Official Journal of the Association of Neurovascular Clinicians

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Message from the Editor-in-Chief

Stroke Clinician: A Journal for YOU!

Anne W. Alexandrov, PhD, AGACNP-BC, ANVP-BC, ASC-BC, CCRN, FAAN

Welcome to the inaugural issue of *Stroke Clinician*, the official journal of the Association of Neurovascular Clinicians (ANVC). We've designed this journal with you in mind, creating a one-of-its kind, clinically focused, stroke-specific journal that fills a tremendous gap in the available scientific literature. Unlike other journals that require paid subscriptions, *Stroke Clinician* is fully open-access allowing you and your professional colleagues to read content at no cost. For those interested in authoring a publication in the *Stroke Clinician*, you'll be pleased to know that submission/acceptance fees are waived; you'll even find expert editorial support to help you develop your work into a valuable contribution to the clinical literature.

Please take a moment to become familiar with the different sections of the journal. You'll find original research using a variety of designs and addressing a diverse number of stroke-specific phenomena. Featured papers in this issue are focused on methods to educate and clinically train acute stroke advanced practice providers, and an eye-opening international survey of stroke coordinator roles. Each issue will also feature a review paper to broaden readers' knowledge about specific topics and highlight gaps in knowledge that deserve further study. This issue features work that explores what's known about hospital-to-hospital transfer delays in hyperacute stroke patients. We also feature in this issue original abstracts presented at the ANVC 2023 annual conference in Las Vegas, Nevada covering a variety of important topics clinically relevant topics.

Stroke Clinician also has standing columns that will be featured in each issue to support your work in caring for neurovascular patients. Our *Stroke Center Corner* column offers advice to those managing hospital certification and ongoing program improvement, covering a wide-variety of topics that are of interest to stroke coordinators and stroke program managers. This issue's content is focused on changes to the new hospital certification standards, an essential topic for all those charged with overseeing preparation for stroke center certification. *Research Corner* presents concise reviews of newly published, clinically relevant studies that may be useful in your practice. This issue features the INTERACT3 study[1] which tested a bundled-care intervention in patients with acute intracerebral hemorrhage. Each issue's *Neuroimaging Case Review* column will present interesting clinical cases to develop your diagnostic and image interpretation

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knowledge; this issue features a patient presenting cerebral venous sinus thrombosis. In *Certification Corner*, sample test items will be available to further your knowledge and preparation for taking a Neurovascular Clinicians Certification Corporation (NVC-3) board exam as a Neurovascular Registered Nurse (NVRN™), Advanced Neurovascular Practitioner (ANVP™), Advanced Stroke Coordinator (ASC™), or a Certified Neurointerventional Clinician (CNIC™). Lastly, the *In Our Stroke Unit* column features a specialized stroke unit from different hospitals throughout the world, and in this issue highlights the Royal Blackburn Hospital in East Lancashire, England. If you are interested in sharing your stroke unit with the readers, please submit descriptive content and photos using the submission portal at: https://journals.psu.edu/strokeclinician.

We hope you'll enjoy and value the *Stroke Clinician* as essential reading to support your professional growth. After all, our patients "deserve nothing less" than the best, and we hope to bring you that in each issue.

References

1. Ma L, Hu X, Song L, Chen X, Ouyang M, Billot L, Li Q, Malavera A, Li X, Muñoz-Venturelli P, de Silva A, Thang NH, Wahab KW, Pandian JD, Wasay M, Pontes-Neto OM, Abanto C, Arauz A, Shi H, Tang G, Zhu S, She X, Liu L, Sakamoto Y, You S, Han Q, Crutzen B, Cheung E, Li Y, Wang X, Chen C, Liu F, Zhao Y, Li H, Liu Y, Jiang Y, Chen L, Wu B, Liu M, Xu J, You C, Anderson CS; INTERACT3 Investigators. The third Intensive Care Bundle with Blood Pressure Reduction in Acute Cerebral Haemorrhage Trial (INTERACT3): an international, stepped wedge cluster randomised controlled trial. Lancet. 2023 Jul 1;402(10395):27-40. doi: 10.1016/S0140-6736(23)00806-1. Epub 2023 May 25.

ANVC President's Message

Global Burden of Stroke: A Call for Action

Alicia Richardson, MSN, ACCNS-AG, ANVP-BC, ASC-BC

Stroke clinicians typically are focused on the stroke population within their own regions. Sometimes this focus can span nationally, but rarely does it focus on stroke globally. However, a recent publication by the *World Stroke Organization-Lancet Neurology Commission Stroke Collaboration Group*[1] sends an urgent call for stroke clinician action with global projections of a 50% increase in stroke mortality by 2050, leading to almost 10 million deaths worldwide. This finding is tied to a predicted increase in disability adjusted life-years (DALYS) from 144.8 million in 2020, to 189.3 million by 2050. DALYS are the sum of life years lost due to premature mortality and years lived with a disability, providing a staggering glimpse of stroke's global devastation if nothing changes.

Low- and middle-income countries (LMICs) are already at high risk for increased mortality, carrying 86% of the burden of stroke today. There are a variety of reasons LMICs are at greater risk, including but not limited to higher rates of undetected and uncontrolled hypertension, lack of easily accessible-high quality healthcare services, insufficient attention to and investment in prevention, increased air pollution, population growth, higher rates of stroke in the young (age < 55 years), greater proportion of hemorrhagic stroke, and the burden of infectious disease resulting in competing limited healthcare resources. If circumstances remain the same as they are today, 90% of the stroke deaths worldwide by 2050 will occur in LMICs.[1]

The economic burden of stroke can be measured by both direct costs and income losses due to mortality and/or disability. In 2050, the projected cost of stroke is $880 billion to $2.31 trillion dollars worldwide.[1] The continents that are expected to be most impacted by stroke are Asia and Africa, with Asia expected to experience the highest increase in mortality from a rate of 61.3% to 68.9%, equaling around 6 million deaths, whereas Sub-Saharan Africa (SSA) is projected to have the fastest growing number of deaths from intracerebral hemorrhage.[1] Unfortunately, limitations within African countries are significant, with few using scientific guidelines to support practice, few physicians with expertise in stroke diagnosis and management, and rare use of national quality registries. Additionally, many African countries have limited computed tomography and magnetic resonance imaging access, few have stroke units to support patient care, and treatment with systemic thrombolytics or mechanical thrombectomy is often not an option for patients with acute

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ischemic stroke. Complicating these limitations even further is the high cost of systemic thrombolytic agents in LMICs, which is over 200% of per-person health expenditures compared to only 18% over expenditures in high income countries. Even when systemic thrombolysis is available in LMICs, associated administration costs often reduce its availability resulting in treatment rates as low as 1%.[1]

To tackle the burden of stroke, the Collaboration Group calls for implementation of a four-pillared approach: *Surveillance*, *Prevention*, *Acute Care*, and *Rehabilitation*.[1] The *Surveillance Pillar* is aimed at monitoring risk factors and health care services using community-based surveys and health records. The *Prevention Pillar* is aimed at controlling modifiable risk factors through public health strategies. The *Acute Care Pillar* is focused on quality metrics, staff training, and planning for stroke-related healthcare services. Lastly, the *Rehabilitation Pillar* is aimed at increasing access to interprofessional care, caregiver training, and improved community-based social services.

The World Stroke Organization (WSO) Road Map can provide stroke clinicians working in different world regions with a framework for implementing, monitoring, and evaluating stroke services.[2] The WSO Road Map is a self-assessment tool that standardizes and recommends minimal, essential, and advanced stroke services, covering the entire stroke care continuum so that stroke clinicians may conduct gap analyses within particular regions or institutions.

Knowing that Sub-Saharan Africa is an at-risk region, the *WSO Future Leaders Programme* has chosen to implement a research project aimed at bringing Tanzania and Ethiopia from minimal to essential stroke services on the WSO Road Map. I am excited to share that I serve as the only nurse on this research group, bringing the voice of my profession and that of ANVC members to the project planning table. Because ANVC's *Vision* and *Mission* complement this research project, our Board of Directors has agreed to allow modification of existing ANVC teaching resources to support this innovative project. As a first step, we have modified our Neurovascular Registered Nurse™ educational resources to suit the learning needs of nurses working in Tanzania and Ethiopia to enable capacity building by mentored education and training within interprofessional stroke teams. Trainings will occur over the course of 2024 and will bring the WSO Future Leaders Research Team closer to meeting the overall goal of moving to essential stroke services in Tanzania and Ethiopia.

It is imperative that stroke clinicians become involved with international efforts such as our work with the WSO so that we may actively contribute to decreasing the global burden of stroke. *As the number one cause of preventable disability, neurovascular disease demands excellence in clinical services to reduce disability and death. Neurovascular clinicians depend on ANVC to empower them with knowledge and skills, because our patients around the world deserve nothing less.* Please join with me to support ANVC's partnership with the WSO by using your discounted membership code to become an active member in the WSO when you renew your ANVC membership. Together, we can focus beyond our own regions, directing

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powerful stroke clinician contributions toward reducing the global burden of stroke.

References

1. Feigin, V. L., Owolabi, M. O., & World Stroke Organization–Lancet Neurology Commission Stroke Collaboration Group (2023). Pragmatic solutions to reduce the global burden of stroke: a World Stroke Organization-Lancet Neurology Commission. *The Lancet. Neurology*, *22*(12), 1160–1206. https://doi.org/10.1016/S1474-4422(23)00277-6
2. WSO (2023). Roadmap Guidelines to delivering quality stroke care. Global_Stroke_Guidelines_and_Action_Plan_All_in_one_English.pdf (world-stroke.org)

Stroke Coordinator Developmental Needs Around the Globe: An MT - ANVC International Survey

Sushanth Aroor, MD,[1] Desiree M. Cihelka, MSN, ACNP, ANVP-BC,[2] Dileep Yavagal, MD[3]

Abstract

Background

Stroke Coordinators (SC) should be commonly utilized in Stroke Centers to ensure provision of evidence-based services, oversee quality improvement, and support interdisciplinary and community education. Mission Thrombectomy (MT) partnered with the Association of Neurovascular Clinicians (ANVC) to understand how SCs are utilized outside the US and to compare developmental needs for this role across the world.

Methods

A brief survey was constructed to capture information about the use of SCs and their duties, including personnel utilized to execute the role and areas deemed important for role development. The survey was disseminated through the MT and ANVC membership rosters; returned data were assembled in SPSS (version 25) and analyzed using descriptive and X^2 statistical tests.

Results

A total of 74 surveys were returned from 17 countries (63% USA). Survey responders were SCs (41%), physicians (39%), program managers (19%) and advanced practice providers (APPs) (1%); 47% were from thrombectomy centers. The SC role was filled at 92% of centers; MDs more commonly assumed the SC role outside the USA (63%), versus registered nurses in the USA (95%; X^2 =25.2, p<0.001). Of the 70% of respondents interested in receiving assistance from MT and ANVC for SC development resources, the functions deemed most important were "quality improvement" and "emergency medical service personnel education" for USA respondents (36%), whereas "development of stroke systems of care" (60%) and "government policy change" (40%) were ranked highest outside the USA.

Conclusions

Non-USA Stroke Centers have significant SC development needs that differ markedly from those within the USA. MT provides an important platform to engage international programs and the MT/ANVC partnership is well positioned to further stroke nursing care and SC development globally.

Key words: Stroke coordinator, stroke centers, stroke systems of care, nursing education.

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INTRODUCTION

Stroke Coordinators (SC) should be an integral part of the interprofessional stroke team and components of the SC role are a requirement for stroke center certification in many parts of the world.[1-3] Despite this, role adoption, requirements, and SC functions remain poorly described and until recently lack standardization,[4,5] although in the United States (USA) elements of the role commonly include development of internal hospital stroke systems to ensure timely provision of emergent care, overseeing stroke program quality improvement, monitoring methods for complication avoidance and provision of secondary stroke prevention, preparing for and maintaining stroke center certification, and delivering education to patients/family members, interprofessional staff, and the community.[5,6]

The SC role emerged in the USA during the NINDS rt-PA Stroke Study[7] when nurse research coordinators were charged with activities such as organizing timely emergency department response to stroke, providing ambulance personnel education and training in acute stroke recognition with rapid priority transport to study hospitals, overseeing appropriate drug administration and ongoing nursing care, and training nurses in the management of alteplase-treated patients.[8] However, at conclusion of the trial, vascular neurology leaders noted that the systems they had built to ensure timely patient diagnosis and management deteriorated once research nurse coordinators left their positions; this fostered recognition of the need for resumption of these activities under the SC title by the later-half of the 1990s in hospitals committed to the provision of alteplase treatment.[8] Although early stroke guidelines were silent on the need for the SC role, the emergence of stroke metrics[9] and ultimately Primary Stroke Center (PSC) certification in 2003 by The Joint Commission (TJC)[10] made clear the need for a role that ensured provision of quality stroke care with attainment and ongoing maintenance of certification status. In 2012, The Joint Commission introduced Comprehensive Stroke Center (CSC) certification as mechanical thrombectomy was emerging[11] and their guidance for CSC status became the first to mention a requirement for the SC role.

Advances in acute stroke treatment have expanded the role of SCs in the USA to oversee the necessary infrastructure to sustain robust stroke systems of care.[5] In fact, implementation of the SC role has been associated with improved stroke education performance measure scores,[12] better ambulance personnel relationships, improved quality of care in rural hospitals,[13] improved telestroke initiation times, reduced length of stay, and improved delivery of evidence-based care in hospitals within a stroke unit.[14]

Formal education and board certification for SCs was introduced in 2019 by the Association of Neurovascular Clinicians (ANVC), however USA[4] and Australian survey[1] findings indicated that those working in the SC role most commonly only receive on the job training, often without resources or direction provided by an experienced SC leader. To date, little is known about how this role is performed in other countries around the world, or whether it is considered an essential role within acute Stroke Centers internationally. Additionally, within the USA the exact number of SC positions remains difficult to quantify due to elements of the role being assumed within hospital quality improvement departments, service line management, or by nursing administrators. Inconsistencies in titles and role descriptions further complicate quantification of USA SC positions.

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Intravenous thrombolysis and mechanical thrombectomy for large vessel occlusions have revolutionized acute revascularization therapy for ischemic stroke.[15] Rapid growth in stroke treatment demands the availability of focused expertise within hospitals, as well as external community-based and regional stroke systems, responsibilities that should ideally be led by a well-tooled SC. In fact, widespread SC role adoption, supported by standardization of education/training and role components[5] offers legitimacy to what should be an essential position within acute stroke teams throughout the world. To better understand the role components, training, and learning needs of SCs internationally, the Society of Vascular and Interventional Neurology's (SVIN) Mission Thrombectomy (MT) partnered with the ANVC to conduct a survey to better understand characteristics of the individuals working in the SC role, the functions performed, and the greatest educational needs for optimal role performance.

METHODS

Institutional Review Board approval was obtained for the conduct of a cross-sectional anonymous survey exploring the SC role and educational needs. A brief English-language survey was developed from a review of the SC literature describing common role components, and input from role content experts. The survey was piloted in advance of circulation by a group of international SCs, and revised based on feedback to ensure global relevancy. The SC role was defined on the survey header to ensure international understanding of the study's focus regardless of local role titles as:

> *"Health personnel that are empowered to oversee the quality of acute stroke services within their hospital and community. As leaders in acute stroke care, Stroke Coordinators collaboratively design and implement quality improvement programs that are supported by clearly defined measurable outcome targets; interdisciplinary evidence-based processes of care that are theoretically in-line with outcome attainment are implemented, cyclically measured for performance stability and reliability, and ultimately evaluated alongside outcome improvement. Foundational to the Stroke Coordinator role is expert acute stroke clinical knowledge and skills which support the synthesis of new evidence and evolving practice paradigms in relation to actual clinical practice, promoting an understanding of critical gaps in care, resources, and services. Stroke Coordinators oversee clinical staff competencies and the need for added education and training, supporting these needs as necessary to enhance interdisciplinary stroke services."*

Surveys were distributed via SurveyMonkey to enhance global distribution; both MT partners and ANVC members were invited to participate over a 3-month period from June 2020 to August 2020. Purposive snowballing techniques were employed to encourage survey distribution within local and regional networks internationally. Returned surveys were evaluated by Internet server; duplicate server entries were excluded after identifying the survey which was returned by the person working in the SC role. Data were assembled in SPSS (version 25), cleaned and ultimately analyzed using descriptive statistics and Chi square (X^2) tests.

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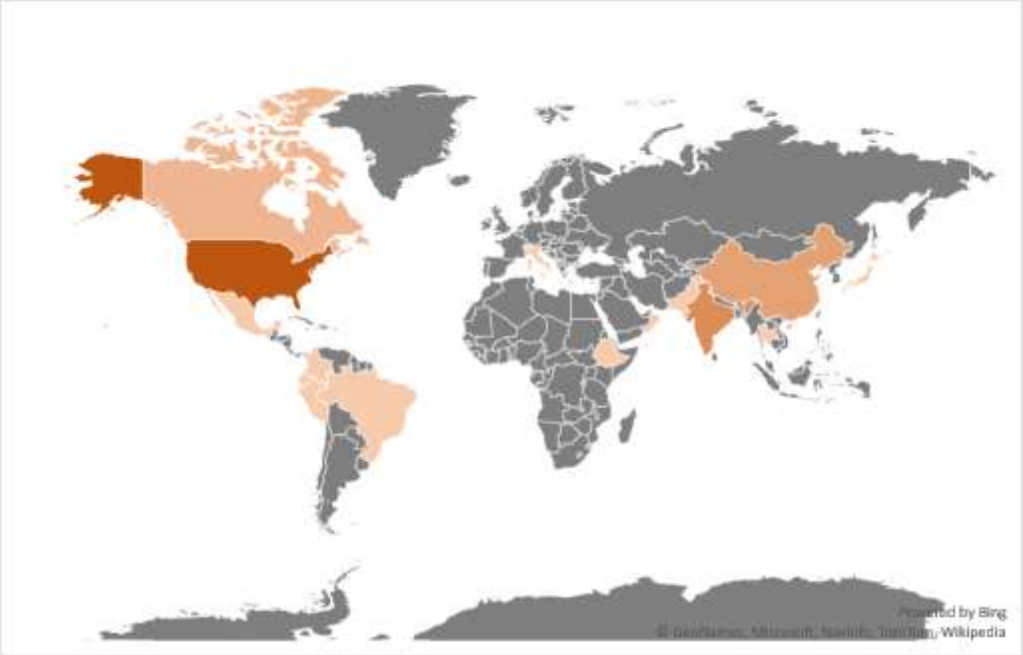
Figure 1. Global distribution of 68 stroke center responses representing 17 countries.



USA	45
Mexico	1
Brazil	1
Ecuador	1
Qatar	1
Japan	1
Pakistan	1
Columbia	1
Switzerland	1
Thailand	1
China	3
Peru	1
India	4
Canada	2
Italy	1
Oman	1
Ethiopia	1

RESULTS

A total of 74 surveys representing stroke centers in 17 countries were received, of which 6 were removed as duplicates from the same stroke center; 68 were included in the final analysis: 45 USA SCs; 23 non-USA SCs (Figure 1). Surveys were most commonly (53%) submitted by SCs working at stroke centers lacking thrombectomy capabilities. The SC title was used by 41% of survey responders, whereas other responders that assumed SC duties as part of their role were physicians (39%), stroke program managers (19%), and advanced practice providers (APP) such as nurse practitioners or stroke clinical nurse specialists (1%).

Regardless of title, the SC role was performed most often by licensed registered nurses in the USA (95%), whereas outside the USA, components of the role were usually performed by stroke physicians (vascular neurologists, general neurologists, or neurointerventional surgeons) (63%; $p<0.01$). An inventory of SC role functions demonstrated consistency among USA responders with the role focused primarily on stroke team/program leadership, provision of interdisciplinary staff, patient, community, and ambulance personnel education, and leadership overseeing quality improvement initiatives. However, outside the USA, SC role components lacked consistency in performance, with only the *educator* role component documented by more than 50% of non-USA SCs (Table 1). Nurses working in the SC role were also more likely to review medical records for compliance with stroke center quality measures, examine whether evidence-based practices were consistently applied, and develop practice policies and procedures to standardize use of evidence-based processes. (Table 2).

Within the USA, 73% of SCs were interested in partnering with MT and ANVC to further the development of resources for the SC role, whereas 65% of non-USA SC were similarly interested. Among USA SCs, the

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Table 1. Comparison between roles performed by USA and non-USA stroke coordinators.

Roles of Stroke Coordinators	USA (N= 45)	Non-USA (N=23)	p-value
Data Collection	71.1%	34.8%	0.004
Lead Meetings	82.2%	43.5%	0.001
Enter Quality Data	53.3%	26.1%	0.032
Staff Educator	86.7%	56.5%	0.006
Develop Policies & Procedures	86.7%	43.5%	<0.001
Conduct Research	44.4%	30.4%	0.264
Patient Educator	71.1%	17.4%	<0.001
Educate MDs	68.9%	39.1%	0.018
Review Certification Standards	82.2%	30.4%	<0.001
Update Evidence-Based Practices	84.4%	21.7%	<0.001
Concurrent Chart Review	84.4%	21.7%	<0.001
Attend Code Strokes	73.3%	43.5%	0.016
Point of Contact for Stroke Program	82.2%	26.1%	<0.001
Community Educator	77.8%	21.7%	<0.001
Quality Improvement	84.4%	43.5%	<0.001
EMS Education	64.4%	8.7%	<0.001
Monitor EMS DX Accuracy	53.3%	4.3%	<0.001

most common area of interest for resource development was in the area of ambulance personnel and community education, while the physician dominated non-USA SC sample was more interested in assistance with government policy change and development of stroke systems of care. The development of resources supporting quality improvement processes was ranked high by both groups. (Table 3).

DISCUSSION

Our study found that the SC position is held most commonly in the USA by nurses, whereas physicians manage some but not all SC role components outside the USA. This may reflect differences in medical culture that limit the potential of nurses as partners in development and leadership of stroke systems of care, as well as differences in educational models for both nurses and physicians that may overlook the benefit of

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Table 2. Comparison between nurse- and physician-performed stroke coordinator role functions.

Nurse vs Physician Stroke Coordinator	Nurse (N=44)	Physician (N=14)	p-value
Data Collection	69.6%	57.1%	0.388
Lead Meetings	80.4%	71.4%	0.474
Enter Quality Data	52.2%	42.9%	0.542
Staff Educator	89.1%	78.6%	0.309
Develop Policies & Procedures	87.0%	57.1%	0.015
Conduct Research	41.3%	50.0%	0.565
Patient Educator	76.1%	7.1%	<0.001
Educate MDs	67.4%	71.4%	0.776
Review Certification Standards	82.6%	42.9%	0.003
Update Evidence-Based Practices	82.6%	35.7%	0.001
Concurrent Chart Review	84.8%	28.6%	<0.001
Attend Code Strokes	73.9%	57.1%	0.231
Point of Contact for Stroke Program	80.4%	42.9%	0.006
Community Educator	78.3%	35.7%	0.003
Quality Improvement	84.8%	64.3%	0.093
Ambulance Personnel Education	65.2%	14.3%	0.001
Monitor Ambulance Diagnostic Accuracy	54.3%	0.0%	<0.001

teaching medical knowledge alongside nursing knowledge.[16-20] We also found that consistency in how the SC role is operationalized was lacking outside the USA, with many role responsibilities not identified by non-USA respondents. Additionally, the dominance of nurses in the USA vs. physicians outside the USA working in SC roles was reflected in the areas each group described as future resource needs, with nurse SCs wanting practical resources that could be used to support provision of interdisciplinary education, and physicians identifying the need for improvement of the overall stroke system of care, including government responsiveness to stroke.

Similar to what others have found, those that responded to our survey were predominately self-taught in the SC role, learning on the job with few resources and lacking access to expert SC guidance.[1,4] This remains a

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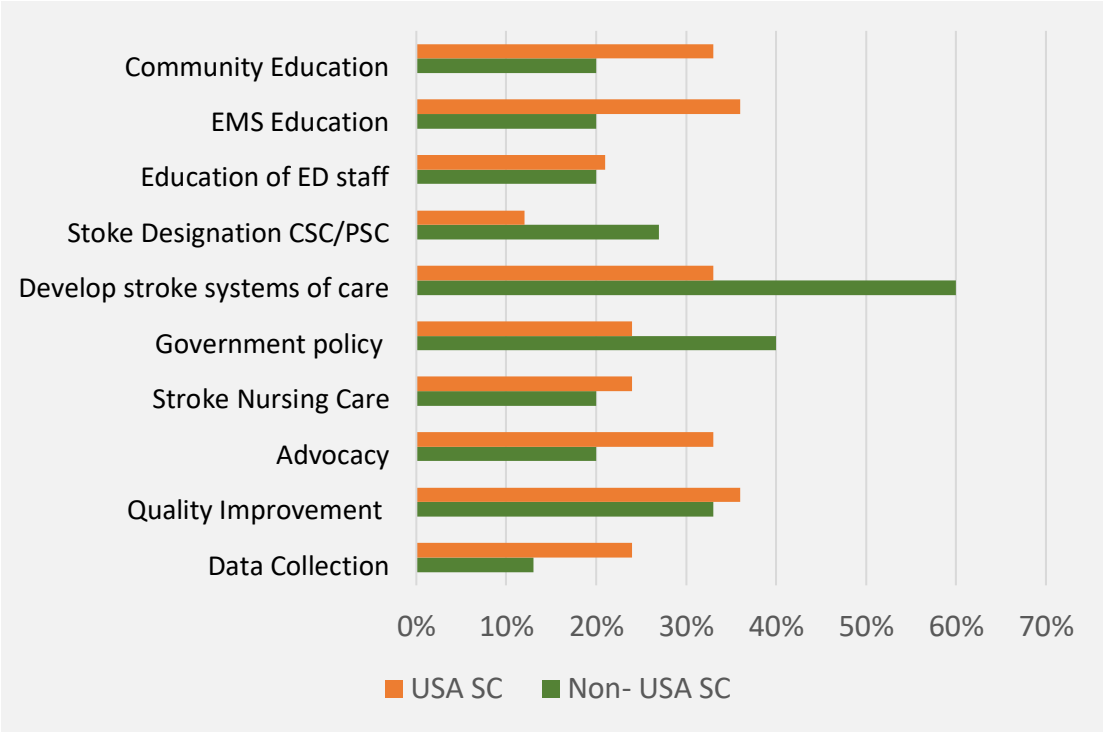
Table 3. Comparison of stroke development needs between USA and non-USA Stroke coordinators.



Note: EMS = Emergency medical services [ambulance] personnel; ED = emergency department; CSC = comprehensive stroke center; PSC = primary stroke center.

tremendous barrier to role enactment, as well as the ability to perform the role competently. Unfortunately, there is limited administrator understanding of the workload of SCs, the education and skillset necessary to support the role, nor the time necessary to carry out all role functions,[5] and this is not only true within the USA,[4] but has also been reported in Australia.[1]

We also found that only a small fraction of non-USA respondents were involved in ambulance personnel education, with even fewer monitoring stroke diagnostic accuracy among ambulance transported patients. Many countries outside the USA depend on physician personnel to staff ambulances[21] and this may have contributed to why this was not seen as a priority for the non-USA SC role, with an assumption that physicians on ambulances will validly diagnose stroke. However, this is an area that is becoming increasingly important to ensure appropriate triage of large vessel occlusion (LVO) acute ischemic stroke patients to thrombectomy-capable stroke centers.[22]

Lastly, community education and patient education were commonly identified as important components of SC roles in the USA, whereas these functions were not identified as common role components outside of USA respondents. This may be due to the primarily non-USA physician sample considering both patient and community education to be a nursing role however, we cannot know this with any certainty. Additionally, the finding that community education was not seen as a key SC role outside the USA is important, because lack of clearly defined role responsibilities for provision of information on stroke warning signs and available treatment may limit early recognition and

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rapid transport of patients with LVO or other stroke emergencies.

Our study has several limitations. First, our survey return was relatively modest and may reflect reluctance on the part of SCs to add to their high workload which is commonly underappreciated and supported by administrators. Respondents from outside the USA were also quite limited in number, suggesting that among MT collaborators, the SC role may be underutilized. However, despite this limited return, we were able to identify several important differences that will be useful in driving future initiatives around the SC role. Additionally, as with all surveys, we must assume that the returned responses were a true reflection of the SC role and role components in place at the responding sites. Because respondents within the USA demonstrated consistency in their documentation of role responsibilities, we conclude that our findings are likely an accurate reflection of role enactment. Lastly, our ability to invite the majority of SCs internationally to complete this survey was not only limited by our use of an English-only survey, but also by differences in role titles and diversity in the positions working in these roles globally, further demonstrating the need for role standardization to support development of highly skilled SCs capable of complimenting vascular neurologist and neurointerventional surgeon roles.

CONCLUSIONS

Stroke coordinators have been instrumental in achieving and maintaining certification of stroke centers in the USA, performing important functions that collectively improve delivery of evidence-based stroke services. We identified marked differences in role enactment between highly evolved USA SCs and those providing some components of the SC role at non-USA MT sites. Use of the USA SC model to support development of non-USA SC roles will likely further collaboration between stroke physicians and nurses, and also improve the overall recognition and response to important quality issues tied to delivering of evidence-based stroke services. The partnership between MT and ANVC is well positioned to further stroke nursing, advanced practice provider and SC care globally.

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Author Contributions

Drs. Aroor, Yavagal, and Alexandrov conceived the project.

Drs. Aroor and Alexandrov led manuscript development.
Dr. Yavagal and Ms. Cihelka participated in manuscript editing.
Dr. Alexandrov led statistical analyses for the project.

Conflict of Interest Statement

The authors report no conflicts.

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Resource Sharing

The data used and analyzed during this study are available from the corresponding author upon reasonable request and ethics board approval.

References

1. Purvis T, Middleton S, Alexandrov AW, Kilkenny MF, Coote S, Kuhle S, Cadilhac DA. Understanding coordinator roles in acute stroke care. Journal of Stroke and Cerebrovascular Diseases. 2021;30(12);106111.
2. Berge E, Whiteley W, Audebert H, et al. European Stroke Organisation (ESO) guidelines on intravenous thrombolysis for acute ischaemic stroke. *European Stroke Journal*. 2021;6(1):I-LXII.
3. Gladstone DJ, Lindsay MP, Douketis J, Smith EE, Dowlatshahi D, Wein T, Bourgoin A, Cox J, Falconer JB, Graham BR, Labrie M. Canadian Stroke Best Practice Recommendations: Secondary Prevention of Stroke Update 2020. Canadian Journal of Neurological Sciences. 2021 Jun 18:1-69.
4. Cudlip F, Swatzell V, Alexandrov AV, Alexandrov AW. US National Survey on Stroke Center Coordination: Time for Role Standardization? Stroke. 2013;44, suppl. 1:ATP352.
5. American Nurses Association & Association of Neurovascular Clinicians. *Neurovascular Nursing: Scope and Standards of Practice*. 2023. Silver Spring, MD: American Nurses Association.
6. Alexandrov AW. ANVC's *Core Curriculum for Advanced Stroke Coordination*. 2020. Fountain Hills, AZ: Health Outcomes Institute, Inc. ISBN:978-0-578-65806-3.
7. U.S. Food and drug administration. Drugs@fda: Fda approved drug products. Available at: Https://www.Accessdata.Fda.Gov/drugsatfda_docs/appletter/1996/altegen061896l.Htm. Accessed may 4, 2021.
8. Alexandrov AW. ANVC's *Core Curriculum for Advanced Stroke Coordination*. 2020. Fountain Hills, AZ: Health Outcomes Institute, Inc. ISBN:978-0-578-65806-3.
9. Get with the guidelines-stroke | healthy people 2020. Accessed September 30, 2023. Https://www.Healthypeople.Gov/2020/data-source/get-with-the-guidelines-stroke.
10. Alberts MJ, Hademenos G, Latchaw RE, Jagoda A, Marler JR, Mayberg MR, et al. Recommendations for the establishment of primary stroke centers. Brain attack coalition. *JAMA*. 2000;283:3102-3109
11. Gorelick PB. Primary and comprehensive stroke centers: History, value and certification criteria. j Stroke. 2013;15:78-89.
12. Malfitano J, Turner BS, Piper E, Burlingame PA, D'Angelo E. Improving stroke education performance measures scores: The impact of a stroke nurse coordinator. *J Neurosci Nurs*. 2013;45:332-337
13. Cadilhac DA, Purvis T, Kilkenny MF, Longworth M, Mohr K, Pollack M, et al. Evaluation of rural stroke services: Does implementation of coordinators and pathways improve care in rural hospitals? *Stroke*. 2013;44:2848-2853.
14. Purvis T, Kilkenny MF, Middleton S, Cadilhac DA. Influence of stroke coordinators on delivery of acute stroke care and hospital outcomes: An observational study. *Int J Stroke*. 2018;13:585-591
15. Goyal M, Menon BK, van Zwam WH, Dippel DW, Mitchell PJ, Demchuk AM, et al. Endovascular thrombectomy after large-vessel ischaemic stroke: A meta-analysis of individual patient data from five randomised trials. *Lancet*. 2016;387:1723-1731
16. Tang CJ, Chan SW, Zhou WT, Liaw SY. Collaboration between hospital physicians and nurses: An integrated literature review. *International Nursing Reviews*. 2013;60(3):291-302.
17. Hojat M, Nasca TJ, Cohen MJ, Fields SK, Rattner SL, Griffiths M, Ibarra D, de Gonzalez AA, Torres-Ruiz A, Ibarra G, Garcia A. Attitudes

towards physician-nurse collaboration: A cross-cultural study of male and female physicians and nurses in the United States and Mexico. *Nursing Research*. 2001;50(2):123-128.
18. House S, Havens D. Nurses and physicians perceptions of nurse-physician collaboration: A systematic review. *Journal of Nursing Administration*. 2017;47(3):165-171.
19. Wang Y, Wan Q, Guo J, Jin X, Zhou W, Feng X, Shang S. The influence of effective communication, perceived respect and willingness to collaborate on nurses' perceptions of nurse-physician collaboration in China. *Applied Nursing Research*. 2018. 41:73-79.
20. Berduzco-Torres N, Choquenaira-Callanaupa B, Medina P, Chihuantito-Abal LA, Caballero S, Gallegos E, San-Martin M, Delgado Bolton RC, Vivanco L. Factors related to the differential development of inter-professional collaboration abilities in medicine and nursing students. *Frontiers of Psychology*. 2020;11:432. Doi: 1-.3389/fpsyg.2020.00432.
21. Wilson MH, Habig K, Wright C, Hughes A, Davies G, Imray CHE. Pre-hospital emergency medicine. *Lancet*. 2015;386(10012):2526-2534.
22. Venema E, Burke JF, Roozenbeek B, Nelson J, Lingsma HF, Dipple DWJ, Kent DM. Prehospital triage strategies for the transportation of suspected stroke patients in the United States. Stroke. 2020;51(11):3310-3319.

Equipping Stroke Nurses to Take on Extended Roles Within Acute Stroke Care Through an Advanced Practice Fellowship: An Evaluation Study

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Abstract

Background

Stroke nurses are adopting extended roles to improve patient care due to limited numbers of vascular neurologists, however, little is known of this experience. We evaluated the impact of an internationally implemented fellowship education program to equip experienced stroke nurses, nationally and internationally, to undertake extended acute stroke roles.

Methods

We conducted semi-structured interviews with the following groups of individuals associated with the NET SMART Advanced Practice fellowship program: 1) Stroke nurse program graduates; 2) currently enrolled stroke nurse fellows; 3) local physician mentors; 4) service managers of program graduates. Interviews took place between February-August 2018 and were analysed using the Theoretical Domains Framework.

Results

Interviews were held with stroke nurses (n=11), mentors (n=4) and a service manager (n=1). Four themes were identified: 1) 'The learning journey'- describing motivations for undertaking the training and course content; 2) 'Organizational and professional change'- experiencing professional resistance to the new role, or lack of a suitable role to move into after program completion; 3) 'What hindered the learning journey?'- small hospitals with low patient volume makes completion challenging; 4) 'What helped the learning journey?'- a supportive team facilitated completion.

Conclusion

We found overwhelming skill development and professional growth by nurses, and this was echoed by mentors and managers. However, despite expanding their stroke-specific knowledge and skills, non-U.S.A. nurses faced systemic challenges in implementing their skills including lack of acceptance of extended nurse roles from wider professions.

Key words: nurse roles, nurse education, advanced practice, stroke, qualitative approaches, workforce issues.

INTRODUCTION

Stroke is a leading global health problem. Despite increased knowledge of stroke diagnostics, treatments and prevention, it remains the second leading cause of death and the third leading cause of disability worldwide (1). Developments in care have led to major redesign of stroke services to ensure that stroke is now treated as a medical emergency. The rapid development of acute stroke treatments means that the health care workforce must have the relevant skills, knowledge, and experience to ensure patients have effective access to care. However, we currently face a significant shortage of staff to deliver specialist stroke services. In the UK there is a dearth of all healthcare staff (2), and globally there is a scarcity of highly specialized stroke staff including stroke physicians, general neurologists and vascular neurologists (3, 4). Therefore, to maintain and improve access to specialist stroke care within the context of increasing demand and staff shortages, the stroke workforce needs to innovate new ways of working. With a lack of stroke physicians, one solution is to advance the role of stroke specialist nurses through structured programs of training and development that will enable them to take on clinical roles traditionally performed by the physician workforce.

Background

Roles such as the United Kingdom's Advanced Clinical Practitioner (ACPs) are pivotal to the healthcare workforce (5) . To develop the capabilities of experienced stroke practitioners that will enable them to work at the ACP level within acute stroke care, the Neurovascular Education and Training in Stroke Management and Acute Reperfusion Therapy (NET SMART®) Advanced Practice (AP) program was developed as a post-graduate (Masters or Doctorate) fellowship and first implemented in the United States in 2008. The program combines standardized didactic content and clinical practice procedures, delivered through web-based training modules and face-to-face teaching, supported by a local clinical mentor. Successful completion of the course requires demonstration and integration of clinical competence and knowledge which is validated in an on-site clinical testing session by program faculty after all learning modules have been successfully completed. Additionally, the Association of Neurovascular Clinicians (www.anvc.org) offers a culminating certification credential, the Advanced Neurovascular Practitioner (ANVP) for those successfully completing the NET SMART®-AP program or a similar fellowship.

NET SMART®-AP was conceived in the U.S.A. to develop advanced practice providers (APPs) capable of working alongside stroke physicians in expanded roles at the point of stroke diagnosis and decision-making for time-critical reperfusion therapy. Use of APPs in these roles have demonstrated improved thrombolysis treatment rates at enrolling hospital stroke centers in the U.S.A (6). The NET SMART®-AP program content has been expanded to ensure applicability to stroke services beyond the U.S.A. and has been successfully implemented in Canada, the UK, Australia, and New Zealand. The NET SMART®-AP course and training were implemented for the first time in the UK in 2012, and to date the program has graduated over 140 APPs worldwide. However, despite successful uptake internationally, the experience and impact of completing the NET SMART®-AP program has not been formally evaluated across countries. This study aimed to understand the experience of stroke nurses and their mentors undertaking NET SMART®-AP and explore the impact at an individual, team and organizational level, nationally and internationally. The purpose of this study is to inform implementation of advanced stroke nursing knowledge and skills into clinical practice.

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METHODS

Design

The study used a qualitative exploratory approach and semi-structured interviews for data collection. Ethical approval was obtained in June 2017 [REC Reference 18/HRA/0119]. We used the consolidated criteria framework for reporting qualitative studies (COREQ) (7).

Participant recruitment

Criteria for participating in the study were: (i) stroke nurses who had completed NET SMART®-AP; (ii) stroke nurses who had registered, but not completed, the NET SMART®-AP course; (iii) local course mentors; (iv) managers of staff completing NET SMART®-AP. To maintain confidentiality and blinding, NET SMART®-AP students were approached and invited to participate via an email invitation, which included a participant information sheet from the NET SMART®-AP program director. Those interested in taking part contacted the research team directly. Mentors and managers were approached and invited to take part by the research team. Verbal and written informed consent were obtained from each participant ahead of interviews.

Data collection

Interview schedules were developed based on the Theoretical Domains Framework (TDF (8)). The TDF is used to understand health professional behavior by providing a theoretical lens through which to view the cognitive, affective, social and environmental influences on behavior and implementing healthcare interventions. The TDF encompasses 14 domains: knowledge; skills; social/professional role and identity; beliefs about capabilities; beliefs about consequences; goals; intentions; memory, attention and decision processes; optimism; reinforcement; environmental context and resources; social influences; emotion; and behavioral regulation.

Data collection occurred between February to August 2018. One-to-one, semi-structured interviews were conducted by two Research Assistants independent from the training course (EJH, female, PhD, background in Psychology; SL, male, MSc in Psychology) both with training and experience in conducting qualitative research interviews. Interviews lasted between 20-55 minutes were held via video-call or telephone and were audio-recorded and transcribed. Interviewees reviewed their transcript ahead of analysis to ensure accuracy.

Data analysis

Data were analysed using the TDF in NVivo 12.0 and interpreted thematically (9). Two researchers independently coded anonymized transcripts (EJH, SL), double coding approximately a third. Coding and interpretation were independently assessed by two further researchers (CEL, RG; both health researchers and registered nurses). Relevant themes were identified, and discussions were held if there were disagreements to agree on appropriate themes. Authenticity was maintained through use of participant quotes to support readers in understanding participants' experiences.

RESULTS

A total of 19 individuals who had completed, mentored or managed others through NET SMART®-AP participated in an interview. Eleven APP interviews were conducted with nurses working in U.S.A. (n=6), U.K. (n=4) and Australia (n=1). All had fully completed the program. No staff were recruited that had partly-completed the program. Four NET SMART mentors and one service manager were interviewed, all of whom held UK-based physician roles.

The TDF domains that were relevant in the data were: goals, skills, knowledge, beliefs about capabilities, environmental context and resources, social and professional role

and identity, social influences, behavioral regulation, and beliefs about consequences. Four key themes emerged from these domains including 1) The learning journey; 2) Organizational and professional change, 3) What hindered the learning journey? and, 4) What helped the learning journey?

Theme 1: The Learning Journey

Subtheme 1: Motivations for Completing the Course; TDF Domain: Goals

All APPs expressed their desire to further develop stroke-specific knowledge and skills, and to increase their role confidence, and they felt NET SMART®-AP would help them achieve that. When asked their reasons for undertaking the training, one explained,

"*To enhance my skills, increase my knowledge, but to gain a bit of credibility, that yes, I'm specifically stroke trained, we've got those skills."* **UK APP 01.01.003**

Mentors and the manager wanted APPs to increase their knowledge and skills through completion of the training. The manager hoped the training would lead to upskilling nursing staff and aid leadership skills development.

"To promote their independence in working, to promote their leadership skills, to redevelop them as trainers themselves, to give them the skills that they then can pass down to train other people." **UK Manager 03.01.001**

Subtheme 2: Course Content

TDF Domain: Knowledge

APPs found the course content was more advanced than anticipated. Some described that before starting the training they felt they had a good knowledge of stroke, however seeing the content of the course raised their awareness of their knowledge gaps. Despite initially feeling overwhelmed, after completing the training they felt the higher level of learning was beneficial. APPs suggested the learning provided a structure: both for their learning and their clinical practice, which they described as not usually provided in nursing courses.

"*Doing the training is the difference between learning somebody else's practice habits, because you are partnering with somebody and learning the ropes through that partner, versus having an academic-based understanding that's organized and structured to give you a workflow understanding of what it is you are doing and why you are doing it."* **US APP 01.02.001**

Mentors were similarly surprised at the advanced nature of course materials. Some mentors felt in the future that it may be worthwhile to divide the course content into different levels to allow staff to recap on basic nursing skills, as well as covering higher-level skills and knowledge. This may be helpful to staff who wish to achieve different levels of qualifications in a manageable format.

"I think some of the content, I actually thought was quite advanced for the nursing. I think they managed it, but some of the feedback and some of the comments were that it was fairly advanced." **UK Mentor 03.01.001**

Theme 2: Organizational and Professional Change; TDF Domains: Social and Professional Role Identity, Social Influences, Behavioral Regulation, Beliefs About Consequences

While all APPs felt they had increased their stroke-specific knowledge and skills, there were differences in the nurses' ability to implement these skills in clinical practice. U.S.A.-based APPs described their ability to work independently to assess and administer emergency stroke care following NET SMART®-AP completion. Conversely, all APPs, mentors and

managers from the UK or Australia described themselves, or their students, as not as independent as anticipated. They felt professional resistance may account for this difference, with wider clinical staff unable to accept the advanced role of nurses or their capability for new nursing roles with greater responsibility. One APP described,

"*There is a lack of understanding of what you are capable of. Or people expect you to be able to do stuff but actually they are not really that interested because you're not a doctor, you're a nurse, so we'll ask a doctor, and that can be a bit insulting."* **UK APP 01.01.004**

"I think obviously there are a lot of different service barriers and acuity barriers and role barriers that prevent us taking that leadership that one step further." **UK Mentor 03.01.001**

This was further compounded when team members with the same job role had completed NET SMART®-AP yet were not allowed to work at a higher level than their colleagues who had not; new advanced practice roles had to be created. APPs highlighted that the lack of recognized accreditation of the course within their country exacerbated these issues, and some clinical coworkers failing to value their new knowledge and skills.

All mentors felt their NET SMART role fitted within their responsibility to supervise and educate staff and reported satisfaction in carrying out the role.

Across all groups, the role of peer-support was discussed. UK-based APPs described the value of having contact with peers for ongoing support and motivation. They felt this was particularly relevant as training was often online leaving little opportunity for contact with others as compared to classroom-based learning. A network of support was not established for mentors; however, mentors suggested this as desirable going forwards.

Managers and mentors described secondary and unexpected outcomes. One mentor described the consequence of promoting interactions with clinicians beyond enabling thrombolysis, which led to an increased sense of trust and confidence in the APP's capacity following completing NET SMART®-AP. They felt that empowering nurses through NET SMART®-AP led to the development of leadership skills, creating a 'ripple effect' whereby the APP nurse was able to pass on their new skills and knowledge to the wider team.

"*Whatever was said earlier, he managed to get it infused into his colleagues afterwards, not exactly from the course but actual knowledge-based part of it. But the way he learned, he managed to pass it on to others.*" **Mentor M3.01.002**

Theme 3: What Hindered the Learning Journey? TDF Domain: Environmental Context and Resources

Graduates identified several barriers to completing NET SMART®-AP and implementing their learning. The time commitment meant that APPs often had to study at home, but this was offset by the flexibility to work at their own pace. APPs commented that individuals required self-discipline and motivation to ensure timely completion of the course. Time was also a limiting factor for managers and mentors, affecting their ability to provide support and guidance, particularly for fellows who were completing out-of-hours shifts.

The hospital environment also impacted course completion. APPs based in hospitals with fewer patients described having less opportunity to be involved in procedures, for example reviewing imaging.

"*There was quite a lot on imaging and localization you learn but looking at images you do have to absorb yourself in it and I wasn't getting that kind of exposure*

in the same way that [others in the course] were. Because they were seeing patients on a day-to-day basis, reviewing scans of everyone on ward rounds. I did find it hard." **UK APP 01.01.001**

One manager described that the significant increase in demand for healthcare services over the winter months meant that APPs were regularly required to provide support on the ward which reduced their learning opportunities.

Theme 4: What Helped the Learning Journey? TDF Domains: Social and Professional Role Identity, Social Influences, Environmental Context and Resources

Several factors were identified as facilitating completion of the course or implementing learning. Firstly, APPs described the importance of a supportive team. One APP described,

"*I think that it's key to have some sort of supportive environment that has the capability of supporting the learner in the areas that they need more help with."* **US APP 01.02.001**

APPs reported that completing an external placement, where they could demonstrate their clinical skills and competencies was a fantastic opportunity. They felt that working alongside teams with qualified APP nurses allowed them to observe their work in practice, allowing comparison of clinical practice and healthcare systems. This gave them the confidence to change how they worked within their own team. UK APPs described that completing a U.S.A. clinical placement allowed them to apply the theoretical skills they had learned, which they could then implement in clinical practice on return to their institution.

Staff who received funding to complete NET SMART®-AP reported this as a facilitator. They felt that without financial support, it may not have been possible to participate.

Finally, staff reported wider and perhaps unanticipated benefits to completing NET SMART®-AP. APPs had developed professional networks with individuals from clinical and academic settings nationally and internationally. They felt that the training instigated networking opportunities and built their confidence to establish these relationships. Others described that following completion of NET SMART®-AP, they had progressed within their careers and were able to take opportunities that otherwise would not have been available.

"*It has given me opportunities that I wouldn't have had otherwise. It has made a huge impact on my professional life with presenting, writing and publishing. Being able to be a part of a ground-breaking research project such as the mobile stroke unit that we have going on because I actually was recruited for that position. So, it was just an honor and it never would have happened had I not had that education."* **US APP 01.02.005**

Managers expressed that a shared agreement across team managers to support the nurses undertaking NET SMART®-AP acted as a facilitator. This mutual agreement made practical changes possible, such as allowing staff to alter shifts, or for extra staff to work in clinics enabling APP nurses to engage in specific aspects of training, while minimizing disruption.

DISCUSSION

The primary aim of NET SMART®-AP was to build confidence and capabilities in nurses to provide emergency stroke assessment and interventions. Our study found that experienced senior nurses participating in NET SMART®-AP reported overwhelming skill development and professional growth. This was confirmed by their mentors and managers. Managers felt the program was worthwhile given the time and level of support

required, and the overall improvement in services and benefit to patients. NET SMART®-AP served to standardize the required knowledge level expected of an APP working in acute stroke. However, our findings indicate that despite expanding their stroke-specific knowledge and skills and increasing their confidence, nurses faced systemic challenges in implementing their learning, particularly outside the U.S.A.

We found that U.S.A.-based nurses were more likely to have applied their new skills within their role or had advanced to a position where they could implement their skills following program completion. However, while U.S.A.-based APPs watched their careers flourish, UK and Australia-based staff experienced barriers including professional resistance, where nurses were reluctant to accept their advanced preparation, while other disciplines were reluctant to allow role expansion. In particular, course graduates based outside of the U.S.A. felt that other professions did not appreciate the value of APPs regardless of their knowledge and skills. This suggests an ethical dilemma, whereby upskilling as acute stroke nursing experts is not valued, or perhaps respected. This problem is seen across various countries for APPs (10), and raises the question of why professional roles should be limited, and who should set those limits. While there may be obvious concerns for patient care, when staff who are shown to be capable and safe to practice "who" should decide the limit of knowledge and learning? Ironically, it is arguably true that when all professions are optimally educated and trained, bringing this higher skill to the bedside is likely to improve patient outcomes.

Additional barriers to implementing NET SMART®-AP skills included the lack of appropriate role and context to work within, particularly for those outside the U.S.A. We found that one UK-based APP was able to progress in the APP role, being added to the on-call rotation for telestroke assessments, while another, based within a neighboring NHS Trust, struggled to find a role on the same level and in effect required a position to be created. This finding is perhaps reflective of an organizational limitation. Similar findings occurred in another NHS healthcare leadership program, which found 61% of staff had changed roles following program completion, with three quarters of these stating this was to take on a more senior role (11).

Placement difficulty may in part be explained by variations in how APPs are defined, increasing recruitment challenges and limiting support and professional development (12). One explanation for these variations may be the way in which the role has been developed historically. APP roles were established in the U.S.A. and Canada in the 1960s, and are now well-established and regulated, with a requirement of a Master's degree to begin training and a protected role title on completion. However, in the UK, APP roles have existed since the 1980s and there are inconsistencies in APP educational requirements, competencies, (10) and role title (13). While some clarity is provided through a framework published by Health Education England (5), prior to this, the development of APP roles has often lacked standardization and has instead been locally driven. To date, although work has been undertaken to establish credentialing for APPs in emergency care (14), there is no national regulatory body for UK-based APPs which may exacerbate the lack of standardization. One solution is to require APPs working in stroke care to sit a certified examination, such as ANVC's internationally recognized, ANVP certification. The ANVP certificate ensures graduates are capable of working safely within their advanced expanded role, holding expert clinical practice skills.

One unanticipated benefit of those completing the UK-based NET SMART is the ongoing support networks which have

been maintained. Although initiated as part of peer-support for course participants, we found that even years after completing the course, APPs remained in contact for support and advice.

Limitations

This study has limitations. Firstly, those staff who were interviewed who had completed NET SMART®-AP were all nurses; therefore, we cannot account for the experience of other health professionals such as physician assistants, which may have been quite different. Secondly, only a small number of interviews were conducted with staff who had completed NET SMART®-AP. Although all known staff were invited to take part, including those who failed to complete the course, some had changed jobs and their contact details were invalid. Without hearing the experiences of nurses who did not complete the course, we cannot understand the full extent of the barriers faced. Another weakness of the study relates to the time between completion of NET SMART®-AP and interview participation; there was a lag between completing the training, or mentors'/managers' students completing the training and the interview. Interviews were relying on staff recollections that may be less accurate.

CONCLUSION

We found that NET SMART®-AP improved nursing knowledge and skill in acute stroke care and increased confidence in extending their role. The training had the potential to allow experienced nursing staff to take on higher-level roles in acute stroke care. However, there are stark differences in the application of APP roles. APPs in the U.S.A. were able to flourish in their career and accessed opportunities not otherwise available. UK or Australia-based nurses at times met organizational barriers. In the UK this experience varied across NHS Trusts. Some nurses experienced resistance to the role from other professions, which limited their ability to incorporate their APP role in clinical practice. Standardization of UK APP roles may be facilitated through agreed regulatory and educational requirements, which may in turn increase acceptance from wider professions. It remains unclear why some physicians or nurses would want to restrict the knowledge of nurses seeking role advancement and improving patient care.

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Conflict of interest statement

The authors report no conflicts.

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Resource Sharing

The data used and analysed during this study are available from the corresponding author on reasonable request and ethics board approval.

References

1. Johnson CO, Nguyen M, Roth GA, Nichols E, Alam T, Abate D, et al. Global, regional, and national burden of stroke, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Neurology*. 2019;18(5):439-58. 10.1016/S1474-4422(19)30034-1
2. The Health Foundation, The King's Fund, Nuffield Trust. The health care workforce in England: Make or break? Nuffield Trust; 2018. 1-14. Accesed May 2, 2023. https://www.nuffieldtrust.org.uk/sites/default/files/2018-11/health-foundation-king-s-fund-and-nuffield-trust-the-health-care-workforce-in-england.pdf.
3. Burton A. How do we fix the shortage of neurologists? *The Lancet Neurology*. 2018;17(6):502-3. 10.1016/S1474-4422(18)30143-1
4. Adams HP, Biller J. Future of Subspecialty Training in Vascular Neurology. *Stroke*. 2014;45(12):3730-3. 10.1161/STROKEAHA.114.006318
5. Health Education England. Multi-professional framework for advanced clinical practice in England. Health Education England; 2017. 1-23. Accesed May 2, 2023. http://allcatsrgrey.org.uk/wp/download/education/medical_education/continuing_professional_development/HEE-ACP-Framework.pdf.
6. Alexandrov AW, Baca T, Albright KC, DiBiase S, Alexandrov AV, for the NET SMART Faculty and Fellows. Post-graduate academic neurovascular fellowship for advanced practice nurses and physician assistants significantly increases tPA treatment rates: Results from the first graduating class of the NET SMART program. *Stroke*. 2011;42(1):e206.
7. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007;19(6):349-57. https://doi.org/10.1093/intqhc/mzm042
8. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science*. 2012;7(1):37. 10.1186/1748-5908-7-37
9. Braun V, Clarke V, Hayfield N, Terry G. Thematic Analysis. In: Liamputtong P, editor. *Handbook of Research Methods in Health Social Sciences*. Springer Singapore; 2019: 843-60. Accessed May 2, 2023. https://doi.org/10.1007/978-981-10-5251-4_103.
10. Delamaire M-L, Lafortune G. Nurses in Advanced Roles: A Description and Evaluation of Experiences in 12 Developed Countries. *OECD Health Working Papers*. 2010;54(1):1-107. https://doi.org/10.1787/5kmbrcfms5g7-en
11. Ipsos MORI Social Resarch Institute prepared for the NHS Leadership

Academy. Elizabeth Garrett Anderson Programme: Evaluation of Intake One and Two - Final Report. NHS Leadership Academy; 2017. 1-110. Accesed May 2, 2023. https://www.leadershipacademy.nhs.uk/wp-content/uploads/dlm_uploads/2019/08/A78-EGA-Evaluation-%E2%80%93-Ipsos-Mori.pdf.

12. Evans C, Pearce R, Greaves S, Blake H. Advanced Clinical Practitioners in Primary Care in the UK: A Qualitative Study of Workforce Transformation. *Int J Environ Res Public Health.* 2020;17(12):4500. 10.3390/ijerph17124500

13. Leary A, Maclaine K, Trevatt P, Radford M, Punshon G. Variation in job titles within the nursing workforce. *Journal of clinical nursing*. 2017;26(23-24):4945-50. 10.1111/jocn.13985

14. Crouch R, Brown R. Advanced clinical practitioners in emergency care: past, present and future. *British Journal of Hospital Medicine*. 2018;79(9):511-5. 10.12968/hmed.2018.79.9.511

Hospital-to-Hospital Transfer Delays in Hyperacute Stroke: Known Causes and Gaps in Knowledge

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Abstract

Background

Transfer challenges from primary stroke centers and acute stroke ready hospitals (PSC/ASRH) to a higher level of care are excessive. This narrative review examines the published literature for factors within and external to PSC/ASRH emergency departments that contribute to delays in the transfer of large vessel occlusion (LVO) patients to a higher level of care for thrombectomy.

Methods

A review of the literature was conducted incorporating findings from January 1996 to April 2020. Reference software was utilized to organize and track references. Retrieved papers were screened first by abstract to eliminate non-pertinent studies; papers selected for full review were then fully examined for relevance, and those retained were subsequently divided into thematic groups based on content.

Results

Guideline standardization of intrahospital practices and associated performance metrics, along with prehospital provider education and training have contributed to improved acute stroke service efficiency. Factors associated with transfer delays have not been identified nor quantified, yet delays contribute to significantly worse patient outcomes. Calls for bypass of lower levels of care with direct transport to CSC are fueled primarily by assumptions of poor PSC/ASRH internal performance.

Conclusions

Although transport delay times have been quantified as excessive, the reasons for delays are not fully understood. Additional research is warranted to fully understand why delays occur.

INTRODUCTION

Stroke remains a leading cause of disability[1] worldwide and can be physically, financially and, socially devastating.[2,3] Recent advancements in acute treatment by mechanical thrombectomy have been shown to improve patient outcomes for large vessel

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occlusion (LVO) ischemic stroke patients out to 24 hours from symptom onset in select cases.[4–7] However, for most patients treatment remains time-dependent[8–12] and, now more than ever developing efficient stroke systems of care capable of rapid interfacility transport is of utmost importance.

Best practice within a stroke system includes prioritizing LVO transfer to the most appropriate facility since delays in transport have been associated with poor patient outcomes.[8,10,12–17] However, standardized guidelines have not been established to support change throughout the entire system of care that would ensure rapid transport, instead favoring the transport of suspected acute stroke patients to the nearest Stroke Center hospital.[18–21] Furthermore, factors causative of delayed patient transfer from Primary Stroke Centers (PSC) to Comprehensive Stroke Centers (CSC) have not been well defined by credentialing organizations or guideline developers. Despite lack of study and accrediting organization guidance, it is often assumed that slow emergency department processes within the PSC are the primary contributor to delayed transport.[13,14,16,22,23] It can be argued that without a thorough understanding of all potential contributors to transport delay, strategies that aim to reduce them cannot be developed with any degree of precision. Therefore, this review examines the published literature to identify factors within and external to transferring facilities located in the United States that contribute to delays in the transfer process in an effort to frame the design of future study and the crafting of interventions capable of improving performance of stroke systems of care.

Methods

A narrative review of the literature on stroke system transfer delays was performed utilizing published articles between January 1996 and April 2020. Zotero was utilized to organize and track references. The publication date was established to include the time following publication of the NINDS rt-PA Stroke Study in the *New England Journal of Medicine* in December 1995; these dates ensured capture of pertinent systems of care developments associated with reperfusion therapy, and known methods to optimize systems of care, as well as allowing analyses of apparent gaps in knowledge about systems contributors that may account for transfer delays. Search terms were selected using PubMed and included: *Stroke* AND *large vessel occlusion* AND *stroke protocol*; *transfer* AND *delay* AND *emergency* NOT *pediatrics*; *emergency medical services* AND *stroke* AND *transfer*. Retrieved papers were screened first by abstract to eliminate unrelated studies; papers selected for full review were then fully examined for relevance, and those retained were subsequently divided into thematic groups based on content.

Results

Resource Availability is Associated with Improved Stroke Outcomes

Variations in patient outcomes are related to the availability of resources such as vascular neurologists, dedicated stroke units, and the availability of endovascular therapies.[1,3–5,8–14,24–26] This finding is consistent with the initial recommendations by the NINDS rt-PA Study Investigators who in 1996 first suggested the need for *Stroke Centers* development using a similar model to that of Trauma Center credentialing.[27] In 2000, the Brain Attack Coalition was the first to recommend specific resources that should be required by Stroke Centers, delineating center level by resource capabilities.[19–21] Regulatory agencies including The Joint Commission and later Det Norske Veritas led

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the development of formal credentialing processes for Stroke Center hospitals. Since its initiation in 2003, the Stroke Center Certification process has developed multiple credentialing levels based on resource availability. The evolution of evidence-based process metrics for acute stroke has been woven into the fabric of Stroke Center performance and contributes to practice standardization that benefits patient outcomes.[28]

Organizational certification as a Stroke Center has been associated with improved hospital performance and with patient care standardization supported by acute stroke performance metric benchmarking; ultimately Stroke Center certification has been shown to lead to improved patient outcomes and important reductions in complications.[29,30] Registry systems have evolved to include standard stroke performance metrics, and participation in a national stroke registry that offers performance benchmarking is now a Centers for Medicare and Medicaid Services (CMS) requirement for Stroke Centers.

Prehospital Emergency Medical Services (EMS) Personnel Education and Training is Associated with Improved Stroke Outcomes

Prehospital providers are tasked with the initial responsibility of ensuring fast and appropriate triage of suspected stroke patients to Stroke Centers.[31–36] State regulatory requirements for ambulance personnel routinely include annual education and training on stroke identification and prehospital stroke scales are commonly used by ambulance personnel to assist in the early identification of stroke patients. Guidelines have evolved to specify the type of care that emergency responders should include in their management of stroke patients (i.e. avoidance of glucose-based IV solutions, maintaining nil per os status, etc.), while also mandating collection of essential assessment data including the medical history, medications, and *time last known well*.

Some professional guidelines recommend transport to the closest Stroke Center, whereas some more recent guidelines advocate using what is referred to as *LVO clinical* scales to determine the appropriate level of Stroke Center for patient transport. While the use of LVO scales has the potential to improve field triage of stroke patients to centers with appropriate resources, overall they lack precision in LVO detection, with 20% of patients on average not actually having an LVO.[37] Additionally, EMS compliance with the use of LVO protocols is inconsistent[23] and this may be due to high rates of turnover,[31,38,39] or a failure to understand how best to perform the more complex assessment components within these scales.[40,41] Accurate EMS dispatch and on-scene EMS recognition of stroke symptoms have been shown to improve patient outcomes by reducing scene time and offering prehospital notification, resulting in faster emergency department arrival to initial head computed tomography (CT) times.[42] Few states have developed protocols to bypass hospitals with limited resources. However, in many states, no guidelines for stroke-specific transport exist; therefore, patients are transported to the facility of their choice,[43] even if this facility is incapable of managing acute stroke patients. Given that EMS diagnostic accuracy is modest, ambulance transport of suspected stroke patients to the wrong level of stroke services may result in significant delays in the provision of definitive disability-reducing and life-saving care.[23,44]

The use of mobile stroke units (MSU) has recently been associated with appropriate and accurate ambulance triage of stroke patients than the use of LVO scales. Additionally,

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MSU patient management has been shown to improve 3-month outcomes in patients treated with alteplase.[45,46] However, MSUs are not widely available across throughout America and the world. Currently, researchers are attempting to find a reliable tool to aid early detection of stroke and appropriate allocation of resources, including exploration of telemedicine cameras within regular EMS ambulances to improve scene clinical assessment[47] and stroke biomarker testing[48] that may direct early field treatment.

Prehospital transfer delays have been associated with worse outcomes after trauma, stroke, and, myocardial infarction.[22,49–57] In contrast, the use of care algorithms have been shown to streamline care and improve outcomes. The American Heart Association initiated *Mission: Lifeline* to enhance systems processes and ultimately improve the quality of care delivered to patients suffering life-threatening events such as ST-segment elevated myocardial infarction (STEMI), non-ST segment elevated myocardial infarction (NSTEMI), and out of hospital cardiac arrest. These programs incorporated a multi-team approach to cardiac care and stressed the importance of providing seamless care to those needing it most. The *Mission: Lifeline* initiative also called for additional metrics to eliminate time delays and defined expected transfer times of less than one-hundred and twenty minutes. In comparison, programs supporting acute stroke patients currently only include the *door-in door-out* (DIDO) metric, although it lacks detail allowing it to capture reasons for delay; because of this, today, no quality metrics exist to promote an understanding of contributors to transfer delays in LVO patients.

Internal Emergency Department System Efficiencies

Reduction in the transport and treatment times within the STEMI population relied on several factors including infrastructure, logistics, and operation of the interprofessional teams.[58–62] In 2006, Saver quantified neurons at risk of death when reperfusion is delayed, estimating that approximately 1.9 billion neurons are lost with each minute that passes.[63] Over the past 28 years since approval of alteplase intravenous thrombolysis for stroke, emergency department teams have improved internal performance efficiency, moving diagnosis and treatment times from a 60 minute goal, to less than a 30 minute goal.[64,65] Zachrison and colleagues examined the benefits of hospitals working together to create a synergistic, high-functioning stroke system of care, showing that when relationships are built between transferring and receiving hospitals, that this strengthened communication and positively impacted the quality of care.[24] As Saver's work suggested,[63] clearly every second counts when it comes to diagnosis and emergent management of acute stroke patients.

The DIDO Movement

The negative impact of being transferred from one facility to another includes higher morbidity and mortality rates. The DIDO metric aims to capture the time from entry into a lower level of care hospital to the time that the patient leaves with a transport service for the higher level of care hospital. Measurement of DIDO has gained momentum since 2019 within American Stroke Centers, although clear reasons for long DIDO times remain evasive. The average time reported for stroke patients to be transferred from lower to higher levels of care for thrombectomy is 180 minutes on average,[66] with interfacility transfer causing at least a 100 minute delay to start of thrombectomy.[67] With the quality metric for emergency department arrival to diagnosis and door to needle time moving to under 30 minutes, recommendations for transfer or

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DIDO times within no more than 40 minutes have been proposed.[68] Primary Stroke Center protocols have been developed to enable early vessel imaging; additionally, cloud-based artificial intelligence-supported neuroimaging transfer with both originated PSC hospitals and affiliated CSC providers facilitates early diagnosis and transport mobilization to improve DIDO times.[8] But, a significant gap in knowledge of what contributes to delays up to 180 minutes[12,66,67,69] exists, with no objective data available on stroke transfer delays in the published literature.

In elective transfers of non-traumatic surgical patients, delays have been attributed to clinical decision-making regarding the transfer indication, administrative issues, and bed availability. Lack of health insurance has also been found to be an independent risk factor for inter-facility transfer delay in patients with STEMI.[70] While little is known about causes of DIDO delays in acute stroke patients, recommendations for PSC bypass with direct ambulance transfer of all suspected stroke patients to a CSC have been made.[60,71]

Discussion

This review shows that strategies including standardized performance guidelines, quality metrics, paramedic education and training, mobile stroke units and potentially other evolving technologies including artificial intelligence-supported neuroimaging are facilitating improved early diagnosis and treatment. Additionally, the significant risk to health associated with the need for inter-facility transfer is well known, as are the very real delays that are currently experienced by patients.[72–74] However, a large gap remains in understanding contributors to delayed transfer from lower levels of stroke services to CSC hospitals, with many assuming faults lie solely within the transferring hospitals.[66,67,69]

As advances in stroke care evolve, so will the need for optimization of stroke systems of care. With recent recommendations suggesting that the time from hospital arrival to departure for a higher level of care should not exceed 60 minutes, knowledge of specific barriers to efficient transfer must become known; without this knowledge, methods capable of driving improvement cannot be created or effectively tested. Rapid transfer of interventional cardiology patients targets an aggressive 30-minute DIDO time; similar targets could ultimately be extended to include LVO patients and other critical stroke emergencies such as intracerebral and subarachnoid hemorrhage. Yet even the cardiac literature fails to identify and quantify the contribution of systemwide barriers to achievement of this aggressive 30-minute goal, although DIDO times greater than 30 minutes have been associated with a 5.5% increase in the risk of in-hospital mortality in patients with STEMI transferred for PCI.[75]

While Stroke Center performance has significantly benefitted from the processes identified in this review, DIDO times remain quite long. Whether complete ambulance bypass of lower level Stroke Centers is needed, with redistribution of 100% of suspected strokes to CSC remains unknown, yet there is a growing call for this among neurointerventionalist physicians.[41,76] The consequences of stroke ambulance bypass would create the need for significant resource redistribution away from PSC hospitals to CSC hospitals, including physician, nurse, and therapist manpower, along with an additional allocation of hospital beds to manage this shift in volume. Additionally, since a large volume of stroke patients may not require CSC-level services, bypass could displace a significant number of patients that

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may have been able to receive evidence-based acute stroke services closer to their homes. A redistribution of resources away from PSC hospitals would also likely result in the complete removal of stroke services from these centers altogether, and this could devastate patient care for stroke patients that arrive in err to a hospital lacking resources and manpower to emergently respond to stroke symptoms. Given that approximately 45% of patients arrive to hospitals in private automobiles[77] instead of calling for emergency ambulance response, the potential that the wrong hospital could be selected for acute stroke patient transport is very likely.

This review suggests that contributors to DIDO delays are likely multifactorial existing within transferring centers' emergency departments, telemedicine responders, transport agencies, and receiving CSC hospitals. Furthermore, public policy may contribute to transfer delays by mandating requirements for transport providers, such as critical care certified paramedics for transfer of LVO and/or intravenous thrombolysis-treated patients which may not be widely available; this calls into question the need for CSCs to maintain their own ground and/or air transport services staffed by stroke specialists or MSUs, adding additional complexity and expenses for CSC hospitals. Shortages of specialty stroke-trained nurses and physicians at both the transferring and receiving hospital sites may also be a contributor, as treatment with vasoactive medications or thrombolytics requires expertise to prescribe and oversee management, including during the actual transport process. Additionally, bed availability within CSCs themselves is often contingent upon the availability of both nurse staffing and inpatient bed availability, and therefore may limit the availability of higher-level services. While we need to fully understand the implications associated with hospital bypass, we also need to know how, when, and why barriers to streamlined transfer exist.

Conclusions

For almost 3 decades, hyperacute stroke diagnosis and treatment have demanded improved attention to treatment times supported by highly efficient services, and while recent work suggests that advanced imaging can expand treatment time windows overall, improved outcomes are associated with rapid reperfusion.[78] Knowledge is lacking about why transfer delays occur for acute stroke patients. Operating on assumptions that slow internal PSC processes are the chief cause of transfer delays despite findings show significant improvements in diagnosis and treatment efficiencies, seems illogical. Research is necessary to fill the gap in knowledge that limits our understanding of contributors to transfer delay, so that interventions may be developed and tested to improve the seamless management of all components within stroke systems of care.

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References

1. Campbell BCV, Khatri P. Stroke. *The Lancet*. 2020;396(10244):129-142. doi:10.1016/S0140-6736(20)31179-X
2. Rajsic S, Gothe H, Borba HH, et al. Economic burden of stroke: a systematic review on post-stroke care. *Eur J Health Econ HEPAC Health Econ Prev Care*. 2019;20(1):107-134. doi:10.1007/s10198-018-0984-0
3. Shavelle RM, Brooks JC, Strauss DJ, Turner-Stokes L. Life Expectancy after Stroke Based On Age, Sex, and Rankin Grade of Disability: A Synthesis. *J Stroke*

Cerebrovasc Dis Off J Natl Stroke Assoc. 2019;28(12):104450. doi:10.1016/j.jstrokecerebrovasdis.2019.104450

4. Biggs D, Silverman ME, Chen F, Walsh B, Wynne P. How should we treat patients who wake up with a stroke? A review of recent advances in management of acute ischemic stroke. *Am J Emerg Med*. 2019;37(5):954-959. doi:10.1016/j.ajem.2019.02.010
5. Saver JL, Goyal M, Lugt A van der, et al. Time to Treatment With Endovascular Thrombectomy and Outcomes From Ischemic Stroke: A Meta-analysis. *JAMA*. 2016;316(12):1279-1289. doi:10.1001/jama.2016.13647
6. Albers GW, Marks MP, Kemp S, et al. Thrombectomy for Stroke at 6 to 16 Hours with Selection by Perfusion Imaging. *N Engl J Med*. 2018;378(8):708-718. doi:10.1056/NEJMoa1713973
7. Nogueira RG, Jadhav AP, Haussen DC, et al. Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct. *N Engl J Med*. 2018;378(1):11-21. doi:10.1056/NEJMoa1706442
8. McTaggart Ryan A., Moldovan Krisztina, Oliver Lori A., et al. Door-in-Door-Out Time at Primary Stroke Centers May Predict Outcome for Emergent Large Vessel Occlusion Patients. *Stroke*. 2018;49(12):2969-2974. doi:10.1161/STROKEAHA.118.021936
9. Ali SF, Fonarow G, Liang L, et al. Rates, Characteristics, and Outcomes of Patients Transferred to Specialized Stroke Centers for Advanced Care. *Circ Cardiovasc Qual Outcomes*. 2018;11(9):e003359. doi:10.1161/CIRCOUTCOMES.116.003359
10. McTaggart RA, Yaghi S, Cutting SM, et al. Association of a Primary Stroke Center Protocol for Suspected Stroke by Large-Vessel Occlusion With Efficiency of Care and Patient Outcomes. *JAMA Neurol*. 2017;74(7):793-800. doi:10.1001/jamaneurol.2017.0477
11. Bandettini di Poggio M, Finocchi C, Brizzo F, et al. Management of acute ischemic stroke, thrombolysis rate, and predictors of clinical outcome. *Neurol Sci*. 2019;40(2):319-326. doi:10.1007/s10072-018-3644-3
12. Asif KS, Lazzaro MA, Zaidat O. Identifying delays to mechanical thrombectomy for acute stroke: onset to door and door to clot times. *J Neurointerventional Surg*. 2014;6(7):505-510. doi:10.1136/neurintsurg-2013-010792
13. Mourand I, Malissart P, Dargazanli C, et al. A Regional Network Organization for Thrombectomy for Acute Ischemic Stroke in the Anterior Circulation; Timing, Safety, and Effectiveness. *J Stroke Cerebrovasc Dis*. 2019;28(2):259-266. doi:10.1016/j.jstrokecerebrovasdis.2018.09.051
14. Kodankandath TV, Wright P, Power PM, et al. Improving Transfer Times for Acute Ischemic Stroke Patients to a Comprehensive Stroke Center. *J Stroke Cerebrovasc Dis Off J Natl Stroke Assoc*. 2017;26(1):192-195. doi:10.1016/j.jstrokecerebrovasdis.2016.09.008
15. Shah S, Xian Y, Sheng S, et al. Use, Temporal Trends, and Outcomes of Endovascular Therapy After Interhospital Transfer in the United States. *Circulation*. 2019;139(13):1568-1577. doi:10.1161/CIRCULATIONAHA.118.036509
16. Craig LE, McInnes E, Taylor N, et al. Identifying the barriers and enablers for a triage, treatment, and transfer clinical intervention to manage acute stroke patients in the emergency department: a systematic review using the theoretical domains framework (TDF). *Implement Sci*. 2016;11(1):157. doi:10.1186/s13012-016-0524-1
17. Schlemm Ludwig, Ebinger Martin, Nolte Christian H., Endres Matthias. Impact of Prehospital Triage Scales to Detect Large Vessel Occlusion on Resource Utilization and Time to Treatment. *Stroke*. 2018;49(2):439-446. doi:10.1161/STROKEAHA.117.019431
18. Adeoye Opeolu, Nyström Karin V., Yavagal Dileep R., et al.

Recommendations for the Establishment of Stroke Systems of Care: A 2019 Update. *Stroke*. 2019;50(7):e187-e210. doi:10.1161/STR.0000000000000173

19. Alberts MJ, Latchaw RE, Jagoda A, et al. Revised and Updated Recommendations for the Establishment of Primary Stroke Centers: A Summary Statement From the Brain Attack Coalition. *Stroke*. 2011;42(9):2651-2665. doi:10.1161/STROKEAHA.111.615336
20. Alberts MJ, Latchaw RE, Selman WR, et al. Recommendations for Comprehensive Stroke Centers: A Consensus Statement From the Brain Attack Coalition. *Stroke*. 2005;36(7):1597-1616. doi:10.1161/01.STR.0000170622.07210.b4
21. Alberts MJ, Wechsler LR, Jensen MEL, et al. Formation and Function of Acute Stroke–Ready Hospitals Within a Stroke System of Care Recommendations From the Brain Attack Coalition. *Stroke*. 2013;44(12):3382-3393. doi:10.1161/STROKEAHA.113.002285
22. Middleton S, Levi C, Dale S, et al. Triage, treatment and transfer of patients with stroke in emergency department trial (the T3 Trial): a cluster randomised trial protocol. *Implement Sci IS*. 2016;11. doi:10.1186/s13012-016-0503-6
23. DiBiasio EL, Jayaraman MV, Oliver L, et al. Emergency medical systems education may improve knowledge of pre-hospital stroke triage protocols. *J NeuroInterventional Surg*. 2020;12(4):370-373. doi:10.1136/neurintsurg-2018-014108
24. Zachrison KS, Onnela J-P, Hernandez A, et al. Ischemic Stroke Transfer Patterns in the Northeast United States. *J Stroke Cerebrovasc Dis Off J Natl Stroke Assoc*. 2019;28(2):295-304. doi:10.1016/j.jstrokecerebrovasdis.2018.09.048
25. Threlkeld ZD, Kozak B, McCoy D, Cole S, Martin C, Singh V. Collaborative Interventions Reduce Time-to-Thrombolysis for Acute Ischemic Stroke in a Public Safety Net Hospital. *J Stroke Cerebrovasc Dis Off J Natl Stroke Assoc*. 2017;26(7):1500-1505. doi:10.1016/j.jstrokecerebrovasdis.2017.03.004
26. Rai AT, Seldon AE, Boo S, et al. A population-based incidence of acute large vessel occlusions and thrombectomy eligible patients indicates significant potential for growth of endovascular stroke therapy in the USA. *J NeuroInterventional Surg*. 2017;9(8):722-726. doi:10.1136/neurintsurg-2016-012515
27. Tissue Plasminogen Activator for Acute Ischemic Stroke. *N Engl J Med*. 1995;333(24):1581-1588. doi:10.1056/NEJM199512143332401
28. Reeves Mathew J., Parker Carol, Fonarow Gregg C., Smith Eric E., Schwamm Lee H. Development of Stroke Performance Measures. *Stroke*. 2010;41(7):1573-1578. doi:10.1161/STROKEAHA.109.577171
29. Slivinski A, Jones R, Whitehead H, Hooper V. Improving Access to Stroke Care in the Rural Setting: The Journey to Acute Stroke Ready Designation. *J Emerg Nurs*. 2017;43(1):24-32. doi:10.1016/j.jen.2016.10.006
30. Waldman A, Tadi P, Rawal AR. Stroke Center Certification. In: *StatPearls*. StatPearls Publishing; 2020. Accessed August 19, 2020. http://www.ncbi.nlm.nih.gov/books/NBK535392/
31. Asimos AW, Ward S, Brice JH, Rosamond WD, Goldstein LB, Studnek J. Out-of-hospital stroke screen accuracy in a state with an emergency medical services protocol for routing patients to acute stroke centers. *Ann Emerg Med*. 2014;64(5):509-515. doi:10.1016/j.annemergmed.2014.03.024
32. Kreitzer P. Acute Stroke: From Prehospital Care to In-Hospital Management. JEMS. Published May 2, 2018. Accessed August 19, 2020. https://www.jems.com/2018/05/01/acute-stroke-from-prehospital-care-to-in-hospital-management/
33. Jumaa MA, Castonguay AC, Salahuddin H, et al. Long-term implementation of a prehospital severity scale for EMS triage of acute stroke: a real-world experience. *J*

NeuroInterventional Surg. 2020;12(1):19-24. doi:10.1136/neurintsurg-2019-014997
34. Hastrup S, Damgaard D, Johnsen SP, Andersen G. Prehospital Acute Stroke Severity Scale to Predict Large Artery Occlusion: Design and Comparison With Other Scales. *Stroke*. 2016;47(7):1772-1776. doi:10.1161/STROKEAHA.115.012482
35. Lima FO, Mont'Alverne FJA, Bandeira D, Nogueira RG. Pre-hospital Assessment of Large Vessel Occlusion Strokes: Implications for Modeling and Planning Stroke Systems of Care. *Front Neurol*. 2019;10. doi:10.3389/fneur.2019.00955
36. Michel P. Prehospital Scales for Large Vessel Occlusion: Closing in on a Moving Target. *Stroke*. 2017;48(2):247-249. doi:10.1161/STROKEAHA.116.015511
37. Zhao H, Coote S, Pesavento L, et al. Large Vessel Occlusion Scales Increase Delivery to Endovascular Centers Without Excessive Harm From Misclassifications. *Stroke*. 2017;48(3):568-573. doi:10.1161/STROKEAHA.116.016056
38. Oostema JA, Chassee T, Baer W, Edberg A, Reeves MJ. Accuracy and Implications of Hemorrhagic Stroke Recognition by Emergency Medical Services. *Prehosp Emerg Care*. Published online November 5, 2020:1-6. doi:10.1080/10903127.2020.1831669
39. Mould-Millman N-K, Meese H, Alattas I, et al. Accuracy of Prehospital Identification of Stroke in a Large Stroke Belt Municipality. *Prehospital Emerg Care Off J Natl Assoc EMS Physicians Natl Assoc State EMS Dir*. 2018;22(6):734-742. doi:10.1080/10903127.2018.1447620
40. Lawner BJ, Szabo K, Daly J, et al. Challenges Related to the Implementation of an EMS-Administered, Large Vessel Occlusion Stroke Score. *West J Emerg Med*. 2020;21(2):441-448. doi:10.5811/westjem.2019.9.43127
41. Zhao H, Pesavento L, Coote S, et al. Ambulance Clinical Triage for Acute Stroke Treatment: Paramedic Triage Algorithm for Large Vessel Occlusion. *Stroke*. 2018;49(4):945-951. doi:10.1161/STROKEAHA.117.019307
42. Oostema JA, Chassee T, Reeves M. Emergency Dispatcher Stroke Recognition: Associations with Downstream Care. *Prehospital Emerg Care Off J Natl Assoc EMS Physicians Natl Assoc State EMS Dir*. 2018;22(4):466-471. doi:10.1080/10903127.2017.1405131
43. Brown AT, Wei F, Culp WC, et al. Emergency transport of stroke suspects in a rural state: opportunities for improvement. *Am J Emerg Med*. 2016;34(8):1640-1644. doi:10.1016/j.ajem.2016.06.044
44. Man Shumei, Zhao Xin, Uchino Ken, et al. Comparison of Acute Ischemic Stroke Care and Outcomes Between Comprehensive Stroke Centers and Primary Stroke Centers in the United States. *Circ Cardiovasc Qual Outcomes*. 2018;11(6):e004512. doi:10.1161/CIRCOUTCOMES.117.004512
45. Grotta JC, Yamal JM, Parker SA, Rajan SS, Gonzales NR, Jones WJ, Alexandrov AW, Navi BB, Nour M, Spokoyny I, Mackey J, Persse D, Jacob AP, Wang M, Singh N, Alexandrov AV, Fink ME, Saver JL, English J, Barazangi N, Bratina PL, Gonzalez M, Schimpf BD, Ackerson K, Sherman C, Lerario M, Mir S, Im J, Willey JZ, Chiu D, Eisshofer M, Miller J, Ornelas D, Rhudy JP, Brown KM, Villareal BM, Gausche-Hill M, Bosson N, Gilbert G, Collins SQ, Silnes K, Volpi J, Misra V, McCarthy J, Flanagan T, Rao CPV, Kass JS, Griffin L, Rangel-Gutierrez N, Lechuga E, Stephenson J, Phan K, Sanders Y, Noser EA, Bowry R. Prospective, Multicenter, Controlled Trial of Mobile Stroke Units. N Engl J Med. 2021 Sep 9;385(11):971-981. doi: 10.1056/NEJMoa2103879. Erratum in: N Engl J Med. 2023 Jun

29;388(26):2495-2496. PMID: 34496173.
46. Alexandrov AW, Alexandrov AV. Innovations in Prehospital Stroke Management Utilizing Mobile Stroke Units. *Contin Lifelong Learn Neurol*. 2020;26(2):506. doi:10.1212/CON.0000000000000850
47. Simon LE, BA. Paramedics' Perspectives on Telemedicine in the Ambulance: A Survey Study. JEMS. Published April 30, 2020. Accessed April 3, 2021. https://www.jems.com/exclusives/perspectives-on-telemedicine/
48. Bustamante Alejandro, López-Cancio Elena, Pich Sara, et al. Blood Biomarkers for the Early Diagnosis of Stroke. *Stroke*. 2017;48(9):2419-2425. doi:10.1161/STROKEAHA.117.017076
49. Harmsen AMK, Giannakopoulos GF, Moerbeek PR, Jansma EP, Bonjer HJ, Bloemers FW. The influence of prehospital time on trauma patients outcome: a systematic review. *Injury*. 2015;46(4):602-609. doi:10.1016/j.injury.2015.01.008
50. Dharap SB, Kamath S, Kumar V. Does prehospital time affect survival of major trauma patients where there is no prehospital care? *J Postgrad Med*. 2017;63(3):169-175. doi:10.4103/0022-3859.201417
51. Choi JC, Kim JG, Kang CH, et al. Effect of Transport Time on the Use of Reperfusion Therapy for Patients with Acute Ischemic Stroke in Korea. *J Korean Med Sci*. 2021;36(11):e77. doi:10.3346/jkms.2021.36.e77
52. Feero S, Hedges JR, Simmons E, Irwin L. Does out-of-hospital EMS time affect trauma survival? *Am J Emerg Med*. 1995;13(2):133-135. doi:10.1016/0735-6757(95)90078-0
53. Pepe PE, Wyatt CH, Bickell WH, Bailey ML, Mattox KL. The relationship between total prehospital time and outcome in hypotensive victims of penetrating injuries. *Ann Emerg Med*. 1987;16(3):293-297. doi:10.1016/S0196-0644(87)80174-9
54. Dinh MM, Bein K, Roncal S, Byrne CM, Petchell J, Brennan J. Redefining the golden hour for severe head injury in an urban setting: The effect of prehospital arrival times on patient outcomes. *Injury*. 2013;44(5):606-610. doi:10.1016/j.injury.2012.01.011
55. Fladt Joachim, Meier Nicole, Thilemann Sebastian, et al. Reasons for Prehospital Delay in Acute Ischemic Stroke. *J Am Heart Assoc*. 2019;8(20):e013101. doi:10.1161/JAHA.119.013101
56. Saczynski JS, Yarzebski J, Lessard D, et al. Trends in Pre-hospital Delay in Patients with Acute Myocardial Infarction (From The Worcester Heart Attack Study). *Am J Cardiol*. 2008;102(12):1589-1594. doi:10.1016/j.amjcard.2008.07.056
57. Golden AP, Odoi A. Emergency medical services transport delays for suspected stroke and myocardial infarction patients. *BMC Emerg Med*. 2015;15(1):34. doi:10.1186/s12873-015-0060-3
58. Clemmensen P, Schoos MM, Lindholm MG, et al. Pre-hospital diagnosis and transfer of patients with acute myocardial infarction--a decade long experience from one of Europe's largest STEMI networks. *J Electrocardiol*. 2013;46(6):546-552. doi:10.1016/j.jelectrocard.2013.07.004
59. Bagai A, Jollis JG, Dauerman HL, et al. Emergency Department Bypass for ST-Segment–Elevation Myocardial Infarction Patients Identified With a Prehospital Electrocardiogram: A Report From the American Heart Association Mission: Lifeline Program. *Circulation*. 2013;128(4):352-359. doi:10.1161/CIRCULATIONAHA.113.002339
60. Shi O, Khan AM, Rezai MR, et al. Factors associated with door-in to door-out delays among ST-segment elevation myocardial infarction (STEMI) patients transferred for primary percutaneous coronary intervention: a population-based cohort study in Ontario, Canada. *BMC Cardiovasc Disord*. 2018;18(1):204. doi:10.1186/s12872-018-0940-z
61. Writing Committee Members, Antman EM, Anbe DT, et al. ACC/AHA

Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction—Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction). *Circulation*. 2004;110(5):588-636. doi:10.1161/01.CIR.0000134791.68010.FA

62. Glickman SW, Lytle BL, Ou F-S, et al. Care Processes Associated With Quicker Door-In–Door-Out Times for Patients With ST-Elevation–Myocardial Infarction Requiring Transfer: Results From a Statewide Regionalization Program. *Circ Cardiovasc Qual Outcomes*. 2011;4(4):382-388. doi:10.1161/CIRCOUTCOMES.110.959643
63. Saver Jeffrey L. Time Is Brain—Quantified. *Stroke*. 2006;37(1):263-266. doi:10.1161/01.STR.0000196957.55928.ab
64. Fonarow GC, Zhao X, Smith EE, et al. Door-to-Needle Times for Tissue Plasminogen Activator Administration and Clinical Outcomes in Acute Ischemic Stroke Before and After a Quality Improvement Initiative. *JAMA*. 2014;311(16):1632. doi:10.1001/jama.2014.3203
65. Fonarow GC, Smith EE, Saver JL, et al. Improving Door-to-Needle Times in Acute Ischemic Stroke: The Design and Rationale for the American Heart Association/American Stroke Association's Target: Stroke Initiative. *Stroke*. 2011;42(10):2983-2989. doi:10.1161/STROKEAHA.111.621342
66. Sablot D, Farouil G, Laverdure A, Arquizan C, Bonafe A. Shortening time to reperfusion after transfer from a primary to a comprehensive stroke center. *Neurol Clin Pract*. 2019;9(5):417-423. doi:10.1212/CPJ.0000000000000675
67. Goyal M, Jadhav AP, Bonafe A, et al. Analysis of Workflow and Time to Treatment and the Effects on Outcome in Endovascular Treatment of Acute Ischemic Stroke: Results from the SWIFT PRIME Randomized Controlled Trial. *Radiology*. 2016;279(3):888-897. doi:10.1148/radiol.2016160204
68. Southerland AM, Johnston KC, Molina CA, Selim M, Kamal N, Goyal M. Suspected Large Vessel Occlusion - Should EMS transport to the nearest PSC or bypass to a CSC with Endovascular Capabilities? *Stroke J Cereb Circ*. 2016;47(7):1965-1967. doi:10.1161/STROKEAHA.115.011149
69. Ng FC, Low E, Andrew E, et al. Deconstruction of Interhospital Transfer Workflow in Large Vessel Occlusion: Real-World Data in the Thrombectomy Era. *Stroke*. 2017;48(7):1976-1979. doi:10.1161/STROKEAHA.117.017235
70. Ward MJ, Kripalani S, Zhu Y, et al. Role of Health Insurance Status in Inter-facility Transfers of Patients with ST-Elevation Myocardial Infarction. *Am J Cardiol*. 2016;118(3):332-337. doi:10.1016/j.amjcard.2016.05.007
71. Choi Philip M.C., Tsoi Andrew H., Pope Alun L., et al. Door-in-Door-Out Time of 60 Minutes for Stroke With Emergent Large Vessel Occlusion at a Primary Stroke Center. *Stroke*. 2019;50(10):2829-2834. doi:10.1161/STROKEAHA.119.025838
72. Zerwic J, Hwang SY, Tucco L. Interpretation of symptoms and delay in seeking treatment by patients who have had a stroke: exploratory study. *Heart Lung J Crit Care*. 2007;36(1):25-34. doi:10.1016/j.hrtlng.2005.12.007
73. Sheppard JP, Lindenmeyer A, Mellor RM, et al. Prevalence and predictors of hospital prealerting in acute stroke: a mixed methods study. *Emerg Med J EMJ*. 2016;33(7):482-488. doi:10.1136/emermed-2014-204392
74. Jauch EC, French DM, McGeorge T. Prehospital Stroke Treatment (EMS Stabilization Protocols). In: Ovbiagele B, ed. *Ischemic Stroke Therapeutics: A Comprehensive Guide*. Springer International Publishing; 2016:7-12. doi:10.1007/978-3-319-17750-2_2

75. Wang TY. Association of Door-In to Door-Out Time With Reperfusion Delays and Outcomes Among Patients Transferred for Primary Percutaneous Coronary Intervention. *JAMA*. 2011;305(24):2540. doi:10.1001/jama.2011.862
76. Optimal Transport Destination for Ischemic Stroke Patients With Unknown Vessel Status. doi:10.1161/STROKEAHA.117.017281
77. Patel MD, Rose KM, O'Brien EC, Rosamond WD. Prehospital Notification by Emergency Medical Services Reduces Delays in Stroke Evaluation: Findings From the North Carolina Stroke Care Collaborative. *Stroke*. 2011;42(8):2263-2268. doi:10.1161/STROKEAHA.110.605857
78. Fisher M, Albers GW. Advanced imaging to extend the therapeutic time window of acute ischemic stroke. *Ann Neurol*. 2013;73(1):4-9. doi:10.1002/ana.23744

ANVC 2023 Annual Conference Accepted Abstracts

Innovative Education Strategies

Multidisciplinary System Based Stroke Education for New Nurses

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Background: Caring for stroke patients of varied complexity can be challenging, especially for new-hire nurses. Nurses must develop competence to deliver high quality care and comprehensive patient centered stroke education. Objectives: It was noted that within a 5-region hospital system the process of onboarding new stroke nurses was varied. Stroke education was primarily delivered via Healthstream and not all regions were incorporating a hands-on component. The main objective was to align best practice, reduce redundant online modules and standardize content. The curriculum was developed by subject matter experts (SMEs), including stroke coordinators, nurse educators, speech pathologists, physical and occupational therapists. Methods: Representatives from each region joined a workgroup which focused on creating content to onboard new nurses. The education follows a flipped classroom approach in 4 out of the 5 regions. Upon hire, new nurses complete modules related to the assessment and care of the stroke patient, which provides strong foundational content. Then the nurses precept on the stroke units to gain experience over several weeks. After completing 4 - 6 weeks of direct patient care, nurses return for standardized hands-on education that is delivered collaboratively by the SMEs. The hands-on content includes the swallow screening process, NIHSS simulation, educating stroke patients, Alteplase reconstitution/administration and early mobilization. Results: Posttest surveys are given to assess retained knowledge/overall experience. Data collection is ongoing at this time. Conclusion: Standardized multidisciplinary stroke education for new hires nurses can be an effective way to deliver both foundational and hands-on content.

Exploring Nurse's Experiences and Perceptions of a Hospital-Based Stroke Nurse Champion Committee on Stroke Care

Nicole Schumacher, St. John's Regional Medical Center, Oxnard, USA; Jennifer Patterson, CHI Memorial Stroke & Neuroscience Center, Chattanooga, USA

Stroke care is a critical aspect of healthcare, affecting a substantial number of individuals each year. Nurses play a pivotal role in providing comprehensive stroke care, from assessments to interventions and education. To enhance nursing engagement in stroke care, a Stroke Nurse Champion Committee (SNCC) was established as a platform for nurses to participate in stroke-specific quality improvement processes and education. However, the impact of such committees on nurses' experiences and perceptions remains underexplored. This qualitative study seeks to fill this knowledge gap by investigating nurses' experiences within the SNCC and its influence on stroke care. This study employs a qualitative approach, utilizing a phenomenological lens to explore nurses' perceptions and experiences within the SNCC. Focus group interviews are to be conducted using a semi-structured interview guide. Purposeful sampling targeted nurses serving as Stroke Champions on the SNCC. The NVivo software with be utilized for data analysis to identify categories, themes, and codes from verbatim transcriptions.

Beyond the mRS - Supporting True Functional and Participation Change Post-Stroke

Lauren Sheehan, Kandu Health, Campbell, USA; Nancey Tsai, Medical University of South Carolina, Charlotte, USA

The modified Rankin Scale (mRS) is used as a global measure of function after stroke. Its limitations include a need for granularity in identifying factors that contribute to improvements. Much of the use of the mRS in the literature has focused on interventional efforts to reduce damage in the acute phase of stroke. Subacute and chronic outcomes relate more to the management of comorbidities and receiving necessary follow-up care in order to monitor and mitigate risk factors. As

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it has been a part of the lexicon of post-stroke recovery for decades, it is unlikely that the modified Rankin Scale is going to go away any time soon. This session will break down the modified Rankin Scale for nursing providers to provide additional guidance as to the factors that allow for improvement on the mRS as well as review other patient-reported outcome measures (PROMs) that can be utilized to supplement the mRS to increase the understanding of functional recovery.

Progress in a Pandemic

K. Ruth Whelan, Saskatchewan Health Authority, Saskatoon, Canada; Christine Catton, Saskatchewan Health Authority, Saskatoon, Canada

In the Canadian province of Saskatchewan, approximately 3200 patients are admitted to hospital with a diagnosis of stroke each year. Royal University Hospital (RUH) is the province's only comprehensive stroke center, receiving all patients requiring advanced stroke care from around the province. RUH strives to maintain "Stroke Distinction" certification through Accreditation Canada. Preparation for a distinction survey occurred during the COVID 19 pandemic presenting many challenges when engaging staff exhausted by pandemic protocols, policies and restrictions. Kotter's 8 steps for effective transformation were used to encourage successful change by creating a sense of urgency amongst staff. After reviewing quality indicators that needed to be met for distinction, nursing leaders initiated interventions that emphasized essentials for staff to take ownership of. Creative methods were adopted to manage COVID restriction obstacles, including songs and videos staff could watch via private social media platforms. High engagement was reflected in the number of video views and comments. Staff reported being confident in answering potential questions surveyors might ask. Distinction leads were approached for more details around protocols and how individuals could improve care they provided. In November 2021, the Saskatoon Stroke Program was surveyed for Acute Stroke Distinction by Accreditation Canada. Using Kotter's change theory as a guide and a variety of creative outlets, staff and team members were engaged and made aware of protocols and indicators that surveyors would assess. This successful method of engagement helped staff feel prepared for the survey and the Saskatoon Stroke Program obtained Distinction.

Methods to Improve Stroke Systems of Care

When "Call Me Maybe" Means a Little More: Operationalizing the Patient Discharge Call Process

Jamie Baker, UC Health, Loveland, USA

Background: Process improvement around individual patient experience following hospitalization remains a goal of all stroke programs. Data collection around this experience remains a challenge and is largely dependent on post discharge phone calls. We sought to create a systematic process for performing these calls to support data collection to identify improvement opportunities. Methods: Utilizing an established order set, an order to "consult stroke coordinator" identified patients for follow-up. A phone call was made within 2-3 business days post discharge to patients with a diagnosis of transient ischemic attack, ischemic or hemorrhagic stroke. Quantifying the patient experience with qualitative data was achieved by classifying feedback categories into positive, negative, mixed, and no feedback. A spreadsheet was developed to include patient demographics, call attempts, follow-up appointments, feedback classification and free text. Total attempted call volumes in fiscal years 2019 and 2020 were compared with 2021 following implementation. Results: By developing an effective tool and standardized workflow, the patient experience phone call process was operationalized. In 2019, 30 calls were attempted with an increase to 175 calls in 2020. In 2021, a total of 375 calls were attempted and 2022, 458. Calls made in 2021 alone reflected an 83% increase from 2019 and 2020 volumes combined. Additional outcomes from this change included increased opportunities to provide staff with positive feedback. Conclusion: Creating a systematic approach to post-discharge phone calls related to patient experience significantly increased data collection and created a method for continuous process improvement around individual patient experience after CVA.

Stroke Response – Utilizing Neuro ICU Nurses in the Code Stroke Process

Hannah Bell, Cone Health, Greensboro, USA

For every minute a stroke goes untreated, a patient loses 1.9 million neurons; however, state-of-the-art timely treatment can reduce these losses. We evaluated the effect of having stroke nursing expertise within the Code Stroke Process in our Comprehensive Stroke Center to promote a decrease in hospital

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arrival (door) to treatment time. Using retrospective data collection and analyses of 1261 patients, we found that having an expert stroke nurse decreased the median Door to First Pass time by 13 minutes and Door to Needle time by 2 minutes. Expert stroke nursing was only available 58% of the time, specifically Monday through Friday during 0800-1630. Our team implemented a pilot program to develop, train, and expand a team of expert stroke nurses within the Neuro ICU to allow for extended Code Stroke coverage. With an increase of stroke nursing expertise available at 79% of Code Stroke activations, our Door to First Pass has decreased by a median of 40 minutes (134 minutes to 94 minutes) and Door to Needle by 6 minutes (32 minutes to 26 minutes) over three years. In the acute Code Stroke Process, stroke nursing expertise was shown to create consistency and efficiency, allowing for improvements in hospital arrival to treatment times and less neurons lost for patients. Overall, we conclude that utilizing stroke nursing expertise in the acute Code Stroke process decreases overall treatment times.

Door to Treatment Quality Improvement Project

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Background: Timely administration of intravenous (IV) thrombolysis for patients presenting with acute ischemic stroke symptoms increases positive patient outcomes. Door-to-treatment (DTT) times were exceeding the target at Northwestern Medicine Delnor Hospital. Methods: DMAIC framework was utilized to improve DTT times for Emergency Department (ED) activated Stroke Alerts patients with a last known well (LKW) <24 hours. Identified key stakeholders met weekly to develop actions aimed at improving the timeliness of interventions. Changes included alignment to a single Stroke Alert, setting aggressive targets for stroke alert metrics, activating stroke alerts promptly, culture change in the ED, implementing a process for attaining patient's weights, pre-registering stroke alert patients activated through Emergency Medical Services (EMS), and initiating a stroke alert Vocera Communication Group. Results: Increased DTT within 60 minutes from 50% to 100% without adding additional resources, Fiscal year (FY) 2023 DTT <60 minutes 100% (8/8), FY2023 DTT <45 minutes 100% (6/6), and FY2023 DTT <30 minutes 100% (4/4). Additionally, door to stroke alert activation was lowered from 10 minutes to 6 minutes (excluding field alerts), CT completed-to-resulted was reduced from 7 minutes to 6 minutes, CT resulted-to-thrombolysis started was reduced from 31 minutes to 15 minutes, and our DTT was reduced from 54 minutes to 35 minutes, with an improvement of 19 minutes within few months of implementing our new processes. Conclusion: The implementation of aggressive targets, a culture shift, and the utilization of our resources we successfully decreased the DTT times for patients with AIS symptoms who met inclusion criteria.

It's the Door to Puncture Countdown: Reducing Door-to-Reperfusion Times for Mechanical Thrombectomy via a Door-to-Puncture Countdown

Sherri Greif, St. John's Regional Medical Center, Oxnard, USA; Nicole Schumacher, St. John's Regional Medical Center, Oxnard, USA; Akinwunmi Oni-Orisan, St. John's Regional Medical Center, Oxnard, USA; Renee Ayala, St. John's Regional Medical Center, Oxnard, USA

Background: Published recommendations and current benchmark for door-to-puncture (D2P) set by American Heart Association (AHA) is 90 minutes and door-to-reperfusion (DTRp) within 120 minutes. Research shows earlier endovascular reperfusion therapy for large vessel occlusion (LVO) strokes improves patient functional outcomes, independent ambulation at discharge, and discharge to home.

Purpose: The purpose of the D2P countdown was to give our neurointerventional team a guided timeframe to decrease D2P and DTRp medians. Prior to implementation, the patient's arrival time was not known to the team. The goal of the D2P countdown is to increase awareness of the timeline to achieve shorter D2Rp times. Method: Collaboration occurred with the neurointerventional team on how to make the D2P time more obvious. We retrospectively calculated the median D2P time between January and April 28, 2022 (78 minutes), median D2Rp time (126 minutes), and puncture-to-reperfusion median time (32 minutes), excluding cases without reperfusion, transfers, and inpatient LVOs. We determined that a 75 minutes D2P goal would likely meet the D2Rp goal. The process change included obtaining the arrival time for thrombectomy

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eligible patients, then sharing the goal puncture time of 75 minutes with the team. Results: After implementing the process change with the D2P countdown on April 28, 2022, our median D2P time decreased to 75 minutes and our median D2Rp decreased to 110 minutes. Conclusion: Implementation of D2P countdown decreased our median time for D2Rp below the benchmark of 120 minutes. Continued data collection will show whether there is sustained improvement utilizing this process.

Stroke Mortality: Taking a Closer Look at Risk Stratification and Withdrawal of Life Sustaining Treatments in a Comprehensive Stroke Center

Kasey Grimmett, Baptist Health Medical Center, Little Rock, USA; Rhonda Finnie, Baptist Health Medical Center, Little Rock, USA

Objective: Data from a Comprehensive Stroke Center (CSC) located in the U.S. Mid South suggested that this center had a higher mortality than would be expected for a CSC. We sought to evaluate stroke mortality in the context of the National Institute of Health Stroke Scale (NIHSS), ICH score, Risk of Mortality and Severity of Illness, and the withdrawal of life sustaining treatments (WLST) based on goals of care discussions. Methods: Retrospectively, 70 patients were examined from the AIS (n=41), ICH (n=24), and SAH (n=5) populations by discharge diagnosis. Results: None were risk-adjusted using the NIHSS. 89% of all mortalities had WLST after goals of care discussions Conclusions: Mortality in this patient population was largely related to WLST after discussions with family surrogates and palliative care/supportive medicine consults. The ICH and AIS guidelines recommend waiting 24-48 hours before making such decisions in patients, while CMS only allows for mortality exclusion if discharged to hospice within 24 hours or enrolled in hospice within the previous 12 months. In order to better stratify patients, CMS announced in April, 2023 that the NIHSS would be used to stratify risk. Currently, only 63% of facilities report a NIHSS. Since the ICH score isn't a measure of disability, we shouldn't rely on ICH score alone; especially given that the NIHSS was recently validated for ICH patients. We plan to collaborate with our coding department to provide a NIHSS with the discharge diagnosis to facilitate better CMS comparison to like centers and risk stratification.

Improving Community Awareness and The Power of Strategic Partnerships

Brandon Herning, University of Louisville Health, Louisville, USA

Thrombolytic therapy treatment is consistently low at a stroke network due to arrival beyond the therapeutic window. The community does not recognize the signs and symptoms of a stroke. A collaborative project between the stroke program and the top prehospital agencies in the county was developed to connect with a target population. The goal of this project is to reach the population group who are at high risk of stroke and do not normally seek preventative care. The project design combined the BEFAST magnet with their smoke detector program. During fire detector home inspections, a BEFAST door magnet was placed in the home. The signs and symptoms are reviewed as well. This came about after a stroke program nurses gave a door magnet to her parents and a few days later, started experiencing signs and symptoms. Due to the magnet being on their refrigerator, they realized they needed to call 911. Project kickoff was during stroke month, May 2023 in conjunction with their smoke detector program targeting the higher risk areas of our service area. A process to capture if a stroke patient came in because of this program was instituted. Within one week of starting this program, a patient came to the hospital as a direct result of having a magnet placed on their refrigerator door. This patient did not get treated with Alteplase due to not arriving within 4.5hrs. This program has gained momentum and is expanding across the state

Improving EMS LVO Identification

Brandon Herning, University of Louisville Health, Louisville, USA

Lack of emergency medical system (EMS) identification of Large Vessel Occlusion (LVO) is a persistent issue. Documentation, transport policies, quality assurance and education of EMS with a heavy emphasis on EMS operations, contribute to this gap. Training of EMS began in March of 2023, focusing on the hallmark clinical findings of large vessel occlusions and how to utilize the state board recommended Cincinnati Stroke Assessment Tool (CSTAT). The top EMS agencies serving the comprehensive stroke center were the first target for training. Thanks to agency engagement, Agency 1 instituted a documentation policy and Agency 2 deployed a quality assurance process. EMS operates similarly to physicians when performing an initial assessment. There are specific items that lead hospital clinicians to believe there is an LVO present before performing lengthy examinations. EMS operates the same way. Emphasis was placed on identifying the hallmark signs and symptoms of LVO's and their presentations. Being horizontal gaze deviation, left sided neglect (inattentiveness), aphasia and double vision with nausea/vomiting/dizziness. For

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standardization CSTAT was chosen for its simplicity and state EMS board recommendations. Results as of July 21, 2023: Agency 1: 6 months prior to instituting the policies and training the CSTAT score compliance was: 63% percent. Post: CSTAT score compliance is: 100%. Agency 2: 6 months prior CSTAT compliance 54%. Post: 74%. Comparing this data with the same time in 2021, the CSTAT Score compliance of both agencies was 0%. Passive education with feedback of stroke outcomes was done during this timeframe.

Outpatient Stroke Care – The How and Why

Debbie Hill, Stroke Challenges, Gainesville, USA.; Sarah Livesay, Rush University College of Nursing, Chicago, USA

Background: Lack of coordinated care at hospital discharge contributes to readmission and risk of recurrent stroke within 90 days. Problem: New innovations in transitions of care and stroke follow-up clinics have proven to address patient needs. While data supports improved outcomes with these models, the adoption of outpatient clinics and care navigators in stroke systems of care has been extremely slow. Approach: We researched existing Medicare reimbursement for management of transitions of care, ongoing chronic care and remote physiological monitoring and modeled assumptions for patient volume, billing revenue and staff needs to illustrate post-discharge care return on investment. Literature supporting patient navigator models and stroke clinics was also reviewed. Results: Modeling was developed using Medicare billing and reimbursement opportunities for coordinated outpatient stroke care, including remote physiological monitoring post-discharge. Models to support clinics and/or navigators will be presented in a format that facilitates stroke leader advocacy with financial and business leads in their organizations. We also outlined the "value-adds" with examples for stroke navigator positions. Conclusions: Improved post-discharge care improves readmissions rates and contributes to improved chronic disease management. When the requisite clinical workflows are employed, Medicare reimbursement can help offset the cost of providing coordinated outpatient stroke care.

Transitional Groups to Help Decrease Post-stroke Readmission

Natalie Labit, Baptist Health Medical Center, Little Rock, USA; Lindsey Bourne, Baptist Health Medical Center, Little Rock, USA; Kasey Grimmett, Baptist Health Medical Center, Little Rock, USA

In 2023 the estimated cost of 30 day readmissions was $41 billion (Center for Health Information and Analysis), with 75% of Arkansas hospitals still incurring readmission penalties. As a Comprehensive Stroke Center in Arkansas we serve a population with a low state-wide education level (47th in the country). With well identified limited socioeconomic resources, limited health education, and rural living it is no surprise that our patients are at risk for inappropriate discharge disposition, inadequate health knowledge, medication non-compliance, and further morbidity/mortality, prompting us to evaluate how and where we can make a difference. Transitional Group services provide 90 day in-home care for patients discharged to an Independent Living facility or home. The goal is to supplement on-going health care provided by established providers by ensuring continuity of care as patient's transition from hospital to home. They provide weekly in-person or telemedicine visits, addressing needs/issues that may be identified by patients or family. The purpose of this retrospective analysis was to determine if implementation of a Transitional group for select patients, could reduce 30 day readmission rates. A baseline 30-day readmission rate was established using our 2022 stroke population. In December of 2022 the use of a third party transitional group was implemented. Stroke patients from December 2022 through August 2023 were included in the analysis. If selected, will discuss what patients benefited from transitional groups and if they can reduce 30-day readmissions and improve post-stroke recovery.

Pit Crew Code Stroke Method Decreases Door to Needle Time

Catherine Michael, Atrium Wake Forest Baptist Lexington, Lexington, USA

Target Stroke III suggested timeline helps to reduce the door to the needle to under 45 minutes. The stroke champion committee determined the need for quick assessment and movement of possible ischemic stroke patients through the emergency department. After observation, the committee determined the whole team was not present at the launch pad, and the staff did not have defined roles. We determined a need for the Emergency Room Nurse, provider, registration, and certified nursing assistant at the launch pad. Prenotification of EMS to all team members was the most efficient way to ensure all staff were present. We established a "pit crew" model of care with all staff available and could work simultaneously with defined roles. A message would alert them on their mobile phone to report to the launch pad directly across from the EMS bay, outside of triage. Each team member was provided their role and responsibility. Nurses would assist the provider in

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completing NIHSS and receiving reports from EMS. The CNA would prepare the room, zero the stretcher, and ensure the transport monitor was ready before arrival. When the patient arrived, the CNA would get the blood glucose and report to MD. The team would follow the patient directly to the CT scanner with the ED stretcher. While prepping the patient for CT, the patient was placed on a monitor to prevent delay in starting the CT scan. The outcome was an overall reduction of the door-to-needle from an average of 49 minutes to 38 minutes.

Characteristics of Stroke Patients Without an EMS Notification: A Descriptive Analysis

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Stroke treatment is time-sensitive and requires a coordinated system of care. One challenge to this care is prehospital recognition of stroke patients. Studies have reported variable performance, with some demonstrating that <50% of stroke patients are recognized by EMS clinicians. We aimed to describe characteristics of those stroke patients who do not receive an EMS notification.

Care Coordination and Post Acute Stroke Care: Is this the Key to Improving Quality Outcomes for Stroke Survivors while Reducing Readmission Rates for this Patient Population?

Barbara Sedita, Gates Vascular Institute, Buffalo, USA

Background: Acute stroke care has advanced exponentially over the last 20 years. Readmission rates and better outcomes for stroke survivors is an area of focus for quality improvement. Comprehensive acute stroke care is fast paced and complex, including multiple disciplines necessary to address the needs of the stroke survivor and their loved ones. The stroke journey is overwhelming and is different for every stroke survivor. Care coordination is currently a national focus with the goal of improving patient experience and population health, while decreasing healthcare costs. Care coordination carried out by a stroke care coordinator during the post acute phase of stroke care can be the key to improving readmission rates by meeting individual needs of the patient and their family from admission through discharge. Purpose: This paper will discuss if the addition of a post acute stroke care coordinator (PASCC) to the comprehensive stroke team (CST) would improve patient outcomes through support and education while reducing readmission rates in this patient population. Focus: This performance improvement study would be carried out in a comprehensive stroke center. Readmission data and patient satisfaction scores would be extracted the 3 months before the addition of the PASCC to the CST and 3 months after the PASCC has followed a set number of stroke patients to compare and determine if this intervention proves to be effective.

Complex Needs and Dynamic Solutions - Metrics that Yield Outcomes in a Post-Acute Stroke Navigation Program

Lauren Sheehan, Kandu Health, Campbell, USA; Nancey Tsai, Medical University of South Carolina, Charleston, USA

Background: The post-stroke recovery course is a complex multitude of physical, cognitive, and emotional impairments experienced by survivors. With decreasing length-of-stays and disjointed outpatient systems of care, additional support is needed to provide stroke survivors and their care partners with the education, resources, and guidance to navigate the healthcare landscape. Purpose: The aim of this tech-enabled post-acute stroke recovery program is to prepare survivors to receive follow-up care, prevent recurrent strokes and readmissions, identify and manage emotional challenges, and connect with community support. A lens of self-determination theory is utilized to put the survivor in the driver's seat of their care, encouraging participants to "take charge" of their life and health after stroke. Method: This study evaluates digital platform-enhanced navigation in the outcomes of 50 graduates of the Kandu Health program including functional status, return to work and community statistics, quality of life, assessment of depression and anxiety, and the completion of indicated follow-up care. Results: A curvilinear relationship exists between the number of navigator touchpoints and time spent with a stroke survivor or survivor/care partner dyad and their overall outcomes. This study demonstrates that there appear to be both threshold and dose-dependent effects to optimizing post-stroke recovery. As stroke impacts physical, emotional, and cognitive function, using a combination of on-demand learning and recovery tools along with building a trusted relationship with survivors to increase the accountability and partnership between navigators and survivors can reduce the incidence of future

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stroke-related complications and yield improved overall outcomes.

Let me be your guide: The Impact of Stroke Navigators on Post-acute Stroke Follow up

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Introduction: Stroke patients often require complex post-discharge management in an outpatient setting. However, post-acute follow up appointments are typically established after discharge, leading to scheduling delays for the 30-day appointment, patients lost to follow up or no showing to appointments. Stroke Navigators are an emerging role that can bridge the gap between acute and post-acute care settings and are integral to ensuring stroke patients receive optimal follow up care. Methods: In 2022, a Stroke Navigator was added to the care team and collaborated with the Stroke Clinic to project volume of clinic slots needed for expected ischemic and TIA hospital discharges. The Stroke Navigator implemented follow up scheduling with the patient/family prior to discharge and emphasized the importance of the 30-day appointment. Preintervention and postintervention data was then collected and analyzed from Q2 2022 to Q1 2023 regarding timeliness of scheduling, appointment type, and rate of no shows for all ischemic stroke/TIA patients. Results: Pre-intervention data on 30-day appointments showed that only 23% of patients were scheduled and attended their provider visit, while post-intervention data showed 60%. The clinic no show rate went from 19%, down to 10% in the post intervention phase. (Table 1)

Conclusion: The Stroke Navigator has made a significant impact on the number of patients with 30-day visits, eliminated the wait time for appointments due to scheduling prior to discharge, and decreased the no show rate for patients at 30 days.

Supporting Safe Transitions of Care for Interfacility LVO Transfers

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Background: Mechanical thrombectomy has become standard of care for eligible Acute Ischemic Stroke (AIS) patients identified to have Large Vessel Occlusion(LVO). Improved morbidity and mortality occurs in patients who achieve timely reperfusion. Internal processes and systems of care must be optimized once the patient arrives at the Comprehensive Stroke Center (CSC). Patient safety is negatively impacted by significant process variation. Method: An A3 tool was used to guide the project to identify gaps and waste within the hospital transfer process, analyze the meaning and impacts to the care delivery system and illuminate the path to a future state. Results: Year one data showed significant improvement with the overall process exceeding initial projections and goals. Years two and three established sustainability through incremental Plan Do Study Act cycles. Process measures included door to imaging order and door to imaging performed. Year three data showed overall improvement in door to imaging order time of a mean of 11 minutes and a median of 10 minutes, as well as an improvement of door to imaging mean of 22 minutes and median improvement of 18.5 minutes. The baseline door to puncture percentage in under 60 minutes was 67%, at year three the door to puncture percentage in under 60 minutes improved to 91.3%.

Important Clinical Interventions that may Improve Stroke Care

Improving Communication Through the Use of Post Angio Hand off from IR – NICU

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Transitions of care represent a major source of medical errors, patient morbidity/mortality, and increased healthcare waste. Evidence show that there is unfavorable response toward handoffs and care transitions from Interventional Radiology to

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neurointensive care. Use of the Angio handoff tool is associated with up to 30% reduction in adverse events aad 100% improved documentation due to accurate information as guided by the hand off created by the Neuroscience dept, collaborative effort with IR dept and the NICU Shared governance. Implementation of IR specific post angio handoffs in the NICU has improved missing post IR documentation and reduce fall outs. It led to safety, and communication. A formalized handoff process –created and presented in Shared governance and stroke champions helped with the adaptation and campaign of the use to improve compliance. This includes a post IR process map and structured angio handoff. This was presented in the monthly comprehensive Stroke committee meetings. It reduced major non compliances of documentation and resulted to improved stroke metrics - the hospital as a comprehensive Stroke center is the highest with Stroke compliance metrics compared to other Stroke centers in the area. Following an initial intervention phase of 4 months, a brief postintervention survey as well as serial handoff observations were conducted to reassess the process and guide future interventions.

To Bolus or Not to Bolus: Use of Heparin Protocols and Outcomes in Ischemic Strokes

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After an acute ischemic stroke, therapeutic anticoagulation using intravenous heparin may be required for a variety of concomitant indications, such as venous and arterial thrombi. The utilization of heparin boluses in this population, as well as the timeframe in which to initiate therapeutic anticoagulation after acute ischemic stroke is controversial given the risk of hemorrhagic transformation; however, there are certain instances in which prompt initiation of therapeutic anticoagulation with intravenous heparin is recommended. At WVU Medicine – WVU Hospitals there are three primary heparin drip protocols providers may choose from: Thrombotic [includes bolus dose of 25-50 units/kg based on activated partial thromboplastin time (aPTT), goal aPTT: 60-100 seconds], Non-Thrombotic (includes bolus dose of 50 units/kg for aPTT less than 40 seconds, goal aPTT: 50-70 seconds), and Low-Intensity, No Bolus (does not include bolus doses, goal aPTT: 50-70 seconds) Protocols. The aim of this retrospective review was to assess patient outcomes, as well as our hospital's utilization of the various heparin protocols in those with acute ischemic stroke who also required a continuous heparin infusion for the following indications: pulmonary embolism, deep vein thrombosis, cardiac or carotid thrombus, cerebral venous sinus thrombosis, or mechanical heart valves. The primary outcome of this study was to determine the incidence and grade of hemorrhagic transformation in patients who received therapeutic heparin for the aforementioned indications. Secondary outcomes include length of stay, average time to achieve first therapeutic aPTT, and average time in which patient was switched to oral anticoagulation with each protocol.

Time is Brain: Optimizing State Level Prehospital Protocol to Achieve Timely Presentation of a Patient with a Large Vessel Occlusion

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Purpose: Emergency Medical Services play a critical role in the timely presentation of patients experiencing a potential large vessel occlusion to the appropriate Stroke Center. Minimizing time on-scene, bypass a Primary Stroke Center, without intervention capability, to bring the patient directly to a Comprehensive Stroke Center, and/or initiate air transport from the scene may improve a patients outcome upon discharge. Method: A case study method was used to outline the critical importance of prehospital decision making in patients experiencing a potential large vessel occlusion. A 29-year-old male developed sudden onset of left sided weakness, slurred speech, facial droop, and gaze deviation. The patient had a history of atrial fibrillation and recently per physician orders stopped taking anticoagulation due to having an ablation. The patient lived in a rural setting which was an approximate 25 minute drive to the closest Primary Stroke Center and a 60 minute drive to a Comprehensive Stroke Center. The EMS crew initiated air transport for this patient direct from the scene to the Comprehensive Stroke Center. Results: The patient arrived to the Comprehensive Stroke Center within 12 minutes of departing the scene. After arrival to the Comprehensive Stroke Center, the patient received alteplase within 32 minutes, had door to puncture time of 54 minutes, and a door to reperfusion time of 64 minutes. The patient was discharged home with a Modified Rankin of 0 and a 90-day Modified Rankin of 0.

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The Need for Speed: Reducing Endovascular Treatment Times in Ischemic Stroke

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Background: Endovascular treatment (EVT) of vascular occlusions for treatment of disabling strokes is more effective when reperfusion is achieved quickly. Streamlining protocols from patient presentation to groin puncture can lead to improved timelines to treatment and functional outcomes. Purpose: This study's purpose was to identify the impact of specific hospital-based process improvement strategies in the stroke population undergoing endovascular therapy with focus on decrease median arrival to groin puncture. In November 2018 (FY 2019) multidisciplinary team meetings to update such workflows began. Implementation of the group's recommendations began FY 2020 (9/1/19- 12/31/19). Methods: The study includes retrospective review of consecutive adult patients, with hospital admissions between January 1, 2014, and December 31, 2022, who underwent EVT for treatment of acute ischemic stroke. The primary outcome variables were time from arrival to groin puncture and first pass during the acute ischemic stroke admission. The data points were collected from internal stroke review dataset and anonymized prior to analysis. All thrombectomy's at our site are performed under general anesthesia. Results: Post PI project roll out we have continued our process and for FY2021 (n=42) our median door to groin puncture time was 48 minutes and our door to first pass time was 67 minutes ($p<.05$), a statistically significant improvement of 47 minutes from baseline FY2017 and 72 minutes from baseline FY2018. Conclusions: Improving awareness of process expectations by meeting with stakeholders resulted in substantial and sustainable decreases in median door to groin puncture and door to first pass times.

Use All of Your Tools, When Imaging and Patient's Assessment Don't Match: An Interesting Case Study

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This is a case study about a patient who was transferred to our hospital after presenting to an outside hospital with an NIHSS 14. He was given IV tPA and flown to us. CT angiogram showed possible non-flow limiting partial thrombus vs intracranial atherosclerosis of right middle cerebral artery M1 segment. However, when patient arrived to our hospital his NIHSS was worse at 17 and he truly looked like a right middle cerebral artery M1 occlusion. CT scan with only subtle loss of gray white in posterior temporal lobe. CT perfusion with: CBF< 30: 10ml; Tmax >6.0s: 36ml; mismatch volume: 26; mismatch ratio: 3.6. However further looking and interpretation of the perfusion maps showed Tmax >4.0s: 264 (enitre RMCA). Given assessment finding's screaming right middle cerebral artery large vessel occlusion and CT perfusion findings, the decision was made to bring the patient up to the lab to further assess what is going on and possibly perform thrombectomy. DSA angiography revealed patient had a right middle cerebral artery M1 segment fenestration (0.6% occurrence) with an occlusion of the superior aspect of the fenestration (lenticulostriate perforators originate). Thrombectomy was performed of the superior aspect of the fenestration with TICI 3 reperfusion obtained. Patient significantly improved and was discharged 3 days later with NIHSS 3. At 90 day follow-up NIHSS and mRS were 0. Looking at everything collectively made us realize something wasn't adding up and when we investigated further, we were able to remove a rare thromboembolism and improve the patient's outcomes.

Safety and efficacy of Tenecteplase versus Alteplase for Thrombolysis in Acute Ischemic Stroke: Single Center Experience

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Stroke remains one of the major causes of mortality and morbidity, and thrombolytic therapy has been the gold standard for ischemic stroke since 1996. Alteplase (tPA) remains the only US FDA-approved thrombolytic treatment for acute ischemic strokes proven to be efficacious. However, recent studies have shown that Tenecteplase (TNK) can also be utilized for acute stroke treatment due to its advantageous drug characteristics and ease of administration. The purpose of our study is to evaluate clinical outcomes after transition from tPA to primarily TNK as thrombolytic agent for acute ischemic stroke at our institution. The primary aim is to compare the efficacy (defined as improvement in functional status or Modified Rankin Scale (mRS) 0 to 1 at 90 days) and safety (defined as the presence of side effects and incidence rate

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of spontaneous intracerebral hemorrhage (sICH) and mortality rate) of TNK over tPA.

Using Post-void Residual Measurement to Identify Risk for Urinary Complications Post-Stroke

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Urinary complications are common post-stroke and these can negatively impact recovery. Increased post-void residual (PVR) is a risk factor for incontinence and UTI's. Identifying the risk allows for early interventions. The goal of this project was to determine if a nurse driven protocol using bladder scanning is an effective strategy for early recognition of urinary dysfunction and prevention of urinary complications after stroke. Urinary incontinence and infection rates post-stroke are estimated to be around 20%. In patients with stroke, the increase in PVR volume is a risk factor for both urinary incontinence and UTI. Bladder scanning is a safe, non-invasive method to measure retention volumes. A bladder scanning protocol/algorithm was designed to assess PVR in patients post-stroke. This encouraged nurses' autonomy in identifying patients at a higher risk for urinary complications. More than half of the 78 patients scanned in the original phase of the project had PVR volumes >100 mL on the initial scan and a quarter of them still had volumes >100 after the second scan. Based on this data, utilization of the bladder scanning protocol for all post-stroke patients has been recommended to assess for urinary retention and identify those at risk for urinary complications as part of the standard nursing practice for patients admitted with stroke. In addition, education will be provided to all patients post-stroke with strategies to decrease urinary retention and prevent complications. Additional data will be evaluated going forward for effects on rates of urinary complications such as UTI.

Exploration of the Relationship Between Admission Glycemic Status with Ischemic Stroke Patients Receiving Reperfusion Therapy and Clinical Outcomes

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Stroke is a leading cause of preventable disability in the United States with reperfusion therapies can significantly improve patient outcomes. However, hyperglycemia in reperfusion patients has been associated with worse outcomes and an increased risk for symptomatic intracerebral hemorrhage. Currently, clinical guidelines lack specific recommendations for managing hyperglycemia for this population. This study aims to investigate the relationship of admission blood glucose, HbA1c, and diabetic medication use on clinical outcomes following reperfusion therapy in ischemic stroke patients. This study plans to conduct a retrospective review of medical records from one medical center will be conducted for ischemic stroke patients who received reperfusion therapy between January 2018 and June 2023. Data will be collected on admission blood glucose, HbA1c, previous diabetic medication use, and 3-month modified Rankin Scale (mRS) scores. Statistical analyses will include analysis of variance and logistic regression models.

Adventures in Clot-Busting: Replacing Alteplase with Tenecteplase for Stroke Treatment Across Northwestern Medicine (NM)

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In the fall of 2022, the Northwestern Medicine (NM) Stroke Quality Committee approved replacing alteplase with tenecteplase as the IV thrombolytic of choice for stroke. This large-scale change was implemented for 11 acute care facilities in the spring of 2023. This project was successful due to an interdisciplinary project team providing expertise from each area. The team reviewed the literature which helped establish best practices in giving tenecteplase. Communicating the ease of drug administration and cost savings when compared to alteplase facilitated buy-in from all parties. The project team also enjoyed excellent partnership from various NM teams/departments, including the NM Pharmacy & Therapeutics Committee, Epic/IT, NM Academy (Professional Education), Marketing, and Policy Management. Overall, converting to tenecteplase streamlined the stroke care provided in acute care settings across NM, as well as strengthened site-to-site relationships and teamwork across NM.

The Price to Pay for Faster Door to Needle Treatment. Does the Switch to Tenecteplase (TNKase) Improve Door to Needle Times?

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Introduction: There's considerable evidence supporting Tenecteplase (TNKase) as the safer, more effective, thrombolytic of choice for acute ischemic stroke treatment than Alteplase (tPA). Ease of preparation and administration is also thought to contribute to improve Door-to-Needle (DTN) times. Methods: Using a prospectively maintained Comprehensive Stroke Center quality improvement database, IV thrombolytic data from February 2020 to May 2023 was reviewed. Inpatient and transferred stroke patients were excluded from the data. Median DTN times were compared between time periods using tPA versus TNKase. Variables reviewed included, initial National Institute of Health Stroke Scale (NIHSS) score on arrival and Modified Rankin Score at discharge (mRS). Results: From February 2020 to September 2021 a total of 90 cases received tPA, compared to 118 cases receiving TNKase from October 2021 to May 2023. The median DTN time was 7 minutes longer after transitioning to TNKase (October 2021 to May 2023, 50 minutes) compared to when tPA was utilized (February 2020 to September 2021, 43 minutes). In both tPA and TNKase time periods, the median NIHSS = 5. Discharge mRS was not significant, with median tPA mRS = 4, and median TNKase mRS = 3. Conclusion: Our data suggests faster DTN with tPA versus TNKase, and no significant difference in patient disability regardless of thrombolytic used for acute treatment. The reasons are likely multifactorial but may include ED staff comfort and familiarity with using tPA over TNKase and the financial loss associated with wasting unused thrombolytic if decision to treat is no longer warranted.

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Complex Needs & Dynamic Solutions – Metrics that Yield Outcomes in a Post-Acute Stroke Navigation Program

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Background

Post-stroke recovery requires support for a complex combination of physical, cognitive, and emotional impairments experienced by survivors.

With decreasing length-of-stays and disjointed outpatient systems of care, additional support is needed to provide stroke survivors and their care partners with the education, resources, and guidance to navigate the healthcare landscape.

This research explores how demographics, impairments, SDOH, and presence of a care partner interact with survivor engagement and outcomes in a remote post-acute stroke navigation program.

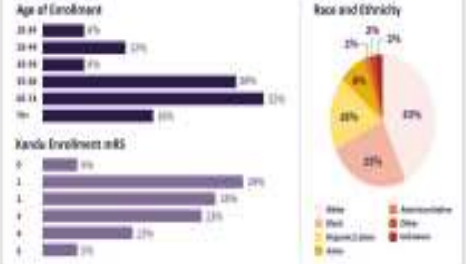
Methods

Participants (n=65) were facilitated by a clinical navigator (occupational therapist or licensed clinical social worker) with the goals of reducing barriers to recovery and increasing survivor health literacy and agency.

Clinicians worked through phone, asynchronous messaging, and video calls with the survivor and care partner who had shared access within the app, with separate profiles. The Kandu app offers a curriculum of accessible learning articles and in-app tools including symptom tracking and other features to support recovery.

The average participant had **10 Navigator touchpoints totaling an average 5.8 hours of one-on-one Navigator time** over the duration of the program **(average 12 weeks)**. Additional time was spent in curating resources, articles and managing the complexities of transitions of care.

Demographics



The Kandu Health program has **served survivors from age 27 to 86 years of age**. In addition, survivors in various stages of function as indicated by the enrollment mRS of 0-5 were able to participate. Survivors were from a diverse population related to socioeconomic status, race, and ethnicity.

Program Philosophy

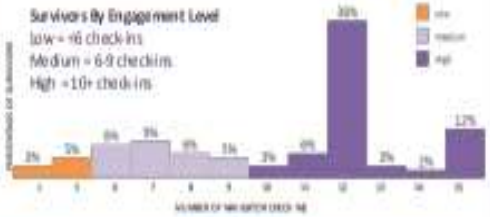
A lens of **self-determination theory** was utilized to encourage participants to "take charge" of their life and health after stroke.

The "Take Charge" intervention is utilized between weeks 6-8 to encourage a sense of purpose, autonomy, mastery and connectedness with others. In several RCTs, **recipients of "Take Charge" have demonstrated decreased dependent disability (mRS 3 to 5) at 12 months** (Furie et al, 2020).

Using a survivor-centric and impairment informed approach, clinical navigators tailored their interventions to the survivor and care partners' needs based on SDOH, impairments and subsequent stroke risk.

Correlations Between Navigator Engagement and Survivor Demographics

With the complexity of post-stroke sequelae and the dynamics of recovery, a "one size fits all approach" is neither possible nor desirable.



64% of Kandu participants were categorized as "high" engagers, with 10 or more check-ins over an average of 12 weeks. 28% were categorized as "medium", with 6-9 check-ins and 8% were "low" engagers with fewer than 6 check-ins .

	Engagement by Reach		
	LOW	MED	HIGH
0	14%	80%	50%
1-3	4%	20%	68%
4+	7%	15%	60%

Total # of impairments	Engagement by Total # of Impairments		
	LOW	MED	HIGH
0		50%	50%
1-2	10%	30%	58%
3-5	4%	33%	63%
6+	7%	21%	71%

Survivors with higher social needs (SDOH) utilized a greater number of navigator touchpoints. The categorization of social needs did not consider the severity of individual needs. 80% of survivors with 4 or more social needs were High Engagers.

Survivors with a larger number of stroke related impairments also utilized more navigator touchpoints. 73% of survivors with 6 or more stroke-related impairments were High Engagers.

Navigator Engagement and Survivor Demographics

	Engagement by CP Involvement		
	LOW	MED	HIGH
Has CP	5%	23%	73%
No CP	35%	36%	52%

Enrollment mRS	Engagement by Enrollment mRS		
	LOW	MED	HIGH
0-1	9%	35%	57%
2-3	7%	17%	77%
4-5	8%	42%	50%

The involvement of a care partner was associated with a greater number of navigator touchpoints, potentially indicating greater complexity in family dynamics and the need for more education and support.

There was not a consistent trend in engagement increasing with mRS scores. The least (mRS 0-1) and most (mRS 4-5) disabled patients had similar engagement, while 77% patients with mRS 2-3 were highly engaged. This possibly speaks to the balance of need and overwhelm in driving desire and ability to engage with Kandu's programing.

Navigator Engagement and Readmissions

Kandu's all-cause readmissions rates for patients referred from hospital discharge were approximately half of the published national average for unplanned readmissions at 30 and 90 days. There was no correlation between readmissions and # of Navigator engagements, likely due to the nature of touchpoints being both proactive and reactive.

Readmissions	Kandu	Published Ranges
30-Day	4.4%	8.7-12.5%
90-Day	8.9%	18.9-20.7%

Conclusion

The descriptive statistics demonstrate an increased number of Navigator touchpoints with higher survivor social needs, stroke-related impairments, and care partner participation. Programs designed for stroke survivors should anticipate and adapt to those individual needs accordingly.

In Kandu's program, engagement of survivors was not correlated with 90-day readmission rates. While we assume patients benefit from high proactive engagement, readmissions also demand reactive engagement, resulting in high engagement across both readmitted and readmission-free cohorts. Future research will explore which program attributes are predictive of readmission risk.

Kandu

ANVC 2023 Winning Abstract Poster

INTERACT 3: Review of the Evidence for Intracerebral Hemorrhage (ICH) Treatment

The Third Intensive Care Bundle with Blood Pressure Reduction in Acute Cerebral Hemorrhage (INTERACT 3) trial was recently published in *Lancet*[1] showing significant improvement in 6-month outcomes for ICH patients that received an intracerebral hemorrhage (ICH) "care bundle" intervention consisting of blood pressure (BP) reduction, serum glucose control, fever control, and reversal of warfarin-related coagulopathy. INTERACT 3 used a stepped-wedge cluster randomized trial design. This design randomizes the timing of when different "clusters" or groups of hospitals will join the study. All clusters initially start out in the control arm of the study, with no change in how ICH patients have traditionally been managed at the hospital; during this time, investigators collect data on patient management processes, patient characteristics, and the study outcomes in the sample of enrolled patients receiving "usual care." By randomly selecting when clusters will start in the control phase in small sequences or groups, investigators may ensure proper trial conduct in a small number of participating sites before initiating additional sites that will also require study oversight. At a pre-determined timepoint, control sites then cross-over to begin using the intervention, in this case the ICH management bundle. The cross-over period to the intervention arm is similarly staggered to allow for oversight of smaller numbers of sites in each sequence. Ultimately, stepped-wedge cluster randomized trials allow an investigator to explore differences caused by an intervention in what are expected to be rather similar groups of patients enrolled before and after start of an intervention.

The INTERACT 3 study recruited hospitals from nine low-income and middle-income countries (Brazil, China, India, Mexico, Nigeria, Pakistan, Peru, Sri Lanka, and Vietnam), as well as one high-income country (Chile). To be eligible to participate, hospitals had to lack consistent relevant, disease-specific protocols for ICH patient management; additionally, participating sites had to agree to implement the ICH bundle to consecutive adult patients with computed tomography confirmed spontaneous ICH that presented within 6 hours of symptom onset. A total of 122 sites began enrolling in the study, however, 1 site was withdrawn from the study and all their patient data was eliminated due to failure to complete institutional review board/ethics approval processes (final number of sites: 121). Overall, 7036 patients were enrolled: 3221 ICH care bundle group and 3815 control/usual care group. Of these, data allowing for measurement of the primary outcome were available in 90% of the ICH care bundle group and 88% of the control group due to investigators failing to capture the required data at the time of follow-up; this happens most commonly due to an inability to "find" the subject at follow-up, in this case 6-months after release from hospital.

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The INTERACT 3 ICH care bundle consisted of intensive lowering of systolic blood pressure (SBP; target <140 mm Hg), strict glucose control (target = 6.1–7.8 mmol/L [110-140.5 mg/dL] in those without diabetes and 7.8–10.0 mmol/L [140.5-180 mg/dL] in those with diabetes), fever management (target = body temperature ≤37.5°C), and rapid reversal of warfarin-related anticoagulation (target = international normalized ratio [INR] <1.5); treatment had to be initiated to manage these parameters within 1 hour.

Subjects enrolled in the trial were 90% Chinese, with a mean age of 62 ± 13 years, 64% were men, and the presumed cause of ICH was hypertension in 94%, with 82% of bleeds located in the deep subcortex. Median hemorrhage size was 15 (IQR 7.8-30) mL, and overall admission mean SBP was 174.5 ± 28.3 mm Hg. Only 36% of patients had elevated blood glucose, and of these the overall mean serum glucose concentration was 8 mmol/L (144 mg/dL). Only 1.7% had an elevated body temperature, and only 1.2% had INR >1.4 at presentation. Because of this, the intervention used in the clinical trial was primarily limited to SBP lowering to below 140 mm Hg.

The proportion of patients receiving antihypertensive treatment in the first 24 hours was higher in the care bundle group (78.9%) compared to the usual care group (70.9%), however after this time it did not differ between groups. Mean SBP was 148.4 ± 21.5 mm Hg by 1 hour after treatment in the care bundle group and 154.7 ± 22.5 mm Hg in the usual care group; note that this is a mean difference of only 6.3 mm Hg at 1 hour from start of treatment. At 24 hours, the care bundle group had a mean SBP of 136.1 ± 16.5 mm Hg, while the usual care group had a mean SBP of 139.0 ± 17.2 mm Hg; the overall adjusted mean difference between groups at 24 hour was only -3.6 mm Hg (95% CI: -4.5 to -2.7; p<0·0001). Not surprisingly, care bundle patients achieved SBP ≤ 140 mm Hg faster (median 2.3 [IQR 0.8-8] hours) than usual care patients (median 4 [IQR 1.9-16] hours). Mean diastolic BP (DBP) was 86.2 ± 13.8 mm Hg at 1 hour in the care bundle group compared to 88.3 ± 14.2 mm Hg in the usual care group; at 24 hours, the care bundle group had mean DBP of 78.9 ± 11.5 mm Hg, compared to 80.4 ± 12.1 mm Hg in the usual care group with an overall adjusted mean difference at 24 h of -2.4 mm Hg (95% CI: -3.0 to -1.8; p<0.0001). Given how small these differences are in both SBP and DBP between groups, statistical significance was driven primarily by the extremely large patient sample.

Of patients with elevated serum glucose, more care bundle patients achieved control than in the usual care group (13.4% *vs.* 6.5%), but there were minimal differences in both adjusted mean serum glucose concentrations over 24 hours and time to achievement of glycemic control. There was no overall adjusted mean difference in fever control over 24 hours between the two groups, nor were there differences in anticoagulation reversal between groups. Additionally, data in the study appendices for differences in hematoma volume are limited by "clinician report" of hematoma size without unbiased, external adjudication; these data exclude about 800 cases at 24 hours yet show a reduction in volume in both groups which is highly unusual without a large volume of patients undergoing surgical hematoma removal, and they contain multiple outliers with a skewed distribution. Therefore, it is difficult to determine whether the care bundle affected hematoma volume. Ultimately, at 6 months patients in the care bundle group had better scores on the modified Rankin Score (mRS) compared to usual care patients (odds ratio 0.86 (95% CI: 0.76–0.97; p=0.015).

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External validity, also called generalizability, refers to how *widely applicable* study methods are across different practice settings, with highly generalizable methods capable of producing outcomes across various types of patients and practice settings. As a first step in considering generalizability, readers are encouraged to consider how closely their practice sites resemble those that participated in the study, including the standard of care for ICH patients that was in place at the study's practice sites *prior to* initiating the ICH care bundle. In this case, INTERACT 3 is clearly generalizable to ICH under-resourced practice sites in low- to middle-income countries. Secondly, readers should consider how similar their patient populations are to those patients enrolled in the study, in this case 90% Chinese patients with admission SBP means of approximately 170 mm Hg and hematoma volumes approximating 15 mL.

Internal validity considers the credibility of conclusions tied to a causal relationship, in this case whether the ICH care bundle alone could have produced the difference in mRS 6-month functional outcome. Readers should evaluate how great the differences are between the two groups in each component of the care bundle and how these differences could theoretically cause a shift in functional status, in particular the small differences in SBP.

Could it be that when under-resourced sites in low- and middle-income countries start to pay closer attention to ICH patients by closely monitoring a variety of parameters, that this vigilance is so effective that it has an additive effect capable of increasing the "potency" of the ICH care bundle? It is difficult to measure what are often considered "soft" parameters such as nursing and medical attention, and the degree of stroke team vigilance in overseeing care, yet these changes may cause a potent shift in functional status. Certainly, it is essential that stroke scientists continue to search for potent ICH interventions, but for well-resourced practice sites that are staffed with interprofessional stroke specialists, it's likely that many aspects of INTERACT 3's ICH care bundle are already in place, along with vigilant oversight and in some cases more sophisticated treatments such as early hematoma evacuation and use of agent-specific antidotes for anticoagulation reversal in patients on direct oral anticoagulants. So, while INTERACT 3 may be a big step for low- to middle-income under-resourced sites, much more still needs to be discovered and implemented to reduce the significant disability caused by this most severe form of stroke.

References

1. Ma L, Hu X, Song L, Chen X, Ouyang M, Billot L, Li Q, Malavera A, Li X, Muñoz-Venturelli P, de Silva A, Thang NH, Wahab KW, Pandian JD, Wasay M, Pontes-Neto OM, Abanto C, Arauz A, Shi H, Tang G, Zhu S, She X, Liu L, Sakamoto Y, You S, Han Q, Crutzen B, Cheung E, Li Y, Wang X, Chen C, Liu F, Zhao Y, Li H, Liu Y, Jiang Y, Chen L, Wu B, Liu M, Xu J, You C, Anderson CS, for the INTERACT 3 Investigators. The third Intensive Care Bundle with Blood Pressure Reduction in Acute Cerebral Haemorrhage Trial (INTERACT3): an international, stepped wedge cluster randomised controlled trial. *Lancet*. 2023; 402: 27-40.

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Navigating Changes in Stroke Center Certification Standards

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Abstract

Stroke programs seeking disease specific certification must stay abreast of certification standards; these may change on an annual basis to reflect evolving evidence and best practice amongst stroke programs. New standards implemented in early 2024 impact expectations for educational competencies, integration with quality improvement (QI) departments, and timeliness of treatment. The new standards also further define roles and responsibilities for key personnel, relationships within the program and with external groups such as emergency medical services (EMS), and evolving expectations at discharge and other transitions of care. Organizations maintaining stroke certification may benefit from a focused review of their program related to the new standards to ensure compliance and optimal care.
Keywords: stroke, ischemic stroke, certification, quality improvement

Introduction

Stroke program disease specific certification by external accrediting agencies is a mainstay of the American stroke system of care.[1] Program certification is associated with improved patient outcomes.[2,3] Successful stroke program certification requires careful monitoring of certification standards, which can change annually or even semiannually depending on the accrediting agency. This year, The Joint Commission (TJC) is the only agency to publicly announce standard updates.[4] The TJC certification updates published in June 2023 and effective January 2024 mark several significant changes in stroke program standards. We review several themes noted in the updated certification standards and provide suggestions that may help ensure success with certification review and improved program performance.

Stroke Program Certification Standards

Stroke disease-specific certification is provided primarily by three accreditation agencies: The Joint Commission (TJC), Det Norske Veritas (DNV), and the Accreditation Commission for Healthcare (ACHC, formerly known as Healthcare Facilities Accreditation Program). While each accreditation company uses a different process and cadence to set their certification standards, they generally seek input from experts in the field and update their standards annually. The organization that currently accredits most American hospitals[5] is TJC; they utilize their Technical Advisory Panel which consists of an assembled group of national stroke experts, along with the published literature to determine necessary standard updates.[6] Standards are generally published for public comment, with final standards pre-published several months ahead of expected implementation. Stroke program leaders should be aware of the process and timing of stroke program certification standard changes depending on their organization's accrediting organization.

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Significant Changes in the Stroke Certification Standards

The 2024 TJC stroke program certification standard updates cover several major themes. Programs are allowed more latitude and flexibility when managing education and competency of staff, and additional emphasis is placed on continuous quality improvement and integration with the organization's quality improvement department. Timeliness of treatment continues to be emphasized in the standards, with edits to expected timeliness of care for patients receiving mechanical thrombectomy and those who transfer to another facility. Additionally, emphasis is placed on defining and developing relationships, roles, and responsibilities within the program and with key outside partners such as emergency medical system (EMS) personnel. Finally, there are significant changes to post-discharge transition expectations in the standards.

Education and Competency

The 2024 certification standards include several significant changes to expectations for staff education and competency. Previous versions of the TJC Comprehensive Stroke Certification (CSC) standards outlined a list of expected competencies for nursing staff working in neurocritical care units. Presently, TJC standards for each level of stroke center certification no longer list a minimum number of education hours for nursing staff; additionally, and both the TJC CSC and TSC standards now require advanced practice providers (APPs) to have focused expertise in *neuroscience care* rather than a more narrowly defining the area of expertise required as *stroke*. Despite this change in wording, stroke programs are still required to assess staff competencies for provision of specialized stroke care and to provide educational programs that meet the needs of those staff. In fact, by deleting the former TJC-defined list of expected knowledge and the number of hours of education required, the program leadership must now systematically evaluate staff competencies and design customized educational interventions based on staff needs. Methods to assess educational needs can include formal evaluation through testing, findings in quality improvement studies, and interprofessional staff and program leadership findings based on clinical interactions. Findings from educational needs assessments should be documented to demonstrate compliance with this new standard. We recommend that an annual education plan be developed to organize the educational work required to support competency improvement.

QI Department Integration

The 2024 TJC standards now clearly call for the organization's quality improvement department to be involved in analyzing stroke program metrics. This reflects a significant shift in the standards and is likely welcome news to leaders who've struggled to engage their quality improvement leadership. This also may reflect the continued evolution in stroke program quality improvement that necessitates expertise to guide meaningful improvement.

The standards highlight several areas where documentation must be addressed (e.g., the reason "*potentially*" eligible patients didn't receive intravenous thrombolysis) and several new items that should be included in stroke logs (e.g., "*time of diagnostic tests and acute treatments"*) reflecting a broadening of items that may require monitoring. A process for reducing time from arrival to intervention is also required, with the maximum time to

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treatment of 60 minutes expected. Programs are also required to monitor both stroke and death rates for transcarotid artery revascularization (TCAR) procedures. The standards also require monitoring of at least two relevant patient care data elements in addition to core measures. Since most organizations are not resourced with staff to manage the growing number of quality improvement requirements for stroke certification, collaboration with quality improvement departments may help to manage the workload and ensure meaningful work.

Timeliness of Treatment

Over the past 10 years, timeliness of care in the first few hours of an acute stroke has been an increasing focus in the stroke certification standards. As studies showed that patients had better outcomes when they received faster thrombolysis and/or mechanical thrombectomy, the expected timeline to provide both interventions continued to decrease.[7] Stroke program leaders must acknowledge that provision of safe and fast care requires a dedicated team with clearly defined roles, responsibilities, and processes of care.[8]

The 2024 TJC certification standards for CSC, TSC, and PSC hospitals outlines the following time-based expectations:

- Intravenous thrombolytics are given in less than 60 minutes from arrival;
- Endovascular treatment is provided in less than 90 minutes for those arriving direct to the emergency department of a TSC or CSC;
- Endovascular treatment is provided in less than 60 minutes from transfer arrival at a TSC or CSC facility; and,
- Door in - door out time is less than 2 hours for patients requiring management at higher level stroke centers.

While organizations have centered performance improvement initiatives in these areas for years, many still struggle to meet time-based performance goals consistently. In these situations, a sophisticated quality improvement initiative is warranted that includes leadership from all impacted departments and support from quality improvement experts. If support by these individuals is lacking within an organization, seeking outside consultation may be important to identify methods to optimize performance.

Relationships, Roles, and Responsibilities

The 2024 standards reflect a needed investment in relationships, along with clarification of roles and responsibilities. Previously program leadership included the appointment of a qualified medical director. First, the new standards clearly require a stroke leadership dyad consisting of a medical director and another qualified individual with collective responsibility for program direction. Standards for the interprofessional team now clearly require inclusion of a nurse or advanced practice provider and a physician; while the team may be larger than this, at a minimum, these individuals must be included. The standards also emphasize that the roles and responsibilities of the interprofessional team be outlined within the stroke program, whereas previous standards required this of only the medical director and stroke coordinator. Further, the interprofessional team must meet at least quarterly, and attendance and meeting minutes must be recorded.

The standards further clarify the responsibility of the stroke program to work

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with EMS. While prehospital notification is often standard for patients arriving to the hospital,[9] this is not always the case for patients transferred between facilities. Documentation by the program and/or ambulance or helicopter transfer agency should now include a statement that the patient is being transferred to a higher level of care for stroke services. The stroke program is also expected to work collaboratively with EMS to provide educational opportunities. Perhaps the most significant change in the standards reflects the stroke programs responsibility to ensure EMS has specific training in at least one evidence-based prehospital stroke assessment tool.

Post-Discharge and Transitions of Care

Finally, the standards for post-discharge and transitions of care changed for several levels of stroke centers. The timeframe for post-discharge call was deleted and no longer specifies a call within 7 days; this has been replaced with a requirement to have a process for follow up for patients that are discharged home, with some prescriptive items that could be discussed, including follow-up appointments, medications, therapy compliance, risk of recurrent stroke, and knowledge of personalized risk factors. While many centers previously focused their efforts on ensuring compliance with a call within 7 days, the focus now shifts to the content and quality of the patient/family conversation after discharge. Additionally, assessment of family readiness and/or capabilities was added to the requirements for Acute Stroke Ready Hospitals (ASRH) and PSCs. Of note, the term *"caregiver"* was expanded to include the term *"family members."*

Implications

This summary reflects several major changes in the 2024 stroke center certification standards. The summary is not an exhaustive list of changes to the standards but it reflects the sort of analysis that stroke program leaders should conduct when new standards are published. Changing standards highlight areas that are closely tied to the evolution of acute stroke care, while providing a window into the areas that agency reviewers may focus on during visits in 2024. Programs that are most successful navigating each certification change are those that engage in gap analyses and develop implementation plans tied to key priorities.

Conclusions

As stroke disease-specific certification continues to drive evolution within the American stroke systems of care, staying current with certification standard changes will remain a core responsibility of stroke program leadership. We highlight key changes to the published 2024 TJC certification standards in an effort to provide an organizational guide to support ongoing program analyses and continuous improvement.

Note: This article is intended to serve as a complimentary guide to certification agency standards and is not a replacement for the standards themselves. Stroke program leaders are encouraged to refer directly to the stroke certification standards to ensure program goals, activities, and systems are compliant with certification agency requirements.

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References

1. Towfighi A, Ovbiagele B, Saver JL. Therapeutic milestone: stroke declines from the second to the third leading organ- and disease-specific cause of death in the United States. *Stroke*. 2010; *41*:499–503. doi: 10.1161/STROKEAHA.109.571828.
2. Jasne AS, Sucharew H, Alwell K, Moomaw CJ, Flaherty ML, Adeoye O, Woo D, Mackey J, Ferioli S, Martini S, de Los Rios la Rosa F, Kissela BM, Kleindorfer D. Stroke Center Certification Is Associated with Improved Guideline Concordance. *Am J Med Qual*. 2019 Nov/Dec;34(6):585-589. doi: 10.1177/1062860619835317.
3. Man S, Schold JD, Uchino K. Impact of Stroke Center Certification on Mortality After Ischemic Stroke: The Medicare Cohort From 2009 to 2013. *Stroke*. 2017 Sep;48(9):2527-2533. doi: 10.1161/STROKEAHA.116.016473.
4. The Joint Commission. *2024 Comprehensive Certification Manual for Disease-Specific Care*. Oakbrook Terrace, IL.
5. Schmaltz SP, Williams SC, Chassin MR, Loeb JM, Wachter RM. Hospital performance trends on national quality measures and the association with Joint Commission accreditation. *J Hosp Med*. 2011 Oct;6(8):454-61. doi: 10.1002/jhm.905.
6. The Joint Commission. *Joint Commission Advisory Groups*. Accessed January 12, 2024. https://www.jointcommission.org/who-we-are/facts-about-the-joint-commission/joint-commission-advisory-groups/#:~:text=Comprised%20of%20individuals%20with%20expertise,highest%20quality%20and%20value%20through.
7. Man S, Xian Y, Holmes DN, Matsouaka RA, Saver JL, Smith EE, Bhatt DL, Schwamm LH, Fonarow GC. Target: Stroke Was Associated With Faster Intravenous Thrombolysis and Improved One-Year Outcomes for Acute Ischemic Stroke in Medicare Beneficiaries. *Circ Cardiovasc Qual Outcomes*. 2020 Dec;13(12):e007150. doi: 10.1161/CIRCOUTCOMES.120.007150.
8. Dusenbury W, Mathiesen C, Whaley M, Adeoye O, Leslie-Mazwi T, Williams S, Velasco C, Shah SP, Gonzales NR, Alexandrov AW; American Heart Association Council on Cardiovascular and Stroke Nursing and the Stroke Council. Ideal Foundational Requirements for Stroke Program Development and Growth: A Scientific Statement From the American Heart Association. *Stroke*. 2023 Apr;54(4):e175-e187. doi: 10.1161/STR.0000000000000424.
9. Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, Biller J, Brown M, Demaerschalk BM, Hoh B, Jauch EC, Kidwell CS, Leslie-Mazwi TM, Ovbiagele B, Scott PA, Sheth KN, Southerland AM, Summers DV, Tirschwell DL. Guidelines for the Early Management of Patients With Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke*. 2019 Dec;50(12):e344-e418. doi: 10.1161/STR.0000000000000211.

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The Royal Blackburn Hospital, Acute Stroke Unit

Victoria Ramsden & Sheeba J. Philip, M.Sc. (Stroke), ANVP-BC

East Lancashire is found in northwest England and has a population of approximately half a million. There you will find our hospital, the Royal Blackburn Hospital, which provides primary stroke care services for the people in their region.

Our hospital's stroke pathway begins with their close working relationships with colleagues at Northwest Ambulance Service. If a patient calls *999* with FAST scale-positive symptoms, the ambulance service pre-alerts the emergency department before arrival allowing our stroke specialist team to be at the emergency department door on patient arrival.

Our program has dedicated stroke physician consultants, a nurse consultant, specialist nurses, and healthcare assistants on the Stroke Team, and collectively, they ensure rapid access to neuroimaging and treatment. The British Royal College of Physicians 2023 stroke guidelines state, "*patients need specialist care on a stroke unit focused initially on preserving life, limiting brain damage and preventing complications*." Therefore, we aim for all stroke patients to be admitted directly to our Acute Stroke Unit from the emergency department within 4 hours of arrival to hospital. Our Acute Stroke Unit admission consists of initial assessments by a registered nurse, a stroke specialist physiotherapist, an occupational therapist, and a speech and language pathologist. Our specialist therapy team works from 0900 to 1700, seven days a week ensuring all newly admitted stroke patients are seen for initial assessment within 24 hours.

Our Acute Stroke Unit has recently upgraded to a 26-bed ward with 16 cardiac monitored beds managed through a central monitoring system. This is a significant improvement in the patient journey as it enables us to monitor cardiac rhythms for the first 24-48 hours of care to identify abnormalities warranting treatment.

Each morning we hold a safety huddle to identify any new patients that have been admitted between 1700 and 0900; this promotes an interprofessional team approach to concerns raised in patients' conditions and any other issues such as care needs that fall within a gap in the published guidelines. We meet again for midday rounds to discuss every patient's diagnosis and care needs in more depth, and to develop and ensure execution of realistic plans and discharge pathways. To ensure available beds for all new stroke admissions, we know we must create personalized discharge plans in a timely manner.

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In Our Stroke Unit

Working collaboratively as an interprofessional team enables us to review systems and methods to make improvements that better patient care and outcomes. For example, our speech and language team have created a care bundle that staff follow to ensure good oral hygiene practices are maintained with the use of chlorhexidine gel and specific mouthcare items to reduce the risk for post-stroke associated pneumonia in our patients; this was implemented with a bright yellow oral hygiene tray so that all staff could quickly identify patients requiring the oral hygiene intervention. We have measured a significant reduction in stroke associated pneumonia following implementation of this protocol. We also have developed and implemented an early mobilization protocol for hemodynamically stable patients to ensure a consistent approach and "mobilization dose" at 24-48 hours after Acute Stroke Unit admission. When it comes time to mobilize our patients, all available interprofessional staff are on hand to make this happen in an efficient and caring fashion.

Our relationship with external hospital services ensures seamless support for our acute stroke patients across the care continuum. We work closely with our local Stroke Association charity which offers stroke survivors and their families support and advice. Our Stroke Association staff come to the Acute Stroke Unit once a week and attends our interprofessional meetings so that they can identify which patients may benefit their support. They also provide follow-up support in the community to address any concerns that may arise once a stroke patient returns home. After discharge, all stroke patients are followed by our Community Stroke Therapy Team. Development and ongoing improvement of this service has expedited hospital discharge, which in turn creates capacity on the Acute Stroke Unit to ensure rapid admission of new patients.

Lastly, we are also supported by a rapid assessment service that allows patients with non-disabling stroke to be quickly assessed and undergo all required neuroimaging. This service sees approximately 60 patients per month preventing 30 admissions to the Acute Stroke Unit, with 30 referrals to our Transient Ischemic Attack (TIA) clinics. Our TIA clinics are run by staff from the Acute Stroke Unit along with stroke physician consultants and is available 7 days a week.

Our Acute Stroke Unit shares best practices with other stroke units regularly, as well as with our wider stroke network. We celebrated World Stroke Day by holding a conference with other stroke units in the area, inviting a variety attendees and presenters from within our interprofessional team; we also had 2 patients that attended to share their experiences on our stroke pathway. We always strive to listen to others and make changes that better both the service and the patient experience.

Having an Acute Stroke Unit means that patients get the right care at the right time provided by highly specialized

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interprofessional teams. Stroke Units that are supported by specialists improve patient outcomes, and we are proud to work on this important unit caring for these vulnerable patients.

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Neuroimaging Case Review

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The Case

A 40-year-old White non-Hispanic obese (body mass index 41) female presents to the emergency department by ambulance with a chief complaint of severe headache. Past medical history includes hypertension, hyperlipidemia, 24-year pack history of menthol cigarette smoking, and migraine headaches for which she takes rizatriptan. The day prior to admission she developed a headache in the morning hours which was common with her migraine history. She spent the day in bed sleeping on and off, which her spouse reports as normal for her during migraine episodes. The morning of her hospitalization, her husband reported hearing her yelling out in pain and noticed she seemed confused and unable to respond, so he called 911 for ambulance transfer to hospital.

On admission to the emergency department, the patient's National Institutes of Health Stroke Scale (NIHSS) score was 12 reflecting expressive aphasia (item 9 = 2 points, item 1B = 1 point, item 1C = 1 point), right arm (4 points) and lower facial weakness (2 points) with sensory loss (1 points) and lethargy (1 point).

Figure 1 presents the arrival noncontrast computed tomography (CT). Note the area of hypodensity signifying and irregular pattern of edema with a left to right midline shift measuring ~ 7mm, and an irregular, patchy parenchymal hemorrhage in the left hemisphere. A CT angiogram and venogram were performed immediately following the noncontrast CT (Figure 2) showing a positive "empty delta sign" indicative of a superior sagittal sinus thrombosis.

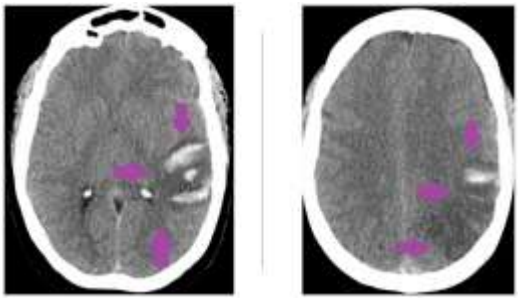

Figure 1: Axial non-contrast CT image showing areas of hyperdensity (blood) within areas of regional hypodensity (ischemia) (purple arrows).

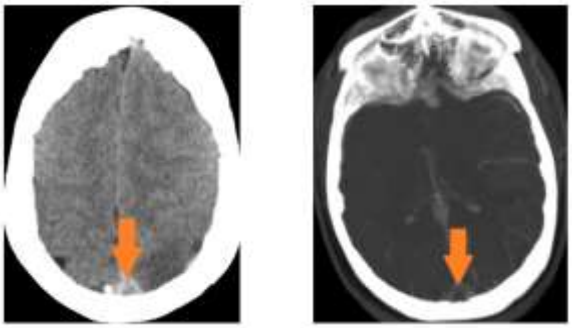

Figure 2: Axial non-contrast CT image: Orange arrow points to triangular filling defect in the superior sagittal sinus indicating an "empty delta sign" suggestive of cerebral venous sinus thrombosis.

The patient was subsequently diagnosed with a left hemispheric venous infarct caused by cerebral venous sinus thrombosis. Further discussion with her husband identified that the patient was on oral contraceptives, a known contributor to hypercoagulable state especially in combination with cigarette smoking, and a full hypercoagulable lab

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panel identified an antithrombin III deficiency.

The patient was started on a heparin drip but continued to deteriorate with progressive worsening of her level of consciousness over the course of the next 8 hours. She was taken to the neurointerventional suite for clot extraction when her NIHSS score increased from 12 to 17, however she continued to deteriorate over the subsequent 3 days and ultimately required tracheotomy and placement of a percutaneous gastrostomy tube (PEG). On day 6, she was started on a direct oral anticoagulant drug via PEG. She progressed over the next 10 days and was therefore transferred to a skilled nursing facility for continued care and rehabilitation.

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Certification Corner

Are you preparing for stroke certification as a Neurovascular Registered Nurse (NVRN), Advanced Neurovascular Practitioner (ANVP), Certified Neurointerventional Clinician (CNIC), or an Advanced Stroke Coordinator (ASC)? Use these questions to gauge your preparedness to test.

Part I: ASC, NVRN, CNIC, & ANVP Applicable Questions

1. AK is admitted with weakness in the left lower face, 2/5 left arm weakness, and decreased tactile sensation affecting the left arm and face; visual fields are intact, but on exam you find left visual neglect. Based on these assessment findings, what vascular territory is implicated?
    a. Right posterior cerebral artery
    b. Top of the basilar artery
    c. Left distal internal carotid artery
    d. Right middle cerebral artery

2. CF is a 42-year-old female who arrives in the emergency department with a 5-hour history of neurologic symptoms. Past medical history is negative. On exam, you note 1/5 left-sided motor deficits affecting the arm and leg, and complaints of dense sensory loss in the left arm and leg. Face is symmetric and she complains of a headache; she also says her vision is "coming and going." Swallow function is normal. The noncontrast computed tomography (CT) scan and CT angiography (CTA) are normal. Which of the following is appropriate?
    a. Notify the neurointerventional team of a thrombectomy candidate
    b. STAT magnetic resonance imaging (MRI)
    c. Tenecteplase (TNK) bolus
    d. Aspirin 325 mg per os

3. Which of the following scales instructs scoring the patient's "best response" on exam?
    a. Glasgow Coma Scale
    b. National Institutes of Health Stroke Scale (NIHSS)
    c. Hunt & Hess
    d. FUNC Score

4. GW presents with right upper and lower facial weakness and left arm and leg weakness. Such a presentation suggests:
    a. Left midbrain infarction
    b. Stroke mimic diagnosis
    c. Left posterior cerebral artery infarction
    d. Right pontine infarction

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Certification Corner

5. You examine a patient that has arrived in the emergency department finding that he has his eyes closed. When you ask him to open them, you notice passive right medial eye deviation and when following your finger, you note that he cannot move his right eye laterally beyond midline. The left eye has full extraocular movements. He also complains of diplopia. You suspect which of the following?
    a. Classic frontal middle cerebral artery territory eye deviation
    b. Opthalmic artery related monocular eye dysfunction
    c. Brainstem associated gaze deviation
    d. Occipital lobe related eye deviation

Part II: ASC Questions

6. The American Nurses Association/ANVC Scope and Standards of Neurovascular Nursing Practice and the American Heart Association/American Stroke Association 2023 Scientific Statement describe the stroke coordinator role as:
    a. The key person responsible for data collection in a stroke quality registry within a certified stroke center hospital.
    b. A leadership position that oversees the stroke program and works to optimize program performance through expert knowledge, data analytics, and practice optimization.
    c. A registered nurse clinician with an earned bachelor's (master's degree preferred) that responds to code stroke alerts and assists interdisciplinary staff with patient management.
    d. The stroke program service line manager that oversees and directs all administrative aspects of the certified stroke center.

7. You note that the emergency department staff continue to violate the certification standard that requires nothing be given by mouth until assessment of swallow confirms intact function. Numerous hours have been spent educating the staff how to assess swallow competency and instructing them not to fill the "Aspirin 325 mg PO" order in non-thrombolysis cases until evaluation of swallow competency has been confirmed. As a stroke coordinator, you recognize that this continued problem reflects which of the following?
    a. Normalized deviance
    b. Lean processes
    c. The Swiss Cheese Model in action
    d. Weak error signals

Certification Corner

Part III: CNIC Questions

8. RP is undergoing a diagnostic cerebral angiogram for further evaluation of an incidental carotid terminus aneurysm. He reported a post procedural headache with mild nausea, no vomiting. On exam, his vital signs are stable, and he is neurologically at baseline without any focal neurological deficits. Based on your assessment of his symptoms, you would likely order which of the following?
    a. STAT noncontrast head CT
    b. Normal saline bolus and antiemetic
    c. Steroid and antihistamine
    d. Subcutaneous epinephrine

9. Which of the following best defines the principle of *justification* as it relates to radiation?
    a. Radiation exposure is justified if the neurointerventional procedure request form is signed and dated by the attending physician.
    b. Radiation is allowable if the exposure produces benefits that offset the potential for radiation harm.
    c. Imaging quality needs to be balanced with the radiation dose the patient will receive.
    d. The neurointerventional procedure requiring radiation exposure can proceed if a written informed consent has been signed.

10. Which of the following is used to grade aneurysm occlusion post-coiling procedure?
    a. World Federation of Neurological Surgeons Scale
    b. Hunt and Hess Scale
    c. Raymond Roy Classification
    d. Fisher Grading Scale

Part IV: ANVP Questions

11. When considering types of thrombophilias, the ANVP knows that:
    a. Cerebral venous thrombosis is commonly associated with antiphospholipid antibody profile.
    b. Thrombophilias are commonly tied to arterial thrombosis risk in patients that fall within the “Stroke of Unusual Etiology” category.
    c. The most common inherited thrombophilias are factor V Leiden and prothrombin 20210 mutations.
    d. Positive lupus anticoagulant falls within the inherited thrombophilia classification.

Certification Corner

12. Your 53-year-old female patient presents with recurrent, progressive lacunar strokes, depression, and cognitive dysfunction. Risk factors include well-controlled hypertension (current BP 124/68 mm Hg), past 32-year pack year smoking history for which the patient has abstained for the past 10 years, and familial hyperlipidemia which is treated with high dose atorvastatin. She has had 3 stroke admissions within the past 18 months, with each demonstrating new lacunar infarction and worsening cognitive dysfunction that has caused her to retire from work. Considerations at this point include which of the following?
    a. Enzyme replacement therapy with migalastat
    b. Molecular genetic testing for *NOTCH3* gene
    c. Pyridoxine, methionine-restricted diet, folate and vitamin B12 supplements, and betaine
    d. Loop recorder implantation for continuous cardiac monitoring

13. Blood flow is the product of:
    a. (Resistance^1 – Resistance^2) x Preload
    b. (Pressure^1 – Pressure^2)/Resistance
    c. (Preload – Afterload)/Stroke Volume
    d. (Stroke Volume x Heart Rate)/Resistance

14. Drivers of increased myocardial oxygen consumption for increased pressure to support forward blood flow include which of the following?
    a. Arterial vasomotor exhaustion
    b. Increased endovascular nitric oxide release
    c. Increased arterial elasticity
    d. Decreased afterload

15. Which of the following best describes a randomized controlled clinical trial?
    a. An observational study that examines differences in groups that evolve over time.
    b. A mixed methods study that includes both qualitative and quantitative data to answer specific research questions in a patient sample.
    c. An interventional study that tests a new device, drug, or process on a patient sample.
    d. A prospective study that collects a large number of variables in a patient sample over a period of time, and then analyzes the data for differences between groups on pre-specified outcomes.

Part I: Answers

1. **D**. The right MCA territory produces contralateral motor and sensory findings and visual and tactile neglect. The right posterior cerebral artery would produce findings that are limited to a left visual field cut. Top of the basilar occlusions can produce total blindness from loss of flow to both the right and left posterior cerebral arteries. Left distal internal carotid artery occlusions can produce coextensive right-sided deficits that would likely also include aphasia.

Certification Corner

2. **B**. The patient's symptoms are inconsistent with any one vascular territory; dense motor and sensory loss without loss of the face are suspicious for a stroke mimic as is total loss of vision with the described motor findings. Negative CTA further confirms the likelihood of a stroke mimic diagnosis. MRI is useful to confirm this conclusion. The patient is not a candidate for thrombectomy since there is no evidence of occlusion. She is also not a candidate for TNK given that she is outside a window for intravenous thrombolysis. Lastly, aspirin may ultimately be indicated if a mechanism warranting its need is identified, but until the diagnosis is confirmed with MRI, it would be withheld.
3. **A**. The Glasgow Coma Scale is a level of consciousness instrument that prognosticates outcome but has been adopted for ongoing assessments; it has scoring instructions that specify scoring with "best response" which will cause focal deficits on one-side of the body to be ignored when the other side of the body is intact. The NIHSS captures actual neurologic disability found on exam and is useful in both ischemic stroke and patients with intracerebral/intraparenchymal hemorrhage. The Hunt and Hess scale scores deficits in patients diagnosed with subarachnoid hemorrhage. The FUNC score is used to prognosticate functional disability in patients with intracerebral/intraparenchymal hemorrhage.
4. **D**. Pontine infarction may produce bilateral symptoms with the upper and lower face weak on the side of the pons infarcted, and the arms and legs weak on the opposite side of the body because voluntary motor fibers cross over in the pyramids of the medulla oblongata. Midbrain infarction can include findings affecting cranial nerves III and IV. The symptoms are consistent with vascular territory, therefore this is not a stroke mimic presentation. Left posterior cerebral infarction would produce symptoms that include a right visual field cut.
5. **C**. Dysconjugate gaze is suggestive of a brainstem lesion affecting one of the cranial nerves associated with extraocular movement; with a loss of fused ocular movement, patients commonly complain of diplopia and therefore, they commonly present with the eyes closed. Ischemia affecting the frontal eye fields within the middle cerebral artery territory commonly produce forced conjugate eye deviation toward the side of the brain with the stroke. Infarcts within the ophthalmic artery result in monocular vision loss, not eye deviation, and posterior cerebral artery stroke does not cause medial eye deviation or diplopia.

Part II: Answers

6. **B**. The stroke coordinator position is considered a leadership position within the hospital's certified stroke program. Stroke coordinators are not data collectors and instead are prepared to use their competencies in data analytics to identify key findings that can be used to drive program improvement. Stroke coordinators do not have to be registered nurses, although the majority of those working in the role are licensed registered nurses; similarly, there is no degree requirement for stroke coordinators, but role competencies are described in detail within the scope and standards document. Stroke program service line managers are administrators, not stroke coordinators; however, given that stroke program managers are not required to be stroke experts, they should rely on stroke coordinators and vascular neurologists to guide program management.
7. **A**. Normalized deviance is at play with the staff; they have the knowledge to recognize that the order should be held until swallow is confirmed, however, they have chosen to ignore the

certification quality standard, and this may be tied to the way the order is written. Lean processes are part of a quality model that aims to improve care. The Swiss Cheese Model suggests that normalized deviance can contribute to errors in care; however, the model overall is not the root cause of the problem. Weak signals are warnings of an error that may occur, but the error has already occurred in this scenario.

Part III: Answers

8. **B**. Normal saline bolus and an antiemetic are most appropriate for managing the symptoms of contrast media side effects. Symptoms are not concerning for hemorrhage given the neurological exam is at baseline and there are no complaints of headache so repeat noncontrast CT is unnecessary. Symptoms are not consistent with mild to severe anaphylaxis making options C and D incorrect.
9. **B**. Justification supports exposure if benefit outweighs risk. Neurointerventionalists are licensed radiation providers that are responsible for risk-benefit assessment and justification. The radiation safety optimization principle is reflected by ensuring that optimal quality is provided, and written informed consent occurs after ensuring the justification principle has been met.
10. **C**. The Raymond Ray Classification which is also referred to as *Montreal Scale,* is used to evaluate the occlusion or residual filling in an aneurysm after aneurysm coiling based on the post-coiling DSA runs. The World Federation of Neurological Surgeons Scale and the Hunt and Hess Scale are functional scores used to predict outcomes in patients with subarachnoid hemorrhage. The Fisher Grading Scale is used to predict the risk of cerebral vasospasm after subarachnoid hemorrhage based on the amount of blood shown on the initial CT scan.

Part III: Answers

11. **C**. Factor V Leiden and prothrombin 20210 mutations are relatively common as inherited thrombophilias. Cerebral venous thromboses have shown relationships with inherited thrombophilias. Thrombophilias are more commonly a risk for venous thromboses than they are arterial thromboses. Positive lupus anticoagulant is part of an antiphospholipid antibody profile, an acquired thrombophilia.
12. **B**. NOTCH3 gene testing is indicated given the well-controlled risk factors yet recurrent lacunar infarction in combination with new onset mood disorder and worsening cognitive dysfunction. Migalastat is indicated for Fabry's and is expensive therapy. Treatment for hyperhomocysteinemia is not indicated in this patient, although it would unlikely harm her. While microembolic causes have been associated with small vessel stroke, they are unlikely to be a cause of this woman's recurrent lacunes, mood disorders, and worsening cognitive status; it wouldn't harm the patient and may help to confirm the diagnosis but would likely be noncontributory at finding a cardioembolic source.
13. **B**. Pressure at the proximal end of a tube (P^1) – pressure at the distal end of a tube (P^2) / resistance to flow through the tube = blood flow (Ohm's Law). Other formulas are not representative of blood flow.
14. **A**. In arterial beds that are vasomotor exhausted, lactic acid from a lack of oxygen and glucose cause passive vasodilation; the only way to ensure adequate flow through these regions is to

increase pressure. Other choices represent mechanisms that cause a decrease in the pressure gradient.

15. **C**. Randomized controlled trials test new methods, often in relation to an existing method, but sometimes in a single-arm design. Observational studies (item A and D) do not intervene on patients and instead follow them over time to examine what outcomes occur in relation to a wide variety of patient characteristics. Mixed methods studies combine qualitative and quantitative methods to explore experiences in areas that are poorly understood or new/evolving conditions for which little is known.

Are you an NVRN, ANVP, ASC, or CNIC board certified clinician and interested in writing test items for the Neurovascular Clinicians Certification Corporation (NVC-3)? Contact info@anvc.org at your earliest convenience to learn how to contribute!

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