Mock Stroke Code Simulation for Registered Nurses in a Rural Community Health System

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Abstract

Background and Purpose: Nurses play a key role in rapid identification, critical treatments, and timely care of patients with acute stroke. Although nurses are best placed to identify signs and symptoms of stroke, they may not be prepared to activate or participate in a stroke code due to lack of knowledge and self-confidence. The use of simulation in nursing education can increase knowledge and self-confidence when caring for acutely ill neurological patients. The purpose of this quality improvement project was to evaluate if participation in mock stroke code simulation increased a registered nurse's perception of knowledge and self-confidence when engaged in a stroke code in an acute care rural community hospital.

Methods: This study was a quality improvement project using a pre- and post-intervention to measure a nurses' knowledge and self-confidence after participating in a single 4-hour mock stroke code high-fidelity simulation. Participants completed a pre- and post- simulation questionnaire assessing stroke knowledge and self-confidence.

Results: 11 registered nurses participated in the quality improvement project. There was significant improvement ($p < .001$) in both knowledge and self-confidence scores pre- to post-simulation.

Conclusion: Participation in a single high-fidelity mock stroke code simulation showed improvement in knowledge and self-confidence scores in a rural community hospital. Based on the results of this quality improvement project, a study evaluating nurse led stroke code teams working with emergency department or tele-medicine physicians in underserved or non-stroke certified hospitals could be conducted to evaluate the impact on management of care on acute stroke patients in rural or underserved areas.

Key Words: Stroke Code, Simulation, Self-confidence, Self-efficacy, Nursing Education.

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Mock Stroke Code Simulation for Registered Nurses in a Rural Community Health System

Stroke is a leading cause of death and disability. Stroke ranks as the 5th leading cause of death, accounting for approximately 1 of every 19 deaths in the United States. On average someone suffers a stroke every 40 seconds, and dies every 3 minutes, 45 seconds. Approximately 610,000 persons experience first time strokes and 31% of those were less than 65 years of age, and additional 185,000 will experience recurrent stroke (Benjamin et al., 2018). In 2015, the prevalence of ischemic stroke was 24.9 million, and hemorrhagic stroke was 18.7 million. From 2013 to 2014, the average annual direct and indirect cost of stroke care was $40.1 billion, while between 2015 and 2035, the total direct medical stroke-related costs are projected to range from $36.7 billion to $94.3 billion (Benjamin et al., 2018).

Background

Nurses play a key role in rapid identification, critical treatments, and timely care of patients with acute stroke (Mainali et al., 2017; Middleton, Grimley, & Alexandrov, 2015; Roots, Thomas, Jaye & Birns, 2011). Emergency department (ED) nurse-activated stroke codes improve both process and clinical outcomes in the ED setting (Song et al., 2016). Furthermore, nurses identify in-hospital ischemic stroke with a similar percentage as physicians, and they activate the stroke codes significantly earlier (George, Wisco, Gebel, Uchino, & Newey, 2017). Nurse-driven protocols for stroke codes can be viable and effectual with identification and initiating treatment for acute stroke patients (Kassardjian et al., 2017; Mainali et al., 2017). Mainali et al. (2017) further assert that the use of nurse-initiated stroke codes could increase efficiencies in caring for patients in rural communities where there are lack of primary stroke centers. Although nurses are best placed to identify the signs and symptoms of stroke, they may

not be prepared to activate a stroke code due to lack of knowledge and or self-efficacy (Johnson, Cohn, & Bakas, 2011; Emanuel & Cross, 2012).

Kassardjian et al. (2017) assert that educational interventions aimed at registered nurses and Mehta, et al. (2018) assert that training that utilizes simulation with registered nurses improve the timeliness of initiating care for acute stroke patients. Kassardjian et al. (2017) conducted a quality improvement initiative with the goal of decreased response times to inpatient stroke codes by use of an newly created stroke algorithm and educational intervention aimed at nurses working in neurological and cardiovascular units, surgical units, cardiac catheterization laboratory, and other medical units. The algorithm, based on the guidelines, was developed and the educational intervention was implemented over 5 months. Data was recorded 36-months pre-intervention and 15 months post-intervention. During the intervention period there were 218 inpatient stroke codes (131 pre-intervention and 87 post-intervention). The data was compared pre- and post-intervention, and post-intervention there were reductions in all timed outcome measures. The study concluded that the algorithm and educational intervention may lead to faster stroke intervention which is associated with better outcomes.

Mehta, et al. (2018) implemented a stroke training program for first-year neurology residents and neurology nursing staff with use of simulation utilizing live actors and debriefing to decrease door-to-needle time for administration of tissue plasminogen activator (tPA). The hospital's stroke registries were used for retrospective analysis and identified 448 patients who met inclusion criteria and received tPA and stroke vignettes were created based off the registry data. Mehta, et al. (2018) concluded that simulation based education for management of acute stroke was associated with a 9.64 minute reduction in door-to-needle time.

Simulation as an Educational Tool

Simulation is a technique that can utilize technology for interactive practice and learning that has a real world feel and can be utilized to develop a health professionals' assessment, diagnosis and treatment, decision making, and technical skills (Micieli, Cavallini, Santalucia, & Gensini, 2015; Lateef, 2010). Experts agree that simulation training in the evaluation of acutely ill neurological patients is an important educational tool (Micieli, et al., 2015; Broussad, 2008) and conclude that no other field of medical education and training other than neurology, especially neurological emergencies, is more suited to the use of advanced simulation techniques.

Simulation as a technique has been shown to deliver training without compromising patient safety (Broussard, 2008; McGaghie, 2008; Lateef, 2010). Per the Simulation Society in Healthcare (About SSH, 2018) simulation in education is the link between classroom and real-life experience. Simulations can be live, virtual reality, or computer based. Low- and high-fidelity simulations can be utilized with stroke code education; however, the use of live actors enhances a nurse's ability to detect subtle neurological sign and symptoms seen with ischemic stroke patients (Knippa, Cox & Makic, 2015; Roots et. al., 2011).

Simulation and the Effect on Self-Confidence and Knowledge

Boling & Hardin-Pierce (2016) conducted a review of the literature and identified 17 studies investigating the effects of simulation training on knowledge and confidence among critical care providers. Twelve of the 17 studies concluded that high-fidelity simulation is a useful tool for improving confidence. Franklin & Lee (2014) performed a meta-analysis of 43 studies asking the question of "What is the impact of simulation on self-efficacy?" The authors concluded that simulation was effective at increasing self-efficacy among novice nurses,

compared with traditional control groups. Simulation also improved self-efficacy in single-group, pre- and post-test studies (Hedge's g = 1.21, 95% CI [0.63, 1.78]; $p < 0.001$), as well as favored over control teaching interventions in improving self-efficacy in studies with experimental designs (Hedge's g = 0.27, 95% CI [0.1, 0.44]; $p = 0.002$).

Waterval, Peczinka, & Shaw (2012) conducted a pilot study to assess nurse competencies using simulation-based scenarios. Patient simulators were used at each station for skills assessment. Pre-simulation as well as post-simulation evaluations were performed. Ninety-percent (n = 942) of all participants rated the skill stations as "very good" or "excellent" with a mean score 4.5 on a 5-point Likert scale. The simulation-based educational process provided a more efficient approach to nurse competency assessment and a secondary benefit was increased participant satisfaction.

Stroke is a leading cause of death and disability in the United States and nurse initiated stroke codes could increase efficiencies in the identification of and caring for stroke code patients. Nurses are well placed to identified stroke code patients but may lack the knowledge and self-confidence to do so. Simulation as an educational tool is shown to be effective in improving self-confidence and transfer of knowledge, however there is gap in the literature with use of simulation with registered nurses who encounter stroke code patients.

Theoretical Framework

Individuals can acquire skills through training, however they may not achieve the desired outcome without self-confidence (Price & Archbold, 1995). The construct of self-efficacy in Albert Bandura's Social Cognitive Theory (1977) and Jefferies (2005) theoretical framework for simulation in nursing education serve as the models for this quality improvement project. The most important source of self-efficacy is mastery of experience due to success which improves

one's belief in self (Egenberg, Oian, Eggebo, Arsenovic, & Bru, 2017). Bandura (1977) supports the hypothesized relationship between perceived self-efficacy and behavior change. A factor in improved self-efficacy is performance accomplishments, and the more dependable the sources of knowledge associated with the performance accomplishments the greater the perception of self-efficacy (Bandura, 1977).

Just knowing what to do is insufficient, there must be persistence with performance activities (Bandura, 1982). Perceived self-efficacy is associated with the degree of effort (Bandura, 1977) and self-efficacy varies depending on achieving accomplishments utilizing ability or effort (Bandura, 1977). Accomplishments achieved through less effort are associated with higher degrees of self-efficacy; as opposed to a higher degrees of effort related to less ability, which is associated with lower perceived self-efficacy (Bandura, 1977). Bandura (1982) also asserts that individuals with a stronger sense of self-efficacy can attend to the demands of a given situation and higher levels of perceived self-efficacy lowers the levels of perceived emotional arousal - stress.

Bandura characterizes self-efficacy and self-confidence differently. Self-efficacy is defined as an individual's belief in his or her abilities to succeed in situations or in accomplishing tasks (Bandura, 1982) with set goals (Bandura, 1986). Self-confidence is defined as belief in oneself, and in ones power's and abilities but without a set goal (Bandura, 1986). For the purpose of this study the distinction Bandura makes between self-confidence and self-efficacy will not be adopted. Due to familiarity, the term self-confidence will be utilized with the stated goal of improved knowledge and self-confidence when registered nurses attend stroke-codes.

The Bandura theoretical model and Jeffries framework together provide a context to assess the effect of mock stroke code education with simulation on improving knowledge and self-confidence with registered nurses who encounter stroke codes. The NLN/Jefferies framework for high fidelity simulation was developed as a group effort with the National League for Nursing (NLN) in partnership with the Laerdal Corporation (Jefferies, 2012).

The NLN/Jefferies framework has five conceptual components including the facilitator (teacher), the participant (student), educational practices, simulation design characteristics, and expected participant outcomes (Jefferies, 2005). Simulation is student centered and the teacher plays the role of facilitator who provides support throughout the simulation and debriefing (Jefferies, 2005). The students are either active participants or observers throughout the simulation, and the facilitator instructs the students on what role they will play (Jefferies, 2005). The education practices foster a collaborative diverse learning environment with high expectations and includes active learning due to the students are engaged throughout the simulation activity, feedback is provided and is viewed as encouraging, helpful, and informative (Jefferies, 2005).

A significant proportion of time is spent on the simulation design. The design must be appropriate for the audiences and support the goals based on clearly written objectives that represent the real-life, often complex, patient encounter (Jefferies, 2005). Debriefing occurs at the conclusion of the simulation and is an essential aspect of learning which allows the participants and facilitators to reflect on the what was learned or experienced during the simulation. During debriefing what was done right, wrong, and what can be improved upon is discussed (Jefferies, 2012). Debriefing allows participants to link theory to practice, think

critically, and promotes discussion on how to intervene in complex clinical situations (Jefferies, 2005).

Outcomes are the final component of the model. Didactic knowledge gained through simulation is retained longer than knowledge gained through lecture (Jefferies, 2005). Simulation leads to quicker acquisition of the skills without harm to patients (Jefferies, 2005) and skills acquired by students can be directly applied in the clinical setting which can lead to increased self-confidence and improved clinical judgment (Jefferies, 2005).

Purpose of the Project and Study Question

The use of simulation in medical and nursing education is supported in the literature and the use of simulation can increase knowledge and self-confidence when caring for acutely ill neurological patients (Aebersold & Tschannen, 2013) The literature review revealed a gap in the use of simulation and the effect on knowledge and self-confidence in registered nurses who are often one of the first responders in an acute stroke code. The purpose of this quality improvement project was to evaluate if participation in mock stroke code simulation increased a registered nurse's perception of knowledge and self-confidence when engaged in a stroke code in an acute care rural community hospital. The study question is: Will registered nurses who participate in mock stroke code simulation as compared to pre-simulation have increased levels of perceived knowledge and self-confidence when attending a stroke code?

National Guidelines

The National Guidelines guide practice, and as such they need to be incorporated into stroke code education. National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group (1995) established that intravenous tissue plasminogen activator (tPA) was an effective treatment, and in 1996, an approved treatment for patients with acute ischemic stroke

(Cheng & Kim, 2015). The 2018 national guidelines for management of acute ischemic stroke were developed by members of the American Heart Association and the American Stroke Association (Powers, et al., 2018). The initial treatment for acute ischemic stroke remains intravenous tPA, and it is recommended for eligible patients within 3, and up to 4.5 hours, of last known well time. Guidelines for inclusion criteria for administration of tPA include: non-contrasted head computed tomography (CT) which shows no evidence of intracerebral hemorrhage, and blood glucose which has been obtained to rule out hypoglycemia. (McDerrmot, 2018).

The goal door-to-needle time for administration of tPA is within 45 minutes of arrival to the ED for ≥50% of acute ischemic stroke patients (Powers, et al., 2018). Although tPA can be administered up to 4.5 hours (Hacke, et al., 2008) of last known well time, the sooner treatment is administered there is higher likelihood of better outcomes (Hacke, et al., 2004) and, despite the guidelines, less than 30% of patients are treated within this time-frame (Fonarow, et al., 2014). Patients identified as having a large vessel, proximal artery occlusion on angiographic imaging should undergo mechanical thrombectomy with a stent retriever if within 24 hours from last known well time (McDerrmot, 2018) with a goal door-to-groin time of ≤ 60 minutes from arrival to the ED (Powers, et al., 2018).

Expert stroke care requires specialized training for timely identification of stroke symptoms leading to timely administration of tPA (Mainali, et at., 2017). The conclusion of a Cochrane review of 28 trials with 5,855 participants was that stroke patients who receive care in a stroke unit had better outcomes, which included decreased odds of mortality (median of 1 year; OR, 0.81; 95% CI, 0.69–0.94), death or institutionalized care (0.78; 95% CI, 0.68–0.89), and death or dependency (OR, 0.79; 95% CI, 0.68–0.90), than participants who received an

alternative form of inpatient care (McKinney, Cheng, Rybinnik, Kostis, & Myocardial Infarction Data Acquisition System Study Group, 2015).

A limitation to receiving expert level stroke care is due to lack of access to providers who have specialized stroke education and training, as these centers are often in urban areas. Albright et al. (2010) estimated that 22.3% of Americans have access to a primary stroke center within 30 minutes, 43.2% within 45 minutes, and 55.4% within 60 minutes. Mullen et al. (2015) conducted a cross-sectional analysis based on geographical location and analyzed the accessibility to primary stroke centers. In 2010 there were 811 primary strokes centers, and the authors concluded that 6.9% of the US population lacked access to a comprehensive stroke center within 60 minutes, likely due to a lack of primary stroke centers in rural areas (Mullen et. at., 2014).

Review of the Literature

A review of the literature (Figure 1) was completed regarding use of stroke code simulation and its effect on knowledge and impact on nurses' self-confidence. The literature review was conducted primarily through OVID MEDLINE due to review of CINAHL and PubMed failed to produce meaningful results. Search terms included "Stroke Simulation and Stroke Code" or "Simulation Training" and "Stroke." The choice of academic literature retained for review included all levels of evidence, the year of publication of January of 2010 to December of 2018, English only, and only those articles that the University of Virginia had access to online. Exclusion criteria included articles that were not specific to stroke code simulation, or did not include nursing staff in the simulation.

The initial literature review resulted in 137 articles with 115 eliminated after title review. Seven articles were eliminated after abstract review and an additional 10 were eliminated after full text review. An additional 2 articles were eliminated leaving 3 for the final literature review

as illustrated in Figure 1. GOOGLE Scholar was also utilized using search terms of "Self-Efficacy" and "Stroke Code" resulting in 24 articles with 17 eliminated after title review, and 5 eliminated after abstract review leaving 2 for final literature review. The VIRGO database was also searched resulting in 2 Doctorate of Nursing Practice scholarly projects, however, both were eliminated after text review as they did not meet inclusion criteria. Five studies (Table 1) met the inclusion criteria for the literature review.

Stroke Education – Simulation: Knowledge and Self-Confidence. Three of the five studies used simulation with debriefing, with 2 assessing stroke knowledge, and 1 assessing self-confidence. Aebersold, Kocan, Tschannen, & Michaels (2011) implemented an educational initiative to train stroke unit nurses at an academic medical center in the Midwest in response to the lack of perceived comfort with the knowledge and skills transfer with the established stroke code educational model. All participants were required to compete National Institutes of Health Stroke Scale (NIHSS) training, 32 hours of class room training, and 8 hours of structured clinical time. Three simulation scenarios were created and each lasted 15-20 minutes with immediate debriefing. Nurses reported a better understanding of the practice and increased level of self-confidence in caring for stroke patients. At the conclusion of the stroke training a 3-point Likert scale (excellent, acceptable, and unsatisfactory) survey was administered. The initiative concluded that the simulation was effective in both skills training and knowledge transfer.

Ortega, Gonzalez, de Tantillo & Gattamorta (2018) conducted a longitudinal nonexperimental quality improvement intervention by enrolling 86 registered nurses from neurology and cardiology units at an urban hospital in Miami, Florida. The authors concluded mean stroke knowledge scores increased significantly from baseline (M=5.87, SD=0.19) to pre-simulation (M=6.42, SD=0.18), and from pre-simulation to post-simulation (M=8.34, SD=0.12),

F (2, 140) =79.92, p<0.001, n^2=.0.533). The authors further concluded that simulation plus lecture was more effective than lecture alone with 71% to 78% of participants strongly agreeing with every item on the Simulation Design Scale. An unexpected finding was the increase in knowledge about hospital stroke protocol regardless of the nurses unit, years of experience, or previous exposure to simulation.

The nurses who attended the 45 minute lecture viewed a PowerPoint presentation, and it is unclear if the nurses were required to complete NIHSS certification prior to simulation. Two to three weeks later the nurses chose and completed only 1of 34 simulation activities. Each simulation activity lasted approximately 15 minutes immediately followed by 30-minute debriefing session. All participants completed two assessment instruments. The first instrument was an unvalidated, investigator developed Stroke Module Test designed to measure knowledge of the stroke protocol. Answers to the 10 item instrument were either scored correct or incorrect. This assessment was administered pre-test, pre-simulation, and post-simulation. The second instrument was the Simulation Design Scale which was previously validated and the reliability was excellent as cited in Jeffries and Rizzolo (2006) with Cronbach's α has been rated as 0.92 for presence of design features in simulation and 0.96 for importance of design features in simulation. The assessment was a 20-item measure that asked nurses to rate the degree to which they agreed with the items ranging from simulation objectives, support, problem-solving, feedback and or guided reflection, fidelity and or realism. This assessment was administered post simulation.

To ensure that 12 distinct actions required per simulation were performed the project team member observed each simulation and completed a third, investigator developed, non-validated assessment instrument, called Simulation Evaluation Tool. The participants were their

own comparison and evaluated at: Time Point 1 was the performance on the pre-test as compared to the pre-simulation test at Time Point 3 and performance on the pre-simulation test at Time Point 3 was compared to the post-simulation test at Time Point 5.

Khan et al. (2018) conducted a quasi-experimental pretest/posttest study utilizing using 3 simulation scenarios with debriefing at an academic medical center in Michigan with access to a simulation center with the aim of assessing an advanced practice provider's self-confidence, comfort level, and preparedness in leading stroke codes. A pre-simulation 5-point Likert scale (1=strongly disagree to 5=strongly agree) survey was administered to the participants and all participants were required to complete formal NIHSS training. Post-simulation all participants completed a 5-point Likert scale survey. The authors concluded that nurse practitioners and physician assistants had lower comfort and self-confidence level in taking care of an acute stroke patient pre-simulation as compared to neurology residents, however they achieved similar levels of self-confidence after the simulation. Self-confidence in leading a stroke code increased from 2.4 – 4.2 ($p = < 0.05$).

Stroke Education Without Simulation - Self-Confidence. Two of the five studies evaluated education and the effect on self-confidence. The Increasing Stroke Treatment through Interventional behavior Change Tactics (INSTINCT) Trial (Meurer et al., 2011) was a cluster randomized controlled trial that aimed at increasing use of appropriate tPA administration by focusing on hospital specific barriers and then provide targeted educational interventions to address the unique barriers of a specific study site. Interventions could include mock stroke code training as well as critical incident debriefing.

In Michigan, 24 acute care hospitals were randomly selected and matched into 12 pairs, with each pair having one control and one intervention hospital. There were 2 phases and focus

group participants were recruited by the local principal investigator at each site. During Phase 1, there were 30 participants in the six initial exploratory focus groups which included 15 nurses. During Phase 2, two focus groups were used at each of the 12 interventional sites of which 48 nurses participated. A professional consultant was used for discussion guide development. The focus group's discussions were recorded and transcribed and responses were coded into nine internal or external major themes. The barriers cited by nurses as important were lack of motivation by the provider to administer tPA which related to familiarity with the guidelines and self-efficacy. The authors concluded that designing site specific educational initiatives first requires knowledge of the barriers that impede adherence to the stroke guidelines.

Adelman et al. (2014) conducted a survey of 875 respondents of emergency department or inpatient nurses. As part of mandatory nursing staff education, an optional anonymous survey was embedded and after completion of the survey, the respondents completed an online module on the recognition of signs and symptoms of stroke. This was followed up with small group discussions. A 10-point Likert scale was utilized and respondents were asked to rate their self-confidence in identifying stroke as well as signs of symptoms leading to rapid identification of stroke. A logistic regression analysis was used to investigate the relationship between adequate stroke knowledge, including symptoms, and self-reported degree of self-confidence. The analysis demonstrated greater self-confidence in identifying stroke symptoms (OR 1.13, 95% CI 1.01–1.27), which was associated with stroke knowledge after completion of the online module and small group discussion.

Summary of the Literature. Three of the 5 studies utilized simulation with debriefing. One of the 3 studies (Khan et al., 2018) utilized simulation with debriefing to evaluate self-confidence and 2 of the 5 studies (Aebersold et al., 2011; Ortega et al., 2018) utilized simulation

with debriefing to evaluate increased stroke knowledge without assessing the effect on self-confidence.

Khan et al. (2018) utilized 3 simulation scenarios without debriefing and concluded that nurse practitioners and physician assistants had increased self-confidence in leading a stroke code from 2.4 to 4.2 (p = <0.05) on a 5-point Likert scale pre- to post-simulation. Aebersold et al. (2011) used 3 simulations with debriefing and concluded that simulation was effective in both skills and knowledge transfer without mention of self-confidence. Ortega et al. (2018) used simulation with debriefing and concluded that stroke knowledge scores increased significantly from baseline (M = 5.87, SD = 0.19) to pre-simulation (M = 6.42, SD = 0.18), and from pre-simulation to post-simulation (M = 8.34, SD = 0.12), F (2, 140) = 79.92, p < .0.001, n^2 = .0.533) without mention of self-confidence. The authors further concluded that simulation plus lecture was more effective than lecture alone.

Two of the 5 studies highlight the importance of education and the positive impact on self-confidence without use of simulation. The INSTINCT Trial (Meurer et al., 2011) concluded that designing site specific educational initiatives first required knowledge of the barriers that impede adherence to the stroke guidelines. The barriers cited by nurses as important were lack of motivation by the provider to administer tPA which relates to lack of physician self-confidence. Adelman et al. (2014) concluded there is greater self-efficacy in identifying stroke symptoms (OR 1.13, 95% CI 1.01-1.27) which is associated with stroke knowledge.

Purpose of the Project and Study Question

The literature review revealed a gap in the use of simulation and the effect on knowledge and self-confidence with registered nurses who are one of the first responders in a stroke code. Knowledge of the national stroke guidelines influences nursing practice, including initial

assessment, determination of last known well time, physical assessment with use of the NIHSS, and determining appropriateness criteria for tPA, including initial head CT, blood glucose, and preparation and administration of tPA. The purpose of this quality improvement project was to evaluate if participation in mock stroke code simulation increased a registered nurse's perception of knowledge and self-confidence when engaged in a stroke code in an acute care rural community hospital. The study question is: Will registered nurses who participate in mock stroke code simulation as compared to pre-simulation have increased levels of perceived knowledge and self-confidence when attending a stroke code?

Methods

Research Design.

This study was a quality improvement project using a pre- and post-intervention to measure a nurses' knowledge and self-confidence after participating in a simulated mock stroke code. The intervention was a single high-fidelity simulation in a learning center for simulation and virtual learning at the participating hospital. The simulation was designed using the Jeffries framework based on the national guidelines.

Stroke codes are complex and consist of multiple elements that include patient assessment, which involves performing the NIHSS, determining appropriateness for tPA criteria, and preparing and calculation of the dose of tPA. These elements are examined through use of lecture, demonstration, and case studies. Prior to the simulation participants must have completed the NIHSS certification through HealthCarePoint (Blue Cloud Tutorials, 2018). On the day of the simulation, participants will observe the NIHSS being performed on a standardized patient, as well as hands on exposure to preparation and administration of tPA.

At the onset of the simulation, participants completed a pre-simulation questionnaire (Figure 3), followed by a presentation with interactive discussion of case studies (Appendix A), and observed performance of the NIHSS on a standardized patient. Participants then engaged in tPA preparation which consisted of hands-on practice including reconstitution, calculation of wasted amount, bolus dose, and total dose of tPA (Appendix O). This was followed by two 30-minute mock stroke code simulations with debriefing (Appendix B – M), followed by the completion of the post-simulation questionnaire (Figure 3). The participants finished the simulation with completion of the final evaluation questionnaire (Figure 4). The pre- and post-simulation questionnaire, final evaluation questionnaire, case studies, demonstration of the NIHSS, and preparation and calculation of tPA occurred in a conference room. The stroke code simulation occurred in a room that resembled a hospital ED room. Descriptive and inferential statics were used to describe the outcomes and significance of the intervention.

Definition of Terms

Debriefing. Debriefing is the process of a team to reflect upon a process or situation that has occurred. Debriefing is a necessary activity to be performed at the conclusion of a simulation as it is a teaching strategy which facilitates learning (Jefferies, 2012).

Self-confidence: A belief in oneself, and in ones power's and abilities' however the goal has not been set (Bandura, 1986).

Self-efficacy: An individual's belief in his or her abilities to succeed in situations or accomplishing tasks (Bandura, 1982) with set goals (Bandura, 1986).

Simulation. Jefferies (2012) defines simulations as actions that realistically resemble a clinical environment and are intended to demonstrate procedures and practices as well as

decision-making and critical thinking skills by use of techniques such as role playing and or the use of props such as interactive videos or mannequins or standardized patients.

Standardized Patients. Standardized patients are volunteers who are trained to act as patients or family members. In this simulation they will act as stroke patient and his wife.

Stroke code. A stroke code is activated to alert team members that a patient is having acute stroke symptoms and may be a candidate for an intervention such as tPA or thrombectomy.

Stroke Code Nurses. Registered nurses who work in the neurological intensive care unit (NICU) or neurological intermediate care unit (NIMU) and are members of the rapid response stroke code team.

Setting

The sample was recruited from three sites. Nurses were recruited from a 358-bed regional tertiary care center that is a Joint Commission Primary Stroke Center, Thrombectomy-Capable Stroke Center, AHA/ASA 2018 Get With The Guidelines Stroke Gold Plus designation and Target Stroke Honor Roll Elite Plus recognition. Additional participants, who met the inclusion criteria, were invited to attend from a 50-bed community hospital and free standing community emergency department which are part of the health system. In 2017 through July 2018, 1,161 stroke codes were called; tPA was administered 118 times and 75 thrombectomies were performed.

Sample.

The sample included registered nurses who were eligible to participate in a 4-hour mock stroke code simulation and were employed by an integrated health system in southwest Virginia, and either worked in the NICU, NIMU, the ED or medical-surgical intensive care units (ICU) or floors. The program was advertised on the health system's educational website and targeted the NICU and NIMU nursing staff due to all new hires in either of these units, who were no longer

on orientation, were required to attend the simulation. A flyer advertising the stroke code simulation was distributed to nursing staff at the community hospital ED and intensive care unit. An invitation explaining the stroke code simulation was emailed to the directors of the ED in the tertiary care hospital and the free standing ER, and was also included in the units' daily huddle to increase awareness of, and participation in, the stroke code simulation. Any nurse could register for the class, but it was targeted to those who attended stroke codes. A convenience sample of 11 nurses was enrolled.

The inclusion criteria were:

- Registered nurses who had completed orientation.
- Completion of the NIHSS certification program offered through HealthCarePoint (Blue Cloud Tutorials, 2018). The program was developed in collaboration with global organizations utilizing a standard certification methodology. To receive certification the participant completed 6 scenarios and obtain a passing score. The certification is accepted across healthcare organizations, clinical trial sponsors, and regulatory agencies as the industry standard.
- Held an ACLS or BLS certification.
- Held an active Virginia nursing license.

Exclusion Criteria: Travel nurses and nurses on orientation.

Measures

Limited demographic information was obtained by the investigator developed questionnaire (Figure 2). Due to the anticipated small sample size, information such as age and gender was not asked as it may have led to easy identification of a participant. The questionnaire included participant's years as a nurse, area of practice, experience as a NICU or NIMU nurse,

area of specific certification or credentialing, previous exposure to mock stroke code training and simulation training, and a general question with regards to degree of participation in stroke codes. The pre- and post-simulation questionnaire (Figure 3) was developed as a combined effort between the investigator, clinical nurse educator and clinical nurse navigator. The initial four questions assessed self-confidence using a five-point Likert Scale and an additional 10 questions assessed stroke knowledge based on the 2018 guidelines (Powers et al., 2018). Each knowledge question was scored as either correct or incorrect with a total score ranging from 0 - 10. The questionnaire was face-validated by the clinical nurse educator, clinical nurse navigator, stroke nurse coordinator, 2 neurological ICU nurses, and a clinical nurse instructor. The final evaluation questionnaire (Figure 4), as required by the institution, had 3 open-ended questions regarding the simulation experience.

Procedures

Participants who registered and presented for the Mock Stroke Code simulation received an explanation of the project and signed an institution required consent (Appendix N) for participating in a simulation at the institution's Center for Simulation & Virtual Learning.

Simulation Session. The session was led by the investigator, a neurology nurse practitioner, a clinical nurse educator, and clinical nurse navigator. The session began with a description of the study, completion of the institution's confidentiality agreement (Appendix N) and completion of the demographic questionnaire (Figure 2). As the study was a pre-test post-test design, each participant chose a clicker to be used to enter responses to questions into Survey Monkey. Each clicker had an unique identification number.

The simulation continued with use of 6 case scenarios (Appendix A) which were presented with use of a PowerPoint presentation. Each case scenario included the clinical

presentation, pertinent clinical data, including neuro-imaging, followed by discussion and input from the participants as to how they would respond to the scenario. The scenarios were created as a combined effort between the investigator (a neurovascular nurse practitioner), the clinical nurse educator, and the stroke navigator. The scenarios reflected stroke codes encountered at the clinical site. The case scenarios were followed by demonstration of the NIHSS utilizing the NIHSS certified stroke navigator performing the exam on a standardized patient. The demonstration was followed by discussion. Participants then engaged in tPA preparation and hands-on learning with reconstitution, calculation of wasted amount, bolus dose, and total dose of tPA (Appendix O).

The next segment of the simulation included the two mock stroke code scenarios (Appendix B – M) designed using the Jeffries framework, which were jointly created by the investigator, the clinical nurse educator, and stroke nurse navigator in collaboration with expert simulation advice from the University of Virginia faculty from the Clinical Simulation Learning Center (CSLC). The standardized patients were briefed and rehearsed the scenarios. The simulation took place in a patient room equipped with audio and visual feed to the conference room for viewing. The participants were split into 2 groups, one group participated in the stroke code simulation while the other group viewed. The roles were reversed with use of a second simulated scenario. At the end of each scenario there was a debriefing session. This was the most critical part of the simulation, lasting approximately 30 minutes, and was conducted from the point-of-view of the participants, and the standardized patients and the evaluators. Following the debriefing session, the post-simulation questionnaire (Figure 3) was administered and the simulation concluded with the final evaluation questionnaire (Figure 4).

Day of Session. The 5-segment simulation occurred over a 4-hour period on one day. The initial 20-minute segment included an introduction to stroke and completion of the demographic survey (Figure 2) and pre-simulation questionnaire (Figure 3) via input into Survey Monkey with use of participant selected clickers. The 2nd 45-minute simulation segment included 6 case scenarios (Appendix A) followed by discussion. The 3rd 45-minute segment included a demonstration NIHSS with a standardized patient and hands-on exposure to reconstitution of tPA with calculation of wasted amount, bolus dose and total dose (Appendix O). The 4th 60-minute segment included the stroke code simulations (Appendix B - M) utilizing stroke code standardized patients with a 20-minute debriefing session. The number of participants per simulation was split with 5 participants in the first group and 6 in the second group. The group not actively involved in the simulations viewed remotely from the conference room. The roles were then reversed. The 5th 10-minute segment included the summary discussion and completion of the post-simulation questionnaire (Figure 3) via input into Survey Monkey with use of clickers. The simulation concluded with completion of the final evaluation questionnaire (Figure 4).

Debrief. At the conclusion of each simulation participants, standardized patients as well as the facilitators participated in a 20-minute debriefing session. The debriefing sessions were designed using the Jeffries framework. The points addressed during debriefing (Appendix G and M) were: (1) what went well and what was challenging with the scenario, (2) difference between symptom onset and last know well time, (3) and the time frame for administering tPA, (4) the registered nurses assessment of the patient, (5) how did the patient feel, and (6) what could have been done differently.

Protection of Human Subjects

Approval for the quality improvement study was requested and granted from the investigator site's IRB (Figure 5 and 6) and was deemed to be IRB exempt. An agency form was requested and granted from the University of Virginia IRB, number 21111 (Figure 7).

Data Analysis Plan

Data were analyzed using IBM SPSS Statistics for Mac version 24.0 (IBM Corp, 2016) Descriptive statistics was run on demographic data. Frequencies were run on the 14 question pre- and post-simulation questionnaires and no strange values were identified.

The 4 self-confidence questions (questions 1 – 4, Figure 3) were entered into SPSS using a 5-point Likert-type scale – 5 = "Strongly Agree," 4 = "Agree," 3 = "Neither Agree or Disagree," 2 = "Disagree," and 1 = "Strongly disagree." The sum of the pretest and posttest answers were computed in SPSS into two new variables: Total_confidence_pre and Total_confidence_post. The difference between the Total_confidence_post and Total_confidence_pre was calculated creating the Diff_pre-post_confidence variable. The distribution of the Diff_pre_post_confidence variable was approximately normal and the paired-sample *t*-test was performed to analyze the Diff_pre_post_confidence variable.

The 10 knowledge questions (questions 5 – 14, Figure 3) were questions scored as either correct or incorrect. The scores were entered in SPSS as either 1= "Correct" or 0 = "Incorrect." The sums of the pretest and posttest answers were computed into new variables Total_knowledge_pre and Total_knowledge_post. The difference between the Total_knowledge_post and Total_knowledge_pre was calculated creating the Diff_pre-post_knowledge variable. The distribution of the Diff_pre_post_knowledge variable was

approximately normal and the paired-sample *t*-test was performed to analyze the pre-post change in knowledge scores.

The relationships between the pre-post change in knowledge score and five different nurse characteristics were analyzed using Mann-Whitney *U* tests (Table 5). The characteristics were years worked as a registered nurse, experience worked in a NICU or NIMU, area of current practice, number of stroke codes attended, and previous experience on mock stroke code training and or simulation training. Because of the small sample size, some categories were collapsed for three nurse characteristics: years worked as a registered nurse, area of current practice, and number of stroke codes attended, in order to have only two categories for each characteristic, all of size at least 4.

Results

Demographic Data

The sample of 11 nurses (Table 2) had 6 (54.5%) nurses who had experience working in a NICU or NIMU had 63.6% ($n = 7$) having not previously participated in simulation training, and 9 (81.8%) of the participants had no specialty certification. Four (36.4%) had never attended a stroke prior to the simulation, and 5 (45.5%) had attended greater than 10 stroke codes.

Pre- and Post-Simulation Self-Confidence Analysis

The result of the paired-sample *t*-test comparing the pre and post sums of the four items regarding self-confidence with stroke codes (Table 3) was statistically significant ($p < .001$). Nurses showed the greatest improvement in strongly agreeing or agreeing combined, improving from 45.5% to 90.9% with self-confidence in their ability to calculate dose, and reconstituting, and administering tPA. There were improvements in strongly agreeing or agreeing with self-confidence with regards to adequate knowledge of the American Heart Association (AHA) guidelines for acute ischemic stroke management, improving from 63.6% to 100%, and feeling

confident in evaluating a patient for stroke and tPA criteria, improving from 63.6% to 90.9%. There was improvement in strongly agreeing with self-confidence with regards to communication with the physician, improving from 18.2%% to 72.7%,

Pre- and Post-Simulation Knowledge Analysis

The result of the paired-sample *t*-test comparing the pre and post sums of the ten items regarding stroke code knowledge (Table 4) was statistically significant ($p < .001$). There was an increase in knowledge with regards to lowest possible NIHSS for administration of tPA, n =1 (9.1%) correct pre-simulation improved to n = 11 (100.0%) correct post-simulation. Nurses also demonstrated improved knowledge with knowing the time frame for the last known normal time a patient can have to receive tPA, n =7 (63.6%) correct pre-simulation improved to n = 11 (100.0%) correct post-simulation, the actions required to care for a patient who is admitted to the hospital with an ischemic stroke, n = 6 (54.5%) correct pre-simulation improved to n = 9 (81.8%) correct post-simulation, and what to do if a stroke code patient is noted to have a hemorrhage on their initial head CT, n = 7 (63.6%) correct pre-simulation improved to n = 10 (90.9) correct post-simulation .

Mann-Whitney *U* tests (Table 5) were used to investigate possible relationships between several nurse characteristics and the increase from pre-simulation to post-simulation in stroke code knowledge. While none of the tests were statistically significant, with *p*-values ranging from .527 to .927 (Table 5), several differences suggest possible relationships that might be confirmed in a larger sample. Nurses with 5 years or less experience working as a registered nurse had a greater increase in knowledge score from pre- to post-simulation (*Mean increase* = 2.714, *SD* = 1.496) than nurses with greater than 5 years' experience (*Mean increase* = 2.500, *SD* = 0.577). Nurses who had no experience working in a NICU or NIMU had a greater increase in knowledge scores from pre- to post-simulation (*Mean increase* = 2.800, *SD* = 0.837) than nurses

with experience working in a NICU or NIMU (*Mean increase* = 2.500. *SD* = 1.517). Nurses who were not currently working in a NICU or NIMU had a greater increase in knowledge scores from pre- to post-simulation (*Mean increase* = 2.800, *SD* = 0.837) than nurses who were currently not working in the NICU or NIMU (*Mean increase* = 2.500. *SD* = 1.517). Nurses who had attended no stroke codes had a greater increase in knowledge scores from pre- to post-simulation (*Mean increase* = 3.000, *SD* = 1.633) than nurses who had attended one or more stroke codes (*Mean increase* = 2.429, *SD* = 0.976), Nurses who had no previous simulation or mock stroke code training had a greater increase in knowledge scores from pre- to post-simulation (*Mean increase* = 2.857, *SD* = 1.345) than those nurses who had had previous simulation and or mock stroke code training (*Mean increase* = 2.250, *SD* = 0.957).

Discussion

Demographics

Eleven nurses completed the stroke code simulation and had showed improvement in both knowledge and self-confidence. The majority (54.5%) of participants were from a neuroscience unit with 3 of 11 each from the neurological intensive care unit and neurological intermediate care unit (Table 2). This is an expected finding as all new hires to the NICU and NIMU, who were no longer in orientation, are expected to attend a simulation session.

Self-Confidence and Stroke Codes

There was significant improvement ($p < .001$) in self-confidence scores (Table 3) pre– to post-simulation in self-confidence with calculating dosing, reconstitution and administration of tPA, knowledge of the AHA guidelines for acute ischemic stroke, and in evaluating a patient for stroke and tPA were not unexpected. The literature review performed by Boling and Hardin-Pierce (2016) identified 12 studies which concluded that high fidelity simulation was a tool to be utilized for improving self-confidence. Furthermore, and more specifically with stroke code

education, Khan et al. (2018) concluded that self-confidence improved by use of simulation as an education tool. Simulation is performance and self-confidence is improved due to the persistence of performing activities encountered in a stroke code (Bandura, 1982).

Before the simulation only 18.2% (n = 2) of participants strongly agreed with feeling self-confident with communicating information to the physician, and after the simulation 72.7% (n = 8) of participants strongly agreed with feeling self-confident with communication with the physician. The simulation addressed dosing, reconstitution and administering of tPA, as well as the AHA guidelines, and evaluation of patients with stroke for appropriateness of tPA, but did not specifically address communication with the physician. Having an improved understanding of the AHA guidelines and patient criteria for tPA may be contributing factors to improved self-confidence when communicating with the physician.

Knowledge and Stroke Codes

There was significant improvement ($p < .001$) in stroke knowledge (Table 4) scores pre- to post-simulation. This was an expected finding as Micieli et. al. (2015) assert that simulation can be utilized in a health professional's diagnosis, decision making, and technical skills. Simulation leads to quicker acquisition of skills with can lead to not only increased self-confidence but also improved knowledge based clinical judgement (Jefferies, 2005). With regards to stroke code education, Aebersold et. al. (2011) concluded that use of simulation in education is effective in both skills and knowledge transfer and Ortega et. al. (2018) concluded that stroke knowledge scores increased significantly from baseline with use of simulation, and further concluded that simulation plus lecture was more effective than lecture alone.

There was no statistically significant difference in pre- as compared to post-simulation knowledge scores based on the nurse's length of time working, their experience working in a NICU or NIMU, currently working in a NICU or NIMU, the number of stroke codes attended, or

the nurse's previous experience with mock stroke code training and or simulation (Table 5); however, overall mean scores did improve. This is an expected finding as the meta-analysis performed by Franklin and Lee (2014) concluded that simulation was effective at increasing self-confidence among novice nurses which would include not only those who lack experience as a nurse, but also those that may lack experience as a NICU or NIMU nurse, or lack experience with stroke codes.

Post-Simulation Final Evaluation

The participants overall concluded that the simulation improved self-confidence (Table 6) with initiating stroke codes and identifying tPA as well as thrombectomy candidates when attending a stroke code, with one participant responding "I will call code strokes," and another stating "I will be more confident when acting as code stroke nurse. I feel more confident explaining tPA and explaining stroke in general." There was also improved self-confidence and understanding with performing the NIH stroke scale, improved patient assessment skills and communication skills with patients, their families, and physicians. One participant responded that they would have liked having the simulation geared more towards nurses without specialty back ground.

Strengths and Weaknesses of the Design

Strengths of the design included an already established educational program at the clinical site with an available simulation center and standardized patients. An additional strength was the project was evidence-based and could serve as basis for a larger study as well as an instructional program for other institutions to implement to improve self-confidence and knowledge for nurses to identify and intervene on a patients exhibiting acute stroke symptoms.

The weakness of the design included a single-site pilot study with small sample size (N = 11) and a population that may not be similar to other populations, limiting generalizability and possible relationships between several nurse characteristics from pre-simulation to post-simulation in stroke code knowledge. The pre-test and post-test design with no control group made it difficult to account for confounding variables that may have had an impact on the variable under study. Feeling confident with evaluating a patient for stroke and tPA criteria (Figure 3, question 1) was assessed at one variable. A future study might address this self-confidence with separate measures for each variable. The pre- and post-simulation questionnaire (Figure 3) was developed as a combined effort between the investigator, clinical nurse educator and clinical nurse navigator based on the national stroke guidelines (Powers et al., 2018) and was face-validated by the clinical nurse educator, clinical nurse navigator, stroke nurse coordinator, 2 neurological ICU nurses, and a clinical nurse instructor. The questionnaire was created based on the national guidelines and was face-validated and should not invalidate the outcomes of the study.

Conclusion

Stroke codes are complex and consist of multiple elements that include patient assessment, which involves performing the NIHSS, determining appropriateness for tPA criteria, and preparing and calculation of the dose of tPA. Registered nurses may lack the knowledge and or self-confidence when responding to a stroke code. The use of stroke code simulation as an educational tool for registered nurses increased both stroke knowledge ($p < .001$) and self-confidence ($p < .001$) with the AHA guidelines and patient criteria for tPA administration, dosing, reconstitution, and administering of tPA, and improved self-confidence with communications with the physician. The possible relationships between nurse characteristics

and the increase from pre-simulation to post-simulation in stroke code knowledge may be confirmed with a larger sample.

Nursing Practice Implications

Nursing implications include increasing the body of knowledge regarding preparation of nurses caring for acute stroke patients. Based on the results of this pilot project, a future study evaluating nurse lead stroke code teams working with ED or tele-medicine physicians in underserved or non-stroke certified hospitals could be conducted as means to evaluate the impact on the management of care on acute stroke patients in rural or underserved areas. Future measurement of outcomes of the stroke codes at this organization may continue to provide evidence that is an effective simulation that can be implemented at other rural hospitals.

Products of the Scholarly Practice Project

A completed manuscript will be submitted to the University of Virginia LIBRA database and The Journal of Neuroscience Nursing. A poster will be submitted for presentation summarizing results at the clinical site's annual nursing research day, the Virginia Council of Nurse Practitioners, the Virginia Association of DNP's, and the American Association of Neuroscience Nurses Annual Educational Meeting, and annual Stroke Conference, and the Pho Pi Research Symposium.

This mock stroke code simulation will be the model for stroke code education at the investigator's institution as well as a model that can be implemented at other rural community hospitals as an educational program to improve self-confidence and knowledge for nurses in identify and interviewing if a patient is exhibiting acute stroke symptoms. The mock stroke code simulation will be continued at the clinical site with on-going data collection to further support the effectiveness of the simulation which may encourage other institutions to implement this simulation as part of their nursing education.

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Tables

Table 1

Review of Literature Study Table

Reference & Design	Subjects & Setting/ Period of Data Collection	Outcomes	Limitations
Aebersold, Kocan, Tschannen, & Michaels, 2011 Study Design: Quality Educational Initiative	Subjects: 35 nurses Setting: Newly created six-bed acute stroke unit within the acute care neuroscience unit Period of Data Collection: April 2008 – December 2009	Nurses ratings of knowledge speakers: • 98.2% excellent knowledge • 1.8% adequate knowledge Nurses ratings of effectiveness of the speakers: • 95.5% excellent • 3.2% adequate • 1.3% unsatisfactory Shadowing experience rating: • NICU rated as excellent by 100% of respondents for both knowledge of the topic and effectiveness of presentation • Stroke unit shadow was rated as excellent by only 80% of the respondents in relation to knowledge and 20% of the nurses reported the experience as adequate • Effectiveness of the stroke unit shadow experience, only 55.6% of nurses reported the experience as excellent; 38.9%, as adequate; and 5.6%, as unsatisfactory	Small sample size Simulation evaluation tool was not validated Inferential statistics not utilized Do to small sample size and single site results not generalizable

Reference & Design	Subjects & Setting/ Period of Data Collection	Outcomes	Limitations
		The initiative concluded that the simulation was effective in both skills training and knowledge transfer and Nurses reported increased level of confidence in caring for stroke patients	
Khan et al., 2018 Study Design: Prospective Quasi-experimental, Pretest/Posttest study	Subjects: 9 advanced practice providors(APPs - 3 nurse practitioners and 3 physician assistants) and 9 neurology residents (3 third-year, and 6 second-year residents) Settings: Graduate Medical Education Simulation Center at Spectrum Health in Grand Rapids MI Period of Data Collection: Not specified	Both APPs and neurology residents demonstrated improved confidence in managing stroke codes after the simulation training (p = 0.5126, 0.7804, 0.2666, 0.4309, 0.1991, 0.1427, 0.8250, 0.6848, respectively) No differences were observed between APPs and residents at baseline on all statements (p = 0.3250, 0.8907, 0.9999, 0.7669, 0.9611, 0.0997), except for confidence to lead a stroke code: APPs had lower confidence than residents at baseline (p = 0.0172) No differences were observed between APPs and residents at follow-up on any statement (p = 0.4136, 0.9649, 0.8358, 0.9725, 0.4590, 0.2656, 0.999, 0.9625) **Simulation-based acute stroke training improves confidence in leading a stroke code**	No control group No control for prior exposure to stroke codes for both residents and APPs on pre-simulation survey No control to account for comparable degrees or competence on real-world patient care or patient outcomes No longitudinal assessment for sustainability of confidence levels among residents and APPs over time Single facility with a simulation center and with small sample size so results may not be generalizable to other centers

Reference & Design	Subjects & Setting/ Period of Data Collection	Outcomes	Limitations
Ortega, Gonzalez, de Tantillo, & Gattamorta, 2018 Study Design: Longitudinal Nonexperimental Quality Improvement Intervention	Subjects: 86 registered nurses from the neurology and cardiology Setting: University of Miami. Period of Data Collection: Specific dates were not specified.	The group was compared to itself at three time points: performance on the pre-test (Time Point 1) as compared to the pre-simulation test (Time Point 3), and performance on the pre-simulation test (Time Point 3) Change in stroke knowledge: • A significant effect for time was found, with significant improvement from baseline (M=5.87, SD=0.19) to pre-simulation (M=6.42, SD=0.18) • An even larger change from pre-simulation to post-simulation (M=8.34, SD=0.12), $F(2, 140)=79.92$, $p<0.001$, $n^2=.0.533$) Impact of Simulation: • 71% to 78% of participants strongly agreed with every item on the Simulation Design Scale **Simulation plus lecture was more effective than lecture alone with regards to transfer of knowledge of stroke care**	No control group All eligible nurses received the stroke training, making it impossible to assess for improvement in knowledge Two of the assessment tools, the Stroke Module Test and Stroke Simulation Evaluation Test, were developed for the study and were not externally validated

Reference & Design	Subjects & Setting/ Period of Data Collection	Outcomes	Limitations
Meurer et al., 2011 Study Design: Cluster Randomized, Controlled Trial	Subjects: There were 30 participants in the six initial focus groups (phase 1): 10 EPs, 15 nurses, 3 neurologists, 1 hospitalist, and 1 pharmacist Settings: Twenty-four acute care hospitals were randomly selected in Michigan and matched into 12 pairs (control and intervention) Period of Data Collection: Phase 1 of the barrier assessments occurred 3/26/2007 and Phase 2 of the barrier assessments was conducted at each of the intervention hospitals between 6/12/2007 - 10/05/2007	External barriers including environmental factors and patient factors dominated the barriers discussed for every hospital: • Lack of neurologists • Lack of weekend coverage • Fear of liability both for giving and not giving tPA Internal barriers: • Most participants identified lack of guideline familiarity • Most also had either outcome expectancy or motivation as an important barrier, • The lack of self-efficacy more so with physicians than nurses. Barriers organized by type of Provider: • Patient-controlled factors • Nurses perceived lack of guideline familiarity as the • Physicians perceived physician motivation as the primary barrier (see Figure 4b). **The authors concluded that designing site specific educational initiatives first requires knowledge of the barriers the impede adherence to the stroke guidelines.**	An existing taxonomy was used to to classify responses which may have resulted in missed barriers Results may not be generalizable

Reference & Design	Subjects & Setting/ Period of Data Collection	Outcomes	Limitations
Adelman et al., 2014 Study Design: Survey of Stroke Awareness	Subjects: 875 emergency department and inpatient nurses completed an online mandatory survey Setting: University of Michigan which is an academic tertiary care center. Period of Collection: 2012	Response rate was 83.8% 87% of respondents correctly reported 2 or more stroke warning signs 31% or respondents identified 3 warning signs. Greater self-efficacy in identifying stroke symptoms (OR 1.13, 95% CI 1.01–1.27) and a higher outcome expectations rating (OR 1.23, 95% CI 1.002–1.51) were associated with stroke knowledge Clinical experience, educational experience, nursing unit, and personal knowledge of a stroke patient were not associated with stroke knowledge **Self-efficacy in recognizing stroke is associated with stroke knowledge**.	Due to design of the survey, respondents could have used outsides sources when to identify stroke symptoms. The response rate to our survey was robust, however, it is unknow if non-respondents may have more or less knowledge about stroke symptoms and this could impact our results. Survey was performed at a single academic tertiary care center so results may not be generalizable

Table 2

Demographic Data of Simulation Training Participants (N = 11)

	n	%	Range	Mean (*SD*)
Length of time as a registered nurse in years	11		.33 - 33	6.62 (9.57)
Area of practice				
Emergency Department	4	36.4		
Neurological Intensive Care Unit (NICU)	3	27.3		
Neurological Intermediate Care Unit (NIMU)	3	27.3		
Medical-Surgical Unit	1	9.1		
Experience working as in a NICU or NIMU				
Yes	6	54.5		
No	5	45.5		
Area of specialty certification				
None	9	81.8		
Certified Emergency Nurse (CEN)	2	18.2		
Previously participated in simulation training				
Yes	4	36.4		
No	7	63.6		
Strokes Codes attended prior to simulation				
0	4	36.4		
1-5	2	18.2		
6-9	0	0.0		
Greater than 10	5	45.5		

Table 3

Stroke Code Self-Confidence Questions 1- 4 (N = 11)

	Pre		Post		
Question	*n*	%	*n*	%	
I feel confident evaluating a patient for stroke and IV Alteplase criteria.					
Strongly Agree	0	0.0	8	72.7	
Agree	7	63.6	2	18.2	
Neither Agree or Disagree	0	0.0	1	9.1	
Disagree	3	27.3	0	0.0	
Strongly Disagree	1	9.1	0	0.0	
I feel confident in communicating information to the physician.					
Strongly Agree	2	18.2	8	72.7	
Agree	7	63.6	1	9.1	
Neither Agree or Disagree	0	0.0	2	18.2	
Disagree	2	18.2	0	0.0	
Strongly Disagree	0	0.0	0	0.0	
I feel confident that I have adequate knowledge of the AHA guidelines for Acute Ischemic Stroke management.					
Strongly Agree	1	9.1	6	54.6	
Agree	6	54.5	5	45.5	
Neither Agree or Disagree	2	18.2	0	0.0	
Disagree	2	18.2	0	0.0	
Strongly Disagree	0	0.0	0	0.0	
I feel confident in my ability to calculate dosing, reconstitute, and administer IV Alteplase.					
Strongly Agree	3	27.3	8	72.7	
Agree	2	18.2	2	18.2	
Neither Agree or Disagree	0	0.0	0	0.0	
Disagree	4	36.4	1	9.1	
Strongly Disagree	2	18.2	0	0.0	
	M		*SD*		*p*
Pre- and post-simulation confidence questions					
Sum of pre-simulation confidence questions	12.818		2.359		
Sum of post-simulation confidence questions	18.273		2.724		
Difference between post- and pre-questions	5.455		0.934		.001*

Note: IV = intravenous, AHA = American Heart Association. * Paired-samples *t*-test

Table 4

Stroke Code Knowledge Questions 5 – 14 (N = 11)

	Pre		Post		
Question	*n*	%	*n*	%	
Question 5 – Patient with stroke symptoms on the way to the emergency department					
Correct	8	72.7	11	100.0	
Incorrect	3	27.3	0	0.0	
Question 6 – Patient discovered at nursing home with stroke symptoms					
Correct	10	90.9	11	100.0	
Incorrect	1	9.1	0	0.0	
Question 7 – Actions nursing should know for patient admitted for stroke care					
Correct	6	54.5	9	81.8	
Incorrect	5	45.5	2	18.2	
Question 8 - Patient with small hemorrhage noted on head CT					
Correct	7	63.6	10	90.9	
Incorrect	4	36.4	1	9.1	
Question 9 – Window for last know normal time to receive tPA					
Correct	7	63.6	11	100.0	
Incorrect	4	36.4	0		
Question 10 – What is last know normal time for potential thrombectomy candidate					
Correct	9	81.8	11	100.0	
Incorrect	2	18.2	0	0.0	
Question 11 – Lowest possible stroke score to receive tPA					
Correct	1	9.1	11	100.0	
Incorrect	10	90.9	0	0.0	
Question 12 - What determines patient's need for thrombectomy					
Correct	10	90.9	10	90.9	
Incorrect	1	9.1	1	9.1	
Question 13 - Calculating dose of tPA on patient who weighs 115.6 kg					
Correct	10	90.9	11	100.0	
Incorrect	1	9.1	0	0.0	
Question 14 - Calculating dose of tPA on a patient who weighs 78.0 kg					
Correct	9	81.8	11	100.0	
Incorrect	2	18.2	0	0.0	
	M		*SD*		*p*
Pre- and post- simulation knowledge questions					
Sum of pre-simulation knowledge questions	7.000		1.483		
Sum of post-simulation knowledge questions	9.636		0.674		
Difference between post- and pre-questions	2.636		3.000		.001*

Note. tPA = Alteplase. *Paired-samples *t*-test.

Table 5

Knowledge Scores Pre- and Post-Simulation Based on Experience and Area of Practice

	n	Mean (*SD*)	*p*
Length of time as a registered nurse in years			.927
0 – 5 years	7	2.714 (1.496)	
Greater than 5 years	4	2.500 (0.577)	
Any experience working in a NICU or NIMU			.662
Yes	6	2.500 (1.517)	
No	5	2.800 (0.837)	
Area of current practice			.662
NICU or NIMU	6	2.500 (1.517)	
Emergency Department of Medical-Surgical Unit	5	2.800 (0.837)	
Number of stroke codes attended prior to simulation			.527
None	4	3.000 (1.633)	
One or more	7	2.429 (0.976)	
Previous experience with mock stroke code training and/or simulation			
Yes	4	2.250 (0.957)	.527
No	7	2.857 (1.345)	

Note: NICU = Neurological Intensive Care Unit, NIMU = Neurological Intermediate Care Unit

Table 6

Stroke Code Post-Simulation Final Evaluation Results

Please identify two things you learned from this class.
• How and why to use, prepare, and administer (including inclusion and exclusion criteria) tPA. • Increased understanding of stroke code including need for history and sequence of events. • Understanding need for, and patient's meeting criteria for mechanical thrombectomy. • Better understanding of the NIH Stroke Scale.
As part of the healthcare team, how will your practice change based on this class?
• "I will be more confident when acting as a code stroke nurse. I feel more confident explaining tPA and explaining stroke in general." • Feeling more comfortable and confident going to stroke codes, and tPA assessment and treatment, and providing stroke code care. • "I will call code strokes." • Improved assessment skills of stroke patients, improved communication skills with nurses, and patient's family and physician. Improved ability to obtain history.
Do you have any suggestions of what this class should include in the future?
• First question on pretest had a question with weight that was greater than 100kg and then a second question less than 100kg, to improve understanding of tPA dosing, start with a weight under 100kg. • "Gear classes towards nurses who do not have specialty unit back ground." • None / great / beneficial class.

Note. Responses to open ended questions in quotations are direct quotes, if no quotations then responses are grouped and summarized.

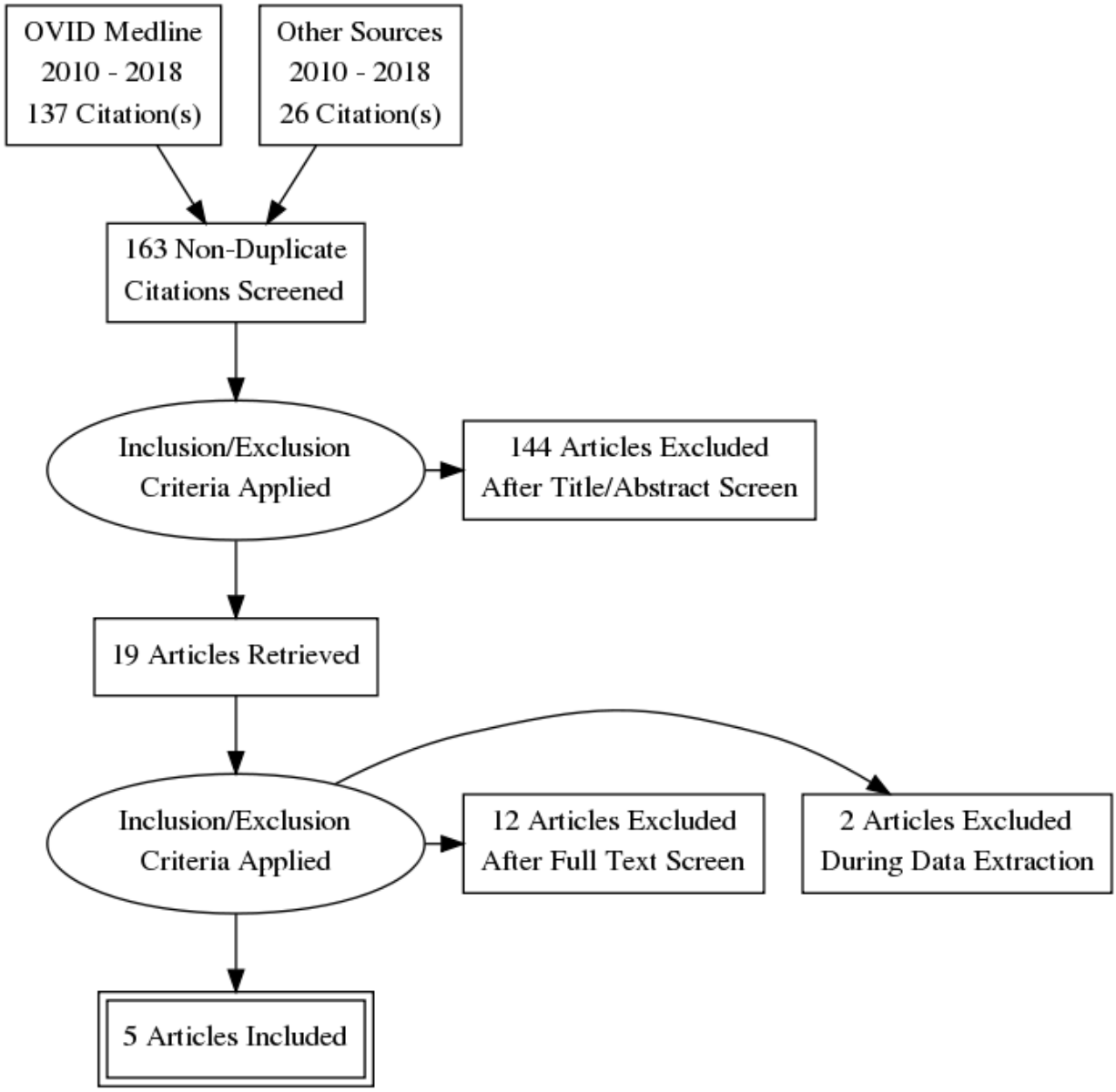


Figure 1. PRISMA flow diagram of articles selected in the review of literature.

Demographic Information

Please do not enter your name, but enter **CLICKER NUMBER here:_____**

Please answer the following questions:

1. How long have you been a licensed nurse (years)?_____
2. What is your area of practice (i.e. ICU, ED, Med-Surg floor)?_____
3. Do you have any experience working in a Neurological ICU or a Neurological Intermediate Care unit?_____
4. Do you have a specialty area of certification or credentialing?_____

a. If you answered yes to above, what certification or credentialing do you have?_____

_____

5. Approximately how many stroke codes have you been present at (Please circle one):

- None
- 1 – 5 stroke codes
- 6-10 stroke codes
- Greater than 10 stroke codes

6. Have you previously participated Mock Code Stroke Training or any other simulation training as a student or as a registered nurse (Please circle):

- YES
- NO

Thank you for your participation.

Figure 2. Demographic collection instrument. The vernacular at the institution is "code stroke" not "stroke code," thus "code stroke" was the vernacular used in the questionnaire.

Pre- and Post- Simulation Questionnaire

1. **I feel confident evaluating a patient for stroke and IV tPA criteria.**

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree

2. **I feel confident in communicating information to the physician.**

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree

3. **I feel I have adequate knowledge of the AHA guidelines for Acute Ischemic Stroke management.**

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree

4. **I feel confident in my ability to calculate dosing, reconstitute, and administer IV tPA.**

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree

5. **A patient is arriving to the Emergency Department with right arm weakness and speech difficulty. Symptom onset reported by family was 2.5 hours prior. What is the most appropriate next action?**

   a. Page Level I Code Stroke overhead prior to patient arrival

   b. Assess patient on arrival to ED prior to calling overhead page

   c. Page Level II Code Stroke overhead prior to patient arrival

6. **A nursing home patient is seen by the CNA at 10:30 pm with no neurological deficits and then is seen again at 7:30 am for vitals and blood glucose checks. The CNA notifies the nursing home RN that the patient is unable to produce speech and cannot move the right side. The patient is taken to the ED. What should be the ED RN's next action?**

   a. Notify the primary MD. A neurological consult may be needed.

   b. Call a Level I Code Stroke

   c. Call a Level II Code Stroke

7. **What actions should the RN ensure for a patient admitted to the hospital with an ischemic stroke?**

    a. Antithrombotic ordered for a patient by second midnight

    b. Swallow screen completed prior to PO intake

    c. TED hose to patient by second midnight

    d. Both A and B

    e. All of the above

8. **A CT scan is performed on a patient admitted with stroke symptoms. The result of the CT reveals a small hemorrhage in the right frontal lobe. What is the next action for the code stroke nurse?**

    a. Abort code stroke and arrange for an ICU room for the patient

    b. Continue to monitor the patient until the CTA report and communication from the Neuro-radiologist

    c. Continue to monitor the patient and prepare for possible IV Alteplase administration

9. **What is the time window from Last Known Normal (LKN) that a patient can receive IV Alteplase?**

    a. 0-3 HRS

    b. 0-3.5 HRS

    c. 0-4.5 HRS

10. **What is the time window from LKN that a patient can be a potential thrombectomy candidate?**

    a. 0-24 HRS

    b. 0-12 HRS

    c. 0-8 HRS

    d. 0-6 HRS

11. What is the lowest possible NIHSS score that a patient can have and still qualify for IV Alteplase?

a. NIHSS 4

b. NIHSS 0

c. NIHSS 2

d. None of the Above

12. What determines a patient's need for treatment in IR for a thrombectomy?

a. Positive CTA for a large vessel occlusion and less than 24 hours from LKN

b. Positive NIHSS >33

c. Positive CTA for a large vessel occlusion and less than 6 hours from LKN

13. **A patient admitted with stroke symptoms meets criteria for IV Alteplase. The patients; weight is 115.6kg. Which is the appropriate dose of IV Alteplase to administer to the patient?**

a. 100mg total, 10mg bolus over 1 min., 0mg wasted, 90mg infused over 1 hour

b. 115.6 mg total, 15.6mg bolus over 1 min, 0mg wasted, 100mg infused over 1 hour

c. 90mg total, 9mg bolus over 1 min, 10mg wasted, 81mg infused over 1 hour

d. None of the Above

14. You are the RN administering IV Alteplase to Mr. Brown who is a stroke patient in the ED. Mr. Brown's weight is 78.0 kg. What is the appropriate dose of IV Alteplase?

a. 36mg wasted, 6mg bolus, and the remaining 64 mg infusing over 1hour

b. 38mg wasted, 8mg bolus, and the remaining 62 mg infusing over 1 hour

c. 37mg wasted, 7mg bolus, and the remaining 63 mg infusing over 1 hour

d. None of the Above

Figure 3. Pre- and Post-simulation evaluation instrument entered into Survey Monkey. The vernacular at the institution is "code stroke" not "stroke code," thus "code stroke" was the vernacular used in the questionnaire. A Level I Stroke Code is LKN less than 4.5 hours and tPA candidate, a Level II Stroke Code is LKN greater than 4.5 hours but less than 24 hours and would be a thrombectomy candidate.

Final Evaluation Questionnaire

1. Please identify two things you learned from this class.

   _____

   _____

2. As part of the healthcare team, how will your practice change based on this class?

   _____

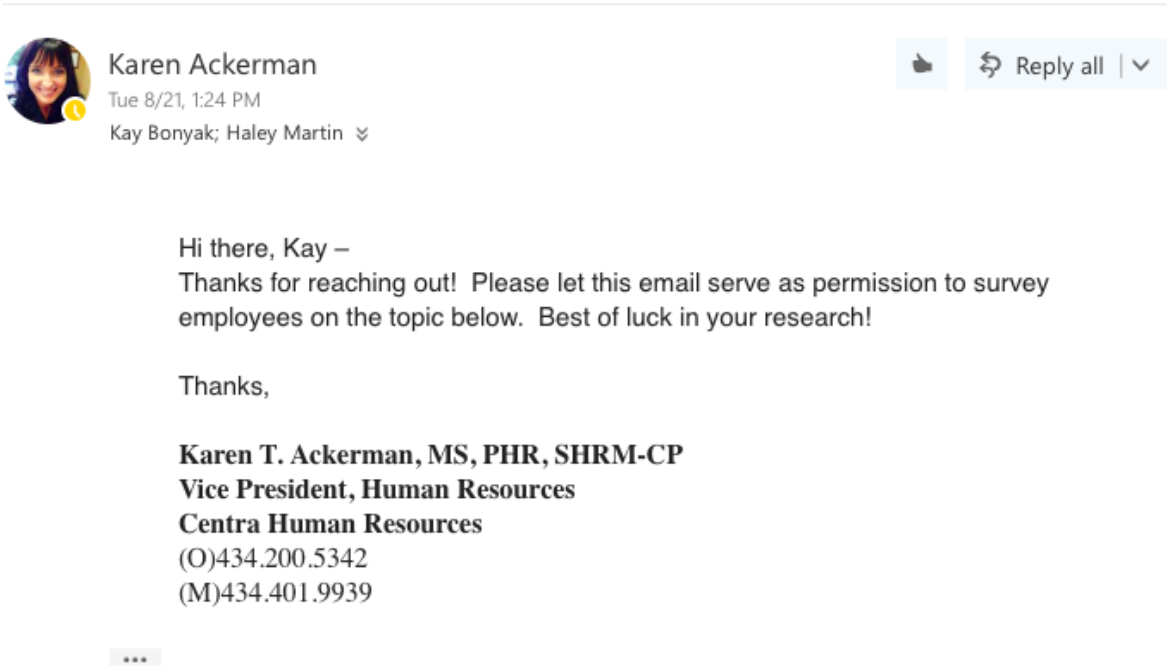
   _____

3. Do you have any suggestions of what this class should include in the future?

   _____

   _____

Figure 4. Post-simulation evaluation questions.



Karen Ackerman
Tue 8/21, 1:24 PM
Kay Bonyak; Haley Martin

Reply all

Hi there, Kay –
Thanks for reaching out! Please let this email serve as permission to survey employees on the topic below. Best of luck in your research!

Thanks,

Karen T. Ackerman, MS, PHR, SHRM-CP
Vice President, Human Resources
Centra Human Resources
(O)434.200.5342
(M)434.401.9939

...

Figure 5. Clinical site approval letter.

Centra Health IRB
Lynchburg, VA
RECEIVED 10/17/18

CENTRA HEALTH Institutional Review Board
EXEMPT RESEARCH CHECKLIST
Version 3, 21APR2015

Centra IRB #: CHRB 0435e **IRB of Record** _____ **Date:** 10/13/2018

Facility: Centra Lynchburg General Hospital Simulation Center

EXEMPT
Date: 10-17-18

Principal Investigator: Kay H. Bonyak, MBA, MSN, ACNP

Email address: kay.bonyak@centrahealth.com

Phone number: 540-539-6988 or 434-944-2285

Title of Research Project/Study Title: Mock Stroke Simulation for Registered Nurses in a Rural Community Health System

Attach documents related to the study.

Checklist Statements	True	Not True
Category 1 – For Educational Settings		
1. The research will only be conducted in established or commonly-accepted educational settings including but not limited to schools and colleges. (May include other sites where educational activities regularly occur.)	X	
2. The research will involve only normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.	X	
3. The research will not involve individuals as participants who are known to be prisoners.	X	
4. The research is not subject to FDA regulations.	X	
Category 2 – For Educational Tests, Surveys, Interviews, Public Behavior Observation:		
5. The research will involve only the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior.		
Address statement 6 only if the research will involve children as participants. If children will NOT participate, check N/A and continue with statement 7. 6. The procedures will be limited to the use of educational tests (cognitive, diagnostic, aptitude, achievement) or observation of public behavior where the investigator will NOT participate in the activities being observed.		
7. The information obtained from educational tests, survey procedures, interview procedures or observation of public behavior will be recorded in such a manner that human subjects CANNOT be identified, directly or through identifiers linked to the subjects. ***"True" to <u>either</u> statement 7 or 8 will qualify for exemption provided that statements 9 <u>and</u> 10 are true.***		
8. Any disclosure of the human subjects' responses outside the research could NOT reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.		
9. The research will <u>not</u> involve individuals as participants who are known to be prisoners.		
10. The research is not subject to FDA regulations.		
Category 3 – For Educational Tests, Surveys, Interviews, Public Behavior		

Observation of Public Officials:		
11. The research will involve only the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior AND the human subjects are elected or appointed public officials or candidates for public office. (Applies to senior officials such as mayor or school superintendent rather than a police officer or teacher.) ***"True" to either statement 11 or 12 will qualify for exemption provided that statements 13 and 14 are true.***		
12. The research will involve only the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior AND federal statute(s) require without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.		
13. The research will not involve individuals as participants who are known to be prisoners.		
14. The research is not subject to FDA regulations.		
Category 4 – For Existing Data, Documents and Specimens:		
15. The research will involve only the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens. ("Existing" means existing before the research is proposed to the IRB to determine whether the research is exempt. All materials to be reviewed currently exist at the time of this exemption request.)		
16. The sources of the existing data, documents, records or specimens are publicly available **OR** the information will be recorded by the investigator in such a manner that participants cannot be readily identified either directly or through identifiers (such as a code) linked to them.		
17. The research will not involve individuals as participants who are known to be prisoners.		
18. The research is not subject to FDA regulations.		
Category 5 – For Public Benefit or Service Programs (Federal):		
19. The project is a research or demonstration project conducted by or subject to the approval of a (federal) Department or Agency head and which is designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those public benefit or service programs.		
20. The research will not involve individuals as participants who are known to be prisoners.		
21. The research is not subject to FDA regulations.		
22. The program under study delivers a public benefit (e.g., financial or medical benefits as provided under the Social Security Act) or service (e.g., social, supportive, or nutrition services as provided under the Older Americans Act).		
23. The research or demonstration project will be conducted pursuant to specific federal statutory authority.		
24. There is no statutory requirement that the project be reviewed by an IRB.		
25. The project does not involve significant physical invasions or intrusions upon the privacy of participants.		
26. The exemption has authorization or concurrence by the funding agency.		
Category 6 – For Taste and Food Quality and Consumer Acceptance Studies:		
27. The research involved only a taste and food quality evaluations or a food consumer acceptance study in which (i) wholesome foods without additives will be consumed **OR** (ii) food will be consumed that contains a food ingredient, agricultural chemical or environmental contaminant that is at or below the level		

found to be safe by the Food and Drug Administration or is approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.		
28. The research will not involve individuals as participants who are known to be prisoners.		
Emergency Use of an Unapproved Test Article (i.e., a drug, device or biologic that is not FDA-Approved)		
The activity involves emergency use of an investigational drug, device or biologic. Such an activity is not exempt from IRB review. However, this emergency use may occur prior to IRB review and approval (see Category A and B in the Emergency Use Policy for details.) Note that such an emergency use must be reported to the IRB within five business days.		
The activity does not meet with DHHS definition of "research."		
Criteria that must be met for the research to be determined to be consistent with IRB ethical standards		
The research holds out no more than minimal risk to subjects.	X	
Selection of subjects is equitable.	X	
If there is recording of identifiable information, there are adequate provisions to maintain the confidentiality of the data.	X	
If there are interactions with subjects: There will be a consent process (and maybe some type of documentation) that will disclose such information as: • That the activities involve research. • The procedures to be performed. • That participation is voluntary. • Name and contact information for the investigator.	N/A	
There are adequate provisions to maintain the privacy interests of subjects.	X	

Signature of Principal Investigator: Kay Harris Bonyak, MBA, MSN, ACNP-bc
Typing my name on the line above constitutes an electronic signature.

Printed Name Kay Harris Bonyak, MBA, MSN,ACNP-bc

Date 10/13/2018

FOR THE IRB REVIEWER ONLY:

Is the activity exempt? YES [X] NO [ ]

Does the research meet the standards of ethical conduct? YES [X] NO [ ]

Which exemption category or categories apply to the activity? Category #1 Educational

Approved by IRB (date): October 17, 2018

Signature of IRB Reviewer:
Typing my name on the line above constitutes an electronic signature.

Printed Name Donna Washburn MSN, RN, CNS, ACNS-BC, AOCNS

Date 10/19/2018

Centra Health IRB EXEMPT RESEARCH CHECKLIST Version 3, 21APR2015 Page 3 of 3

Figure 6. Clinical site's IRB exemption approval form.

UNIVERSITY of VIRGINIA IRB-HSR Institutional Review Board for Health Sciences Research

DETERMINATION OF UVa AGENT FORM

INFORMATION ABOUT THIS FORM

- ☐ This form is to determine if UVa personnel are or are not considered to be working as an Agent* for UVA on this project.
- ☐ If it is determined that UVA personnel are considered to be working as an Agent* for UVA the study, then your team will be required to provide an additional submission to the IRB-HSR, unless the project is determined to not involve human subject research. See Determination of Human Subject Research Form

***Agent-** all individuals (including students) performing institutionally designated activities or exercising institutionally delegated authority or responsibility.*

Enter responses electronically. Email the completed form to IRBHSR@virginia.edu for pre-review.

An IRB staff member will reply with any changes to be made.

Name of Individual to be Working on Project:	Kay H. Bonyak, ACNP-bc
UVA Email:	klh2z@virginia.edu
Phone:	540-539-6988
UVa Messenger Mail Box #	none
Project/Protocol Title if Known:	☐ Unknown or Title: Mock Code Stroke Simulation for Registered Nurses in a Rural Community Health System
List your UVA School or Department affiliation *(e.g. Nursing, Medicine, etc.)*	Graduate School of Nursing
Name of the Division *(if applicable)* *(e.g. Anesthesia, Graduate Studies etc.)*	
Explain your role in the project: (200 words or less)	This is my DNP schlarly project, studying the effect of Mock stroke code education using simulation at the institution where I practice - Centra Health in Lynchburg, Virginia. The IRB at Centra has reviewed the study and given it exempt status.
Explain the reason for traveling to the outside institution.	I am a neurology NP in Lynchburg, and this research project is studying the effect of mock stroke code education with use of simulation at Centra Health.

INSTRUCTIONS: Complete the applicable option below:

Option A: Typically used by UVA personnel who are asked to assist with a research study after arriving at the non- UVA institution. (e.g., resident doing rotation at another institution)

Answer the following questions:

☐**Yes** ☐**No** I was involved in the design of this research project.
☐**Yes** ☐**No** A UVA IRB has approved this research. IRB-HSR/UVA Study Tracking #
☐**Yes** ☐**No** Funding to conduct this research will come from or through UVa.
☐**Yes** ☐**No** Working on this research is required for my degree program.

I confirm that:

☐**Yes** ☐**No** I am a student, employee or faculty member of the University of Virginia.
☐**Yes** ☐**No** My work on this project will be overseen by the Principal Investigator and the IRB at the outside institution. This includes completing any training in human subject research protection or other training as required by the outside IRB.
☐**Yes** ☐**No** I will communicate with the UVA IRB and UVA Contracts Office for my school, to determine what approvals may be needed, prior to receiving any data from the outside institution

Option B: Typically used by graduate students conducting their research outside of UVA.

I confirm that:

☒Yes ☐No I designed this research.
☒Yes ☐No I am a student, employee or faculty member of UVa but am employed by another institution.
☒Yes ☐No All subjects will be enrolled at this outside institution.
☒Yes ☐No Only de-identified data may be brought to UVA. If data is brought to UVA it will be protected according to UVA Data Security Policies.
☒Yes ☐No The research will be overseen by their IRB and, if applicable, their HIPAA Privacy Board. This includes completing any training in human subject research protections or other training as required by the outside IRB.
☒Yes ☐No There is no funding for this study or if there is funding, it will be handled by the non-UVA institution at which I am employed.
☒Yes ☐No I have notified the outside IRB that a UVA IRB will not be overseeing my work. ATTACH COPY OF THE OUTSIDE IRB APPROVAL/DETERMINATION.

Option C: Typically used by a person who will continue working on their research at their previous institution after transferring to UVA. No research protocol will be opened to enroll additional subjects at UVA.

I confirm that:

☐Yes ☐No I am a student, employee or faculty member of UVa but I was employed by another institution when the research was begun.

☐Yes ☐No All subjects were or will be enrolled at the outside institution & all data will remain there.

☐Yes ☐No The research will be overseen by a non-UVA IRB and, if applicable, the HIPAA Privacy Board of my previous institution. This includes completing training in human subject research protections or other training as required by the outside institution.

☐Yes ☐No There is no funding for this study or if there is funding, it will be handled by my previous institution.

☐Yes ☐No I have notified the IRB of Record that I have transferred to UVA and that a UVA IRB will not be overseeing my work on this research protocol.
ATTACH COPY OF THE OUTSIDE IRB APPROVAL/DETERMINATION.

Option D: Typically used by a UVa Faculty member who has an appointment or clinical privileges at another institution. Research to be conducted at outside institution. Research protocol will not be opened to enroll subjects at UVA facilities.

I confirm that:

☐Yes ☐No I am a faculty member of UVA and I have an appointment or clinical privileges at another institution.

☐Yes ☐No All subjects will be enrolled at the other institution and all data will remain there.

☐Yes ☐No The research will be overseen by a non-UVA IRB and, if applicable, the HIPAA Privacy Board of the other institution. This includes completing any training in human subject research protections or other training as required by the other institution.

☐Yes ☐No There is no funding for this study or if there is funding, it will be handled by the other institution.

☐Yes ☐No I have notified the IRB of Record that a UVA IRB will not be overseeing my work on this research protocol.
ATTACH COPY OF THE OUTSIDE IRB APPROVAL/DETERMINATION for this protocol.

FOR IRB-HSR OFFICE USE ONLY

☒ UVa personnel are not considered to be working as an Agent for UVa on this project.
No approvals from the UVa IRB-HSR are required.
UVA Study Tracking # 21111

☐ UVa personnel are considered to be working as an Agent for UVa on this project.
Submit a research application to the UVa IRB-HSR.

Karen Mills _____ 11-01-18
Signature of IRB Chair, Director or Designee Date

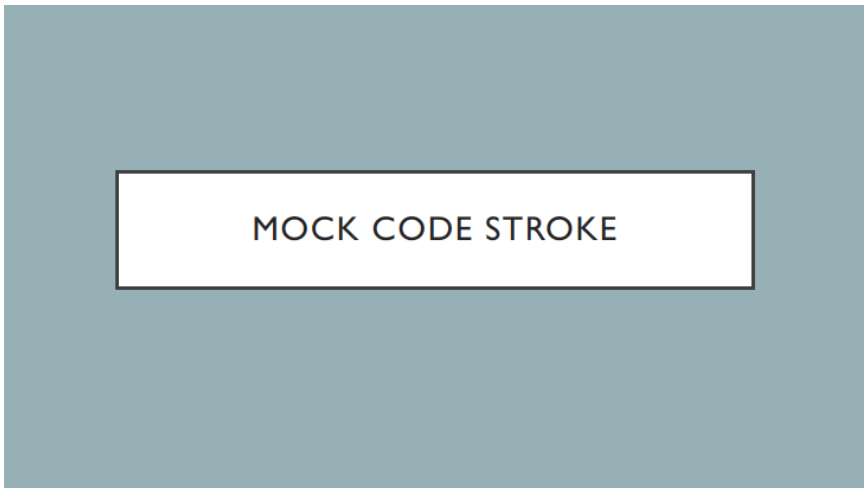
Website: http://www.virginia.edu/vpr/irb/hsr/index.html
Phone: 434-924-2620 Fax: 434-924-2932 Box 800483

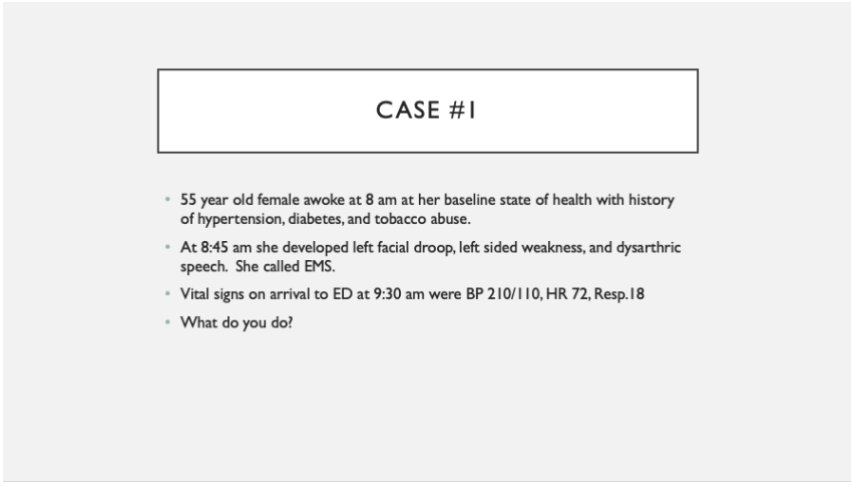
Version date: April 25, 2018
Page 3 of 3

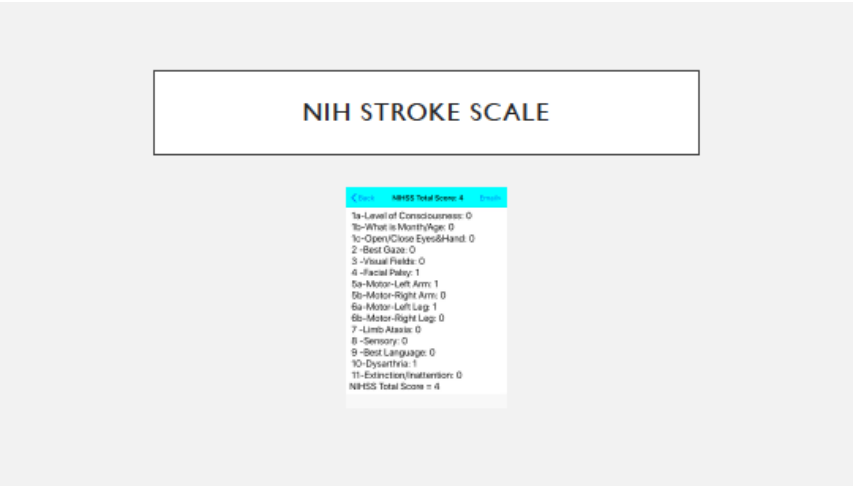
Figure 7. University of Virginia's Determination of Agency Form.

Appendix A

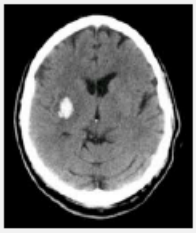
Case Scenario PowerPoint Slides

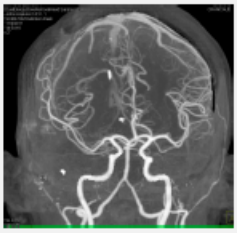






CT HEAD / CTA HEAD AND NECK

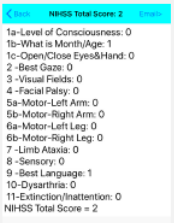




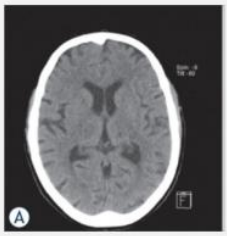
CASE #2

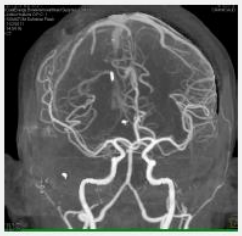
- 65 year old male awoke at 7:00 am at his baseline state of health, at 7:45 am his wife noticed that he was confused, but had no real weakness. She called EMS.
- Patient arrived to the ED at 8:15 and his neuro exam demonstrated moderate aphasia – primarily word finding difficulties..
- Vital signs on arrival to ED were BP 178/85, HR 65, Resp. 18
- What do you do?

NIH STROKE SCALE



CT HEAD / CTA HEAD AND NECK

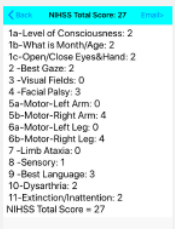




CASE #3

- 78 year old male awoke at 7:30 am at his baseline state of health, with a history of hypertension, diabetes, and CAD.
- At 9:30 am developed right sided weakness, facial droop, dysarthric speech and aphasia. EMS was summoned.
- Vital signs on arrival to ED at 10:30 am were BP 166/78, HR 82, Resp. 18
- Upon arrival to the ED patients right side was flaccid, he has right sided neglect, he is non-verbal, and arousable only by mild stimulation
- What do you do?

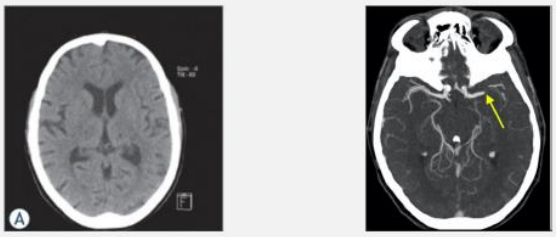
NIH STROKE SCALE



Back NIHSS Total Score: 27 Email+

1a-Level of Consciousness: 2
1b-What is Month/Age: 2
1c-Open/Close Eyes&Hand: 2
2 -Best Gaze: 2
3 -Visual Fields: 0
4 -Facial Palsy: 3
5a-Motor-Left Arm: 0
5b-Motor-Right Arm: 4
6a-Motor-Left Leg: 0
6b-Motor-Right Leg: 4
7 -Limb Ataxia: 0
8 -Sensory: 1
9 -Best Language: 3
10-Dysarthria: 2
11-Extinction/Inattention: 2
NIHSS Total Score = 27

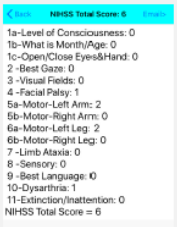
CT HEAD / CTA HEAD AND NECK



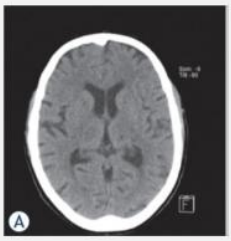
CASE #4

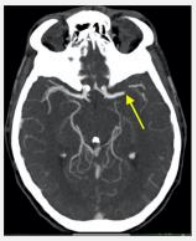
- 75 year old male presented to the ED at 8:30 am with LUE and LLE weakness, left facial droop, and dysarthric speech.
- Symptom onset time per EMS was 7:30 am.
- The patient lives by himself. The family arrives to the ED and state they found him at 7:30 am.
- Vital signs on arrival to ED were BP 178/80, HR 72, Resp. 18
- What do you do?

NIH STOKE SCALE



CT HEAD / CTA HEAD AND NECK

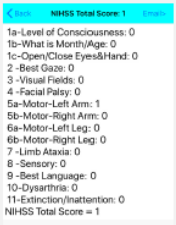




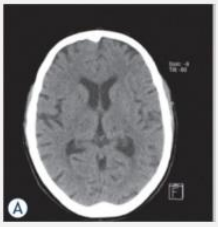
CASE #5A

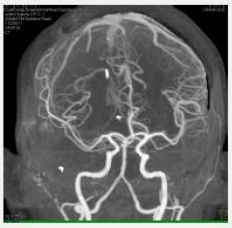
- 90 year old male awoke at 8 am at his baseline state of health with history of hypertension and diabetes.
- At 8:45 am he developed weakness of his left hand and arm only.
- Vital signs on arrival to ED at 9:30 am were BP 166/98, HR 70, Resp.10
- What do you do?

NIH STROKE SCALE



CT / CTA HEAD AND NECK

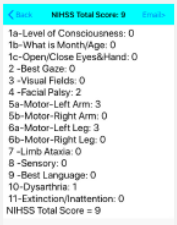




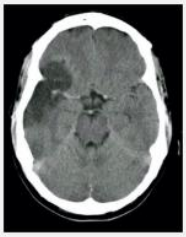
CASE #5B – HOSPITAL DAY #2

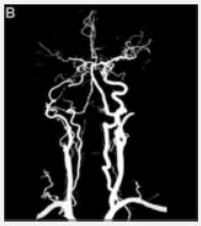
- The patient is admitted for a stroke work-up.
- At 11:00 am on day #2 the patient is found with flaccid LUE, LLE and with left facial droop and dysarthric speech. Last know well time is 6:00 am
- Vital signs are stable.
- What would you do?

NIH STROKE SCALE



CT HEAD / CTA HEAD AND NECK





Appendix B

Stroke Code Simulation #1 – Scenario, Set Up, and Supplies

Code Stroke Simulation #1 - Set Up and Supplies

Vitals (Initial state on arrival to ED)	**Patient History**
• HR : 110 BP: 155/80 • Pulse Ox: 99% on room air • RR: 23 • 12lead EKG: Afib	• History of AFib • Initially, only home medication is digoxin. The family member later finds prescription bottle of Eliquis in the patient's coat pocket.

Labs or XRays available

- Blood Glucose: 80
- PT:1 3
- INR: 1.5
- Platelets: 200
- PTT: 32
- BUN: 8
- Creatinine: 0.6
- Troponin: 0.1

Supplies Needed

- Patient Armband
- Patient Labels
- IV tubing, 2 needles, 2-30 ml syringes
- TPA
- NIHSS book
- DATA collection sheet
- Stroke assessment tools
- Paper clip

Moulage

- Patient is in street clothes
- Jacket with prescription bottle of **Eliquis** in the pocket-Have family member carry jacket
- **Patient has IV in place**

EMS Provided Background Information

Symptoms started:

- The sister left 2 hours ago and says the patient was normal at that time. She left to go shopping and returned 2 hours later to find the patient unable to communicate and slumped over in the chair. It has taken 30 minutes to get the patient to the ED so the total time since symptom onset is now 2.5 hours.
- Sister says the patient digoxin for irregular HR but no blood thinners.
- VS in route:
  - HR 100 AFib
  - BP 140/65 O2 Sats: 97% on room air RR 19
- Review patient assessment:
  - When EMS arrived, patient was conscious but not able to speak and right sided weakness was noted. Right facial droop was noted as well.
- You, as the code stroke nurse, were able to place a working IV.

Appendix C

Stroke Code Simulation #1 – Standardized Patient

Code Stroke Simulation #1 – Standardized Patient

Overall Scenario Description

You are a patient showing signs of a stroke. You were at home when your sister came back from shopping and found you not feeling well. The rescue squad brought you to the Emergency Room and the nurses are there to figure out what is going on.

You are unable to stand, unable to move the right arm and the right leg is very weak. You are unable to speak. You can moan but cannot say words. You are confused and when the nurse asks you a question, you cannot understand her so you can't shake your head to answer. Since you can't communicate, your sister who is with you will have to answer the questions about your health and medicines you take.

The nurses will be trying to assess you by asking you questions which you can't answer. If they **demonstrate** something, such as "raise your arm" or "make a fist" then you can follow what they are showing you. The nurse will ask you to open and close your eyes. You can do this once you see the nurse showing you what to do.

Role Description

Objectives of Scenario:

- The nurse will perform an assessment on you to see if you are having a stroke.
- The nurse will practice calling the doctor and ordering appropriate test for you.
- When the nurse finds the prescription bottle of medicine in the coat pocket, she/he will understand that you are not able to get the TPA medicine for the stroke.

General information regarding role:

You are lying in a hospital bed awake and able to make eye contact. You are looking mostly to the left side because you can't see on the right side. You are completely unable to speak at all and cannot move your right arm. The right leg is very weak and you can't lift it off the bed. Your right side is numb, so when the nurses pretend to pinch your right arm or right leg, you don't respond. You are unable to nod appropriately to questions and continue to look to the left. The left arm and left leg are moving and strong. You can't follow all commands but you are able to follow demonstrations and seem to be able to feel sensations on the left side during the nurse's assessment. The right side of your face is weak.

Examples of phrases and words to use:
Completely unable to speak, moans at times, not able to follow commands but follows demonstrations (raises the left arm when the nurse demonstrates the task).

Somewhat confused, you can't understand what the nurses are saying.

You are able to move the left side whenever you feel like it.

Demographic Information
You were visiting with your sister when symptoms started. Not married, no children.

Description of Affect or Behavior
You appear scared and shocked. You are anxious about what is happening but trying hard to stay calm and cooperate.

Physical Description
General appearance/ grooming: clean, neat appearance. Appears to have good hygiene and is well taken care of.

Dress: Casual attire, wearing light jacket with pockets.

Appendix D

Stroke Code Simulation #1 – Standardized Patient's Family Member

Code Stroke Simulation #1 – Family Member

Overall Scenario Description:

You are the sister of the patient. You were out shopping and arrived home to find the patient sitting in the recliner chair unable to communicate with you. The patient appeared scared and confused and you also noticed right arm and leg weakness. You called EMS and arrived with the patient to the Emergency Room.

You are somewhat anxious. You don't know when the symptoms started, but you left to go shopping from your house 2 hours ago and your family member was doing OK before you left at that time. You know that your family member has a history of A-fib and takes digoxin but you don't know of any other medical history.

General Information regarding your role:

You are feeling nervous but trying to calm your family member. You are asking a lot of questions and trying to hold your family members hand.

You are physically getting in the way until the nurses are forced to respond. Once they address your behavior, you step aside.

The nurses will be asking you questions about the patient because the patient is unable to communicate. The patient has no other family members and you are the closest relative. You don't know all the medical history but you know the patient has A-fib and takes digoxin. You don't think the patient takes any blood thinners. You are holding the patient's jacket which has a bottle of Eliquis in the pocket. You will find this bottle of Eliquis and show it to the nurses only AFTER they have performed NIHSS, called the physician, verbalized head CT was done and Alteplase has been ordered.

Appendix E

Stroke Code Simulation #1 – Emergency Department Nurse

Code Stroke Simulation #1 – ED Nurse

ED Nurse's Role:

- Verbalize IV is in place and patent
- Verbalize labs have been drawn
- Connect patient to monitor and obtain vitals
- May assist with obtaining history and reassuring/educating patient
- Assist with obtaining patient's weight.
- Patient weighs 70 kg

Patient's Labs and Diagnostics:

Lab

- BG: 80
- PT:13
- INR: 1.5
- PLT: 200
- PTT: 32
- BUN 8
- Creatinine: 0.6
- Troponin: 0.1

12 Lead ECG: HR 110 AFib

Results: Head CT Negative, resulted at 10:12

Appendix F

Stroke Code Simulation #1 – Stroke Code Nurse

Code Stroke Simulation #1 – Code Stroke Nurse

Introduction

A woman arrives home after shopping to find her family member sitting in the recliner chair with a look of frustration and panic. When she asks what is wrong, the family member is unable to answer her. She notices also that the family member is unable to stand and the right side is not moving. She calls 911 and EMS arrives. The patient is in route and a Code Stroke was activated. EMS has now arrived with the patient.

Additional Information

Situation:

- A patient with aphasia and severe right sided weakness is in the ED.
- Family is not sure when symptoms started, but saw the patient at baseline 2 hours ago.
- A ***Code Stroke*** was activated to evaluate the patient for stroke and Alteplase criteria.
    - Vital Signs:
        - **HR**: 110 (A-fib)
        - **BP:** 155/80
        - **Pulse Ox:** 99% on room air
        - **RR:** 23

Staff involved:

- EMS
- Code stroke nurse 1
- Code Stroke nurse 2
- ED Nurse

If you have any questions, please direct them to the Educator working with you during your experience.

Appendix G

Stroke Code Simulation #1 – Facilitator Worksheet

Code Stroke Simulation #1 - Facilitator Worksheet

Introduction

A woman arrives home after shopping to find her family member sitting in the recliner chair with a look of frustration and panic. When she asks the family member what is wrong, the family member is unable to answer her. She notices also that the family member is unable to stand and the right side is not moving. She calls 911 and EMS arrives. The patient is in route and a code stroke was activated. EMS has now arrived with the patient.

Objectives

- The nurse will evaluate the patient for stroke and TPA criteria by performing NIHSS and obtaining patient history.
- The nurse will effectively communicate the patient's condition to the neurologist.
- The nurse recalls Eliquis incompatibility with TPA.
- The nurse will follow AHA guidelines for the time frame of AIS management.

Scenario Flow

- Code stroke nurse obtains information from EMS and patient regarding time of symptom onset and time last known well.
- Nurse calms patient and family by explaining assessment for possible stroke and time sensitivity.
- Obtains vital signs
- ED nurse assesses IV and draws labs
- Code stroke nurse and ED nurse facilitate head CT as quickly as possible.
- Code stroke nurse performs NIHSS
- Notify neurologist
- Nurses obtain weight
- Patient's sister finds prescription bottle for Eliquis which belongs to the patient. This happens AFTER the NIHSS is performed, physician has been called, and tPA is ordered.

Labs/Diagnostics/VS:

- Blood Glucose: 80 Head CT is negative, Head CTA pending
- PT:13
- INR: 1.5
- Platelets: 200
- PTT: 32
- BUN 8
- Creatinine: 0.6
- Troponin: 0.1
- HR : 110 BP: 155/80 Pulse Ox: 99% on room air RR: 23

NIHSS Scoring:

- 1a. - 0
- 1b. - 2
- 1c. - 0
- 2. - 1
- 3. - 2
- 4. - 1
- 5a. - 0
- 5b. - 4
- 6a. - 0
- 6b. - 3
- 7. - 0
- 8. - 2 (cannot feel on right side)
- 9. - 3
- 10. - 2
- 11. - 2
- For a total score of 22

Pre-Briefing Points

- Confidentiality and Video Recording agreement signed within a year
- Standardized patient overview: safe word is "Johanna", treat them like a real patient
- Room overview ("real" air/oxygen, phone, resources on paper is the room)
- Expectations (Do real things, don't just talk about it, don't speed up time)
- If you need to assess sensation by pinching the patient, just verbalize "I am pinching your arm to see if you can feel on this side." Do not actually pinch the actor!

Debriefing Points

- What went well during this scenario?
- What did you find was the most challenging?
- What would you have done differently?
- Describe the difference between time of symptom onset and last known well time.
- Time frame for administering TPA: Alteplase (IV r-tPA) within 4.5 hours of stroke onset remains the standard of care for most ischemic stroke patients.
- Additional exclusion criteria Between 3 and 4.5 hours:
  - Age >80 years
  - Severe stroke (NIHSS > 25)
  - History of diabetes and prior stroke
  - Taking an oral anticoagulant regardless of INR

What does the code stroke nurse need to communicate to the neurologist?

- Situation:
  - Your name, patient name, date of birth, medical record number
  - Why you are calling: " I am with this patient who has just arrived to the ED and I am evaluating for stroke intervention."
- Background: When symptoms started and when was last known well time.
  - Pertinent medical history and medications taking
  - What is the patient's baseline function
- Assessment: Give your NIHSS scoring, describe the deficits you have found.
  - Give lab values you have received and what is still pending.
- Recommendation: What do you think the next steps should be? It is Ok to say, "I am looking for your recommendation on how to proceed".

- When communicating, used closed loop communication. Repeat the order and ask questions if you are unsure what to do next.

- Discuss exclusion criteria:
  - Current severe uncontrolled HTN
    - Blood pressure >185 systolic, >110 diastolic
    - What can you do if the patient's BP is elevated?

Other Debriefing Questions:

- What are some examples of intraspinal/intracranial conditions in which we would NOT want to give tPA?
  - Recent (within 3 months) intracranial or intraspinal surgery or serious head trauma, presence of intracranial conditions that may increase the risk of bleeding (e.g., some neoplasms, arteriovenous malformations, or aneurysms)

- What does the term "bleeding diathesis" mean? Ask for some examples?
  - Bleeding diathesis:
    - Acquired: certain medications (coumadin) liver failure, vitamin K deficiency, leukemia
    - Autoimmune or genetic causes
  - All of the NOACs (new oral anticoagulation) would be exclusion for tPA.
  - Arterial puncture at non-compressible site within 7 days

- What lab values would you want to know in evaluating this patient for tPA?
  - Platelet <100,000, INR >1.7, PT >15, BG <50

- Can a patient receive tPA if taking Coumadin?
  - Yes if:
    - A platelet count <100,000/mm3,
    - International normalized ratio (INR) < 1.7

    - No if:
        - Have a history of warfarin use and an INR >1.7

- Other contraindications to tPA:
    - Have received a treatment dose of low-molecular-weight heparin within the previous 24 hours
    - Who are taking direct thrombin inhibitors or direct factor Xa inhibitors, unless the laboratory tests are normal or the patient has not received a treatment dose of these agents for >48 hours

- This patient was prescribed Eliquis. Was the patient a candidate for tPA?

- What is the next step for this patient?

Appendix H

Stroke Code Simulation #2 – Scenario, Setup, and Supplies

Code Stroke Simulation #2 - Set Up and Supplies

Vitals (Initial state on arrival to ED)	**Patient History**
• HR: 110, • BP: 140/76, • RR: 20 • O2: 95% on RA	• The patient has high blood pressure and takes lisinopril daily • Patient began to have symptoms of stroke 45min. ago. • Symptoms include: left facial weakness, left arm weakness, slurred speech, numbness/tingling in left arm and left face.

Labs or XRays available

- PT/INR= 1.0,
- Platelets = 170,
- Blood Glucose = 106,
- BUN = 8,
- Creatinine = 0.6
- CT head: negative
- CTA head: pending
- 12 lead: HR 110 NSR
- Weight: 76.2 kg

Supplies Needed

- IV pump
- IV tubing
- 10ml syringe, 30ml syringe, 2 needles
- TPA
- Stroke assessment tools
- Data form
- Arm band
- Patient labels

Moulage

- Patient has IV in place
- Patient can wear gown or street clothes

EMS Provided Background Information

- You were called to the patient's home and when you arrived you noted that the patient had a left facial droop and left arm weakness.
- The patient and the patient's sister say that the symptoms started about 45minutes ago.
- The patient has slurred speech but was able to tell you her started to feel "funny" about 45 minutes from the present time.
- The sister was with the patient when symptoms started.
- Vitals were stable in route and the patients was in NSR in route to the hospital.
- You have listed that the patient stated a history of hypertension and the only med they take is lisinopril 10mg BID. The patient did not take lisinopril this AM.
- You, as the code stroke nurse were able to have placed a working IV.

Appendix I

Stroke Code Simulation #2 – Standardized Patient

Code Stroke Simulation #2 – Standardized Patient

Overall Scenario Description

You are a patient in the ED with signs of a stroke. You have a medical history of high blood pressure and take a medication called lisinopril twice per day. When you woke this morning you were feeling normal, but 45 minutes ago you started to feel "funny" while watching TV at home. Your sister was visiting and was with you in the living room.

You are feeling nervous about what is happening and you have **weakness on the left side of your face and some weakness of the left arm**. Your **speech is very slurred**, but still understandable. **You can lift the left arm but are not able to hold it up except for a few seconds.**

As the nurse does her assessment, you notice that you are also having some **tingling and numbness in the left arm and left face** as well.

Role Description

Objectives of Scenario:

- The nurses will perform an assessment on you to see if you are having a stroke. The nurse will ask you to answer some simple questions and have you perform some simple tests.
- The nurses are practicing their assessment skills as well as preparing a medication given to patients with a stroke.
- They will calculate the dose of medicine based on the weight.

General information regarding role:

You were at home with your sister when your symptoms started. You are feeling nervous about what is going on. You can answer all questions appropriately but your speech is slurred. You do not like coming to the hospital, but your sister made you come in. You are having weakness of the left arm. You can lift the left arm, but can only hold it up for 2 seconds. Your left leg is a little weak but you can hold it up for 5 seconds when the nurse asks you to. When the nurse tests sensation, you say you are experiencing numbness and tingling on the left face and left arm.

Examples of phrases and words to use:

"How long will I have to stay here?"

"I felt fine when I woke up this morning, but then I started to feel funny when I was watching the news."

"When can I have something to drink?"

Demographic Information
Not married, no children, only family is the sister

You live by yourself.

Description of Affect or Behavior
Anxious

You dislike hospitals and doctors

Ready to go home

Physical Description
General appearance/ grooming: Well groomed, able to take good care of yourself

Dress: casual comfortable clothing

Appendix J

Stroke Code Simulation #2 – Standardized Patient's Family Member

Code Stroke Simulation #2 – Family Member

Overall Scenario Description:

You are the sister of the patient and were with the patient when symptoms started. You and your family member were watching TV at home when you noticed that the family member started to slur words. You noticed that you were having trouble understanding them and that their face looked different. You are very anxious and concerned. You know what medications your family member takes: *lisinopril.* You know that they have high blood pressure. When asked when the symptoms started you say you aren't sure but you think about an hour ago.

General Information regarding your role:

You are nervous and scared about what is happening. You are trying to remain calm and you are asking a lot of questions:

- "What is going on?"
- "I don't understand why this is happening."
- "Do you think everything will be OK?"
- "Why do you have to draw so much blood?"
- "I shouldn't have left the house this morning! I should have stayed with (him/her)."

Appendix K

Stroke Code Simulation #2 – Emergency Department Nurse

Code Stroke Simulation #2 – ED Nurse

ED Nurse's Role:

- Verbalize IV is in place and patent
- Verbalize labs have been drawn
- Connect patient to monitor and obtain vitals
- May assist with obtaining history and reassuring/educating patient
- Assist with obtaining patient's weight.
- Patient weighs 76.2 kg

Lab Results:

- PT/INR = 1.0
- PTT = 28
- Platelets = 170
- Blood Glucose = 106
- BUN = 8
- Creatinine = 0.6
- Troponin = 0.01

12 Lead ECG: NSR, HR 110 (resulted at 11:08)

Head CT result: Negative (resulted at 11:20)

Appendix L

Stroke Code Simulation #2 – Stroke Code Nurse

Code Stroke Simulation #2 – Code Stroke Nurse

Introduction

This is a patient with history of hypertension. The patient developed sudden onset of slurred speech while watching TV. The patient's sister recognized abnormal speech and left facial droop. EMS was called and upon assessment, a left facial droop was noted as well as left arm drift. The patient arrived to the ED and has head CT ordered.

Additional Information

Situation:

- The patient started to feel "funny" about 45 minutes ago.
- The sister of the patient was present when symptoms started.
- The sister noted that the patient had left arm weakness and difficulty speaking and called EMS.
- A ***Code Stroke*** is activated to evaluate the patient for stroke and Alteplase
    - **Vital Signs:** See patient monitor for VS, they appear to be stable.
- The beds do not actually weigh the patient. State you are getting the weight and the educator with give you the number.
- The ED nurse will give you the lab values as well as 12 lead.
- Verbalize you are taking the patient to head CT, we will not actually take the patient out of the room

If you have any questions, please direct them to the Educator working with you during your experience.

Appendix M

Stroke Code Simulation #2 – Facilitator Worksheet

Code Stroke Simulation #2 – Facilitator Worksheet

Introduction

The patient present to the ED with stroke symptoms and has history of hypertension. The patient developed sudden onset of slurred speech while watching TV. The sister recognized abnormal speech and left facial droop. EMS was called and upon assessment, a left facial droop was noted as well as left arm drift. The patient arrived at the ED and has already had a CT/CTA completed. The ED physician has performed NIHSS and scored a 6. The code stroke nurse will also assess the patient to confirm results. CT was negative.

Objectives

- Calculate appropriate total dose, waste, and bolus of TPA based on the patient's weight.
- Demonstrate reconstitution of Altepase.
- Demonstrate discarding waste amount of TPA, administration of bolus and infusion of TPA on IV pump using drug library.

Scenario Flow

- The ED nurse provides history and background story of the patient.
- Code stroke nurses introduce themselves to the patient and explain their role.
- Nurses perform NIHSS and confirm lab results and CT results with ED nurse.
- Nurse notifies neurologist.
- TPA is ordered.
- Nurses confirm working IV.
- Nurses weight patient and calculate TPA dose.
- TPA is administered appropriately.

Lab/Diagnostics/VS:

- INR = 1.0, 12lead: NSR, HR 110
- Platelets = 170,
- Blood Glucose = 106,
- BUN = 8,
- Creatinine = 0.6
- VS: HR 110, BP 140/76, RR20, O2: 95% on RA
- **Weight = 76.2KG**

Pre-Briefing Points

- Perform NIHSS
- Confidentiality and Video Recording agreement signed within a year
- Standardized patient: treat as you would a real patient. Safe word is "Johanna"
- Room overview ("real" air/oxygen, phone)
- Expectations (Do real things, don't just talk about it, don't speed up time)
- The beds do not weight the patient. Verbalize "I am weighing the patient" and educator will tell you what the weight is.
- The ED nurse will give you the lab values as well as 12 lead.
- Verbalize you are taking the patient to head CT, we will not actually take the patient out of the room

Debriefing Points

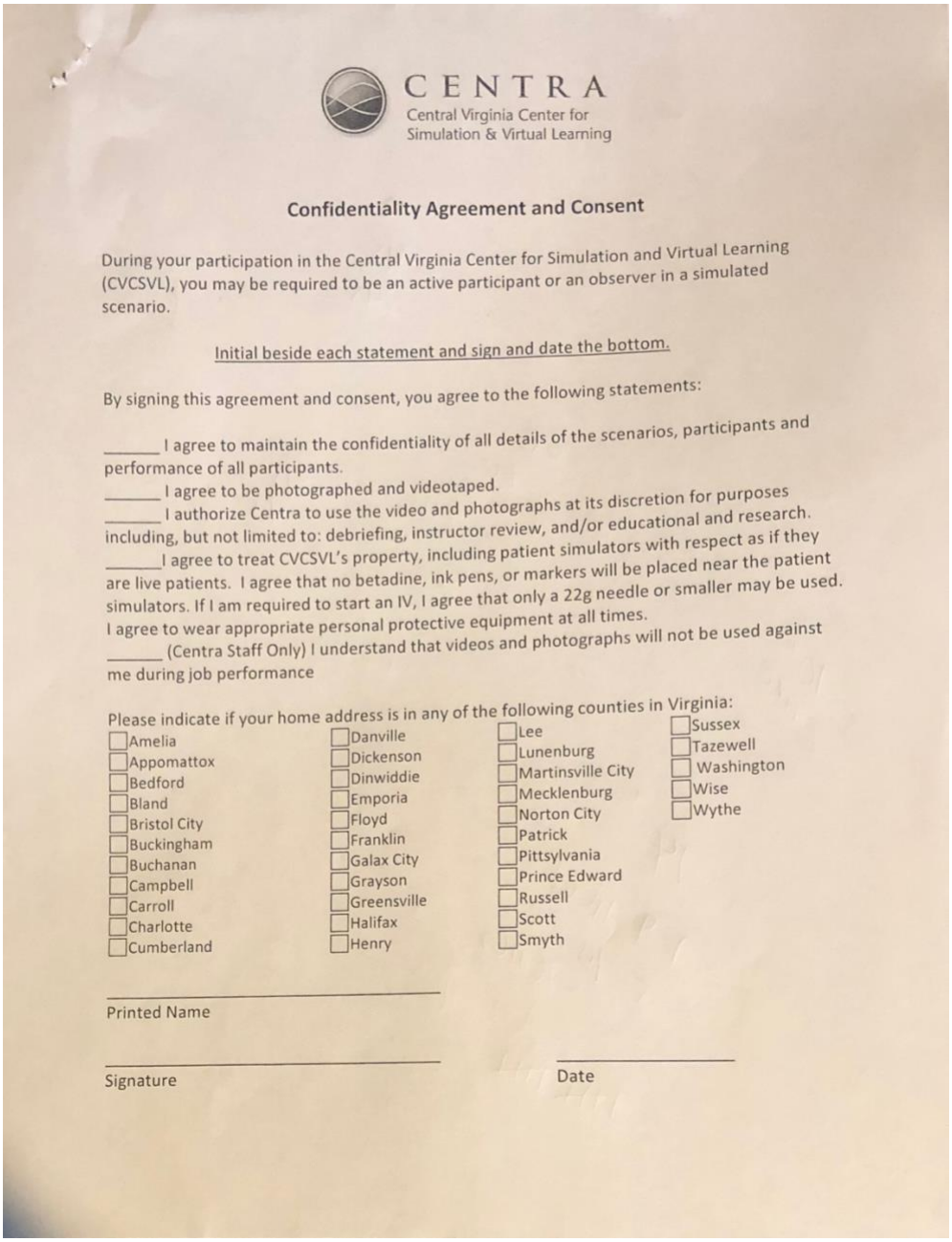
- **What went well during this scenario?**
- **What was the most challenging part of this scenario?**
- **What did you notice about the RNs assessment of the patient?**
- **How do you think the patient felt?**
- **What would you have done differently?**

- What is the Golden Hour of Acute Ischemic Stroke?
  - DTN ≤ 60min
  - 10 min: initiate MD evaluation and labs
  - 15min: notify stroke team including neurologist
  - 25min: CT/CTA initiated, history and time of onset, NIHSS
  - 45min: give Alteplase bolus and infusion
- **Was TPA mixed appropriately?**
  - **What was the total dose?** 76.2kg = 69mg
  - **What was waste?** 31mg **What was bolus?** 7mg **Infusion?** 69mg/hour
  - **Was the drug library used?**
  - **What is the highest total dose of TPA?** 90mg

- **Consider if this patient's head CT read positive for large vessel occlusion. What would be your next action?**
- **Consider if this patient's head CT read positive for small area of hemorrhage. What would be you next action?**

Appendix N

Simulation and Learning Center Confidentiality Agreement



CENTRA
Central Virginia Center for
Simulation & Virtual Learning

Confidentiality Agreement and Consent

During your participation in the Central Virginia Center for Simulation and Virtual Learning (CVCSVL), you may be required to be an active participant or an observer in a simulated scenario.

Initial beside each statement and sign and date the bottom.

By signing this agreement and consent, you agree to the following statements:

_____ I agree to maintain the confidentiality of all details of the scenarios, participants and performance of all participants.
_____ I agree to be photographed and videotaped.
_____ I authorize Centra to use the video and photographs at its discretion for purposes including, but not limited to: debriefing, instructor review, and/or educational and research.
_____I agree to treat CVCSVL's property, including patient simulators with respect as if they are live patients. I agree that no betadine, ink pens, or markers will be placed near the patient simulators. If I am required to start an IV, I agree that only a 22g needle or smaller may be used. I agree to wear appropriate personal protective equipment at all times.
_____ (Centra Staff Only) I understand that videos and photographs will not be used against me during job performance

Please indicate if your home address is in any of the following counties in Virginia:

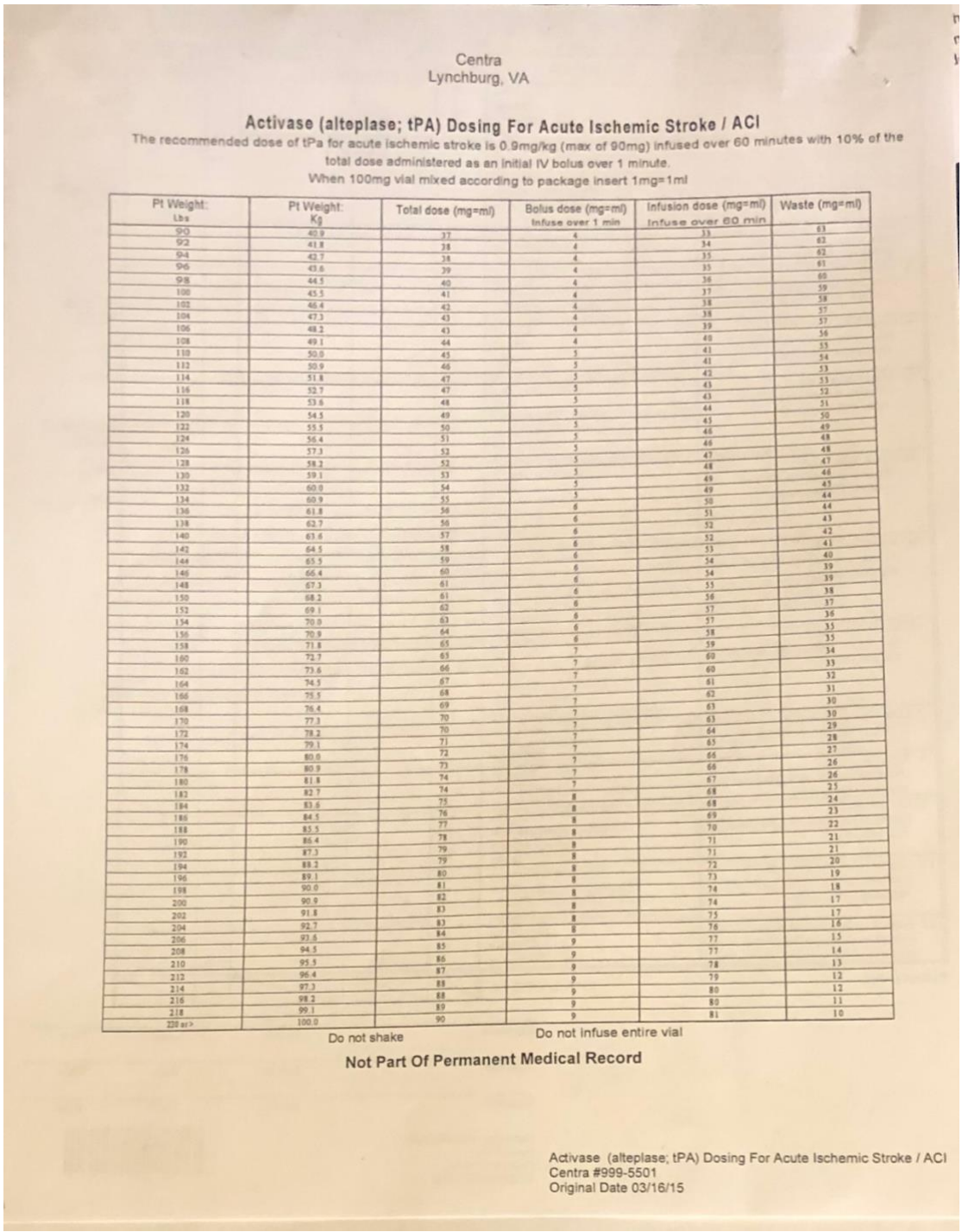
- ☐ Amelia
- ☐ Appomattox
- ☐ Bedford
- ☐ Bland
- ☐ Bristol City
- ☐ Buckingham
- ☐ Buchanan
- ☐ Campbell
- ☐ Carroll
- ☐ Charlotte
- ☐ Cumberland
- ☐ Danville
- ☐ Dickenson
- ☐ Dinwiddie
- ☐ Emporia
- ☐ Floyd
- ☐ Franklin
- ☐ Galax City
- ☐ Grayson
- ☐ Greensville
- ☐ Halifax
- ☐ Henry
- ☐ Lee
- ☐ Lunenburg
- ☐ Martinsville City
- ☐ Mecklenburg
- ☐ Norton City
- ☐ Patrick
- ☐ Pittsylvania
- ☐ Prince Edward
- ☐ Russell
- ☐ Scott
- ☐ Smyth
- ☐ Sussex
- ☐ Tazewell
- ☐ Washington
- ☐ Wise
- ☐ Wythe

_____
Printed Name

_____ _____
Signature Date

Appendix O

Intravenous tPA Dosing for Acute Ischemic Stroke



Centra
Lynchburg, VA

Activase (alteplase; tPA) Dosing For Acute Ischemic Stroke / ACI

The recommended dose of tPa for acute ischemic stroke is 0.9mg/kg (max of 90mg) infused over 60 minutes with 10% of the total dose administered as an initial IV bolus over 1 minute.
When 100mg vial mixed according to package insert 1mg=1ml

Pt Weight: Lbs	Pt Weight: Kg	Total dose (mg=ml)	Bolus dose (mg=ml) Infuse over 1 min	Infusion dose (mg=ml) Infuse over 60 min	Waste (mg=ml)
90	40.9	37	4	33	63
92	41.8	38	4	34	62
94	42.7	38	4	35	62
96	43.6	39	4	35	61
98	44.5	40	4	36	60
100	45.5	41	4	37	59
102	46.4	42	4	38	58
104	47.3	43	4	38	57
106	48.2	43	4	39	57
108	49.1	44	4	40	56
110	50.0	45	5	41	55
112	50.9	46	5	41	54
114	51.8	47	5	42	53
116	52.7	47	5	43	53
118	53.6	48	5	43	52
120	54.5	49	5	44	51
122	55.5	50	5	45	50
124	56.4	51	5	46	49
126	57.3	52	5	46	48
128	58.2	52	5	47	48
130	59.1	53	5	48	47
132	60.0	54	5	48	46
134	60.9	55	5	49	45
136	61.8	56	6	50	44
138	62.7	56	6	51	44
140	63.6	57	6	52	43
142	64.5	58	6	52	42
144	65.5	59	6	53	41
146	66.4	60	6	54	40
148	67.3	61	6	54	39
150	68.2	61	6	55	39
152	69.1	62	6	56	38
154	70.0	63	6	57	37
156	70.9	64	6	57	36
158	71.8	65	6	58	35
160	72.7	65	7	59	35
162	73.6	66	7	60	34
164	74.5	67	7	60	33
166	75.5	68	7	61	32
168	76.4	69	7	62	31
170	77.3	70	7	63	30
172	78.2	70	7	63	30
174	79.1	71	7	64	29
176	80.0	72	7	65	28
178	80.9	73	7	66	27
180	81.8	74	7	66	26
182	82.7	74	7	67	26
184	83.6	75	8	68	25
186	84.5	76	8	68	24
188	85.5	77	8	69	23
190	86.4	78	8	70	22
192	87.3	79	8	71	21
194	88.2	79	8	71	21
196	89.1	80	8	72	20
198	90.0	81	8	73	19
200	90.9	82	8	74	18
202	91.8	83	8	74	17
204	92.7	83	8	75	17
206	93.6	84	8	76	16
208	94.5	85	9	77	15
210	95.5	86	9	77	14
212	96.4	87	9	78	13
214	97.3	88	9	79	12
216	98.2	88	9	80	12
218	99.1	89	9	80	11
220 or >	100.0	90	9	81	10

Do not shake

Do not infuse entire vial

Not Part Of Permanent Medical Record

Activase (alteplase; tPA) Dosing For Acute Ischemic Stroke / ACI
Centra #999-5501
Original Date 03/16/15

Appendix P

Author Guidelines for Clinical Simulation in Nursing

The *Journal of Neuroscience Nursing* (JNN) is a peer reviewed journal published bimonthly online and in print. JNN is committed to provide evidence-based clinically applicable research to neuroscience practitioners and readers who care for patients with neurological disorders. The JNN accepts manuscripts for exclusive publication:

- The peer review is double blind and the author and institution names should only be on the sperate title page file, but not in any other files or names.
- Manuscripts are limited to ≤ 2,500 words not including the abstract, tables and references. Manuscripts should be consistent with AMA Manual Style (10th ed.) guidelines
- Abstract length should be consistent with the AMA Manual of Style (10th ed.) guidelines (150-400 words).
- Only 2 tables, or 2 figures, or 1 table and 1 figure will be included in the print version of the manuscript.
- Stedman's Medical Dictionary is to be used for correct spellings. Abbreviate only after term has been used in full with abbreviation in parentheses.
- Do not use author name(s) anywhere in text.

On a separate sheet, list both work and home addresses, telephone numbers, fax numbers, email address, educational credentials, current position, and title for each author.

All relevant conflicts of interest and sources of funding should be included on the title page of the manuscript with the heading "Conflicts of Interest and Source of Funding:".

- Authors must state all possible conflicts of interest in the manuscript, including financial, consultant, institutional and other relationships that might lead to bias or a conflict of interest.
- If there is no conflict of interest, this should also be explicitly stated as none declared.
- All sources of funding should be acknowledged in the manuscript.

Each author must complete and submit the journal's copyright transfer agreement, which includes a section on the disclosure of potential conflicts of interest based on the recommendations of the International Committee of Medical Journal Editors, "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" (www.icmje.org/update.html).

The journal uses AMA style for citations and references. All references should be numbered in the order in which they appear in the text. Follow AMA style guidelines (AMA Manual of Style: A Guide for Authors and Editors, 10th ed.) and abbreviate journal names as they appear in PubMed. List up to 6 authors/editors; if there are more than 6, list on the first 3 followed by "et al."

Mock Stroke Code Simulation for Registered Nurses in a Community Health System

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The authors declare that there is no conflict of interest

Abstract

Background and Purpose: Nurses play a key role in rapid identification, critical treatments, and timely care of patients with acute stroke. Although nurses are best placed to identify signs and symptoms of stroke, they may not be prepared to activate or participate in a stroke code due to lack of knowledge and self-confidence. The use of simulation in nursing education can increase knowledge and self-confidence when caring for acutely ill neurological patients. The purpose of this quality improvement project was to evaluate if participation in mock stroke code simulation increased a registered nurse's perception of knowledge and self-confidence when engaged in a stroke code in an acute care rural community hospital.

Methods: This study was a quality improvement project using a pre- and post-intervention to measure a nurses' knowledge and self-confidence after participating in a single 4-hour mock stroke code high-fidelity simulation. Participants completed a pre- and post- simulation questionnaire assessing stroke knowledge and self-confidence.

Results: 11 registered nurses participated in the quality improvement project. There was significant improvement ($p < .001$) in both knowledge and self-confidence scores pre- to post-simulation.

Conclusion: Participation in a single high-fidelity mock stroke code simulation showed improvement in knowledge and self-confidence scores in a rural community hospital. Based on the results of this quality improvement project, a study evaluating nurse led stroke code teams working with emergency department or tele-medicine physicians in underserved or non-stroke certified hospitals could be conducted to evaluate the impact on management of care on acute stroke patients in rural or underserved areas.

Key Words: Stroke Code, Simulation, Self-confidence, Self-efficacy, Nursing Education.

INTRODUCTION

Stroke is a leading cause of disability and the 5th leading cause of death accounting for approximately 1 of every 19 deaths in the United States.[1] Nurses play a key role in rapid identification, critical treatments, and timely care of patients with acute stroke.[2-4] Emergency department (ED) nurse-activated stroke codes improve both process and clinical outcomes in the ED setting.[5] Nurses identify in-hospital ischemic stroke with a similar percentage as physicians and activate stroke codes significantly earlier.[6] Use of nurse-initiated stroke codes could increase efficiencies in caring for patients in rural communities with lack of primary stroke centers.[2] Although nurses are best placed to identify signs and symptoms of stroke, they may not be prepared to activate a stroke code due to lack of knowledge and or self-confidence.[7-8] Educational interventions and training that utilizes simulation aimed at registered nurses improves timeliness of initiating care for acute stroke patients.[9-10]

Simulation is a technique that can utilize technology for interactive practice and learning that has a real world feel and can be utilized to develop a health professionals' assessment, diagnosis and treatment, decision making, and technical skills.[11-12] Simulation as a technique has been shown to deliver training without compromising patient safety.[12-14] Experts agree that simulation training in evaluation of acutely ill neurological patients is an important educational tool.[11,13]

A literature review conducted in 2016 identified 17 studies investigating the effects of simulation training on knowledge and self-confidence among critical care providers. Twelve of the 17 studies concluded that high-fidelity simulation is a useful tool for improving self-confidence.[15] In 2014 a meta-analysis of 43 studies asking the question of "What is the impact of simulation on self-efficacy?" was conducted. The authors concluded that simulation was effective at increasing self-efficacy among novice nurses, compared with traditional control

groups.[16] In 2012 a pilot study to assess nurse competencies using simulation-based scenarios concluded that simulation-based educational process provided a more efficient approach to nurse competency assessment, a secondary benefit was increased participant satisfaction.[17]

National Guidelines

National Guidelines guide practice, and needs to be incorporated into stroke code education. The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group[18] established that intravenous tissue plasminogen activator (tPA) was an effective treatment, and in 1996, an approved treatment for patients with acute ischemic stroke.[19] The 2018 national guidelines state the initial treatment for acute ischemic stroke remains intravenous tPA, and it is recommended for eligible patients within 3, and up to 4.5 hours, of last known well time. The goal for door-to-needle time for administration of tPA is within 45 minutes of arrival to the ED for ≥50% of acute ischemic stroke patients.[20.] Despite the guidelines, less than 30% of patients are treated within this time-frame.[21] Patients identified as having a large vessel, proximal artery occlusion on angiographic imaging should undergo mechanical thrombectomy with a stent retriever if within 24 hours from last known well time[22] with a goal door-to-groin time of ≤ 60 minutes from arrival to the ED.[20]

Review of the Literature

A review of the literature was completed regarding use of stroke code simulation and its effect on knowledge and impact on nurses' self-confidence. Khan et al.,[23] utilized simulation with debriefing to evaluate self-confidence and concluded that nurse practitioners and physician assistants had increased self-confidence in leading a stroke code from 2.4 to 4.2 (p = <0.05) on a 5-point Likert scale pre- to post-simulation. Aebersold et al.,[24] used 3 simulations with debriefing and concluded that simulation was effective in both skills and knowledge transfer without mention of self-confidence. Ortega et al.,[25] used simulation with debriefing and

concluded that stroke knowledge scores increased significantly from baseline (M = 5.87, SD = 0.19) to pre-simulation (M = 6.42, SD = 0.18), and from pre-simulation to post-simulation (M = 8.34, SD = 0.12), F (2, 140) = 79.92, p < .0.001, n^2 = .0.533) without mention of self-confidence. The authors concluded that simulation plus lecture was more effective than lecture alone. Adelman et al.,[26] concluded there is greater self-efficacy in identifying stroke symptoms (OR 1.13, 95% CI 1.01-1.27) which is associated with stroke knowledge.

The literature review revealed a gap in use of simulation and effect on knowledge and self-confidence with registered nurses who are one of the first responders in a stroke code. Knowledge of national stroke guidelines influences nursing practice and must be incorporated into nursing stroke code education. The purpose of this quality improvement project was to evaluate if participation in mock stroke code simulation increased a registered nurse's perception of knowledge and self-confidence when engaged in a stroke code in an acute care rural community hospital.

Theoretical Framework

Individuals can acquire skills through training, however they may not achieve the desired outcome without self-confidence.[27] The construct of self-efficacy in Albert Bandura's Social Cognitive Theory[28] and Jefferies[29] theoretical framework for simulation in nursing education serve as the models for this quality improvement project.

METHODS

Research Design

This study was a quality improvement project using a pre- and post-intervention to measure a nurses' knowledge and self-confidence after participating in a simulated mock stroke code. The intervention was a single high-fidelity simulation in a learning center for simulation and virtual learning at the participating hospital. The simulation was designed using the Jeffries

framework[29] based on national guidelines[18,20] with the goal of increasing knowledge and self-confidence of registered nurses who attend stroke codes.

Stroke codes are complex and consist of multiple elements that include patient assessment, including performance of the National Institute of Health Stroke Scale (NIHSS), and determining appropriateness for tPA criteria including preparation and calculating the dose. These elements are examined through use of lecture, hands on learning, demonstration, and case studies. The 5-segment simulation occurred over a 4-hour period on one day. At the onset of the simulation, participants received an explanation of the project and the initial 20-minute segment included introductory discussion of stroke, completion of the demographic survey, and pre-simulation questionnaire via input into Survey Monkey with use of participant selected clickers. The 2nd 45-minute simulation segment included 6 case scenarios followed by discussion. The 3rd 45-minute segment included a demonstration NIHSS with a standardized patient and hands-on exposure to reconstitution of tPA with calculation of wasted amount, bolus and total dose. The 4th 60-minute segment included the stroke code simulation utilizing stroke code standardized patients with a 20-minute debriefing session. Debriefing sessions were designed using the Jeffries framework.[29] Points addressed during debriefing were: (1) what went well and what was challenging with the scenario, (2) difference between symptom onset and last known well time, (3) time frame for administering tPA, (4) registered nurses' assessment of patient, (5) how did the patient feel, and (6) what could have been done differently.

The number of participants per simulation was split with 5 participants in the first group and 6 in the second group. The group not actively involved in simulations viewed remotely from the conference room. The roles were then reversed. The 5th 10-minute segment included summary discussion and completion of post-simulation questionnaire via input into Survey

Monkey with use of clickers. The simulation concluded with completion of the final evaluation questionnaire.

Setting and Sample

The sample was recruited from three sites. Nurses were recruited from a 358-bed regional tertiary care center that is a Joint Commission Thrombectomy-Capable Stroke Center, Participants who met inclusion criteria were invited to attend from a 50-bed community hospital and free standing community ED which are part of the health system. The sample (N = 11) included registered nurses who were eligible to participate in a 4-hour mock stroke code simulation and were employed by an integrated health system in southwest Virginia, and either worked in the ED, medical-surgical intensive care units (ICU) or floor, or neurological ICU (NICU) or intermediate care unit (NIMU).

The inclusion criteria were registered nurses who had completed orientation, completed the NIHSS certification program offered through HealthCarePoint,[30] held ACLS or BLS certification and an active Virginia nursing license. Exclusion included travel nurses and nurses on orientation.

Measures

Demographic information included participant's years as a nurse, area of practice, experience as a NICU or NIMU nurse, certification or credentialing, previous exposure to mock stroke code training and simulation training, and a general question regarding participation in stroke codes. The face-validated pre- and post-simulation questionnaire was developed based on national stroke guidelines[20] and had 4 questions on self-confidence and 10 on stroke knowledge. The final evaluation questionnaire had 3 open-ended questions regarding the simulation experience.

Protection of Human Subjects

Approval for the quality improvement study was requested and granted from the investigator site's IRB and was deemed to be IRB exempt. An agency form was requested and granted from the University of Virginia IRB, number 2111.

Data Analysis Plan and Results

The sample of 11 nurses had 6 (54.5%) nurses who had experience working in a NICU or NIMU (36.4%) had never attended a stroke prior to simulation, and 5 (45.5%) had attended greater than 10 stroke codes.

Data were analyzed using IBM SPSS Statistics for Mac version 24.0 (IBM Corp, 2016). The 4 self-confidence questions were entered into SPSS using a 5-point Likert-type scale – 1 = "Strongly Disagree," to 5 = "Strongly Agree" for a maximum score of 20. The sum of pre-test and post-test answers were computed in SPSS into two new variables: Total_confidence_pre and Total_confidence_post. The difference between the Total_confidence_post and Total_confidence_pre was calculated creating the Diff_pre-post_confidence variable which was analyzed with the paired-sample *t*-test (Table 1). There was a statistically significant increase in mean confidence scores of 5.455 from pre- to post- simulation ($p < .001$).

The 10 knowledge questions were scored in SPSS as either 1= "Correct" or 0 = "Incorrect" with a maximum score of 10. The sums of pre-test and post-test answers were computed into new variables Total_knowledge_pre and Total_knowledge_post. The difference between the Total_knowledge_post and Total_knowledge_pre was calculated creating the Diff_pre-post_knowledge variable which was analyzed with the paired-sample *t*-test (Table 2). There was a statistically significant increase in mean knowledge scores of 2.636 from pre- to post-simulation ($p < .001$).

The relationships between the pre-post change in knowledge score and five different nurse characteristics were analyzed using Mann-Whitney *U* tests. The characteristics were: years worked as a registered nurse, experience worked in a NICU or NIMU, area of current practice, number of stroke codes attended, and previous experience on mock stroke code training and/or simulation training. Because of the small sample size, some categories were collapsed for three nurse characteristics: years worked as a registered nurse, area of current practice, and number of stroke codes attended, in order to have only two categories for each characteristic, all of size at least 4. Mann-Whitney *U* tests were used to investigate possible relationships between several nurse characteristics and the increase from pre-simulation to post-simulation in stroke code knowledge. No tests were statistically significant, with *p*-values ranging from .527 to .927, but several differences suggest possible relationships that might be confirmed in a larger sample.

DISCUSSION

The improvement in self-confidence scores pre– to post-simulation ($p < .001$) in self-confidence (Table 1) with stroke codes were not unexpected. The literature review performed by Boling and Hardin-Pierce[15] identified 12 studies which concluded that high fidelity simulation was a tool to be utilized for improving self-confidence. Regarding stroke code education, Khan et al.,[23] concluded that self-confidence improved by use of simulation as an education tool. Simulation is performance, and self-confidence is improved due to the persistence of performing activities encountered in a stroke code.[31]

Pre-simulation only 18.2% ($n = 2$) of participants strongly agreed with feeling self-confident with communicating information to physicians, and post-simulation 72.7% ($n = 8$) of participants strongly agreed with feeling self-confident with communication with physicians. The simulation addressed dosing, reconstitution and administering of tPA, the guidelines, and

evaluation of patients with stroke for appropriateness of tPA, but did not specifically address communication with physicians. Having an improved understanding of guidelines and patient criteria for tPA, may be contributing factors to improved self-confidence when communicating with physicians.

The significant improvement ($p < .001$) in stroke knowledge (Table 2) scores pre- to post-simulation was an expected finding as Micieli et. al.,[11] assert that simulation can be utilized in a health professional's diagnosis, decision making, and technical skills. Simulation leads to quicker acquisition of skills which can lead to increased self-confidence and improved knowledge- based clinical judgement.[29] Aebersold et. al.[24], concluded that use of simulation in education is effective in both skills and knowledge transfer. Ortega et. al.,[25] concluded that stroke knowledge scores increased significantly from baseline with use of simulation, and further concluded that simulation plus lecture was more effective than lecture alone.

There was no statistically significant difference in pre- as compared to post-simulation knowledge scores based on the nurse's length of time working, experience working in a NICU or NIMU, currently working in a NICU or NIMU, number of stroke codes attended, or the nurse's previous experience with mock stroke code training and/or simulation; however, overall mean scores did improve. This is an expected finding as the meta-analysis performed by Franklin and Lee[16] concluded that simulation was effective at increasing self-confidence among novice nurses which would include not only those who lack experience as a nurse, but also those that may lack experience as a NICU or NIMU nurse, or lack experience with stroke codes.

The participants overall concluded that simulation improved self-confidence with initiating stroke codes and identifying tPA and thrombectomy candidates. After attending the

simulation nurses stated they would feel more comfortable in calling stroke codes, and explaining stroke in general.

Strengths and Weaknesses of the Design

Strengths of the design included an already established educational program at the clinical site with an available simulation center and standardized patients, and the project was evidence-based and could serve as a basis for a larger study, as well as an instructional program for other institutions to implement to improve self-confidence and knowledge for nurses in identifying and intervening on patients who exhibit acute stroke symptoms.

Weakness of the design included a single-site pilot study with small sample size ($N = 11$) limiting generalizability. Pre-test and post-test design with no control group made it difficult to account for confounding variables that may have had an impact on the variable under study. The pre- and post-simulation questionnaire was a face-validated instrument.

Conclusion

Stroke codes are complex and registered nurses may lack knowledge and/or self-confidence when responding to a stroke code. The use of stroke code simulation as an educational tool for registered nurses increased both stroke knowledge ($p < .001$) and self-confidence ($p < .001$).

Nursing Practice Implications

Based on results of this pilot project, a study evaluating nurse led stroke code teams working with ED or tele-medicine physicians in underserved or non-stroke certified hospitals could be conducted to evaluate impact on management of care on acute stroke patients in rural or underserved areas. Future measurement of outcomes of stroke codes at this organization may continue to provide evidence that is an effective simulation that can be implemented at other rural hospitals.

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Table 1

Stroke Code Self-Confidence Questions 1- 4 (N = 11)

	Pre		Post		
Question	*n*	%	*n*	%	
I feel confident evaluating a patient for stroke and IV Alteplase criteria.					
Strongly Agree	0	0.0	8	72.7	
Agree	7	63.6	2	18.2	
Neither Agree or Disagree	0	0.0	1	9.1	
Disagree	3	27.3	0	0.0	
Strongly Disagree	1	9.1	0	0.0	
I feel confident in communicating information to the physician.					
Strongly Agree	2	18.2	8	72.7	
Agree	7	63.6	1	9.1	
Neither Agree or Disagree	0	0.0	2	18.2	
Disagree	2	18.2	0	0.0	
Strongly Disagree	0	0.0	0	0.0	
I feel confident that I have adequate knowledge of the AHA guidelines for Acute Ischemic Stroke management.					
Strongly Agree	1	9.1	6	54.6	
Agree	6	54.5	5	45.5	
Neither Agree or Disagree	2	18.2	0	0.0	
Disagree	2	18.2	0	0.0	
Strongly Disagree	0	0.0	0	0.0	
I feel confident in my ability to calculate dosing, reconstitute, and administer IV Alteplase.					
Strongly Agree	3	27.3	8	72.7	
Agree	2	18.2	2	18.2	
Neither Agree or Disagree	0	0.0	0	0.0	
Disagree	4	36.4	1	9.1	
Strongly Disagree	2	18.2	0	0.0	
	M		*SD*		*p*
Pre- and post-simulation confidence questions					
Sum of pre-simulation confidence questions	12.818		2.359		
Sum of post-simulation confidence questions	18.273		2.724		
Difference between post- and pre-questions	5.455		0.934		.001*

Note: IV = intravenous, AHA = American Heart Association. * Paired-samples *t*-test

Table 2

Stroke Code Knowledge Questions 5 – 14 (N = 11)

	Pre		Post		
Question	*n*	%	*n*	%	
Question 5 – Patient with stroke symptoms on the way to the emergency department					
Correct	8	72.7	11	100.0	
Incorrect	3	27.3	0	0.0	
Question 6 – Patient discovered at nursing home with stroke symptoms					
Correct	10	90.9	11	100.0	
Incorrect	1	9.1	0	0.0	
Question 7 – Actions nursing should know for patient admitted for stroke care					
Correct	6	54.6	9	81.8	
Incorrect	5	45.5	2	18.2	
Question 8 - Patient with small hemorrhage noted on head CT					
Correct	7	63.6	10	90.9	
Incorrect	4	36.4	1	9.1	
Question 9 – Window for last know normal time to receive tPA					
Correct	7	63.6	11	100.0	
Incorrect	4	36.4	0		
Question 10 – What is last know normal time for potential thrombectomy candidate					
Correct	9	81.8	11	100.0	
Incorrect	2	18.2	0	0.0	
Question 11 – Lowest possible stroke score to receive tPA					
Correct	1	9.1	11	100.0	
Incorrect	10	90.9	0	0.0	
Question 12 - What determines patient's need for thrombectomy					
Correct	10	90.9	10	90.9	
Incorrect	1	9.1	1	9.1	
Question 13 - Calculating dose of tPA on patient who weighs 115.6 kg					
Correct	10	90.9	11	100.0	
Incorrect	1	9.1	0	0.0	
Question 14 - Calculating dose of tPA on a patient who weighs 78.0 kg					
Correct	9	81.8	11	100.0	
Incorrect	2	18.2	0	0.0	
	M		*SD*		*p*
Pre- and post- simulation knowledge questions					
Sum of pre-simulation knowledge questions	7.000		1.483		
Sum of post-simulation knowledge questions	9.636		0.674		
Difference between post- and pre-questions	2.636		3.000		.001*

Note. tPA = Alteplase. *Paired-samples *t*-test.