance
- Ability to provide stroke program leadership as a specialist APN
- Ability to articulate the relationship between clinical research findings and recommended medical and nursing therapies
- Ability to integrate advanced nursing practice into medical management of acute neurovascular patients.

Preliminary Program Outcomes

Pretesting of NET SMART fellows indicates significant learning needs among even the most experienced APNs in all program areas, with post-test scores and clinical skills assignments demonstrating significant knowledge growth and competency development. Program outcomes to date demonstrate a 7% increase in the rate of intravenous tPA treatment among fellows' local practice sites compared with baseline reported rates, and several sites have gone on to attain TJC PSC certification under NET SMART fellow leadership. Local physician supervisors indicate a significant increase in fellow knowledge and practice competency and a high degree of satisfaction with fellow performance. Several local physicians admit to learning alongside their fellows by viewing module content on-line.

Program completion time is largely self-paced, although fellows with slow progression are regularly encouraged to pick up the pace of their learning. Responsibilities

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that fellows cite as being added to their roles since the time of NET SMART enrollment include first-responder duties for all code strokes, preliminary interpretation of neuroimaging findings, prescribing intravenous tPA for treatment of ischemic stroke, intraprocedural management of intra-arterial rescue cases, stroke program leadership, and supervision of medical residents on neurovascular rotations. While credentialing and privileging are dependent on local practice site regulations, scope of practice, and local medical politics, the addition of these responsibilities is promising and serves to position these fellowship-educated APNs in positions that may dramatically improve acute stroke outcomes. For nonprescribing APNs and stroke coordinators, the additional knowledge gained in the fellowship has enabled these nurses to work more effectively through their local neurologists and other physicians providing stroke care. Despite an inability to prescribe tPA or other therapies, these fellows are able to oversee care, expertly localize lesions to neurovascular territory, interpret neuroimaging, communicate findings, cite evidence-based rationale for recommended therapies, and stimulate physician action to treat and prevent acute stroke. Combined, prescribing and nonprescribing fellows are well suited to improve acute stroke care and the impact of stroke burden in their communities.

NET SMART Through the Eyes of Advanced Practice Nursing Fellows

NET SMART fellows are mavericks who have embarked on a first-of-its-kind learning journey and describe the experience as empowering for APNs. Fellows cite outcomes that include improved practice confidence, improved physician-APN relationships, improved physician trust in APN diagnostic judgment and management, recognition of APN neurovascular expertise among different physician specialties (eg, emergency medicine and internal medicine), respect for the neurovascular APN role, and expanded autonomy in role performance. Also valued is the camaraderie and networking that develops among fellows, especially during the on-site clinical validation experience, which brings fellows together from across the country. Fellows learn that they often share challenges and frustrations in their local practice sites that may be solved through shared dialog that promotes collaborative problem solving. Specific strengths of the NET SMART program cited by fellows include

- Authentic practice and research expertise among program faculty
- Accessibility of program faculty throughout the distance learning process
- Distance learning accessibility
- Ability to become immersed in an aggressive treatment philosophy that can challenge local treatment paradigms
- Provision of regular performance feedback
- Clinical exercises that ensure application of new knowledge
- Culmination of the experience in a high-volume, complex, aggressive stroke center, which enables a look at how things are done at other centers
- Esprit de corps among fellows and faculty
- Networking among fellows and faculty
- Regularly updated, evidence-based content
- Expectations for fellows to be able to clearly articulate how clinical trials drive changes in practice

RECOMMENDATIONS FOR ADVANCED PRACTICE NURSING FELLOWSHIPS

Organization of APN fellowship programs is not suited to all organizations. APN fellows are a highly motivated and experienced group of clinicians capable of easily

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spotting imposter faculty who lack practical expertise or are solely dependent on theoretic knowledge. APN fellows also expect a significant degree of expert practice immersion, which necessitates clinical experiences that add value (not busy work), are relevant, and are tied to important practice competencies. Faculty intent on developing an APN fellowship must honestly reflect their ability to mentor this elite group of clinicians.

The hub practice site sponsoring an APN fellowship must also be closely considered, as it reflects the credibility of the program. The site must be recognized for provision of cutting-edge, evidence-based medical and nursing practice; supported by world class, well-recognized, attending physicians and attending nurse leaders; and seen as a leader in the evolution of clinical science for the specialty practice. Collectively, the credibility of a practice site and its faculty will drive the success of any APN fellowship program.

A significant amount of time must be set aside to develop and revise learning materials. Program content must be regularly evaluated against evolving scientific findings. This necessitates attendance at all key scientific meetings worldwide, regular journal scanning for new findings in need of inclusion, and networking with key interdisciplinary practice leaders throughout the world. In the authors' experience, more than 70% of program modules require updating at least every 6 months to maintain their relevancy and accuracy.

Other considerations include an Internet platform to provide the program, because on-line offerings enhance access worldwide. Manpower considerations include the need for personnel to maintain the on-line systems, including Web site updates. Graphic design personnel are also needed to assist with program branding, logo design, and development of original art that supports learning. A program coordinator is necessary to work directly with fellows and assist with registration, program statistics, and program matriculation. A researcher specializing in psychometric analyses should also be contracted, to ensure ongoing evaluation and improvement of test items. Key thought leaders in the specialty should be consulted to assist with regular program content assessment and provide recommendations for revision. Lastly, mechanisms must also be developed to support program marketing, including exhibiting at conferences, direct mailing, Web site positioning, and journal advertisement.

SUMMARY

Acute neurovascular patients remain significantly underserved due to a combination of stroke physician shortages and physician disinterest in acute stroke treatment. Postgraduate neurovascular fellowship–trained APNs are well positioned to improve stroke patient and hospital outcomes while furthering the role of specialty educated/trained nurses.

NET SMART APN serves as a model for postgraduate APN fellowship education and training. Faculty and institutions capable of providing specialty-level APN programs across a wide variety of specialty areas are encouraged take on this charge to promote standardization of evidence-based content and learning methods that will further the role APNs may play within healthcare settings for years to come.

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