ACUTE CARE NURSES' KNOWLEDGE ON IN-HOSPITAL STROKES AND PREDICTORS OF KNOWLEDGE

by

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In-hospital strokes (IHS) account for one in five strokes; however, IHS patients have higher mortality and are half as likely to be discharged home when compared to community-occurring strokes (Chen et al., 2018). Nurse-driven code stroke responses have been heavily utilized to facilitate timely IHS intervention. However, there is no consistency in reported nurse education and training. The purpose of this dissertation is to determine the stroke knowledge (SK) level of acute care nurses and identify nurse characteristics that may be predictors of SK.

A non-experimental, descriptive correlational study sampling nurses caring for adult, hospitalized patients was completed via online survey assessing demographics, stroke education and experience, and the Acute Stroke Management Questionnaire (ASMaQ) to test SK. The sample (N = 196) included mostly female (n=180; 92%), Baccalaureate-prepared nurses (n=131; 67%). There was overall good SK (M = 117.4; SD = 8.1), and six predictor variables were significantly correlated with SK (practice setting, code stroke awareness, activation comfort, and confidence in understanding, self-identified knowledge of acute stroke management, and self-perception of SK). The regression model explains 30.7% of the variance in the ASMaQ total scores, F (6, 189) = 13.93, p < .001. Findings from this study inform the usage of the ASMaQ as a quick, effective measurement tool for nurses' SK as well as gap areas in nurse SK.

ACUTE CARE NURSES' KNOWLEDGE ON IN-HOSPITAL STROKES AND PREDICTORS OF KNOWLEDGE

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Catherine L. Taylor

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DEDICATION

This dissertation is dedicated to my family.

To McLane, and the family that we will one day grow together.

The love that sustains.

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CHAPTER 1: INTRODUCTION

Introduction to Study

Chapter 1 of this dissertation introduces this study's topic and background focusing on the population, issue, significance, and purpose. This chapter will also introduce the phenomenon of interest, which is stroke knowledge. The conceptual and theoretical frameworks will be discussed, followed by variables of interest. These variables will be theoretical and operationally defined. The chapter concludes with the introduction of the research questions and specific aims.

Background

"Time is brain" is a phrase used to emphasize the importance of a timely and efficient response to an acute stroke (National Institute of Neurological Disorders and Stroke [NINDS], 2020). Stroke, or what was formerly described as cerebrovascular accident, is characterized into two main categories: ischemic and hemorrhagic (Sacco et al., 2013). This proposed study will focus on ischemic strokes, as the thrombolytic treatments encouraged in the "time is brain" and code stroke initiatives are for ischemic strokes specifically.

The American Heart Association (AHA) defines ischemic strokes as, "An episode of neurological dysfunction caused by focal cerebral, spinal, or retinal infarction" (Sacco et al., 2013, p. 2066). Ischemic strokes are often preventable and treatable but require a timely response. The two main treatment options for acute ischemic strokes are thrombolytic therapy and mechanical thrombectomy (Caplan, 2022). Thrombolytic therapy is the administration of an intravenous drug known as tissue plasminogen activator (tPA) (Caplan, 2022). Mechanical thrombectomy is the procedure of removing the clot via a vascular access catheter (Caplan, 2022). The purpose of both therapies is to restore blood flow to the brain.

There are many non-modifiable and modifiable risk factors for the severity of ischemic strokes. Non-modifiable risk factors include those the health care team cannot intervene or change, which include the patient's age, sex, race, ethnicity, and past medical history of stroke (Colsch, 2021). However, a modifiable risk is the timeliness of stroke recognition and time to intervention (Yang et al., 2019). For every second an ischemic stroke is left untreated, 32,000 neurons are lost which accelerates the aging process by over eight and a half hours (Saver, 2006). For every hour, 120 million neurons are lost, and a person ages over three and a half years. And for every missed or untreated stroke, a person will lose over one billion neurons and 36 years of life (Saver, 2006).

One out of five strokes will occur while a person is in the hospital (Chen et al., 2018; Emmett et al., 2019; Lu et al., 2019; Saltman et al., 2015). The occurrence of in-hospital strokes (IHS) can be traced to a variety of sources including complications from surgeries, procedures, or risk factors of comorbidities that led to the initial hospitalization (Yang et al., 2019). Recognition of in-hospital strokes may seem much simpler than those occurring in the community, as the person is under direct care of a multi-disciplinary team. However, in-hospital strokes are often missed, misunderstood, or mistaken for a variety of non-stroke related neurological complications, delirium, or reaction to narcotics or pharmacological agents (Chen et al., 2018).

The AHA provides a set of guidelines and recommendations for the healthcare team which serve as benchmark timeframes for response to and treatment of an acute stroke (AHA, 2019). Appendix B shows the timeframes provided by the AHA (2019). The timeframes are used to support the "time is brain" initiative and are set in place to ensure a person experiencing a stroke has optimal chances of receiving the time-sensitive interventions to prevent further

complications of the stroke (AHA, 2019). However, the timeframes can only be met if the entire health care team is knowledgeable and aware of the treatment protocols in place for IHS.

Significance

To increase benchmark times for stroke treatment and improve patient outcomes, hospital systems have initiated a "code stroke" response system. A code stroke is a systematic response to an acute stroke that includes a team of professionals who have expertise in stroke care (Yang et al., 2019; Manners et al., 2019; Kawano et al., 2021). The initiation of code stroke processes dates to 1994 (Gomez et al.), but the prevalence sharply increased after the June 1996 U.S. Food and Drug Administration (FDA) approval of tPA for the treatment of acute ischemic stroke within three hours of symptom discovery (Wang et al., 2000). This medical breakthrough in acute stroke treatment heightened the importance of timely response to ensure eligible patients were able to receive the novel treatment.

In the in-hospital setting, a code stroke is activated when stroke symptoms are identified, and the activation of the code notifies the trained team members who will then respond (Yang et al., 2019; Manners et al., 2019; Kawano et al., 2021). The literature has shown that the implementation of a code stroke process decreases the time from stroke symptom recognition to assessment by neurology and radiologic imaging (Kawano et al., 2021; Yoo et al., 2016). Code stroke processes also decreased the rate of stroke mimics, or false alarms (Manners et al., 2019).

Despite code stroke initiatives, IHS patients have been shown to have longer time to treatment when compared to community occurring strokes (COS) patients (Chen et al., 2018; Saltman et al., 2015). This finding is startling, as the time for transportation from the community to the hospital and need for initial work-up and medical history is eliminated in IHS (Chen et al., 2018). Once a stroke is recognized in the hospital, there should be no delay in time to assessment

and time to ordered radiologic scan and intervention. However, COS patients are still receiving treatment more quickly than their hospitalized counterparts.

Recommended stroke and IHS education for nurses is not clearly stated in the literature. Educational procedures for code stroke processes likewise are not emphasized in the literature for nurses. Assuming nurses are educated on code stroke procedures or that they competent in stroke-related materials is a dangerous assumption which may lead to dire patient outcomes. Although many nurses may have received education throughout their schooling and initial job training, stroke guidelines and practice are constantly evolving. This, in addition to the time-sensitive component, results in unrealistic expectations for nurses to stay current with the guidelines without proper continuing education.

Purpose of the Study

The purpose of this dissertation is to: (a) determine the knowledge level of acute care nurses about in-hospital strokes and (b) identify nurse characteristics that may be predictors of stroke knowledge.

Conceptual Framework

Phenomenon of Interest

The primary phenomenon of interest is stroke knowledge, specifically among nurses. The AHA defines stroke as, "… when a blood vessel that carries oxygen and nutrients to the brain is either blocked by a clot or bursts" (2022). Knowledge is defined as, "Information, understanding, or skill that you get from experience of education" (Merriam-Webster, n.d.). Based on these definitions, stroke knowledge can be defined as a nurses' understanding and skills regarding the various aspects of stroke. The various aspects of stroke knowledge are general stroke

information, the care available in the acute stroke phase, and management of patients. These three domains of stroke knowledge are adopted from the ASMaQ by Sim et al. (2021).

The contributing variables to stroke knowledge are from both professional acute stroke experience and personal acute stroke experience. Professional acute stroke experience is conceptually defined as "Application of nursing knowledge in demonstrating clinical judgement in a current or evolving practice setting (specifically stroke setting)" (Law Insider, n.d.). Nurses gain professional acute stroke experience through past work experiences with patients with stroke, and both formal and informal pre-licensure and post-graduate stroke training.

Personal acute stroke experience is conceptually defined as, "The moment-to-moment experience and sensory awareness of internal and external events or a sum of experiences forming an empirical unity such as a period of life" (Definitions, n.d.). Nurses have the potential to gain personal acute stroke experience through personal or familial experiences with acute stroke outside of professional work.

It is hypothesized that in addition to professional and personal acute stroke experience, various nurse characteristics, i.e., education, employment status, work experience, current practice setting, also relate to and/or affect the phenomenon on interest, stroke knowledge.

The primary phenomenon and the related variables inform the overall understanding of the state of the science because an increased understanding and exploration of nurses' stroke knowledge is crucial for the development of future interventions to *improve* stroke knowledge. The improvement of nurses' stroke knowledge will in turn improve code stroke processes, and mend the current poor outcomes associated with IHS.

Assumptions and Propositions

The main assumptions and propositions of stroke knowledge must be identified when analyzing the concept. The first assumption of stroke knowledge is that nurses have some level of stroke knowledge, as this content area is introduced in their pre-licensure educational programs. The second assumption is that a nurses' stroke knowledge matters and influences the environment around them. This is due to nurses' commitment to provide optimal patient care. The third assumption is that nurses' stroke knowledge improves their ability to provide evidence-based nursing care, as nurses practice is based on current and the highest level of evidence-based research.

The first proposition of stroke knowledge is that nurses with increased stroke knowledge will feel a responsibility to apply the knowledge. The second proposition is that nurses with increased stroke knowledge are more likely to identify stroke symptoms earlier in patients, leading to quicker stroke treatment. The third proposition is that nurses' application of stroke knowledge will lead to improved patient outcomes, shorter hospital stays, and improved quality of life for those experiencing stroke.

Antecedents

Walker and Avant (2011) explain that antecedents are events that must occur prior to the concept for the concept to occur. The antecedents for stroke knowledge are the existence of strokes and human beings. The human beings must have the ability to think, and that thinking must be rational and sentient.

Critical Attributes

Walker and Avant (2011) explain that identifying and describing the defining or critical attributes of a concept is the "heart of concept analysis" (p. 162). The critical attributes provide exclusivity for the concept and differentiates it from other phenomena. However, Walker and

Avant (2011) note that critical attributes are not unmodifiable and may alter with refined understanding of the concept.

In 1994, Sweeney developed a concept analysis of personal knowledge and its application to nursing education. The concept analysis this dissertation presents is adapted from the attributes identified by Sweeney (1994) to analyze stroke knowledge specifically. Some of the key attributes of personal knowledge as reported by Sweeney (1994) are investment of energy, interpretation of information, active comprehension, and personal judgement. In addition to these attributes, stroke best practices, source of information, value of information, and application are the critical attributes of stroke knowledge this concept analysis identifies.

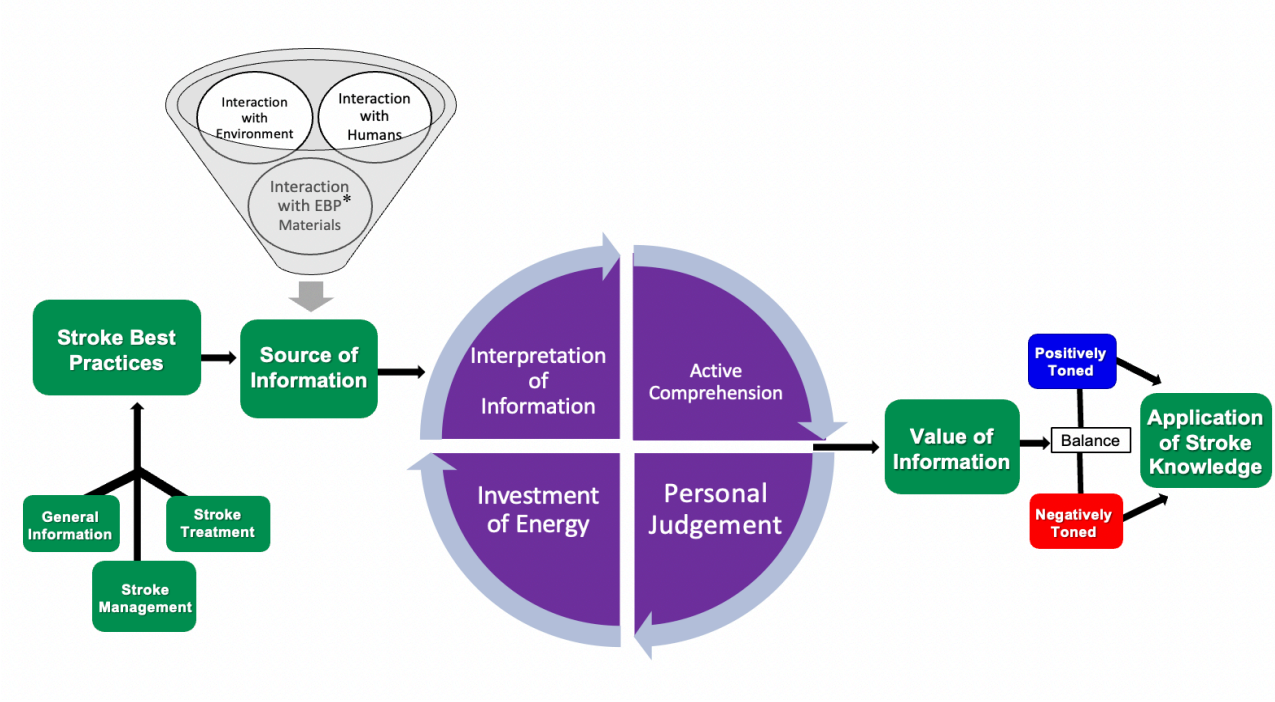
The critical attributes of the concept strategically affect and relate to one another in order to explain stroke knowledge. The following section of this dissertation will further elaborate on the exact relationships of the critical attributes to explain the process/throughput of the concept analysis.

Process/Throughput

The process/throughput section of the model refers to the section of the model explaining the relationships between the critical attributes. Refer to Figure 1 for the visual representation of the concept map/analysis of stroke knowledge.

Figure 1

Stroke Knowledge Concept Map



Note. Adapted from Sweeney's concept analysis of personal knowledge (1994). *EBP: Evidence-Based Practice.

Stroke best practices consist of general stroke information, stroke management, and stroke treatment. Stroke best practices are constantly evolving to uphold evidence-based practice to continue to improve outcomes. Nurses are relayed stroke best practices through various sources of information: interaction with humans (professional and personal), interaction with the environment (professional or personal), and interaction with evidence-based practice materials and resources. There is then an interpretation of the information received.

Interpretation of the information leads to active comprehension, which leads to personal judgement of the information, leading to investment of energy. These four attributes affect one another in a cyclical manner. Once this process is complete, nurses' place internal value on the

information received. Value of stroke information by nurses is described and observed as a positively and negatively toned balance. A balance is observed and not an exclusively positive or negative value as each nurse is not going to always experience one or the other. The nurse may place more positive value if the stroke information is applicable to their daily practice, or the value may be more negatively toned if the nurse deems the information irrelevant. There will be both positively and negatively toned value for all nurses, however, one will ultimately weigh heavier than the other.

The value the nurse places on the stroke information (either positively or negatively toned) will lead to the nurse's application of the stroke knowledge. The Merriam-Webster dictionary defines "application" as "an act of putting something to use" (n.d.). The collective application of all nurses' stroke knowledge ultimately affects stroke patient outcomes.

Outcomes and Consequences

In opposition to antecedents, outcomes and consequences occur as a result of the concept. The immediate outcomes of stroke knowledge are feeling energized and passionate about work, intellectual satisfaction, and responsibility to communicate the knowledge. These three outcomes have been adopted from Sweeney's (1994) concept analysis of personal knowledge.

The consequences of stroke knowledge are improved job performance by the nurse, early identification of stroke symptoms, quick time to stroke treatment, and improved code stroke processes.

Empirical Referents

Walker and Avant (2011) explain that identifying empirical referents is the final step in concept analysis. Empirical referents are, "classes or categories of actual phenomena that by their existence or presence demonstrate the occurrence of the concept itself" (p. 168). However,

empirical referents are not tools to measure the concept, which in this case, would be the Acute Stroke Management Questionnaire (ASMaQ) to measure nurses' stroke knowledge (Sim et al., 2021). The empirical referents of stroke knowledge are improved patient outcomes, shorter hospital stays for stroke patients, and improved quality of life.

Theoretical Underpinnings

The theoretical framework used to guide this study is the Translational Mobilisation Theory (Allen, 2018). This middle-range theory explains the many components and complexity within an institution that affects the actions of nurses (Allen, 2018). This theory recognizes the organizational awareness component needed in modern-day nursing. Allen explains that a nurse cannot simply show up for work and begin providing nursing tasks and interventions (Allen, 2018). The nurse must first recognize the many layers of the organization in which they work to provide proper care while simultaneously applying their skills and knowledge (i.e., *stroke knowledge*) to provide care.

The three core components of the theory are the strategic action field, project, and mechanisms. The strategic action field is created when there is an interaction between certain individuals and their knowledge, and there is a common set of understanding about the purpose of the interaction (Allen, 2018). The project provides a frame for understanding the relationships connected to various actions. Allen explains that these actions can be either planed or emergent, however, the action is always time-bound (Allen, 2018). Finally, the mechanism is when the action is mobilized or put into effect within the context of the specific organization (Allen, 2018). Figure 2 displays a concept map created by Allen (2018) to visualize the interaction of the three components.

When applying the variables of this study, the strategic action field is the interaction between the nurse and the patient, the assessment of the patient by the nurse, and recognition of any change in assessment, specifically stroke symptoms. The project is a code stroke process, or the emergency response procedures when an acute, in-hospital stroke is recognized. The mechanism is the acute care nurses' ability to use their skills and stroke knowledge to respond appropriately based off the organizational policy and procedures. Figure 3 shows an adapted version of the concept map provided by Allen (2018).

Figure 2

Translational Mobilisation Theory Concept Map

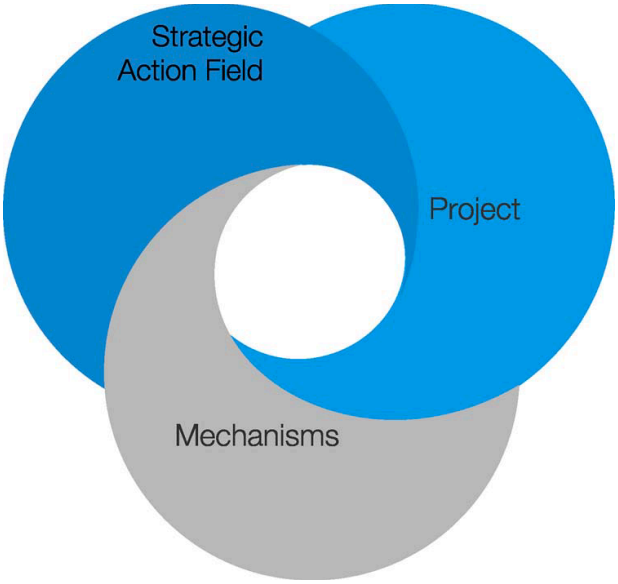
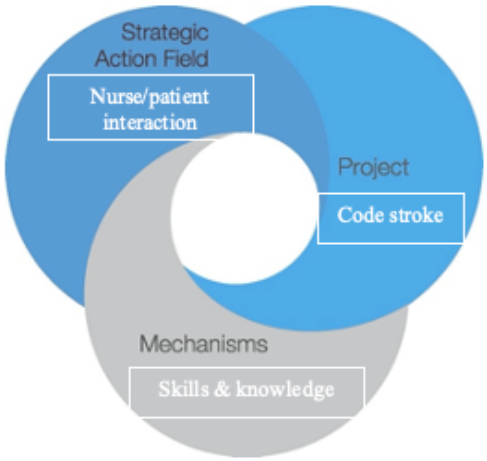


Figure 3

Adapted concept map of Translational Mobilisation Theory



Note. Adapted from Allen (2018).

Theory Development

To move the conceptual understanding of the primary phenomenon (stroke knowledge), the most appropriate theory development strategy is the "Theory-to-Research-to-Theory Strategy" as described by Meleis (2018). Meleis (2018) explains that this strategy is utilized when theory drives the research question. In applying the specific variables of this dissertation to the existing Translational Mobilisation Theory, the four main steps of Meleis's (2018) Theory-to-Research-to-Theory Strategy will be implemented.

In the first step, Meleis (2018) explains that the chosen theory must be compatible with nursing, which to its core, the Translational Mobilisation Theory is used to help explain the action of nurses (2018). The theory must also explain the phenomenon of interest. When applying the variables of this study to the original components of the theory, stroke knowledge appears under one of the three main core components.

During the second step of the Theory-to-Research-to-Theory Strategy, concepts of the theory are redefined to fit the research study at hand (Meleis, 2018). In the above section, it is explained how the variables of this research study are applied and fit into the three core components of the Translational Mobilisation Theory (Allen, 2018).

The third and fourth steps are done after the completion of the research study. The third step occurs when the findings of the research study are used to modify or refine the original theory (Meleis, 2018). The fourth step occurs in some instances and is used when the results are used to develop a new theory. The findings of this research study have the potential to achieve the elements of both steps three and four. Step three would be used if the findings of the phenomenon of interest, stroke knowledge, bring a greater understanding to how this domain affects the collective action of nurses, as explained in the original Translational Mobilisation Theory (Allen, 2018). Step four would occur if the findings inform the development of a new theory, specific to stroke knowledge of nurses, which has not yet been developed.

Theoretical and Operational Definitions

The variables of interest are Acute Care Registered Nurse (RN), Stroke Knowledge, Education, Employment Status, Work Experience, Current Practice Setting, Professional Acute Stroke Experience, and Personal Acute Stroke Experience. This section will provide conceptual and operational definitions for the variables, as well as the tool that will be used to measure each variable.

Acute Care RN

“Acute Care RN” is conceptually defined as “highly skilled and trained nurses that provide care for critically ill patients within an acute care or hospital setting. Acute care involves patients who have experienced severe illness or trauma, who require pre-and post-operative care,

or other urgent medical conditions" (CareerStaff Unlimited, 2021). For this dissertation, the operational definition of Acute Care RN is "A Registered Nurse (RN) currently working at WakeMed Raleigh, Cary, or North Hospital providing direct patient care." This variable will be measured using the Demographic Survey.

Stroke Knowledge

The AHA (2022) defines "stroke" as, "… when a blood vessel that carries oxygen and nutrients to the brain is either blocked by a clot or bursts." "Knowledge" is defined as, "Information, understanding, or skill that you get from experience or education" (Merriam-Webster, n.d.). This dissertation operationally defines "stroke knowledge" as an Acute Care RN's knowledge of 1) general stroke information, 2) the care available in the acute stroke phase, and 3) management of patients experiencing acute stroke. Stroke knowledge will be measured using the Acute Stroke Management Questionnaire (ASMaQ) and the Nurse Stroke Education and Experience Survey.

Education

"Education" is defined as, "The knowledge, skill, and understanding that you get from attending a school, college, or university" (Merriam-Webster, n.d.). For the purpose of this dissertation, "education" will be operationally defined as the highest level of formal education (PhD, DNP, MSN, BSN, ADN) completed by the Acute Care RN. Education will be measured using the Demographic Survey.

Employment Status

"Employment status" can be defined as, "The status of a worker in a company on the basis of the contract of work or duration of work done" (US Legal, n.d.). However, this dissertation operationally defines "employment status" as the Acute Care RN's status at

WakeMed (full-time, part-time, travel RN, contract RN). This variable will be measured using the Demographic Survey.

Work Experience

"Work experience" is defined as "The experience and skills that you gain in doing a particular job" (Macmillan Dictionary, n.d.). The operational definition of "work experience" for this dissertation is the Acute Care RNs total number of years (options provided in increments of five years) as an RN. This will be measured using the Demographic Survey.

Current Practice Setting

The Nursing and Midwifery Board of Ireland (n.d.) defines "current practice setting" as, "both the place in which nurses and midwives work and the nature of the working environment." The operational definition for "current practice setting" is the home unit in which the Acute Care RN provides direct patient care; this includes patient population, level of acuity, and the nurse-to-patient ratio. Current practice setting will be measured using the Demographic Survey.

Professional Acute Stroke Experience

"Professional acute stroke experience" has been defined as, "Application of nursing knowledge in demonstrating clinical judgment in a current or evolving practice setting [specifically stroke setting]" (Law Insider, n.d.). The operational definition of "professional acute stroke experience" for this dissertation is the Acute Care RN's past work experienced with patients with stroke, and any in-formal, post-graduate stroke training. This variable will be measured in years and frequency of stroke patient care using the Nurse Stroke Education and Experience Survey.

Personal Acute Stroke Experience

"Personal experience" is defined as, "the moment-to-moment experience and sensory awareness of internal and external events or a sum of experiences forming an empirical unity such as a period of life" (Definitions, n.d.). "Personal acute stroke experience" for the purpose of this dissertation is operationally defined as any personal or familial experience with acute stroke outside of work. This includes immediate family (spouse, child, parent, guardian, grandparent), extended family (aunt, uncle, cousin, in-laws), and friends and significant others. This variable will be measured using the Nurse Stroke Education and Experience Survey through multiple choice and select-all-that-apply response.

Specific Aims and Research Questions

This dissertation focuses on Acute Care RNs knowledge of IHS as well as nurse characteristics that may be predictors of knowledge. The goal of this research study is to address the following specific aims and research questions:

1. To examine acute stroke knowledge among acute care nurses.

   Question (RQ) 1. What is the level of acute stroke knowledge among study participants as measured with the Acute Stroke Management Questionnaire (ASMaQ)?

   Question (RQ) 2. What is the relationship of ASMaQ total scores, domain scores, and individual item scores with (a) acute nurse demographics including age, education, current practice setting, employment status, and work experience and (b) professional and personal stroke experience, specific stroke education and training, and self-perception of stroke knowledge?

2. To examine the predictability of categorical and quantitative study variables of acute stroke knowledge among study participants.

Question (RQ) 3. How well do the study variables of education, employment status, work experience, current practice setting, personal stroke experience, professional stroke experience, specialized stroke education and training, and self-perception of stroke knowledge predict the ASMaQ total acute stroke score and which of the study variables are the best predictors of acute stroke knowledge?

Summary

This dissertation consists of Chapters 1, 2, and 3 for the background, review of literature, and methods. The remaining chapters include two separate manuscripts. Chapter 4 is entitled, "The Use of the ASMaQ to Measure Nurses' Stroke Knowledge Manuscript." The second manuscript is in Chapter 5 and is entitled, "What are the Predictors of Acute Care Nurses' Stroke Knowledge? A Manuscript."

CHAPTER 2: REVIEW OF THE LITERATURE

This review of the literature identifies the current state of knowledge for this study. Stroke is the fifth leading cause of death in the United States and is projected to cost the United States $2.2 trillion by 2050 (Natteru et al., 2016). Out of all strokes, one out of five will occur while a person is in the hospital (Chen et al., 2018; Emmett et al., 2019; Lu et al., 2019; Saltman et al., 2015). The occurrence of in-hospital strokes can be traced to a variety of sources including complications from surgeries, procedures, or risk factors of comorbidities that led to the initial hospitalization (Yang et al., 2019).

The AHA provides a set of guidelines and recommendations for the healthcare team which serve as benchmark timeframes for response to and treatment of an acute stroke (AHA, 2019). The timeframes are used to support the "time is brain" initiative and are set in place to ensure a person experiencing a stroke has optimal chances of receiving the time-sensitive interventions to prevent further complications of the stroke (AHA, 2019).

This review focuses on the differentiation between in-hospital strokes (IHS) and community occurring strokes (COS), explores the application and success of code stroke processes, identifies contributing variables to stroke recognition in nursing staff, and explains what is known on acute stroke knowledge in nurses.

IHS versus COS

The setting of stroke onset is categorized into two main groups: hospital and community. An in-hospital stroke (IHS) occurs while a person is currently admitted in the hospital for any reason or diagnosis. A community occurring stroke (COS) occurs anywhere but the hospital (home, work, gym, shopping mall, grocery store, etc.) (Chen et al., 2018; Emmett et al., 2019; Lu et al., 2019; Saltman et al., 2015). The AHA explains that IHS more commonly occurs in

patients undergoing a procedure or testing compared to COS, making the detection and recognition of symptoms more complicated as the differentiation between the result of the procedure or test versus new-onset stroke symptoms is often nebulous (Nouh et al., 2022).

Characteristics

A study consisting of six large hospital systems found the median age of IHS patients to be 70 years (range, 18 to >89 years) (Cumbler & Simpson, 2014). IHS patients are older and have more comorbidities when compared to patients with COS (Nouh et al., 2022). Brunser et al. (2021) found that patients with IHS more frequently suffered from heart failure ($p = .04$) and malignancies ($p < .001$) compared to patients with COS. When comparing characteristics of those with IHS compared to COS, Chen et al. (2022) found that there was a greater proportion of women and heart disease, but lower prevalence of smoking. When testing for immune-inflammatory markers (neutrophil counts, platelet-to-lymphocyte ratio, neutrophil-to-lymphocyte ratio, and systematic immune-inflammation index), they were found to be higher in patients with IHS compared to COS. Chen et al. (2022) explains this is likely a result of IHS patients having multiple comorbidities that resulted in the initial hospitalization (cardiovascular disease, coronary artery disease, infectious disease, metabolic problem). Lu et al. (2019) explain that the most common reason for admission of those who later suffer from a IHS are cardiovascular and oncological diseases.

Mortality and Outcomes

When comparing IHS to COS, IHS patients have a four times higher mortality rate than COS patients (Chen et al., 2018; Saltman et al., 2015). Specifically, patients with IHS have an increased in-patient mortality when compared with COS (OR 3.09; 95% CI 2.81 to 3.38)

(Bekelis et al., 2016). A study conducted by Bekelis et al. (2016) found an overall 27.7% death rate in patients experiencing IHS compared to 7.1% of COS.

IHS patients are half as likely to be discharged home when compared to COS patients and are more frequently discharged to rehabilitation facilities (Emmett et al., 2019; Chen et al., 2018; Saltman et al., 2015). Chen et al. (2018) report that the average stay for COS patients is 14 days compared to 21 days for IHS patients. Similar results were found by Bekelis et al. (2016) (13 days for COS compared to 30 days after IHS). COS patients have shorter hospital stays, which in turn, leads to a lower financial burden and historically better outcomes.

Treatment

Interestingly, IHS patients were shown to have longer time to treatment when compared to COS patients (Chen et al., 2018; Saltman et al., 2015; Brunser at al., 2021). This finding is startling, as the time for transportation from the community to the hospital and need for initial work-up and medical history is eliminated in IHS (Chen et al., 2018). Kamal et al. (2020) found that during a 10-year period at a single institution, only 7.5% of patients with IHS had initial brain scan imaging completed within the AHA recommendation period of 25 minutes from symptom recognition. Once a stroke is recognized in the hospital, there should be no delay in time to assessment and time to ordered radiologic scan and intervention. However, COS patients are still receiving treatment at a quicker timeframe than their hospitalized counterparts.

Akbik et al. (2020) found that 15.5% of IHS patients received tPA compared to 9.9% of COS patients; 3.7% of IHS patients received a thrombectomy compared to 1.9% of COS patients. Contrastingly, Brunser et al. (2021) found IHS patients were less frequently treated with tPA compared to COS (15% vs. 30*%,* $p = .001$). Lu et al. (2019) also found that patients with IHS received tPA significantly less than those with COS (3.6 % vs 7.3%, $p = .01$), but in

congruence with the findings from Akbik et al. (2020), patients with IHS received thrombectomies more frequently than COS patients (7.1% vs 4.2%; OR, 1.74 and 95% CI, 1.10—2.75) (Lu et al., 2019).

After receiving a thrombectomy, 42% compared to 40% (p= 0.53) of the COS and IHS groups experienced positive functional outcomes (Lue et al., 2019). 17% and 12% (p= 0.58) of COS and IHS patients died at 90 days after receiving the intervention (Lu et al., 2019). Although it is evident based on the findings presented in the prior section that IHS patients have worse outcomes than COS patients, Lu et al. (2019) found that when patients from both groups (IHS and COS) are eligible for thrombectomy, outcomes are comparable. These findings lead one to wonder if the poor outcomes experienced in the IHS population are due to delays in recognition and treatment, because when a timely intervention is received, the gap in the two groups' outcomes is lessened.

Prevalence

A review of a national stroke registry by Akbik et al. (2020) found that there was an increase in reported IHS from 2008 to 2018 (2.7% vs. 3.5%, $p < .001$). In addition to the increase in reported IHS, there was an increase in the percent of IHS patients who received tPA (9.1% vs. 19.1%, $p < .001$) (Akbik et al., 2020). Despite the increase in identified IHS and increase of treatment, IHS patients were still treated at a slower timeframe compared to COS and less frequently discharged home (Akbik et al., 2020). Almutairi et al. (2021) explains that only 26% of IHS patients are functionally independent at discharge, and only 42% at 90-days post-discharge. This finding shows although hospitals may be improving their ability to detect an IHS, there is still needed improvement in timely treatment interventions.

Code Stroke

A code stroke process is a systematic response to an acute stroke that includes a team of stroke experts (neurologists, stroke nurses) (Manners et al., 2019; Yang et al., 2019; George et al., 2017; Kawano et al, 2021). In the in-hospital setting, a code stroke is activated when stroke symptoms are noticed, and the activation of the code will notify the trained team members who will then respond (Manners et al., 2019; Yang et al., 2019; George et al., 2017; Kawano et al, 2021).

As mentioned in Chapter 1, the initiation of code stroke processes dates to 1994 (Gomez et al.), but there was an increase in hospitals' development of this systematic response after the FDA approval of tPA in June 1996. Prior to this, there was no acute treatment of ischemic stroke three hours from symptom discovery (Wang et al., 2000). This medical breakthrough in acute stroke treatment heightened the importance of timely response to ensure eligible patients were able to receive the novel treatment.

After the implementation of a systematic code stroke process, the time from stroke recognition to assessment and radiologic imaging decreased (Kawano et al., 2021; Yoo et al., 2016). Code stroke processes also decreased the rate of stroke mimics, or false alarms (Manners et al., 2019). However, when compared to code strokes activated in the emergency department for COS, inpatients more commonly presented with non-focal neurological deficits (46.2% vs 32.4%, $p < .001$) making the discovery of the stroke symptoms more complicated and were more commonly found not to have an acute stroke when a code stroke was activated (62.4% vs 47.5%, $p < .001$) (Del Brutto et al., 2019).

Many of the studies did not indicate who activated the code stroke (nursing, residents, physicians, etc.) (Manners et al., 2019; Kawano et al., 2019; Kassardjian et al., 2017). Additionally, a few of these studies did not explain the type of education or frequency of the

education provided to the health care team when re-vamping or introducing the code stroke process (Manners et al., 2019; Kawano et al., 2021; Kassardjian et al., 2017). El Ammar et al. (2020) and Yoo et al. (2016) explained that the hospitals examined in their studies provides annual stroke education to all staff members, but certain specific stroke training is limited to certain nursing units.

Nurse-Driven

Yang et al. (2019) and George et al. (2017) focused on a nurse-driven code stroke, meaning nursing was at the forefront of the initiative and a nurse led the code stroke team. Yang et al. (2019) explained all in-patient nurses within the hospital system received education prior to beginning the new process, while the study completed by George et al. (2017) focused the education on units at higher risk for stroke. Both studies found that nurses identify acute strokes more frequently and earlier than physicians or other health care team members (median, 2 hours vs 4.9 hours) (Yang et al., 2019; George et al., 2017; Nouh et al., 2022). This could be attributed to the time nurses spend with patients at the bedside compared to other team members.

Stroke Mimics

The National Stroke Association initiated a six-hospital, IHS quality-improvement initiative from July 2010 to June 2011 across six different states (Cumbler & Simpson, 2014). Of the 343 in-hospital code strokes that were alerted across the study period, 42.5% were ischemic strokes but 46.1% were stroke mimics (Cumbler & Simpson, 2014). Nouh et al. (2022) report that approximately half of all IHS code strokes are determined to be stroke mimics. Etiology for stroke mimics include seizure, hypotension, delirium, toxic/metabolic factors, specifically medications such as opioids and benzodiazepines, syncope, and sepsis. (Cumbler & Simpson, 2014; Natteru et al., 2016; Nouh et al., 2022). Nouh et al. (2022) explain that when the primary

neurological deficit triggering the code stroke response is altered mental status in the absence of focal deficits, it is often a stroke mimic.

Chang et al. (2018) generated a scoring system called "2CAN" to help non-neurology health care professionals identify IHS and differentiate stroke symptoms from stroke mimics. From the single-center validation study, Chang et al. (2018) found 90% sensitivity and 70% specificity in discriminating between stroke and mimics. However, an evaluation of the tool by Parrino et al. in 2021 at a single institution found no significant difference in 2CAN scores between patients with actual ischemic strokes and stroke mimics (p =.91). Parrino et al. (2021) found the 2CAN score to have 83.5% sensitivity, but poor specificity at 23.1%. The findings from this study shows the 2CAN score should be further evaluated using a sample from a larger, multi-center population to better assess its usefulness in helping health care professionals accurately detect IHS.

Nouh et al. (2022) explain with increased educational initiatives and awareness of code stroke processes, and the encouragement of code stroke activation, more false-positive or stroke mimics have the potential to emerge. These findings show that the code stroke system is not a perfect, fix-all response for IHS. Staff and nurses activating the code stroke system must first be aware of stroke symptoms, know what to assess and how to assess the patient, and the appropriate interventions and steps to proceed. In addition, hospital systems need to follow code stroke metrics in order to continuously improve the procedures and protocols.

The AHA acknowledges that insufficient data exist to create a standardized in-hospital, code stroke process across all nationwide settings (Nouh et al., 2022). However, hospital systems must use patient metrics and the recommendations by the AHA to ensure the code stroke

response system is constantly evolving and improving to provide the best possible patient outcomes.

Contributing Variables

The first contributing variable in stroke recognition is sex. Women often exhibit unique stroke symptoms making recognition and code stroke activation difficult (Colsch, 2021). The most common initial diagnosis for hospitalization within women who experience IHS is cardiovascular disease (Colsch, 2021). Colsch (2021) found that women who occupy multiple floors/units during their hospital stay are at higher risk for code stroke activation.

Another contributing variable in stroke recognition and code stroke activation is the Covid-19 pandemic. Velez et al. (2021) found that there was a statistically significant decline ($p < 0.001$) in code stroke activation during the height of the pandemic (February 15, 2020, to April 30, 2020) when compared to pre-pandemic (Velez et al., 2021). However, there were no differences in baseline characteristics when comparing the patients who experienced IHS pre-pandemic and during the study period (Velez et al., 2021). Many factors could attribute to the decline in code stroke activation during the pandemic such as the increased use in personal protective equipment (PPE), increased time in between assessments to cluster care to preserve PPE, visitation limitations, new processes for in-patient transport for airborne precautions, etc. Many of these processes that were introduced in early 2020 are still applicable in mid-2022.

Setting

Another contributing variable in stroke recognition is the patient care setting within the hospital. IHS occur most frequently on cardiac/cardiovascular floors (Manners et al., 2019; Kawano et al., 2021; Kassardjian et al., 2017; Lu et al., 2019; Saltman et al., 2015; Topiwala et al., 2020; Chen et al., 2015). However, Topiwala et al. (2020) found that IHS also commonly

occur within the post-operative patient population ($p = 0.001$), and a study by Cummings et al. (2022) found 70% of IHS at a single institution were cared for by surgical services. Specifically, the orthopedic surgery population has been shown to have a higher-than-average prevalence of IHS (Chen et al., 2022; Cumbler & Simpson, 2014). Cummings et al. (2022) found that being in an Intensive Care Unit (ICU), surgical services, intubated, and/or presenting with a higher National Institutes of Health Stroke Score (NIHSS) were associated with delays in the code stroke alert.

Other predictive variables of IHS are ejection fraction of less than 30% ($p = 0.03$) and the symptoms of visual field cut ($p = 0.008$) and facial droop ($p = 0.01$) (Topiwala et al., 2020).

A systematic review by Almutairi et al. (2020) found that of IHS patients that received a thrombectomy, 24.3% of patients were admitted to a cardiology service, 17.1% admitted to a surgery service, and 11.7% hematology.

Acute Stroke Knowledge

Mellon et al. (2015) explain that the lack of knowledge amongst hospital staff may contribute to the delays in treatment and assessment of IHS. Although many public health initiatives have been created and implemented in recent years to promote the lay persons knowledge of stroke, there are little data explaining stroke knowledge provided to nurses and hospital personnel (Mellon et al., 2015). Mellon et al. (2015) used an adapted version of the Stroke Awareness Questionnaire to assess knowledge of stroke symptoms, treatment, and hospital policies and procedures related to the treatment of stroke. However, the Stroke Awareness Questionnaire was developed for use of the general populations' stroke knowledge, not health professionals specifically (Hickey et al., 2011). Mellon et al. (2015) interviewed doctors, nurses, clinical, and non-clinical staff. Half (50%) of the study's sample consisted of

nurses. Mellon et al. (2015) reported that 92% of the sample had adequate stroke knowledge, but to reiterate, the assessment tool used was developed for non-health persons. When asked about acute stroke treatment, 49% of the sample were able to name tPA as a treatment modality, and 47.9% could accurately report the timeframe for giving tPA (Mellon et al., 2015). Mellon et al. (2015) did not report the results separated by discipline, so the specific knowledge results for nursing is unknown.

A 2021 study in Turkey evaluated nurses' knowledge on evidence-based acute stroke, using a researcher-developed evaluation tool (Karadeniz et al., 2022). The researchers found a positively, weak, statistically significant relationship between knowledge score and age (r = .158, p =.013), but no statistically significant relationship between years of work experience and knowledge score (r= .064, p = .334). There was also no significant difference in acute stroke knowledge and educational status (p > .05) (Karadeniz et al., 2022). Karadeniz et al. (2022) found that nurses who self-report attending conferences and following professional publications answered the stroke knowledge questions more accurately.

Ortega et al. (2018) created an in-hospital stroke lecture and simulation training for nurses to improve stroke knowledge. The training resulted in a significant (p < .001) increase in stroke knowledge from pre-lecture (M = 5.87, SD = .19) to pre-simulation (M = 6.42, SD = .18), and pre-simulation to post-simulation (M = 8.34, SD = .012). However, stroke knowledge was measured using a researcher-developed, ten-item tool, specifically designed for this study, and was not validated prior to the study. Another limitation of this study is the lack of a control group, meaning there is no comparison in knowledge to those who did not receive the training.

The AHA recently recommended the education of hospital staff to improve recognition of stroke and the empowering of staff to act when a stroke is recognized (Nouh et al., 2022). Nouh

et al. (2022) name online video learning, simulation, bedside training, pocket cards, posters, in-service lectures, and grand rounds as modalities of educational initiatives. In-service education has been shown to reduce median time from the last known well time to assessment (Nouh et al., 2022). However, specifics related to timeline, and which staff and disciplines should receive the training is omitted. However, Nouh et al. (2022) do recognize nurses as key activators in code strokes and explains nurses should be part of the group receiving hospital-provided, stroke education.

ASMaQ

Sim et al. (2021) developed a tool titled the Acute Stroke Management Questionnaire (ASMaQ). The tool was developed by an expert panel of neurologists in Malaysia (Sim et al., 2021). After formulating the draft, and testing for content and construct validity, 29 items were included in the questionnaire (Sim et al., 2021). The instrument is the first of its kind to evaluate health care professionals' knowledge of acute stroke management through three major components: general stroke knowledge, hyperacute stroke care, and advanced stroke management (Sim et al., 2021).

A recent study by Albart et al. (2022) utilized the ASMaQ to evaluate healthcare professional knowledge of acute stroke management and predictors of knowledge in a Malaysian population. The types of healthcare professionals included in this study were "medical practitioners" and "allied healthcare professionals from various medical disciplines" (Albart et al., 2022). Healthcare professionals who did not work with stroke patients daily had 2.67 times the odds of poor stroke knowledge compared to those working with stroke patients daily ($p <$ .001). Additionally, non-doctors had 3.46 times the odds of having poor stroke knowledge ($p =$ .004). This finding is essential to consider, as most IHS strokes occur in cardiovascular and

surgical areas, as explained above. Albart et al. (2022) did not differentiate nurses from other non-doctors when reporting the results, so it is unknown the level and predictors of stroke knowledge for nurses specifically.

Discussion

Gap

Despite being under the constant care and observation of a trained, multidisciplinary, health care team, in-hospital strokes lead to more deaths and poorer patient outcomes when compared to strokes occurring outside of the hospital. A review of the literature shows that a systematic code stroke in a hospital system leads to greater success in response time for IHS. However, there is not a clear consensus from the literature on the specific education provided to nurses on IHS and code stroke procedures.

The articles included in this review either vaguely explained the stroke education provided to nurses or omitted this information. Assuming nurses are educated on or competent in stroke related materials is a dangerous expectation. Although all nurses should have received education throughout their schooling and initial job training, stroke guidelines and practice are ever-evolving. It is unrealistic for hospital systems to expect nurses to keep up with the updated AHA guidelines and hospital-specific code stroke policies and procedures without proper continued education.

IHS occur throughout the hospital system. As mentioned above, these types of strokes most frequently occur on cardiac and post-operative floors, not neuro-specific or stroke-related units (Manners et al., 2019; Kawano et al., 2021; Kassardjian et al., 2017; Lu et al., 2019; Saltman et al., 2015; Topiwala et al., 2020; Chen et al., 2015). This finding emphasizes the importance of continued education to all nurses across the hospital system, not just for neuro-

specific staff and nurses frequently caring for stroke patients. IHS could occur anywhere within the hospital, and nurses are the ones who most frequently assess this type of change (Yang et al., 2019; George et al., 2017). In addition, there are many contributing variables to recognizing acute strokes making the discovery difficult. The development and usage of a code stroke process is trivial if the nurses who are expected to utilize and activate the response team are not prepared to first assess and recognize the stroke symptoms, are unaware of the response process, and the importance of the timely response.

Summary

Research is needed exploring the preparedness of nurses to recognize and respond to acute strokes in their hospitalized patients. This knowledge has the potential to guide future educational interventions in order to ensure all nurses practicing in the in-patient setting are equipped with the skills and knowledge to act when an IHS occurs. Filling this educational and knowledge gap in nurses could improve the slow response times currently seen in IHS literature. Improving response and intervention time could directly improve IHS mortality, quality of life, and patient outcomes.

In-hospital strokes have worse outcomes when compared to strokes occurring in the community. However, code stroke procedures have shown to improve response times and offer a systematic process for IHS. The code stroke process can only be as successful as intended if nurses are trained and educated on the many aspects of IHS. Recent stroke education efforts have focused on community-outreach, as it may be assumed that all health care professionals and nurses are well-versed in strokes. But the many contributing variables to IHS recognition and the numerous sub-specialties within a hospital system outside of stroke can lead to unpreparedness in nurses who seldom care for stroke patients. Acute care nurse knowledge on IHS must first be

further studied in order to fully understand this gap. This information will then be able to inform educational interventions to ensure nursing competence and preparedness throughout the hospital system in terms of IHS. Closing this knowledge gap will improve IHS patient outcomes, save lives, and reduce the frequency of the debilitating, long-term impairments experienced after in-hospital strokes.

CHAPTER 3: METHODS

Introduction

Chapter three reviews the methodology to study acute care nurses' knowledge of in-hospital stroke and predictors of knowledge. This includes the study design, setting, sample, recruitment, instruments, and data analysis. The validity, threats to validity, and limitations of the methodology is also included.

Design

To answer the research questions, we conducted a non-experimental, descriptive correlational study. Non-experimental designs can be used when the independent (predictor) variables are not manipulated (Polit & Beck, 2021). The predictor variables in this study were not manipulated, but rather the correlation between the predictor and response variables were assessed. Polit and Beck define correlation as "a relationship or association between two variables, that is, a tendency for variation in one variable to be related to variation in another" (Polit & Beck, 2021, p. 194). A strength of conducting correlational research is the ability to address multiple variables and their interrelationships simultaneously (Polit & Beck, 2021).

We also used multiple regression analyses to make inferences about the relationship between nurse characteristics (predictor variables) and stroke knowledge (response variable). Through the non-experimental, descriptive correlational design, we hoped for a better understanding of the relationships of the variables, rather than supporting causality.

Setting

The study took place at three, community hospitals which are part of the same health care system in an urban city in the Southeastern U.S. The hospital system has Magnet certification. Two of the three hospitals are certified Joint Commission Primary Stroke Centers (PSC)

(WakeMed, 2022). The PSC certification is designated to hospitals that have taken extra efforts to ensure improved outcomes for stroke patients (The Joint Commission, 2022). As of February 2022, the system employs about 3,000 nurses. The largest of the three hospitals has 567 acute beds, the second largest has 208 acute beds, and the third has 61 acute beds (WakeMed, 2022). The two larger hospitals are the ones with PSC certification.

Sample

A convenience sample of Registered Nurses (RN) who provide direct patient care as their primary role at one (or more) of the hospitals were invited to participate. For the purpose of this study, nurses who care for hospitalized patients will be referred to as acute care RN. In addition to providing direct patient care and working at one or more of the included hospitals, inclusion criteria included having an active RN license, completion of orientation and working independently without a preceptor, and caring for hospitalized patients. Nurses were not included if they were still on orientation and working with a preceptor as these nurses had not completed all provided training and education and had the potential to provide skewed results. Nurses who cared for non-hospitalized patients were excluded, as this study focuses on stroke knowledge specific to in-hospital strokes.

Exclusion criteria included nurses working in the Neuro Intensive Care Unit (ICU), rehabilitation, pediatric units, labor and delivery and/or mother/baby units, and primarily in managerial roles. Neuro ICU nurses were excluded as it is believed their responses would provide skewed results as they are the hospitals neurological and stroke experts for nursing. Nurses working in the rehabilitation were excluded as this is technically not an acute care setting, and there are many confounding variables for stroke symptom awareness and recognition in the rehabilitation setting. Nurses caring for pediatric, labor and delivery, and/or mother/baby

populations were excluded as this study focuses on the knowledge level of stroke treatment, management, and protocols for adult patients. Nurses in managerial roles were excluded, as their primary role in the hospital is not to provide direct care for patients.

The targeted sample size was $N = 106$. This targeted sample size is based off the $N > 50 + 8m$ (m= number of predictor variables) recommendation by Pallant (2020) when conducting multiple regression analyses.

Human Subjects Protection

IRB approval was received from the ECU – University and Medical Center IRB office prior to data collection. All RNs working within this hospital system were sent an email that included a secure link to an online survey for confidentiality, a flyer advertising the study, as well as pertinent information related to the study purpose, procedures, and inclusion and exclusion criteria. All email addresses used were via secured, hospital-provided domains. By beginning the survey, participants provided verbal consent. All information remained de-identifiable, and the results were anonymous to study team members.

Recruitment

The convenience sample of nurses was recruited for participation via email. As mentioned above, the email included a secured link to an online survey for confidentiality, a flyer advertising the study, as well as pertinent information related to the study purpose and procedures. Two weeks after the initial email was sent, diversity of the sample and practice setting representation was assessed. It was determined that there was even representation amongst demographic groups, so further email follow-ups were not sent as originally planned.

Instruments

The instrument used to study the research consisted of a three-part survey: Demographic survey, Nurse Stroke Education and Experience Survey, and the Acute Stroke Management Questionnaire (ASMaQ) (Sim et al., 2021). As explained above, the survey was sent via email to nurses working at the three hospitals through a nursing listserv. All email addresses used were secured, hospital-provided domains.

Demographic Survey

The demographic survey was developed by the principal investigator (PI) of the study. The variables acute care RN, education, current practice setting, employment status, and work experience were measured via the demographic survey. Additionally, the demographic survey asked participants for birth year, gender, and race/ethnicity. The first three questions of the demographic survey tested for inclusion criteria (licensed RN, provide care for adult, hospitalized patients, and do not work in the Neuro ICU, labor and delivery, and/or or mother/baby unit) to prevent ineligible participants from completing the full survey.

Nurse Stroke Education and Experience Survey

The Nurse Stroke Education and Experience Survey is a researcher-developed instrument developed specifically for this study. The survey consists of ten multiple-choice items, and one drag item. The variables education, professional acute stroke experience, personal acute stroke experience, and stroke knowledge were measured via this portion of the survey. Education was assessed through asking the participant if they received any pre-licensure and/or post-licensure stroke training and the type of training i.e., lecture, clinical experience, simulation, informal on-the-job training, continued education module.

Professional acute stroke experience was assessed through questions that ask the participant if they have previously worked on a stroke or neuro-specific unit, the length of time

they worked there, and in what capacity (RN, student, nurse aide), and the frequency, if ever, that the participant provides care for stroke patients in their current practice.

Personal acute stroke experience was assessed through asking the participants if they have personally had or have a family member who has had a stroke, how the person is related to them, and if and how this impacted their personal stroke knowledge.

Stroke knowledge was partially measured using four items from this portion of the survey. Three multiple-choice questions tested for the participants' awareness of the code stroke process at the hospital in which they work, their comfort with the code stroke policies and procedure, and their confidence in activating the system. One question instructed the participants to drag a line to represent their self-perception of their stroke knowledge from none to expert. Stroke knowledge was objectively measured using the Acute Stroke Management Questionnaire (ASMaQ) (Sim et al., 2021).

Acute Stroke Management Questionnaire (ASMaQ)

The response variable, stroke knowledge, was measured using the Acute Stroke Management Questionnaire (ASMaQ) (Sim et al., 2021). The ASMaQ is a new, validated 29-item questionnaire that tests and measures health care professionals' stroke knowledge (Sim et al., 2021). The ASMaQ was developed by a group of neurologists in Malaysia. The PI of this study has received written permission by the corresponding author of the ASMaQ for permission to use the tool for this proposed study. See Appendix F.

The ASMaQ content was developed through a review of stroke literature, pre-existing stroke assessment scales, clinical practice guidelines of Malaysia that are based on AHA guidelines, and expert opinion (Sim et al., 2021). Content validation of 110 questions was completed using an expert panel. 79 questions were eliminated, and 31 questions were used for

psychometric testing on 158 participants to further evaluate the tool for validity (Sim et al., 2021). The authors also completed exploratory factor analysis, which narrowed the original 31 questions to 29. The Cronbach's alpha value was 0.82, showing good reliability of the measurement tool (Sim et al., 2021).

The 29 questions use a five-point Likert scale ranging from one to five points (Sim et al., 2021). For 23 of the questions, five is the best response, and one is the worst, however, six questions are negatively scored, meaning one is the best and five is the worst. The highest possible score is 145 and the lowest is 29; the higher the score to 145, the higher the stroke knowledge (Sim et al., 2021).

Data Analyses

To analyze the data, descriptive statistics including Pearson's correlation coefficient will be used. Pearson's correlation coefficient will be used to show the relationship between the various independent variables and the dependent variable. Multiple regression will be used to analyze the effect of the various nurse characteristics (predictor variables) on stroke knowledge (dependent variable). Pallant (2020) explains that multiple regression analyses are used to show the ability of certain predictor variables in predicting an outcome. In this study, we are interested to learn if the presence or absence of certain nurse characteristics increase or decrease stroke knowledge. Multiple regression analyses will also help us understand which (if any) nurse characteristics is/are the best predictor of stroke knowledge, or whether certain nurse characteristics predict an increased or decreased stroke knowledge when other characteristics are controlled for. Data analysis will be completed using IBM SPSS version 28.0.

Data Analyses for Specific Aims and Research Questions

Specific Aim 1

The first specific aim is to examine acute stroke knowledge among acute care nurses. RQ1 is, "What is the level of acute stroke knowledge among study participants as measured with the Acute Stroke Management Questionnaire (ASMaQ)?"

To analyze RQ1, the total score of the ASMaQ will be calculated to determine stroke knowledge level. The 29-item Likert scale questions will be scored from 29 to 145, 29 being the worst score and 145 being the best (Sim et al., 2021). Total ASMaQ score, domain score, and individual item score distributions, means, and standard deviations will be computed for the participant sample. Bivariate Pearson correlations will be used to evaluate relationships among total scores, domain scores, and individual item scores.

RQ2 is, "What is the relationship of ASMaQ total scores, domain scores, and individual item scores with (a) acute nurse demographics including age, education, current practice setting, employment status, and work experience and (b) professional and personal stroke experience, specific stroke education and training, and self-perception of stroke knowledge?"

To analyze RQ2, Bivariate Pearson correlations will be used to evaluate relationships between total scores, domain scores, and individual item scores and age and work experience. Independent-samples t-tests will be used to compare ASMaQ mean total scores, domain scores, and individual item scores between two participant subgroups based on personal and professional stroke experience, specialized stroke education and training, and work experience. One-way analysis of variance will be used to compare means among three or more subgroups based on education, current practice setting, and self-perception of stroke knowledge.

Specific Aim 2

The second specific aim is to examine the predictability of categorical and quantitative study variables of acute stroke knowledge among study participants. RQ3 was developed to

answer the second specific aim. RQ3 is as follows, "How well do the study variables of education, employment status, work experience, current practice setting, personal stroke experience, professional stroke experience, specialized stroke education and training, and self-perception of stroke knowledge predict the ASMaQ total acute stroke score and which of the study variables are the best predictors of acute stroke knowledge?"

To analyze RQ3, a standard multiple regression, where all the predictor variables will be entered into the model at once, will be used explain how much of the variance in the dependent variable of total acute stroke knowledge can be explained by the independent predictor variables. In addition, the regression will indicate the relative contribution of each predictor variable.

Validity

Potential anticipated threats to internal validity include confounding participant characteristics that could compete with the predictor variables as the cause of the response (stroke knowledge). To control for confounding characteristic, we have purposefully excluded Neuro ICU nurses and nurses working under a preceptor, as it is predicted that these unique practice characteristics would influence stroke knowledge.

This study aims to recruit nurses working in a healthcare system that is currently experiencing higher than usual volumes of travel and contract nurses. Travel nurses do not receive the same level of new hire orientation and clinical training as nurses hired as employees through the organization and not contract agencies. To control for this confounding variable, one of the items in the demographic survey asks if the nurse is employed as a travel nurse.

Another potential threat to internal validity is attrition. To minimize attrition, data collection will occur using a one-time survey. The survey is condensed to a single form, which is estimated to take less than ten minutes. In addition, the first three questions of the survey assess

for inclusion criteria (licensed RN, provide care for adult, hospitalized patients, and do not work in the Neuro ICU, labor and delivery, and/or mother/baby unit) to prevent ineligible participants from completing the full survey.

Another potential threat to internal validity is history threat. Polit and Beck (2021) describe history threat as external events that may affect the responses of the participants. An example of history threat presenting in this proposed study would be if a nurse participated in a code stroke or cared for a stroke patient for the first time just prior to completing the survey. The nurse has the potential to score higher on stroke knowledge, as the information would still be new and clear. We do not predict this would be a common occurrence, due to the high number of nurses the survey will be sent to.

Internal validity will also be minimized by recruiting an adequate, diverse sample size. After the initial recruitment email is sent with the link to the online, secured survey, a follow-up email will be sent two weeks after the initial send date. Further email correspondence and follow-up is dependent on initial participation, meeting the target sample size, and a diverse sample. If participation is saturated within specific practice areas, future emails will target the under-represented hospital units.

Limitations

Due to the convenience sampling method, results may not be generalizable to the general population. In addition, convenience sampling does not allow for randomization which provides an extra control for confounding variables.

This study is observational, which means there is an inability to support causal relationships (Polit & Beck, 2021).

Summary

This study utilized a non-experimental, observational, descriptive design to better understand nurses' knowledge of in-hospital strokes, as well as potential predictors of knowledge. Acute care nurses working for an urban, health care system consisting of three separate hospitals will be sent a one-time survey for data collection. Approval was received from the ECU – University and Medical Center IRB office prior to the start of data collection and contact with potential participants.

Although this research study focuses on the stroke knowledge of nurses, the research team was enhanced by the addition of interdisciplinary members. A statistician served as the methodological expert to ensure data collection and analysis strategies are sound and appropriate. A behavioral health scientist with a background in cardiovascular psychophysiology also served as a methodological resource and helped ensure topic relevance from a non-nurse perspective.

CHAPTER 4: THE USE OF THE ASMaQ TO MEASURE NURSES' STROKE KNOWLEDGE MANUSCRIPT

BACKGROUND, METHODS, AND CONCLUSIONS

This chapter contains manuscript #1 to be submitted for publication regarding research on acute care nurses' stroke knowledge as measured by the Acute Stroke Management Questionnaire (ASMaQ). The proposed journal is the Journal of Neuroscience Nursing, following author guidelines including AMA formatting and a 2500-word count limit. Background is presented about the ASMaQ as a tool to measure stroke knowledge amongst health professionals, followed by the methodology of the study design, and then results, discussion, and conclusions.

Abstract

Background: Nurses are key in identifying and treating in-hospital strokes (IHS). Delayed treatment times and poor patient outcomes are associated with IHS. Information is needed on nurses' stroke knowledge and the objective measurement of stroke knowledge using a validated tool. The Acute Stroke Management Questionnaire (ASMaQ) was recently developed to test stroke knowledge of health care professionals but has not been used on a nursing-specific population. **Methods:** Through online surveying and use of ASMaQ, we will measure stroke knowledge of nurses caring for adult, hospitalized patients in an urban, Southeast U.S. health system. **Results:** *N*=196. Most participants (74.5%; *n* = 146) never worked on a stroke floor, however, almost all (95.9%; *n* = 188) cared for a stroke patient in the past. Most participants (65.3%; *n* = 128) reported receiving pre-licensure stroke education, 98.5% (*n* = 193) received post-licensure stroke education/training. ASMaQ total scores ranged from 93 to 133 (*M* = 117.35, *SD* = 8.15). Most participants scored in the good stroke knowledge range for all three ASMaQ domains and total ASMaQ score. **Conclusion:** The online delivery of the ASMaQ was successful in testing nurses' stroke knowledge and nurses were shown to have good stroke knowledge. Future initiatives should focus on discerning whether certain nurse characteristics predict higher or lower levels of stroke knowledge to help inform educational initiatives to improve IHS outcomes.

Introduction

One in five strokes occur while a patient is in the hospital.[1-4] The cause of in-hospital strokes (IHS) can be linked to complications from surgeries, procedures, or risk factors of comorbidities that led to initial hospitalization.[5] The American Heart Association (AHA)[6] developed benchmark timeframes to guide response time and treatment for IHS. To improve the response times for IHS, hospitals have initiated a "code stroke" system. Code strokes are a systematic response to an acute stroke consisting of timely evaluation and treatment by a team of stroke care experts.[5,7-8] Despite code stroke initiatives, IHS patients have poorer outcomes when compared to community occurring stroke (COS) patients. IHS patients have longer time to treatment, four times higher mortality rate, are half as likely to be discharged home, and more frequently discharged to rehabilitation facilities.[1-2,4]

Background

Lack of knowledge amongst nurses may contribute to delays in treatment of IHS.[9] Although there have been numerous public health initiatives in recent years to promote lay persons' stroke knowledge, there are little data explaining stroke education provided to nurses and a standard measurement of nurses' stroke knowledge.[9] Many nurses may have received pre-licensure stroke education; however, stroke guidelines and practice are constantly evolving, making it difficult for nurses to stay abreast with the evolving guidelines without proper ongoing education.

Nurses have been recognized as key activators in code strokes and identify IHS more frequently and earlier than other health care professionals.[5,10] The AHA recently recommended the education of hospital staff to improve recognition of stroke.[11] It is evident that nurses must represent a significant portion of the health care professionals that receive continued stroke

education, as they activate code strokes most frequently and spend the most time at patients' bedsides.[5,10]

The Acute Stroke Management Questionnaire (ASMaQ) was developed by an expert panel of neurologists in Malaysia.[12] The instrument is the first of its kind to evaluate health care professionals' knowledge of acute stroke.[12] After testing for content and construct validity, 29 items were included in the questionnaire.[12]

The ASMaQ has been used to evaluate healthcare professional knowledge of acute stroke management and predictors of knowledge in a Malaysian population.[13] The types of healthcare professionals included in the study testing the ASMaQ were "medical practitioners" and "allied healthcare professionals from various medical disciplines."[13] Healthcare professionals who did not work with stroke patients daily had 2.67 times the odds of poor stroke knowledge compared to those working with stroke patients daily ($p < .001$).[13] This finding is essential to consider, as most IHS strokes occur in cardiovascular and surgical areas.[1,3-4,7-8,14-15] However, at the time of writing, the ASMaQ has not been used on a nursing-specific or United States population. Each year in the U.S., around 800,000 people experience stroke, costing $53 billion annually.[16] Early recognition would not only be cost saving but lifesaving.

Research is needed exploring stroke knowledge of nurses caring for a hospitalized, adult population, as the many contributing variables to IHS recognition and the numerous sub-specialties within a hospital system outside of stroke can lead to unpreparedness in nurses who rarely care for stroke patients. Uncovering the stroke knowledge of nurses caring for adult, hospitalized patients has the potential to guide future educational interventions to ensure all nurses practicing in the in-patient setting are equipped with the skills and knowledge to act when

IHS occur. Filling this gap has the potential to improve response and treatment time which could directly improve IHS mortality, quality of life, and patient outcomes.

The purpose of this study is to determine the level of stroke knowledge among nurses providing care to adult, hospitalized patients using the ASMaQ.

Methods

Instruments

The 29-item ASMaQ uses a five-point Likert scale ranging from one to five points.[12] For 23 of the questions, five is the best response, and one is the worst, however, six questions are negatively scored, meaning one is the best and five is the worst. This was done to avoid convenient answering by participants.[12] The ASMaQ consists of three domains: general stroke knowledge (GSK), hyperacute stroke care (HSC), and acute stroke management (ASM). The GSK consists of 10 items with a possible score of 10 to 50, HSC consists of 9 items with a possible score of 9 to 45, and ASM consists of 10 items with a possible score of 10 to 50. Total possible ASMaQ score ranges from 29 to 145, the higher the score, the higher the stroke knowledge. The authors of the ASMaQ[12] found good reliability of the 29 items with Cronbach's alpha of 0.82.

ASMaQ scores are categorized into good and poor stroke knowledge based off cutoff points determined through stroke expert opinion.[13] Individual item scores of one to three are considered poor knowledge, while four and five are considered good knowledge; 3.5 being the cutoff point between good and poor knowledge.[13] Poor overall stroke knowledge scores range from 29 to 101.4, while good overall stroke knowledge scores range from 101.5 to 145. The total ASMaQ score is calculated by summing all item scores after completing reverse coding for the six negatively scored items.

Procedures

A non-experimental, descriptive correlational design was completed. The study sample consisted of Registered Nurses (RNs) who provide direct patient care as their primary role at an urban, Southeast U.S hospital system consisting of three hospitals. Nurses were included if they completed orientation and worked independently without a preceptor and cared for hospitalized, adult patients. Nurses working in the Neuro Intensive Care Unit (ICU), rehabilitation, pediatric units, labor and delivery and/or mother/baby units, and primarily in managerial roles were excluded. Neuro ICU nurses were excluded as they are the hospitals' stroke nursing experts and responses could invoke skewed results. Nurses working in the rehabilitation setting were excluded as this is technically not an acute care setting, and there are many confounding variables for stroke symptom awareness and recognition in the rehabilitation setting. Labor and delivery and mother/baby unit nurses were excluded because this study focused on adult strokes and these nurses also care for pediatric patients. Nurses in managerial positions were excluded as they do not provide care to adult patients as their primary role, thus it is assumed the stroke education they have received post-licensure reflects this.

IRB approval was received from the appropriate office prior to data collection. All RNs working within this hospital system were sent an email that included a secure link to an online survey for confidentiality, a flyer advertising the study, as well as pertinent information related to the study purpose, procedures, and inclusion and exclusion criteria. The online survey consisted of three parts: demographic information, questions related to their stroke education and experience, and the ASMaQ.

Data Analysis

The 29-item Likert scale questions of the ASMaQ were scored from 29 to 145 to determine stroke knowledge level.[12] Total ASMaQ score, domain score, and individual item score distributions, means, and standard deviations were computed, and Bivariate Pearson correlations were used to evaluate relationships among total scores, domain scores, and individual item scores. Analysis was done using Statistical Package for the Social Sciences (SPSS),[17] version 28.0.

Results

Of 219 eligible participants who began the survey, 196 participants completed the full survey. Most participants identified as female (*n* = 180; 91.8%) and White/Caucasian (*n* = 156; 79.6%). Ages ranged from early 20s to early 70s. Most participants (66.8%; *n* = 131) highest nursing degree was a Bachelor of Science in Nursing (BSN), 19.9% (*n* = 39) Associate Degree in Nursing (ADN), 11.7% (*n* = 23) Master of Nursing Science (MSN), 1% (*n* = 2) Doctor of Nursing Practice (DNP), and less than 1% (*n* = 1) Doctor of Philosophy (PhD) in Nursing. Of the participants, 32.1% (*n* = 63) were a RN for less than five years at the time of survey completion, while 11.2% (*n* = 22) had been an RN for more than 25 years. Most participants (72.4%; *n* = 142) worked as a full-time RN (three, 12-hour shifts per week). A wide range of nursing specialties/practice areas were represented amongst the population including emergency department, ICU, cardiac floor, medical/surgical floors, and procedural areas. See Table 1 for full demographic information.

Of the participants who completed the survey, 74.5% (*n* = 146) never worked on a stroke specific floor, however, almost all participants (95.9%; *n* = 188) reported caring for a stroke patient in the past. Most participants (65.3%; *n* = 128) received stroke education in their pre-licensure training, while almost all (98.5%; *n* = 193) received post-licensure stroke

education/training, most commonly through continuing education materials (84.7%; *n* = 166) and informal, on-the-job training (69.4%; *n* = 136). Personal stroke experience (themselves, an immediate family member, extended family member, or close friend) was reported by 42.9% (*n* = 84) of participants. Of those reporting a personal stroke experience, 72.6% (*n* = 61) reported this experience affected their stroke knowledge, and all (*n* = 61) of those who reported an effect on stroke knowledge also reported an increase in knowledge from the experience. See Table 2.

Most of the participants were aware (59.2.%; *n* = 116) or very aware (31.6.%; *n* = 62) of the hospital specific policies and procedures related to code stroke processes; 42.9% (*n* = 84) were very comfortable and 40.3% (*n* = 79) comfortable with activating a code stroke; 44.9% (*n* = 88) were very confident and 39.8% (*n* = 78) confident in their understanding of the purpose of code stroke for IHS. See Table 2.

Reliability analysis of the ASMaQ was computed and showed good internal consistency with a Cronbach's alpha score of 0.76 for this study sample. ASMaQ total scores ranged from 93 to 133 (*M* = 117.35, *SD* = 8.15). GSK scores ranged from 32 to 46 (*M* = 41.7, *SD* = 3.33), HSC scores ranged from 28 to 43 (*M* = 35.16, *SD* = 2.69), while ASM scores ranged from 29 to 50 (*M* = 40.48, *SD* = 4.59). See Table 3. There was a strong, positive correlation between GSK scores and total ASMaQ scores (r= .802; $p < .01$), HSC and total ASMaQ scores (r= .633; $p < .01$), and ASM and total ASMaQ scores (r= .823; $p < .01$). See Table 4.

Most participants scored in the good stroke knowledge range for all three domains and total ASMaQ score. For GSK, 96% (*n* = 188) had good knowledge, 4% had poor (*n* = 8); for HSC, 93% (*n* = 183) had good knowledge, 7% had poor (*n* = 13); for ASM, 86% (*n* = 168) had good knowledge, 14% had poor (*n* = 28); for total ASMaQ score, 97% (*n* = 190) had good stroke knowledge, 3% had poor (*n* = 6). See Table 3.

When looking at individual items of the ASMaQ, one item from the GSK "High blood pressure must be lowered to normal values in acute stroke," had an average score of poor stroke knowledge (*M* = 3.08; *SD* 1.345). One item from the ASM domain, "Mechanical thrombectomy can be performed after thrombolysis therapy" also scored an average of poor stroke knowledge (*M* = 3.47; *SD* 1.178).

Table 1

Demographic Characteristics of Participants

Characteristic	*n*	%
Gender		
Female	180	92
Male	15	8
Non-Binary	1	<1
Age Range		
<23	2	1
23-32	69	35
33-42	55	28
43-52	36	18
53-62	30	15
63-72	4	2
Race/Ethnicity		
White/Caucasian	156	80
Black/African American	16	8
Hispanic/Latinx	6	3
Asian/Pacific Islander	11	6
More than one race	7	4
Highest Nursing Degree		
ADN	39	20
BSN	131	67
MSN	23	12
DNP	2	1
PhD	1	<1

Characteristic	*n*	%
Years of RN		
<5	63	32
5-10	51	26
11-15	25	13
16-20	25	13
21-25	10	5
>25	22	11
Employment Status	1	4
Travel Nurse	142	72
Full-Time	22	11
Part-Time	25	13
PRN/Casual		
Nursing Specialty/Practice Area		
Emergency Department	30	15
Cardiac ICU	13	7
Cardiothoracic ICU	3	2
Medical ICU	11	6
Surgical/Trauma ICU	4	2
COVID ICU	4	2
Medical Floor	4	2
Surgical Floor	3	2
Med/Surg Floor	38	19
OR/PACU/Cath Lab	23	12
Cardiac Telemetry/Stepdown	38	19
Surgical/Trauma Telemetry/Stepdown	6	3
Neurological Telemetry/Stepdown	9	5
Float Pool	10	5

Note. *N* = 196. All percentages are rounded to a whole number.

Table 2

Nurse Stroke Education and Experience

Variable	n	%
Stroke floor experience		
Yes	50	26
No	146	74

Variable	n	%
Stroke floor experience [a]		
As RN	45	90
As student/aide	5	10
Years of stroke experience [a]		
<1	12	24
1-3	23	46
4-6	7	14
7-10	2	4
<10	6	12
Cared for a stroke patient		
Yes	188	96
No	8	4
Frequency of stroke patient care [b]		
Almost every shift	38	20
Once a week	51	27
Once a month	58	31
Once a year	17	9
Less than 5 times	24	13
Pre-licensure stroke education		
Yes	128	65
No	25	13
Unsure	43	22
Type of pre-licensure stroke education [c]		
One lecture	52	41
Multiple lectures	49	38
Simulation/clinical experience	27	21
Post-licensure education		
Yes	193	99
No	3	1

Variable	n	%
Type of post-licensure stroke education [d]		
Continuing education	166	86
In-service	107	55
Supervised practice/externship/residency	44	23
Informal on-the-job training	136	70
Competency training/new hire orientation	105	54
Independent reading/study	85	44
Personal stroke experience		
Yes	84	43
No	112	57
Type of personal stroke experience [e]		
Self	2	2
Immediate family	53	63
Extended family	26	31
Close friend	3	4
Effect of personal stroke experience on stroke knowledge [e]		
Increased knowledge	61	73
Decreased knowledge	0	0
No effect on knowledge	23	27
Familiar with code stroke policy/procedures		
Very aware	62	32
Aware	116	59
Neutral	12	6
Not familiar	6	3
Comfortable with activating code stroke		
Very comfortable	84	43
Comfortable	79	40
Neutral	21	11
Not comfortable	12	6

Variable	n	%
Confident in understanding code stroke for IHS		
Very confident	88	45
Confident	79	40
Neutral	21	12
Not confident	5	3
Never heard of it	1	<1

Note. $N = 196$. All percentages rounded. [a] Reflects the number and percentage of participants answering "yes" to stroke floor experience. [b] Reflects the number and percentage of participants answering "yes" to cared for stroke patient. [c] Reflects the number and percentage of participants answering "yes" to pre-licensure stroke education. [d] Reflects the number and percentage of participants answering "yes" to post-licensure stroke education. [e] Reflects the number and percentage of participants answering "yes" to personal stroke experience. IHS = in-hospital stroke.

Table 3

ASMaQ Scores

Variable	*Min*	*Max*	*Mean*	*SD*	*Poor** *n (%)*	*Good** *n (%)*
D1: General Stroke Knowledge	32	46	41.7	3.3	8 (4)	188 (96)
D2: Hyperacute Stroke Care	28	43	35.2	2.7	13 (7)	183 (93)
D3: Advanced Stroke Management	29	50	40.5	4.6	28 (14)	168 (86)
Total Score	93	133	117.4	8.1	28 (14)	168 (86)

Note. $N = 196$. *poor knowledge scores and good knowledge scores.

Table 4

Pearson Correlation Summary for Domain and ASMaQ Total Score

Variable	*r*	*p*
Domain 1: General Stroke Knowledge	.802	.000
Domain 2: Hyperacute Stroke Care	.633	.000
Domain 3: Advanced Stroke Management	.823	.000

Note. N = 196

Discussion

The ASMaQ was developed to test the stroke knowledge of health care professionals, but at the time of writing, has not been used on a nursing exclusive population. This study shows the successful usage of the ASMaQ as a quick, efficient delivery via online survey to test the stroke knowledge of a nursing population. Of the 219 eligible participants who began the survey, 209 remained at the start of the ASMaQ questions. There was a 94% completion of the ASMaQ amongst those who began the questionnaire as 196 participants completed the survey in its entirety. This shows very low attrition and respondent fatigue. Also, internal consistency showed high reliability with a Cronbach's alpha score of 0.76 for this study sample compared to the Cronbach's alpha score of 0.82 amongst the original sample during tool development (Sim et al., 2021).

In this sample of nurses caring for adult, hospitalized patients, stroke knowledge scores were found to range from 93 to 133 with an average score of 117.35, showing an average of good stroke knowledge among the study sample. The mean scores of the three domains (GSK, HSC, and ASM) for the sample also qualify as good stroke knowledge.

When categorizing the scores into good versus poor knowledge, most participants scored good stroke knowledge scores on all three domains and total scores. This is encouraging that acute care nurses are knowledgeable on stroke, specifically general stroke knowledge, hyperacute stroke care, and acute stroke management. However, two items, one from the GSK and one from the ASM had average scores in the poor knowledge category. These items tested the participants' knowledge on lowering blood pressure to normal values during acute stroke, and the appropriateness of performing mechanical thrombectomy post-thrombolysis therapy. This shows that although the sample mean showed good stroke knowledge, there are still areas of stroke care that needs further education.

Although most participants reported never working on a stroke specific floor, almost all reported taking care of a stroke patient in the past. This could be attributed to off-service patients on various floors during times of high hospital volumes and acuity. Even if nurses are not employed by a stroke specific floor, it should still be noted that all nurses working in the hospitalized setting have the possibility of caring for a stroke patient during any given shift, and additionally, patients who were not originally admitted for stroke have the possibility of having an IHS during their stay. Most IHS take place on cardiovascular and post-operative floors, and 47% (n = 9) of the participants reported working on a cardiovascular or surgical type practice area. Because of this, stroke education should not be limited to neuro or stroke nurses. Hospital systems must acknowledge the poor historical outcomes of IHS, and the fact that IHS occur most frequently on non-neuro/stroke units. All nurses caring for adult, hospitalized patients must be appropriately educated to confidently and successfully identify and intervene on acute strokes.

Limitations

This study was the first of its kind to test the ASMaQ as a tool to measure stroke knowledge in a U.S, nursing population. However, this study only sampled nurses working within one hospital system in an urban, Southeast city. Future studies should diversify the study sample to test nurses' stroke knowledge from various regions including rural areas. Although it may seem that the high percentage of women represented in this study would be a limitation, the 92% female sample is representative of the population. At the hospital system where nurses were sampled, women account for 91.51% of the hospital nursing staff,[18] while the United States' census[19] showed women make up over 85% of the nursing workforce nationwide.

Although this study shows good levels of stroke knowledge amongst the study sample, it is unknown how this is related to stroke outcomes. Future studies should evaluate the relationship between ASMaQ scores and patient outcomes.

Conclusion

There was a successful usage of the ASMaQ to test the knowledge of nurses caring for adult, hospitalized patients. Through using the ASMaQ, this study showed overall good stroke knowledge amongst nurses caring for adult, hospitalized patients. Further studies should elaborate on these findings and discern whether certain nurse characteristics predict higher or lower levels of stroke knowledge. Further detailed information on nurse-specific stroke knowledge could lead to tailored, educational initiatives to continue to increase the overall level of stroke knowledge to help improve the poor patient outcomes associated with IHS.

CHAPTER 5: WHAT ARE THE PREDICTORS OF ACUTE CARE NURSES' STROKE KNOWLEDGE? A MANUSCRIPT

BACKGROUND, METHODS, AND CONCLUSIONS

This chapter contains manuscript #2 to be submitted for publication regarding research on predictors of acute care nurses' stroke. The proposed journal is the Journal of Clinical Nursing, following author guidelines including proper headings, adherence to the relevant research reporting checklist (STROBE), and an 8000-word count limit. Background is presented about the importance of acute care nurses' knowledge on stroke, specifically in-hospital, followed by the methodology of the study design, and then results, discussion, and conclusions.

Abstract

Aims

Specific Aim: To examine the predictability of categorical and quantitative study variables of acute stroke knowledge among study participants.

Design

Non-experimental, descriptive correlational study.

Keywords

In-hospital stroke, nurse, stroke knowledge, stroke education.

Methods

Convenience sample of Registered Nurses (RN) caring for adult, hospitalized patients were recruited from the urban Southeast. All RNs from the included hospital system were sent an email that included a secure link to an online survey and pertinent study information. The survey consisted of three parts: demographic information, stroke education and experience, and the Acute Stroke Management Questionnaire (ASMaQ) to measure stroke knowledge.

Results

Sample included 196 nurses. There were statistically significant differences on three items related to code stroke awareness and stroke knowledge scores. Intensive Care Unit (ICU) and Emergency Department (ED) nurses were found to have higher stroke knowledge scores compared to all other practice settings. Over 98% of the participants reported having some form of post-licensure stroke education. Nurses who reported receiving three or more post-licensure education modalities had higher stroke knowledge scores than those who reported two or less. Of the eight predictor variables, two (practice setting and self-perception of stroke knowledge) were found to be significantly correlated with stroke knowledge along with three items related to code

stroke (awareness, comfort, and confidence in understanding) and self-identified knowledge of acute stroke management.

Conclusion

Although important that ED and ICU nurses have high level of stroke knowledge, half of IHS occur on cardiology/cardiovascular surgery practice areas (Yoo et al., 2016), deeming high importance of educational initiatives for nurses caring for these patient populations. Nurses who reported experiences with three or more modalities of post-licensure stroke education were found to have higher levels of stroke knowledge than those who only received one or two education methods. This shows that various methods of training, and reinforcement of learning using various teaching styles and methods is effective in increasing nurses' knowledge amongst this population.

Implications for the profession and/or patient care

Future studies should consider exploring lived experiences of nurses through interview or focus groups to gain understanding of factors that nurses feel have strengthened their stroke knowledge.

Impact

What problem did the study address?

Addressing the gap in knowledge of predictors of nurse stroke knowledge.

What were the main findings

Practice setting, post-licensure stroke education, code stroke familiarity, confidence, and understanding were all predictive of overall stroke knowledge. Nurses were also shown to have overall good stroke knowledge.

Where and on whom will the research have an impact?

Nurses, nurse educators, patients experiencing and at risk for stroke.

Patient or Public Contribution

Acute care nurses voluntarily participated in this study by completing the online questionnaire.

What does this paper contribute to the wider global clinical community? (1-3 bullet points)

- Provides predictors of stroke knowledge for nurse educators/administrators to have a better understanding of nurses' educational needs.
- Provides evidence that the ASMaQ is a quick, effective measure of stroke knowledge amongst a nurse population.

Introduction

"Time is brain" is a phrase coined to describe the importance of a timely, efficient response to stroke symptoms (National Institute of Neurological Disorders and Stroke [NINDS], 2020). This study focuses on ischemic strokes, as the thrombolytic treatments that result from the "time is brain" and code stroke initiatives are for ischemic, non-hemorrhagic strokes. Although recent efforts have been made to improve treatment times for in-hospital strokes (IHS), these patients are still experiencing high mortality rates and poor outcomes when compared to community occurring strokes (COS) (Chen et al., 2018). Nurses have been shown to play a large role in recognizing and treating IHS (Yang et al., 2019; George et al., 2017; Nouh et al., 2022), however, although nurses receive education upon employment, the everchanging state of the science regarding IHS treatment and resolution presents a challenge for nurses to stay abreast with best practices. Additionally, stroke education recommendations for nurses have not been noted nor standardized.

Background

There are many non-modifiable and modifiable risk factors which help prevent strokes, but when they occur, ischemic strokes are often treatable if the response is timely. Non-modifiable risk factors include those unable to be intervened on i.e., patient's age, sex, race, ethnicity, and past medical history of stroke (Colsch, 2021). However, a modifiable risk is the timeliness of recognition of symptom onset and time to treatment and/or intervention (Yang et al., 2019). Each second an ischemic stroke is left untreated, 32,000 neurons are lost which accelerates aging by close to nine hours (Saver, 2006), and for every missed or untreated stroke, a person will lose over one billion neurons and 36 years of life (Saver, 2006). It is imperative that

nurses intervene with the modifiable risk factor of timeliness of treatment for IHS to preserve the most amount of healthy brain tissue and facilitate positive patient outcomes.

About 20% of strokes will occur while a person is already hospitalized (Chen et al., 2018; Emmett et al., 2019; Lu et al., 2019; Saltman et al., 2015). The occurrence of IHS can be related to surgical/procedural risks and complications and/or comorbidity risk factors that led to the initial hospitalization (Yang et al., 2019). Although the presence of an established multidisciplinary team may imply the simplicity of recognition and treatment of IHS when compared to strokes occurring in the community, IHS are often missed or misunderstood for a variety of non-stroke related conditions such as delirium, or reaction to pharmacological agents including narcotics (Chen et al., 2018).

Because of the complexity of identifying and treating IHS, the American Heart Association (AHA) provides a set of guidelines and recommended benchmark timeframes (AHA, 2019). The timeframes are used to support the "time is brain" initiative and are set in place to ensure patients experiencing stroke symptoms have optimal chances of receiving the time-sensitive interventions to prevent further complications or ischemic brain tissue (AHA, 2019).

To improve benchmark times for stroke treatment and improve patient outcomes, many hospital systems have initiated a "code stroke" system. A code stroke is a systematic response that activates a team of stroke professionals when stroke symptoms are examined in a patient (Yang et al., 2019; Manners et al., 2019; Kawano et al., 2021). The code stroke system has been shown in the literature to decrease the time from stroke symptom onset to assessment by the neurology, radiologic imaging, and treatment (Kawano et al., 2021; Yoo et al., 2016). Certain studies have also noted a nurse-drive code stroke process as being the most effective way to

drive this systematic response (Yang et al., 2019; George et al., 2017). A nurse-driven code stroke implies that the nurse is at the forefront or the leader of the code stroke team. Nurses have been shown to identify acute strokes more frequently and earlier than physicians or other health care team members, which could be attributed to the time nurses spend at the patients' bedsides compared to other team members (Yang et al., 2019; George et al., 2017; Nouh et al., 2022).

Despite effective code stroke initiatives, IHS patients still have shown to have longer time to treatment when compared to (COS) patients (Chen et al., 2018; Saltman et al., 2015). This finding is unexpected, as transportation time to the hospital and medical work-up and triage is eliminated in IHS (Chen et al., 2018). Subsequently, IHS patients experience higher mortality, poorer outcomes, and less frequent discharges home when compared to their COS counterparts (Chen et al., 2018; Saltman et al., 2015; Bekelis et al., 2016; Emmett et al., 2019).

The literature is unclear on recommendations for stroke, IHS, and code stroke education for nurses (El Ammar et al., 2020; Yoo et al., 2016). Mellon et al. (2015) explain that the lack of knowledge amongst hospital staff may contribute to the delays in treatment and assessment of IHS. Many public health initiatives have been created and implemented in recent years to promote lay persons' stroke knowledge, however, there are little data explaining stroke knowledge provided to nurses and hospital personnel (Mellon et al., 2015). The AHA recently recommended the education of hospital staff to improve recognition of stroke and the empowering of staff to act when a stroke is recognized (Nouh et al., 2022). However, the specifics of the education, i.e., timelines, frequency, delivery method, required personnel is omitted. Many studies indicate on-going and annual stroke education to nurses and staff working on neuro-specific or stroke floors. While important, IHS have been shown to occur most frequently on cardiac/cardiovascular and post-operative floors, not stroke floors (Manners et al.,

2019; Kawano et al., 2021; Kassardjian et al., 2017; Lu et al., 2019; Saltman et al., 2015; Topiwala et al., 2020; Chen et al., 2018).

Although nurses should have received stroke education through their pre-licensure programs and initial job training, stroke guidelines and best practices constantly evolve. This, in addition to the time-sensitive component, results in unrealistic expectations for nurses to stay current with the guidelines without proper continuing education. The benchmark timeframes outlined by the AHA, and the effectiveness of code stroke processes can only be achieved if nurses are knowledgeable and aware of IHS and the protocols in place.

Because of the need to improve the knowledge level of health professionals on IHS, the Acute Stroke Management Questionnaire (ASMaQ) was recently developed by an expert panel of neurologists in Malaysia (Sim et al., 2021). The instrument is the first of its kind to evaluate health care professionals' knowledge of acute stroke management through three major components: general stroke knowledge, hyperacute stroke care, and advanced stroke management (Sim et al., 2021). A recent study by Albart et al. (2022) used the ASMaQ to evaluate healthcare professional knowledge of acute stroke management and predictors of knowledge in a Malaysian population. The types of healthcare professionals included in this study were "medical practitioners" and "allied healthcare professionals from various medical disciplines" (Albart et al., 2022). Healthcare professionals who did not work with stroke patients daily had 2.67 times the odds of poor stroke knowledge compared to those working with stroke patients daily ($p < .001$). Additionally, non-doctors had 3.46 times the odds of having poor stroke knowledge ($p = .004$). This finding is essential to consider, as most IHS strokes occur in cardiovascular and surgical areas, as explained above. Albart et al. (2022) did not differentiate

nurses from other non-doctors when reporting the results, so it is unknown the level and predictors of stroke knowledge for nurses specifically.

Little is known on nurses' knowledge on stroke, specifically the specific nurse characteristics that may serve as predictors for their level of stroke knowledge. The purpose of this study is to identify nurse characteristics that may be predictors of stroke knowledge amongst acute care nurses.

Methods

We conducted a non-experimental, descriptive correlational study. We used multiple regression analyses to make inferences about the relationship between nurse characteristics (predictor variables) and stroke knowledge (response variable).

The study took place at three, community, Magnet-designated hospitals which are part of the same health care system in an urban city in the Southeastern U.S. Magnet designation is awarded to organizations who have proven nursing excellence and quality patient care (American Nurses Credentialing Center, 2023). The two largest of the three hospitals are certified Joint Commission Primary Stroke Centers (PSC) (WakeMed, 2022). The PSC certification is designated to hospitals that have taken extra efforts to ensure improved outcomes for stroke patients (The Joint Commission, 2022). As of February 2022, the system employs about 3,000 nurses. The largest of the three hospitals has 567 acute beds, the second largest has 208 acute beds, and the third has 61 acute beds (WakeMed, 2022).

A convenience sample of RNs who provide direct patient care as their primary role at one (or more) of the hospitals were invited to participate. For this study, nurses who care for hospitalized patients will be referred to as acute care RN. Inclusion criteria included having an active RN license, completion of orientation and working independently without a preceptor, and

caring for hospitalized patients. Exclusion criteria include nurses working in the Neuro Intensive Care Unit (ICU), rehabilitation, pediatric units, labor and delivery and/or mother/baby units, and primarily in managerial roles. Neuro ICU nurses were excluded as it is believed their responses would provide skewed results as they are the hospitals' stroke nursing experts. Rehabilitation nurses were excluded as this hospital system technically designates rehabilitation as a non-acute care setting, and there are many confounding variables for stroke symptom awareness and recognition in the rehabilitation setting. Nurses caring for pediatric, labor and delivery, and/or mother/baby populations were excluded as this study focuses on the knowledge level of stroke for adult patients. Nurses in managerial roles were excluded, as their primary role in the hospital is not to provide direct care for patients.

The targeted sample size was $N = 106$. This targeted sample size is based off the $N > 50 + 8m$ (m= number of predictor variables) recommendation by Pallant (2020) when conducting multiple regression analyses.

The protection of human participants to adhere to ethical standards received approval from the appropriate Institutional Review Board (IRB) office prior to data collection. All RNs working within this hospital system were sent an email that included a secure link to an online survey for confidentiality, a flyer advertising the study, as well as pertinent information related to the study purpose, procedures, and inclusion and exclusion criteria. All email addresses used were via secured, hospital-provided domains. The online survey consisted of three parts: demographic information, questions related to their stroke education and experience, and the ASMaQ.

Demographic Survey

The demographic survey was developed by the principal investigator of the study. The first three questions of the demographic survey tested for inclusion criteria (licensed RN, provide care for adult, hospitalized patients, and do not work in the Neuro ICU, labor and delivery, and/or or mother/baby unit) to prevent ineligible participants from completing the full survey. The variables acute care RN, education, current practice setting, employment status, and work experience were assessed via the demographic survey. Additionally, the demographic survey asked participants for birth year, gender, and race/ethnicity.

Nurse Stroke Education and Experience

This portion of the survey is a researcher-developed instrument developed specifically for this study consisting of ten multiple-choice items, and one drag item. The variables education, professional acute stroke experience, personal acute stroke experience, and stroke knowledge were measured via this portion of the survey. Education was assessed through asking the participant if they received any pre-licensure and/or post-licensure stroke training and the type of training i.e., lecture, clinical experience, simulation, informal on-the-job training, continued education module.

Professional acute stroke experience was assessed through questions that ask the participant if they have previously worked on a stroke or neuro-specific unit, the length of time they worked there, and in what capacity (RN, student, nurse aide), and the frequency, if ever, that the participant provides care for stroke patients in their current practice.

Personal acute stroke experience was assessed through asking the participants if they have personally had or have a family member who has had a stroke, how the person is related to them, and if and how this impacted their personal stroke knowledge.

Stroke knowledge will be partially measured using four items from this portion of the survey. Three multiple-choice questions tested for the participants' awareness of the code stroke process at the hospital in which they work, their comfort with the code stroke policies and procedure, and their confidence in activating the system. One question asked the participant to drag a line to represent their self-perception of their stroke knowledge from none to expert (measured from 1 to 100). Stroke knowledge was also measured using the Acute Stroke Management Questionnaire (ASMaQ) (Sim et al., 2021).

ASMaQ

The response variable, stroke knowledge, was measured using the Acute Stroke Management Questionnaire (ASMaQ) (Sim et al., 2021). The ASMaQ is a new, validated 29-item questionnaire that tests and measures health care professionals' stroke knowledge (Sim et al., 2021). The ASMaQ content were developed through a review of stroke literature, pre-existing stroke assessment scales, clinical practice guidelines of Malaysia that are based on AHA guidelines, and expert opinion (Sim et al., 2021). Content validation of 110 questions was completed using an expert panel. After 79 questions were eliminated, 31 questions were used for psychometric testing on 158 participants to further evaluate the tool for validity (Sim et al., 2021). The authors also completed exploratory factor analysis, which narrowed the original 31 questions to 29. The Cronbach's alpha value was 0.82, showing good reliability of the measurement tool (Sim et al., 2021). Cronbach's alpha for this study sample is 0.76.

The 29 items of the ASMaQ are broken up into three domains: general stroke knowledge (GSK), hyperacute stroke care (HSC), and acute stroke management (ASM). All 29 items use a five-point Likert scale ranging from one to five points (Sim et al., 2021). For 23 of the questions,

five is the best response, and one is the worst, however, six questions are negatively scored, meaning one is the best and five is the worst (Sim et al., 2021).

The GSK consists of 10 items with a possible score of 10 to 50, HSC consists of 9 items with a possible score of 9 to 45, and ASM consists of 10 items with a possible score of 10 to 50. Total possible ASMaQ score ranges from 29 to 145; the higher the score, the higher the stroke knowledge (Sim et al., 2021).

Data Analyses

To analyze the data, independent-samples t-tests and one-way analysis of variances (ANOVA) were used to assess differences in stroke knowledge amongst the different demographic and nurse characteristic variables. Multiple regression was used to analyze the effect of the various nurse characteristics (predictor variables) on stroke knowledge (dependent variable). Data analysis will be completed using IBM (IBM Corp, 2021) SPSS version 28.0.

The first specific aim is to examine acute stroke knowledge among acute care nurses. Independent sample t-tests and one-way ANOVAs were used to compare ASMaQ mean total scores, domain scores, and individual item scores between participant subgroups.

The second specific aim is to examine the predictability of categorical and quantitative study variables of acute stroke knowledge among study participants. A standard multiple regression, where all the predictor variables will be entered into the model at once, will be used explain how much of the variance in the dependent variable of total acute stroke knowledge can be explained by the independent predictor variables. In addition, the regression will indicate the relative contribution of each predictor variable.

Results

Of 219 eligible participants who began the survey, 196 participants completed in its entirety. Most participants identified as female and White/Caucasian. Ages ranged from early 20s to early 70s. As shown in Table 1, most participants' highest degree completed was a Bachelor of Science in Nursing (BSN). At the time of survey completion, 32.1% reported less than five years of experience as a RN and 11.2% of the participants had been an RN for greater than 25 years. Most participants worked full-time RN hours (three, 12-hour shifts per week). A wide range of nursing specialties/practice areas were represented amongst the population including emergency department, ICU, cardiac floor, medical/surgical floors, and procedural areas. Table 1 provides full demographic information.

Table 1

Demographic Characteristics of Participants

Characteristic	*n*	%
Gender		
Female	180	92
Male	15	8
Non-Binary	1	<1
Age Range	2	1
<23	69	35
23-32	55	28
33-42	36	18
43-52	30	15
53-62	4	2
63-72		
Race/Ethnicity		
White/Caucasian	156	80
Black/African American	16	8
Hispanic/Latinx	6	3
Asian/Pacific Islander	11	6
More than one race	7	4

Characteristic	*n*	%
Highest Nursing Degree		
ADN	39	20
BSN	131	67
MSN	23	12
DNP	2	1
PhD	1	<1
Years of RN		
<5	63	32
5-10	51	26
11-15	25	13
16-20	25	13
21-25	10	5
>25	22	11
Nursing Specialty/Practice Area		
Emergency Department	30	15
Cardiac ICU	35	19
Med/Surg Floor	45	23
Procedural Area	23	12
Cardiac Telemetry/Stepdown	38	19
Surgical/Trauma Telemetry/Stepdown	6	3
Neurological Telemetry/Stepdown	9	5
Float Pool	10	5

Note. $N = 196$. All percentages are rounded to a whole number.

Table 2 presents stroke education and work experience amongst the nurse participants. Although most participants never worked on a stroke specific floor, almost all participants reported caring for a stroke patient in the past. A majority of participants received stroke education in their pre-licensure training, while almost all received post-licensure stroke education/training, most commonly through continuing education materials and informal, on-the-job training. Personal stroke experience (themselves, an immediate family member, extended

family member, or close friend) was reported by 42.9% of participants. Of those who had a personal stroke experience, almost a third reported this experience affected their stroke knowledge. Of those with personal stroke experience who reported an effect on stroke knowledge, all reported an increase in knowledge from the experience.

Most participants were aware or very aware of the hospital specific policies and procedures related to code stroke processes, were very comfortable or comfortable with activating a code stroke and were very confident or confident in their understanding of the purpose of code stroke for in-hospital strokes.

Table 2

Nurse Stroke Education and Experience

Variable	*n*	%
Stroke floor experience		
Yes	50	26
No	146	74
Years of stroke experience [a]		
<1	12	24
1-3	23	46
4-6	7	14
7-10	2	4
<10	6	12
Cared for a stroke patient		
Yes	188	96
No	8	4
Pre-licensure stroke education		
Yes	128	65
No	25	13
Unsure	43	22

Variable	*n*	%
Type of pre-licensure stroke education [c]		
One lecture	52	41
Multiple lectures	49	38
Simulation/clinical experience	27	21
Post-licensure education		
Yes	193	99
No	3	1
Type of post-licensure stroke education [d]		
Continuing education	166	86
In-service	107	55
Supervised practice/externship/residency	44	23
Informal on-the-job training	136	70
Competency training/new hire orientation	105	54
Independent reading/study	85	44
Personal stroke experience		
Yes	84	43
No	112	57
Effect of personal stroke experience on stroke knowledge [e]		
Increased knowledge	61	73
Decreased knowledge	0	0
No effect on knowledge	23	27
Familiar with code stroke policy/procedures		
Very aware	62	32
Aware	116	59
Neutral	12	6
Not familiar	6	3
Comfortable with activating code stroke		
Very comfortable	84	43
Comfortable	79	40
Neutral	21	11
Not comfortable	12	6

Variable	*n*	%
Confident in understanding code stroke for IHS		
Very confident	88	45
Confident	79	40
Neutral	21	12
Not confident	5	3
Never heard of it	1	<1

Note. N = 196. All percentages rounded. [a] Reflects the number and percentage of participants answering "yes" to stroke floor experience. [b] Reflects the number and percentage of participants answering "yes" to cared for stroke patient. [c] Reflects the number and percentage of participants answering "yes" to pre-licensure stroke education. [d] Reflects the number and percentage of participants answering "yes" to post-licensure stroke education. [e] Reflects the number and percentage of participants answering "yes" to personal stroke experience. IHS = in-hospital stroke.

ASMaQ total scores ranged from 93 to 133 (M = 117.35, SD = 8.15). GSK scores ranged from 32 to 46 (M = 41.7, SD = 3.33), HSC scores ranged from 28 to 43 (M = 35.16, SD = 2.69), while ASM scores ranged from 29 to 50 (M = 40.48, SD = 4.59).

No statistically significant differences of stroke knowledge were found with any of the demographic variables. However, there was statistically significant differences on three survey items related to code stroke awareness and stroke knowledge scores. There were also differences found between ICU and Emergency Department (ED) nurses compared to all other practice settings.

Code Stroke and Stroke Knowledge

A one-way between-groups ANOVA was conducted to explore the impact of code stroke familiarity, comfort, and understanding on stroke knowledge as measured by the ASMaQ. Participants were divided into three groups depending on their level of awareness, comfort, or confidence of understanding of the code stroke measure.

There was a statistically significant difference at the $p < .001$ level in mean ASMaQ total score for the three levels of nurse familiarity (very aware, aware, less than aware) with their hospital's code stroke policy and procedures: F (2, 193) = 22.35, $p < .001$. The effect size calculated using eta squared was large at .19. The Tukey HSD multiple comparison test indicated that the mean scores for all three groups were statistically significantly different from each other (Very aware group (M = 122.1, SD = 6.04; aware group (M = 115.82, SD = 7.97; less than aware group (M = 110.83, SD = 7.56)).

There was also a statistically significant difference at the $p < .001$ level in mean ASMaQ total score for the three levels of nurse comfort (very comfortable, comfortable, less than comfortable) with their ability to activate a code stroke if they assessed stroke symptoms in their patient(s): F (2, 193) = 27.93, $p < .001$. The effect size calculated using eta squared was large at .22. The Tukey HSD multiple comparison test indicated that the mean scores for all three groups were statistically significant from each other (Very comfortable group (M = 121.5, SD = 6.75; comfortable group (M = 115.41, SD = 7.61; less than comfortable group (M = 111.42, SD = 7.37).

Finally, there was a statistically significant difference at the $p < .001$ level in mean ASMaQ total score for the three levels of nurse confidence in understanding the purpose of code stroke for IHS (very confident, confident, less than confident): F (2, 193) = 22.25, $p < .001$. The effect size calculated using eta squared was large at .19. The Tukey HSD multiple comparison test indicated that the mean scores for the very confident group (M = 121.21, SD = 6.61) is significantly larger than that of the confident group (M = 114.62, SD = 7.67) and the less than confident group (M = 113.13, SD = 6.68), however, the means for the confident and less than confident groups are not statistically significant.

Practice Setting

Independent-samples t-tests were conducted to compare the stroke knowledge scores of nurses working in the ED and ICU compared to nurses working in all other practice settings. There was a statistically significant difference in general stroke knowledge scores (domain 1 of ASMaQ) for ED and ICU nurses (M = 42.49, SD = 2.81) compared to all other practice settings (M = 41.31, SD = 3.5; $t(195) = 2.36$, p =.019). The eta squared was small at .03. There was a statistically significant difference in advanced stroke management scores (domain 3 of ASMaQ) for ED and ICU nurses (M = 42.82, SD = 3.84) compared to all other practice settings (M = 39.33, SD = 4.51; $t(195) = 5.35$, p <.001). The eta squared showed a medium effect size at .13. There was also statistically significant difference in total ASMaQ scores for ED and ICU nurses (M = 120.97, SD = 7.18) compared to all other practice settings (M = 115.55, SD = 8.02; $t(195)$ = 4.61, p <.001). The eta squared showed a medium effect size at .10.

There was a statistically significant difference in self-identified stroke knowledge (scoring from 1 to 100) for ED and ICU nurses (M = 74.55, SD = 20.47) compared to all other practice settings (M = 60.92, SD = 20.83; $t(195) = 4.34$, p <.001). The eta squared showed a medium effect size at .09.

Post-Licensure Stroke Training

Over 98% (n= 193) of the participants reported having some form of post-licensure stroke education. The various forms of education methods include continuing education (84.7%), in-service training (54.6%), supervised practice and/or externship (22.4%), informal on-the-job training and/or learning by doing (69.4%), competency training during new-hire orientation (53.6%), and independent reading/study (43.4%). About a third (n= 63; 32.8%) of participants

reported one or two of the listed post-licensure education methods, while 67.2% (*n*= 129) reported three or more education methods. One participant did not report any.

An independent-samples t-test was used to compare the mean ASMaQ scores amongst participants who reported one or two post-licensure education methods versus those who reported three or more. There were strong statistically significant differences between the two post-licensure stroke education groups on GSK, ASM, HSK, and total ASMaQ scores. See Table 3.

Table 3

Independent-samples t-test: Post-licensure stroke education and ASMaQ

Variable	≤2* *M*; *SD*	≥3* *M*; *SD*	*t*	*p*
Total ASMaQ	113.35; 7.73	119.34; 7.68	5.07	<.001
Domain 1: GSK**	40.46; 3.76	42.28; 2.96	3.65	<.001
Domain 2: ASM**	33.94; 2.16.	35.74; 2.75	4.57	<.001
Domain 3: HSC**	38.95; 4.51	41.32; 4.45	3.44	.001
Self-perception stroke knowledge	57.71; 21.56	69.29; 20.72	3.59	<.001

Note. * number of post-licensure stroke education methods **GSK: General Stroke Knowledge; ASM: Acute Stroke Management; HSC: Hyperacute Stroke Care

Predictability of Variables

Standard multiple regression was used to assess the predictability of various nurse characteristics on stroke knowledge as measured by the ASMaQ. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity. Six predictor variables including practice setting (ED/ICU versus all others), code stroke awareness, code stroke activation comfort, code stroke confidence in understanding,

self-identified knowledge of acute stroke management, and self-perception of stroke knowledge were all found to be significantly correlated with the dependent variable (stroke knowledge as measured by ASMaQ total score). The regression model (six predictor variables) explains 30.7% of the variance in the ASMaQ total scores, F (6, 189) = 13.93, $p < .001$. Practice setting (p = .013), self-identified knowledge of acute stroke management (p = .002) and self-perception of stroke knowledge (p = .003) made statistically significant unique contributions to predicting ASMaQ total scores. Using the standardized beta (β) regression coefficients to assess the relative importance of the significant predictors, self-identified knowledge of acute stroke management (β = .25) and self-perception of stroke knowledge (β = .24) were the most important predictors followed by practice setting (β = .16). VIF (variance inflation factor) values were all small (≤10) indicating no problem with multicollinearity among the predictor variables. See Table 4.

Table 4

Regression Analysis Summary of Study Variables Predicting ASMaQ Total Score

Variable	B	SE B	β	*t*	*p*
Practice setting	2.76	1.11	.16	2.50	.013
Code stroke 1	1.82	1.91	.06	0.95	.343
Code stroke 2	1.47	1.63	.07	0.90.	.370
Code stroke 3	-1.12	1.63	-.05	-0.69	.490
Acute stroke management	5.54	1.74	.25	3.18	.002
Self-perception stroke knowledge	0.09	0.30	.24	3.01	.003

Note. R^2 = .307 (N = 196, p < .001). B = unstandardized multiple regression coefficient. SE = standard error. β = standardized multiple regression coefficient. Code stroke 1 = I am familiar with policy/procedures of this hospital stroke code. Code stroke 2 = I would feel comfortable activating a stroke code. Code stroke 3 = I am confident I understand the purpose of stroke code for IHS. Acute stroke knowledge: 1 = very poor to 5 = very good. Self-rating of stroke knowledge: 100-point scale from 1 to 100.

Discussion

In looking at practice setting types, nurses working in the ED and ICU were found to have higher levels of stroke knowledge when compared to nurses working in all other practice settings. This could be attributed to higher frequency and intensity of educational initiatives amongst ED and ICU, as patients often experience higher acuity. Code stroke educational initiatives have also been focused amongst ICU nurses (George et al., 2017) and ED nurses care for both IHS patients as well as COS who present to the ED. Although important that ED and ICU nurses have high level of stroke knowledge, half of IHS occur on cardiology/cardiovascular surgery practice areas (Yoo et al., 2016), deeming high importance of educational initiatives for nurses caring for these patient populations. Although the results did not indicate specific demographic information that may predict stroke knowledge, practice setting, methods of post-licensure stroke education, code stroke familiarity, confidence, and understanding were all predictive of overall stroke knowledge.

Nurses who reported experiences with three or more modalities of post-licensure stroke education were found to have higher levels of stroke knowledge than those who only received one or two education methods. These reported methods include continuing education, in-service training, supervised practice and/or externship, informal on-the-job training and/or learning by doing, competency training during new-hire orientation, and/or independent reading/study. This shows that various methods of training, and reinforcement of learning using various teaching styles and methods is effective in increasing nurses' knowledge amongst this population. This could be attributed to various learning styles and the variance in effectiveness depending on the individual nurse. This survey only allowed the participants to choose from a selection of pre-

labeled education methods and may not be inclusive of all the unique stroke education methods that the nurses have received that contribute to their overall stroke knowledge.

Nurses who reported familiarity with the hospital's code stroke policies and procedures, comfort in activating a code stroke if needed, and understanding of the purpose of code stroke for IHS also were found to have higher levels of stroke knowledge. Nurses who self-identified as having a high level of stroke knowledge were also validated by their ASMaQ stroke knowledge scores. This shows that nurses amongst this population have a high level of self-awareness and were correct in their personal assumptions of their stroke knowledge.

"The Great Resignation" has been coined to describe today's workforce and nursing climate of high turnover rates and increased number of travel nurses and transient staff (Laskowski-Jones, & Castner, 2022). Retaining experienced and senior nurses is essential to high-quality patient care, including stroke care (Laskowski-Jones, & Castner, 2022). However, due to record-breaking turnover rates and the result of nurse burnout, predictions show that new-graduate nurses will soon become an even larger proportion of the nursing workforce (Laskowski-Jones, & Castner, 2022). This creates instability and gaps in support and education for the new graduates as well as a lack of balanced experience levels amongst the nursing units and areas. Soon, if not already, there will be a vacancy of preceptors, mentors, and experienced nurses to provide hands-on support to new graduate nurses or nurses transitioning to new practice areas. Having a more detailed understanding of the factors and lived experiences that have shaped nurses stroke knowledge and ability to carry-out code stroke processes will help educators' creativity in providing effective stroke education.

With the record-breaking nurse turnover rates, it is important for nurse managers and educators to have a good understanding of new nurses (both new graduates and experienced

nurses) baseline stroke knowledge level upon hire. The ASMaQ is a quick, short survey, that takes less than five minutes to complete. Of the survey participants who began the ASMaQ portion of the survey, 94% finished the 29-item questionnaire. This shows very low attrition and respondent fatigue. Nurse managers and educators could use the ASMaQ to assess baseline stroke knowledge at hire to create a tailored stroke orientation experience. This has the potential to be a cost saving initiative as nurses would only be receiving the stroke education that is filling the gaps of what is not already known. Cost saving initiatives are imperative in today's healthcare climate, as an increase in patient acuity and volumes has led to an overall increase in healthcare costs (American Hospital Association, 2022).

The American Hospital Association (2022) has reported an increase in patient acuity and an increase in average hospital length-of-stay by 10% since pre-pandemic. This has led to an increase hospital demands and patient volumes, which in turn has led to heterogenous patient care units. Patients are no longer strictly assigned to specific practice settings due to their diagnoses, but rather assigned to the quickest availability to lessen lengthy holding periods in the ED. However, this leads to nurses caring for a wide variety of patients, and conditions that they are not as familiar with or continually educated on. This is suggested in our survey results, as only about a quarter of participants reported experience working on a stroke specific floor, but almost all reported caring for a stroke patient in the past. This reinforces the importance of standardized stroke education for all nurses caring for hospitalized patients, not just nurses working in the ICU or ED.

Limitations

Due to the convenience sampling method, results may not be generalizable to the general population. Also, since this study was observational in nature, there is an inability to support causal relationships (Polit & Beck, 2021).

This study surveyed nurses from one hospital system, serving an urban Southeast population. Future studies should consider using the ASMaQ or testing the stroke knowledge amongst a wider range of nurses, including those in rural areas.

Conclusion

Future studies should consider exploring the lived experiences of nurses through an interview or focus group format to have a better understanding of the factors that nurses feel have strengthened their stroke knowledge. Certain educational means are not easily captured via survey such as mentorship, an environment of teamwork, grand rounds, etc. These educational experiences could shape a nurse's understanding of stroke and stroke care and contribute to overall stroke knowledge and stroke skillset. Knowing this information could help nurse educators and managers appropriately prepare nurses to care for not only stroke patients but all hospitalized patients that may be at risk for an in-hospital stroke. This is imperative as nurses continue to navigate care of an increasingly complex patient population while also battling the effects of the Great Resignation and high rates of nurse turnover.

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Appendix A

IRB Approval Letter

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board
4N-64 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** ·
rede.ecu.edu/umcirb/

Notification of Exempt Certification

From: Social/Behavioral IRB
To: Catherine Taylor
CC: Linda Bolin
Date: 10/18/2022
Re: UMCIRB 22-000644
Acute Care Nurses' Knowledge on In-Hospital Strokes and Predictors of Knowledge

I am pleased to inform you that your research submission has been certified as exempt on 10/18/2022. This study is eligible for Exempt Certification under category # 2ab.

It is your responsibility to ensure that this research is conducted in the manner reported in your application and/or protocol, as well as being consistent with the ethical principles of the Belmont Report and your profession.

This research study does not require any additional interaction with the UMCIRB unless there are proposed changes to this study. Any change, prior to implementing that change, must be submitted to the UMCIRB for review and approval. The UMCIRB will determine if the change impacts the eligibility of the research for exempt status. If more substantive review is required, you will be notified within five business days.

Document	Description
Email Script(0.03)	Recruitment Documents/Scripts
IHS Flyer(0.04)	Recruitment Documents/Scripts
IHS Informed Consent(0.02)	Consent Forms
IHS Survey(0.03)	Surveys and Questionnaires

For research studies where a waiver or alteration of HIPAA Authorization has been approved, the IRB states that each of the waiver criteria in 45 CFR 164.512(i)(1)(i)(A) and (2)(i) through (v) have been met. Additionally, the elements of PHI to be collected as described in items 1 and 2 of the Application for Waiver of Authorization have been determined to be the minimal necessary for the specified research.

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

Appendix B

AHA Stroke Timeframes

PHASE III
TARGET: STROKE℠
SUGGESTED TIME INTERVAL GOALS

American Heart Association.
Target: Stroke™

THE 30 MINUTES DTN GOAL TIME INTERVAL GOALS ARE:

ACTION	TIME
Door to physician	≤2.5 minutes
Door to stroke team	≤5 minutes
Door to CT/MRI initiation	≤15 minutes
Door to CT/MRI interpretation	≤25 minutes
Door to needle time	**≤30 minutes**

THE 45 MINUTES DTN GOAL TIME INTERVAL GOALS ARE:

ACTION	TIME
Door to physician	≤5 minutes
Door to stroke team	≤10 minutes
Door to CT/MRI initiation	≤20 minutes
Door to CT/MRI interpretation	≤35 minutes
Door to needle time	**≤45 minutes**

THE 60 MINUTES DTN GOAL TIME INTERVAL GOALS ARE:

ACTION	TIME
Door to physician	≤10 minutes
Door to stroke team	≤15 minutes
Door to CT/MRI initiation	≤25 minutes
Door to CT/MRI interpretation	≤45 minutes
Door to needle time	**≤60 minutes**

THE 90 MINUTES DTD GOAL TIME INTERVAL GOALS ARE:

ACTION	TIME
Door to physician	≤5 minutes
Door to stroke team	≤10 minutes
Door to CT/MRI initiation	≤20 minutes
Door to CT/MRI interpretation	≤35 minutes
Door to neurointerventional team activation	≤40 minutes
Door to needle time	≤45 minutes
Door to patient arrival in NI suite	≤60 minutes
Door to puncture	≤75 minutes
Door to device	**≤90 minutes**

The suggested time intervals are intended to facilitate time interval benchmarking and quality improvement efforts towards achieving the Target: Stroke DTN and DTD goals. The interval benchmarks may be modified as needed. Individual institutions may wish to modify these to achieve ultimate intervention within recommended time frame.

heart.org/targetstroke

Appendix C

Recruitment Flyer

Seeking Registered Nurses in direct patient care to answer a quick 10-minute survey related to stroke knowledge

Eligibility:
You are eligible to complete this survey if you are:

- RN at WakeMed (travelers included)
- Work in direct patient care
- Do not work in Neuro ICU, Rehab, labor & delivery, mother/baby
- Not on orientation or working with preceptor

Potential Benefits:
Participating in this research study will help nurse researchers learn about nurses' knowledge on in-hospital strokes and factors that affect this knowledge. We hope that this information will help improve education provided to nurses related to in-hospital strokes and ultimately improve patient outcomes.

Participation Involves:

- Completion of short online survey (7-10 minutes)
- All information collected is solely for research purposes
- All information collected remains anonymous
- Answers will not be tied to personal information

Click or scan to take to survey

Contact Info:
Catherine Taylor
Taylorc15@students.ecu.edu or cattaylor@wakemed.org
(252) 864-3655

Appendix D

Recruitment Email

Dear WakeMed Nurses,

My name is Catherine Taylor, and I am a clinical nurse in the Neuro ICU as well as a doctoral student at East Carolina University. I am conducting a research study that **aims to understand nurses' knowledge on in-hospital stroke**. If you are an RN who provides care for adult, hospitalized patients at WakeMed (travel nurses included) as your primary role, are not on orientation or working alongside a preceptor, and do not work in the Neuro ICU, Rehab, labor & delivery, or mother/baby units, you are eligible to participate in this study. **Participation includes completing a one-time, short, online survey that takes about *10 minutes*.**

I have attached the link to the online survey as well as a flyer providing a brief overview of the study. All information collected in the survey is solely for research purposes only. All answers will remain **confidential**, and no answers will be directly tied to personal information. Your participation will remain **anonymous.**

Your participation in this research study will help us better understand nurses' knowledge on in-hospital strokes as well as certain factors that may impact this knowledge. We hope that the responses will help us make changes to education practices that will ultimately improve patient outcomes.

If you have any questions related to this study, please email me at taylorc15@students.ecu.edu or cattaylor@wakemed.org or the University & Medical Center Institutional Review Board (UMCIRB) at 252-744-2914 for questions about your rights as a research participant.

Thank you so much for your time and dedication to improve evidence-based practice.

Sincerely,

Catherine Taylor, BSN, RN, CCRN, PhD(c)
Taylorc15@students.ecu.edu
Cattaylor@wakemed.org
(252) 864-3655

https://ecu.az1.qualtrics.com/jfe/form/SV_4UsMFtfWEjVI1qm

Appendix E

Survey

Demographic Survey

1. Are you a licensed Registered Nurse?
   - Yes
   - No (If answer is **No**, you are **ineligible** to complete survey)

2. Do you provide direct patient care for hospitalized, adult patients?
   - Yes
   - No (If answer is **No**, you are **ineligible** to complete survey)

3. Do you work in the Neuro ICU, Rehab, labor & delivery, or mother/baby?
   - Yes (If answer is **Yes**, you are **ineligible** to complete survey)
   - No

4. What year were you born?
   - 1940-1949
   - 1950-1959
   - 1960-1969
   - 1970-1979
   - 1980-1989
   - 1990-2000
   - 2000-2005

5. What is your gender?
   - Male
   - Female
   - Non-binary
   - Other

6. What if your race/ethnicity?
   - White/Caucasian
   - Black/African American
   - Hispanic/Latinx
   - Native American/Indian American
   - Asian/Pacific Islander
   - More than one race
   - Other_____ *short answer*

7. What is the highest nursing degree you have completed?
   - ADN
   - BSN
   - MSN

- DNP
- PhD

8. How long have you been a RN?
   - < 5 years
   - 5-10 years
   - 11-15 years
   - 16-20 years
   - 21-25 years
   - >25 years

9. What is your current employment status at WakeMed?
   - Travel Nurse
   - Full-time
   - Part-time
   - PRN/Casual

10. Which WakeMed Hospital do you primarily work at?
    - WakeMed Raleigh
    - WakeMed Cary
    - WakeMed North

11. What is your current nursing specialty/practice area?
    - Emergency Department
    - Cardiac ICU
    - Cardiothoracic ICU
    - Medical ICU
    - Surgical/Trauma ICU
    - COVID ICU
    - Medical floor
    - Surgical floor
    - Med/surg floor
    - COVID telemetry/stepdown
    - OR/PACU
    - Cardiac telemetry/stepdown
    - Surgical/trauma telemetry/stepdown
    - Neurological telemetry/stepdown
    - Float pool

Nurse Stroke Education and Experience Survey

12. Have you ever worked in a stroke or neuro floor/unit in a previous job?
    - Yes
      - As an RN
      - As a non-RN (student, nurse aide)

- No

13. If you answered yes to the previous question, for how many years?
    - <1 year
    - 1-3 years
    - 4-6 years
    - 7-10 years
    - >10 years

14. Have you cared for a stroke patient in the past?
    - Yes
        - If yes:
            - Almost every shift
            - Once a week
            - Once a month
            - Once a year
            - Less than 5 times
    - No

15. Did your pre-licensure (prior to NCLEX) nursing program provide **any information** on stroke management or stroke knowledge prior to graduation?
    - Yes
        - If yes, in what capacity? (please check all that apply):
            - One lecture
            - Multiple lectures
            - Simulation/clinical experience
    - No
    - Unsure

16. I have received the following type of post-licensure (after becoming an RN) training related to strokes and/or stroke management (please check all that apply):
    - None
    - Continuing education
    - In-service
    - Supervised practice and/or externship/residency/clinical experience
    - Informal on-the-job training (i.e., learning by doing)
    - Competency training during new-hire orientation period
    - Independent reading/study
    - Other _____ *short answer*

17. I have personally had or someone close to me has had a stroke in the past
    - Yes (please check all that apply):
        - Me
        - Immediate Family Member (spouse, child, parent, guardian, grandparent, sibling)
        - Extended Family Member (aunt/uncle, cousin, in-laws)
        - Close Friend

- No

18. If you answered yes to the previous question, did your personal experience with stroke affect your knowledge of stroke?
    - Yes
        - Increased my knowledge
        - Decreased my knowledge
    - No

19. I am familiar with the policy and procedures of this hospital's Code Stroke Process.
    - Very aware
    - Aware
    - Neutral
    - Not familiar
    - Never heard of it

20. I would feel comfortable activating a Code Stroke on a patient if I noticed stroke-like symptoms
    - Very comfortable
    - Comfortable
    - Neutral
    - Not comfortable
    - Never heard of it

21. I am confident that I understand the purpose of the Code Stroke process for in-hospital strokes.
    - Very confident
    - Confident
    - Neutral
    - Not confident
    - Never heard of it

22. Drag the following line to indicate your level of stroke knowledge.

None Expert

ASMaQ[6]

23. Acute confusion may be a sign of stroke.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

24. Hypoglycemia can mimic acute stroke.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

25. Stroke can present with visual disturbances.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

26. Stroke patients can present with limb numbness.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

27. Unsteadiness of gait can be a sign of stroke.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

28. Acute stroke can present with reduced level of consciousness.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

29. The Glasgow Coma Scale (GCS) is a tool to assess level of consciousness.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

30. A full neurological examination must be performed immediately in patients presenting acutely with symptoms suggestive of stroke.
    - Strongly agree
    - Agree

- Neutral
- Disagree
- Strongly disagree

31. High blood pressure must be lowered to normal values in acute stroke.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

32. Acute stroke management education should be conducted regularly for healthcare professionals.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

33. Stroke is a medical emergency only within 4.5 hours of stroke onset.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

34. All acute stroke patients must undergo a brain CT immediately.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

35. All suspected stroke patients must be referred to the neurology team immediately.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

36. The earlier the treatment, the better the outcome of acute stroke.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

37. Thrombolysis therapy is given intravenously to break down clots.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

38. My hospital is equipped with thrombolysis treatment.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

39. Coagulation profile must be screened before thrombolysis.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

40. All acute stroke patients must have a 12 leads ECG before thrombolysis.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

41. Intracranial hemorrhage is a contraindication for thrombolysis therapy.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

42. Are you able to detect symptoms of acute stroke?
    - Very likely
    - Likely
    - Neutral
    - Unlikely
    - Very unlikely

43. Are you familiar with FAST (Face, Arm, Speech, Time)?
    - Very familiar
    - Familiar

- Neutral
- Not familiar
- Never heard of it

44. How would you rate your knowledge on acute stroke management?
    - Very good
    - Good
    - Neutral
    - Poor
    - Very poor

45. Are you aware of mechanical thrombectomy treatment for stroke?
    - Very aware
    - Aware
    - Neutral
    - Not familiar
    - Never heard of it

46. Mechanical thrombectomy is administered for clot removal in acute stroke.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

47. My hospital is equipped with mechanical thrombectomy service.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

48. Acute stroke symptoms can be potentially reversed with administration of thrombolysis or with mechanical thrombectomy.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

49. Mechanical thrombectomy can be performed after thrombolysis therapy.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

50. Thrombolysis and mechanical thrombectomy can only be administered within a therapeutic window.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

51. Wake up strokes are not eligible for thrombolysis nor mechanical thrombectomy.
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

Appendix F

ASMaQ Permission

Re: ASMaQ-Request for permission to use

Wan Asyraf Wan Zaidi <wan.asyraf.wan.zaidi@ppukm.ukm.edu.my>

Thu 03/31/2022 08:56 PM

To: Taylor, Catherine <taylorc15@students.ecu.edu>

Cc: Wan Asyraf <drwawz87@gmail.com>

Dear Catherine Taylor,

Thank you for your email and interest. Please kindly proceed for the study mentioned. As the correspondent for the ASMaQ questionnaire I am more than happy to allow it to be use in your study.

Please cite our paper and email me (cc'ed drwawz87@gmail.com) if you have any questions.

Best wishes
Asyraf

Dr. Wan Asyraf Wan Zaidi
(MD, Doc of Int Med (UKM),Neuro (MAS))

Stroke Neurologist & Physician
Clinical Lecturer
Vice Chairman of Malaysia Stroke Council
Member of World Stroke Organization Future Leader Program

Faculty of Medicine
National University of Malaysia (UKM)
Medical Department
UKM Medical Center
Kuala Lumpur, Malaysia

Appendix G

IRB Package

East Carolina University

Date: Tuesday, October 18, 2022 1:25:23 PM Print Close

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 1 - Study Identification Information

Study Identification Information

This is the first step in your Human Research Application. You will automatically be guided to the appropriate page views needed to complete your submission. If a question is not applicable to your study, you may state this as your response. Please read the help text located on the right side of the page throughout this application.

1.0 * **Study Name (Short):**
Acute Care Nurses' Knowledge on In-Hospital Strokes and Predictors of Knowledge

2.0 **Study Name (Long):**

3.0 * **Summary of Research in Lay Terms:**
In-hospital strokes (IHS) account for one of five strokes, however, patients who experience IHS have a four times higher risk of mortality and are half as likely to be discharged home when compared to strokes outside of the hospital. One may think the recognition of IHS is much simpler than those occurring in the community, as the person is under direct care of a multi-disciplinary team. However, in-hospital strokes are often missed, misunderstood, or mistaken for non-stroke related neurological complications, delirium, or reaction to medications. Many health care systems have implemented an evidence-based, nurse-driven "code stroke" process, to facilitate timely response and intervention when stroke symptoms are detected. However, the literature does not explain the type of education provided to nurses to prepare for IHS, and the numerous sub-specialties within a hospital system outside of stroke can lead to unpreparedness in nurses who seldom care for stroke patients. The purpose of this study is to understand how knowledgeable acute care nurses are in identifying new onset stroke symptoms in hospitalized patients and understanding if there is a relationship between stroke knowledge and nurse characteristics (education, employment status, work experience, current practice setting, personal acute stroke experience). We will conduct a non-experimental, descriptive correlational study at three hospitals that are part of the same health system in an urban city in the Southeast. RNs who provide direct patient care as their primary role at one (or more) of the hospitals will be invited to participate. Exclusion criteria includes nurses working in the Neuro ICU, pediatric units, and/or labor and delivery and mother/baby units, nurses on orientation or working under a preceptor, and nurses in managerial roles or who work outside of patient care for the majority of their work. The targeted sample size is N= 106.

4.0 * **Principal Investigator:**
Catherine Taylor

Principal Investigator IRB Certification Renewal Deadline:10/26/2023

Principal Investigator CV/Resume: Catherine Taylor Resume(0.01)

5.0 **Faculty Investigator** (Serving as the responsible individual in the oversight of the research study when the PI is a student, resident, fellow or visiting faculty.)
Linda Bolin

Faculty Investigator IRB Certification Renewal Deadline: 4/27/2023

Faculty Supervisor CV/Resume: CV_Linda_Bolin_08.19.22(0.01)

6.0 Study Coordinator or Contact Individual:

Study Coordinator IRB Certification Renewal Deadline:

Study Coordinator CV/Resume:

7.0 Contact Individual(s) (if different from Study Coordinator or Principal Investigator):

Last Name	First Name	Organization	Profile	IRB Certification Renewal Deadline	CV/Resume

There are no items to display

8.0 Sub-Investigators:

Last Name	First Name	Organization	Profile	IRB Certification Renewal Deadline	CV/Resume

9.0 Other Study Staff - (Read-Only):

Last Name	First Name	Organization	Profile	IRB Certification Renewal Deadline	CV/Resume
Burch	Ashley	Health Services & Information Management, Department of	Ashley Burch's Profile	1/24/2025	
Swanson	Melvin	College of Nursing	Melvin Swanson's Profile	9/6/2024	

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 1.1 Study Staff Roles and Responsibilities

Study Staff Roles and Responsibilities

1.0 * **Click on the UPDATE button beside each person's name to provide the responsibilities for each study staff member:**

	Name	Role	Responsibilities
View	Catherine Taylor	Principal Investigator	Screens potential participants, Obtains Informed Consent, Enters data on paper research records, Data management, Collects data/specimens, Communicates with IRB, Prepares Study initiation activities
View	Linda Bolin	Faculty Supervisor	Trains research team members
View	Melvin Swanson	Other Study Staff	Data management
View	Ashley Burch	Other Study Staff	Data management

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 1.2 IRB Researcher Training Records

IRB Researcher Training Records

The following information is taken from your researcher profile.

1.0 Principal Investigator's Training

IRB CITI Modules Completion Date:
10/26/2020

IRB CITI Modules Renewal Deadline:
10/26/2023

2.0 Study Coordinator IRB CITI Modules Renewal Deadline:

3.0 Other Relevant Training:

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 1.3 Study Funding Information

Study Funding Information

1.0 * **Select the appropriate funding type for this study:**

Funding Type	
☐	Federal Funding
☐	Industry
☐	Non-Profit
☐	State or Local Funding
☐	Internally Funded (ECU)
☐	Other University or College
☐	International Funding
☐	Self Funded
☑	**No Funding**
☐	Other

If other, provide the name of the funding source:

2.0 **Provide your RAMSeS/eTRACS application number, if applicable:**

3.0 * **Does the research include any monetary inducements, compensation or reimbursement for participation in this research study?**

○ Yes ● **No**

4.0 **Will the sponsor/funding agency reimburse the participant for any items or procedures or supply any items at no cost involved in this research study?**

○ Yes ○ No

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 1.4 Conflict of Interest

Disclosing Real or Perceived Conflict of Interest (COI)

Principal Investigator (PI)

The PI must answer the following questions:

1.0 * **Do you or a member of your immediate family have a financial interest consisting of consulting fees, honoraria, royalties, salaries or other payments, ownership of stocks or other interests in any external entity related to this research?**
○ Yes ● **No**

2.0 * **Do you or a member of your immediate family have an executive position or serve as a board member of any external entity related to this research?**
○ Yes ● **No**

3.0 * **Do you hold or plan or hold any claims to intellectual properties, licenses or pending patents on technology that will result from conducting this research study?**
○ Yes ● **No**

4.0 * **Will you receive any incentives or bonuses based on the number or speed in which you enroll human subjects?**
○ Yes ● **No**

5.0 * **Will you or any key study personnel receive any incentives or bonuses, based on the outcome of the research study?**
○ Yes ● **No**

6.0 * **Will any related persons participate on the project?**
○ Yes ● **No**

7.0 **If you have answered "Yes" to any of the questions above, you may have either a real or perceived COI. If you have not already done so, you must contact the** Office of Research Integrity & Compliance (ORIC) **for a determination of whether there is a COI. Please upload ORIC's COI determination and/or, if required, a fully executed COI management plan below.**

Name	Version	Document
There are no items to display		

Provide any additional details regarding the financial or intellectual relationship:

Key Study Personnel Other Than the PI (Study Coordinators, Sub-Investigators, Other Study Team Members, etc.)

1.0 * **Do any of the key study personnel (or their immediate family/significant other) have a financial and/or intellectual property interest in the sponsor or products used with this project?**
○ Yes ● **No**

2.0 **If you have answered "Yes" to the question above for any of the key study personnel**

(KSP) they may have either a real or perceived COI. Each East Carolina University KSP for whom this response is "Yes" must complete a project specific COI disclosure in AIR at ecu.myresearchonline.org/air/. If ORIC determines a COI exists, ORIC will notify the respective KSP of the need for a management plan. A fully executed management plan, if required, must be uploaded below for each KSP for whom a COI is identified.

Name	Version	Document
There are no items to display		

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 1.5 Study Locations

Study Locations

1.0 Select the Research Facilities where this study will be conducted locally:

	Name
☐	Carolina East Medical Center
☐	Marion L. Shepard Cancer Center—A Facility of ECU Health Medical Center
☐	Physicians East, PA
☐	ECU Health Medical Group
☐	Orthopaedics East, Inc.
☑	**East Carolina University**
☐	ECU Health Medical Center
☐	Albemarle Hospital Authority
☐	ECU Health Duplin Hospital
☐	ECU Health Bertie Hospital
☐	ECU Health Chowan Hospital
☐	ECU Health Edgecombe Hospital
☐	ECU HealthAccess, Inc.
☐	ECU Health Surgicenter
☐	ECU Health Roanoke Chowan Hospital

2.0 Other Study Locations (if not captured in the list above):

Name
View WakeMed Health & Hospitals

3.0 Upload letter(s) of support/agreement from the research facility/site/school unless research will be conducted at ECU or Vidant Medical Center.

Name	Version Number
There are no items to display	

4.0 * **Describe the research setting, listing any safeguards in place for participant safety:**
The study will take place at three hospitals which are part of WakeMed Health & Hospitals. Data collection will be completed via an online survey using Qualtrics. An email will be sent to potential participants that will include a secured link to the online Qualtrics survey for confidentiality. Survey links will also be posted on flyers via QR code. All email addresses used will be secured, hospital-provided domains. The completed surveys will return as de-identified using this program.

5.0 * **Is this a multi-site study being conducted at other sites national or internationally?**
○ Yes ● **No**

6.0 * **Will an external IRB act as the IRB of record for this study?** ○ Yes ● **No**

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 2.0 Required Reviews

Required Reviews

1.0 * **Requested Review Type:**

Name
● **Exempt**
○ Expedited
○ Full IRB Review

2.0 **Required Department Approvals:**

Department/School	College/School	Division/Institution
Graduate Nursing, Department of	College of Nursing	Academic Affairs

3.0 **Research Type:**

☐ Clinical Trial
☐ Qualitative Research
☑ **Quantitative Research**

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 2.0.1.1 Exempt Study Population

Study Population

1.0 * **Indicate what your primary targeted population will be:**

Study Population

Adults (18 years of age and older)

Employees

If other, list below:

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 2.0.4 Employee Participants

Employee Participants

1.0 * **Please indicate how you will minimize the potential for employees to feel coerced to participate. Discuss how the potential confusion in roles will be addressed.**

An email will be sent to potential participants explaining the completion of the online survey is completely voluntary. The email will explain that all information collected in the survey is solely for research purposes, all answers will remain confidential, no answers will be directly tied to personal information, and participation will remain anonymous. If participants request that participation in this research study be used as efforts contributing to the clinical ladder program at WakeMed, this request will be denied.

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 2.0.12 Exempt Study Population Summary

Study Population Summary

1.0 * **What is the maximum number of participants you plan to recruit for this site? For record/chart reviews, please provide the number you plan to review.**

500

2.0 **If you are enrolling human participants, provide the number of individuals you may need to approach for recruitment in order to enroll the number above:**
3000

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 2.1.5 Exempt Qualification for Jan 2019

Exempt Study Qualification

If your study meets any of the criteria below, it may qualify for EXEMPT review status under federal guidelines. Please note that some of these categories, once selected, will have additional sub-categories that will appear and need to be selected.

* **Exempt Review Categories:**

2. Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:

* **Exempt Sub Categories 2:**

a. The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects, e.g. coding numbers.

b. Any disclosure of the human subjects' responses outside the research would not reasonably place the individual at risk of criminal or civil liability or be damaging to the person's financial standing, employability, educational advancement or reputation.

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 2.31 Exempt Study Summary

Study Summary

1.0 * **Expected Start Date:**
11/1/2022

2.0 **Expected End Date:**
12/31/2023

3.0 * **Describe the study objectives.**

Specific Aim 1: To examine acute stroke knowledge among acute care nurses.

Question (RQ) 1. What is the level of acute stroke knowledge among study participants as measured with the Acute Stroke Management Questionnaire (ASMaQ)?

Question (RQ) 2. What is the relationship of ASMaQ total scores, domain scores, and individual item scores with (a) acute nurse demographics including age, education, current practice setting, employment status, and work experience and (b) professional and personal stroke experience, specific stroke education and training, and self-perception of stroke knowledge?

Specific Aim 2: To examine the predictability of categorical and quantitative study variables of acute stroke knowledge among study participants.

Question (RQ) 3. How well do the study variables of education, employment status, work experience, current practice setting, personal stroke experience, professional stroke experience, specialized stroke education and training, and self-perception of stroke knowledge predict the ASMaQ total acute stroke score and which of the study variables are the best predictors of acute stroke knowledge?

4.0 **A research protocol is a separate document clearly describing the science, objectives, and ethics of the project. A research protocol must be UPLOADED here for all studies undergoing Full IRB Review by the convened IRB Committee.**

While grant applications can be included in this section, a separate protocol summary that is limited to the science, objectives, and ethics of the project needs to be UPLOADED here as well.

For student projects, UPLOAD your professional paper proposal, thesis, or dissertation proposal.

Name	Version	Document

There are no items to display

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 2.4 Recruitment Methods

Recruitment Methods

1.0 * **Select recruitment methods used on this study:**

- [x] **Advertising such as flyers, letters, or ads (newspaper, TV, radio)**
- [x] **Email Campaign (provide language to be used in email)**
- [ ] Web Site (provide language to be used on website)
- [ ] Phone Solicitations
- [ ] Referral by independent source
- [ ] Pre-existing relationship with participants
- [ ] Selected from pre-existing records
- [ ] Selected from investigators clinic/patient population
- [ ] Treating provider will share PHI of potential participants with study team (also requires Application for Alteration of Authorization form)
- [ ] Treating provider shares contact information of study team with potential participants to allow self-referral, no PHI is shared and no form required.
- [ ] Social Media (Facebook, Twitter, Blogs, Forums, etc)
- [ ] Other

2.0 **What are the "other" methods selected above:**

3.0 **Upload all recruitment documents or scripts that need approval:**

Name	Version Number
Email Script(0.03)	0.03
IHS Flyer(0.04)	0.04

4.0 **If recruitment will use PHI from a designated health care component of ECU or Vidant Health, please describe how the PI and/or study team members are affiliated with that health care component (check all that may apply).**
There are no items to display

If any study team member accessing or using PHI for recruitment is not a workforce member of the health care component from which the PHI will be accessed, or as noted above in Question 1.0, please upload the Application for Waiver or Alteration of HIPAA Authorization in Section 8 of the IRB application.
There are no items to display

ID: UMCIRB 22-000644 **UMCIRB 22-000644**
View: 3 Methods & Procedures: Behavioral Research/Data Collection

Methods & Procedures: Behavioral Methods/Data Collection

1.0

Select all behavioral/data collection methods and procedures which apply to this study:

	Procedure
☑	**Surveys/Questionnaires**
☐	Interview/Focus Groups
☐	Videotaping/Audio Recording/Photography
☐	Intervention or Experimental Procedure
☐	Public Observation
☐	Standardized/Non-standardized tests
☐	Deception
☐	Creating a Databank
☐	Use of Existing Datasets
☐	Teacher Inquiry
☐	Chart Review
☐	Other social science, behavioral, or educational procedures

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 3.4 Surveys and Questionnaires

Surveys & Questionnaires

1.0 * Upload Surveys or Questionnaires that will be used in this study:

Name	Description
IHS Survey(0.03)	Surveys and Questionnaires

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 7.01 Exempt Informed Consent Determination

Informed Consent

1.0 * **Indicate the types of consent that will be involved in this study (check any or all that apply):**

Informed Consent Category

Online/Verbal consent or written information sheet (If research is Expedited or needs Full board review, a Waiver of Documentation of Written or Signed Consent is required).

2.0 * **Do you plan to include non-English speaking participants in this research study?** ◯ Yes

● **No**

3.0 **How will you accommodate a potential participant who does not speak English?**

Name

There are no items to display

If other, please describe:

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 7.02 Exempt Consent Forms & Process of Consent

Consent Forms & Process of Consent for Studies Certified Exempt

1.0 **If needed, there are several different types of consent form templates provided. You may use any of these to develop consent documents or information sheets.**

Instructions:

1.1) Download the applicable consent form template to your computer and modify this where applicable.

- Consent Template for Benign Behavioral Interventions (ONLY for use in Exempt Category #3 research)
- Consent Template: Consent Letter for Expedited Survey Research
- Consent Template: Consent Paragraph for Exempt Survey Research
- Consent Template: Greater Than Minimal Risk Research
- Consent Template: No More Than Minimal Risk Research
- Genetic Testing Consent Template
- Information-Sheet-for-the-Use-of-a-Sponsor-s-ICD-Template-8-10-22-CLEAN.docx
- Local Boilerplate Language for NCI-CIRB Approved Consents Only
- Local Boilerplate Language for NCI-CIRB Approved Youth Information Sheets (Assents)
- Local Boilerplate Language for Sponsor's Consent Template (does not apply to NCI-CIRB approved studies)
- Minor Assent Template
- Parent Consent to Use Child's Data for Research Purposes (ONLY for use in Exempt Category #1 research)
- Parent Permission Form Template: No More than Minimal Risk Research

* **1.2) Upload consent forms, assent forms, or information sheets here:**

Name	Modified	Version
IHS Informed Consent(0.02)	10/13/2022 12:10 PM	0.02

1.3) Upload Tracked Changes versions of consent forms, assent forms, or information sheets here:

Name	Modified	Version

There are no items to display

2.0 * **Describe how, when, and where the consent process will be initiated:**
The consent will be shown as the first page of the Qualtrics survey. By clicking on to the next page and continuing with the survey, the participant agrees to participate.

ID: UMCIRB 22-000644 **UMCIRB 22-000644**

View: 8.01 Exempt Data Privacy & Confidentiality August 2017

Data Privacy & Confidentiality

1.0 * Will you view, collect, generate or analyze protected health information (PHI) from any source (not limited to ECU or ECU Health data) as part of your research study?

○ Yes ● **No**

2.0 * **Where will you obtain the data for this research study?**

Generated during the course of the study

3.0 * **Describe how the identity of individuals research data and/or specimens will be recorded (check all that may apply):**

Anonymous (No Identifying Information)

4.0 **List all categories of data to be collected for this research study (e.g., Name, Date of Birth, Age, Disease status, etc) or upload your data collection sheet below:**

Year of birth, gender, race/ethnicity, education level, years of experience, employment status, area of practice, stroke education, professional stroke experience, personal stroke experience, self-perception of stroke knowledge, stroke knowledge.

If applicable, upload data collection sheet:

There are no items to display

5.0 * **Where will paper and electronic research data be stored? Please specify the physical location (building and room number):**

All data will be stored electronically on a password encrypted university Pirate Drive (specifically in the nurseresearch Pirate Drive) only accessible to the study team.

Note: Data collected and/or generated during the course of the study that includes protected health information (PHI) should have identifiers removed at the earliest opportunity consistent with the conduct of the research and/or clinical needs (if applicable). ***However, regulatory documentation (including signed consent/assent form(s), signed stand-alone HIPAA Authorization(s), documentation of verbal consent/authorization(s), research records documenting that a request for waiver of HIPAA Authorization was approved) must be retained for 6 years following completion of the research.***

6.0 * **How long will data be stored after the study is complete?**

Five years after completion of the study.

7.0 * **How will data be secured to protect privacy, maintain confidentiality, and safeguarded against improper disclosure?**

All data will be stored electronically on a password encrypted university Pirate Drive (specifically in the nurseresearch Pirate Drive) only accessible to the study team.

8.0 * **Who, other than the specified study team, will have access to the study records or data? Specify their name, role, and affiliation.**

No one will have access to the study data except the named study team members.

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 11 Institutional Approvals

Institutional Ancillary Approval

Based on your answers to the following questions, you may need to answer additional questions.

1.0 * **Will this study generate or require the use of protected health information (PHI) or medical records by any ECU research team member at the research location?**

○ Yes ● No

2.0 * **Will this study require the use of medical records at ECU Health Medical Center (or any other ECU Health facility)?**

○ Yes ● No

3.0 * **Will this study utilize clinical areas within ECU Physicians, require recruitment of subjects/procedures/tests/medications/surveys or any other study requirements to be performed at ECU/BSOM?**

○ Yes ● No

4.0 * **Will this study involve inpatient or outpatient units/staff at an ECU Health facility, require recruitment of subjects/procedures/tests/medications/surveys or any other study requirements to be performed at an ECU Health facility?**

○ Yes ● No

5.0 * **Will this study take place at the Leo W. Jenkins Cancer Center (LJCC)?**

○ Yes ● No

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: 12 Additional Material

Additional Material

Please upload any other items for review and approval if not already uploaded on a previous page of this application.
Additional Items for IRB Review and Approval:

Name	Version	Document

There are no items to display

ID: UMCIRB 22-000644 **UMCIRB 22-000644** View: SF - Final Page

Final Page

If you have completed your application, click "Finish" to finalize and exit the application. **This action does NOT submit the application for review,** it just means you have finished editing the application at this particular time.

For those studies that are being submitted for review and approval by the UMCIRB:

1. All research personnel/team members must login to ePIRATE and click the "Agree to Participate" button before ePIRATE will allow a study to be submitted.
2. A submission may only be submitted to the UMCIRB by the Principal Investigator. To do this, the Principal Investigator must login and click the "SUBMIT STUDY" button under My Activities for this Study ID:UMCIRB 22-000644.

For those studies that are being submitted for acknowledgment of the use of an external IRB:

1. Research personnel/team members are not required to "Agree to Participate" before ePIRATE will allow a study to be submitted.
2. A submission may be submitted by any listed team member. To do this, the team member must login and click the "SUBMIT STUDY" button under My Activities for this Study.

You can track the ongoing status of your submission by logging into the study workspace.

Please wait until you receive your final approval/acknowledgement notice prior to beginning your study and feel free to contact the UMCIRB with any questions or concerns.