Large Vessel Occlusion Identification through Rapid Arterial Occlusion Evaluation

Nicole Harden

College of Nursing, East Carolina University

Doctor of Nursing Practice

Dr. Marshburn

July 27, 2021

Abstract

Large vessel occlusions account for nearly half of all acute ischemic cerebrovascular accidents and have an increased risk of morbidity and mortality. Screening suspected stroke patients in the prehospital setting with the Rapid Arterial Occlusion Evaluation Scale allows for prompt recognition and intervention of potential large vessel occlusions. A quality improvement project was designed to standardize the utilization of the Rapid Arterial Occlusion Evaluation Scale among four emergency medical service stations serving a medical center. The project included education of emergency medical service technicians, education of emergency department staff, and the design of a Rapid Arterial Evaluation screening tool. Lewin's Change Theory was utilized as the framework to guide the project. Utilization of the Rapid Arterial Occlusion Evaluation Scale was tracked among four emergency medical services for twelve weeks. During the twelve-week implementation, twenty suspected stroke patients were treated and prehospital screenings were completed for sixteen of the twenty patients. Two large vessel occlusions were identified with a Rapid Arterial Occlusion Evaluation Score greater than five and both were positive for a large vessel occlusive cerebrovascular accident. One of the large vessel occlusive patients underwent a mechanical thrombectomy and surpassed the medical center's treatment goal of less than two hours from arrival to the facility. This project aligns with the Triple Aim Initiative to reduce healthcare cost, improve patient experience, and improve population health.

Keywords: Cerebrovascular accident, large vessel occlusion, rapid arterial evaluation scale, prehospital setting, screening for large vessel occlusion

Table of Contents

Section I. Introduction

Background

When faced with a cerebrovascular accident (CVA), it is essential for healthcare teams to utilize evidence-based practice protocols to reduce mortality and morbidity rates. Cerebrovascular accident is the fifth leading cause of mortality in Americans and the second leading cause of mortality globally (Khalessi et al., 2019). Large vessel occlusion cerebrovascular accidents account for an estimated forty-six percent of all acute ischemic strokes and have a significantly high risk of morbidity and mortality. Large vessel occlusions (LVO) are refractory to intravenous alteplase (tPA) without further treatment such as mechanical thrombectomy. Alteplase is a thrombolytic agent used to dissolve clots formed in arteries in the treatment of acute ischemic CVA (Kerndt, 2020). According to the American Heart Association (AHA) guidelines, intravenous alteplase can be administered within four hours of symptom onset, and mechanical thrombectomy can be performed within twenty-four hours of symptom onset (Khalessi et al., 2019). Time is of the essence in the identification and treatment of large vessel occlusive CVA's; thus, the importance for prompt recognition and intervention.

Currently four local emergency medical agencies transport patients to the same medical center however, they all do not follow the same guidelines for identifying large vessel occlusive CVA. One of the four local emergency medical agencies currently utilize the Rapid Arterial Occlusion Evaluation (RACE) scale for identification of LVO, while the remaining three utilize the Cincinnati Prehospital Stroke Severity Scale (CPSSS). The inconsistent practice and lack of using current evidence-based practice can delay patient care and increase patient morbidity and mortality.

The project site is located at a medical center in northeastern North Carolina. Through collaboration with the project site stroke coordinator, the use of the Rapid Arterial Occlusion Evaluation (RACE) scale for identification of a large vessel occlusion (LVO) cerebrovascular accident (CVA) by emergency medical technicians in the prehospital setting was selected for the project topic. The RACE scale is a five-item scale that can be implemented in the prehospital setting to identify acute stroke patients with a large vessel occlusion (Carrera et al., 2017). A score of five or higher is an indicator of large vessel occlusion and the need for immediate intervention (Adams et al., 2019). The RACE scale will be completed by emergency medical respondents for all suspected stroke patients before arrival at the medical center. The project will include the project lead, the medical center's stroke coordinator, site champion, and emergency medical technicians from the four local emergency medical services: Station A, B, C, and D. The medical center is a certified primary stroke center offering timely administration of intravenous alteplase to eligible acute ischemic stroke patients. However, the medical center does not offer emergent surgical intervention such as mechanical thrombectomy for large vessel occlusion and, therefore, patients are referred to a comprehensive stroke center once stabilized. Providing immediate mechanical thrombectomy for an LVO is a limitation of the medical center. The closest comprehensive stroke center is over an hour away by ground transportation and fifteen minutes by air transportation.

Organizational Needs Statement

The project site has a policy of paging a stroke alert within fifteen minutes of a patient's arrival to the facility. This alerts a rapid response of the stroke team to ensure quick response of the stroke team and resources. The current stroke team consists of one to two emergency department registered nurses and the emergency room physician. Administration of alteplase

(tPA) should be performed within forty-five minutes of arrival to the medical facility according to the medical center's organizational goal. Alteplase administration within forty-five minutes from arrival is above the national guidelines of sixty minutes from arrival to the facility (AHA, 2020). Patients suffering from an LVO must be transferred to a comprehensive stroke center for thrombectomy. The medical center's organizational quality measure is to transfer an LVO patient for thrombectomy services within two hours of arrival to the facility. The America Heart Association 2020 guidelines recommend a door to a mechanical thrombectomy time frame of less than ninety minutes from arrival to a comprehensive stroke facility. Discussion with the medical stroke coordinator revealed a lack of recognition of an LVO in the prehospital setting and the need for a standardized screening tool among the four emergency medical services for pre-hospital screening. Nine of the 118 (8%), stroke patients seen at the medical facility over seven months in 2020 were transferred to a comprehensive stroke center for an LVO. None of these nine patients met the transfer time goal of two hours.

Early identification of a large vessel occlusive CVA tremendously aids in achieving the quality goals and improving patient mortality and morbidity. The RACE scale is the first major quantitative assessment tool used in the prehospital setting to identify potential large vessel occlusive cerebrovascular accidents (Perez de la Ossa, 2020). The evaluation scale is centered around the National Institute of Health (NIH) stroke scale assessment and provides a rapid assessment in the prehospital setting while still retaining sensitivity for severe strokes. The use of the RACE scale by emergency medical services in the prehospital setting allows hospitals to efficiently prepare and care for the arriving stroke patient. Implementation of the RACE scale in the prehospital setting improves patient care through the early identification of a large vessel occlusive cerebrovascular accident. Identification in the pre-hospital setting allows emergency

medical staff at the receiving facility to readily prepare for prompt interventions to improve patient outcomes, morbidity, and mortality. Early identification of an LVO can decrease transfer times to a comprehensive stroke center for surgical intervention. Implementation of the RACE scale aligns with the Triple Aim of Healthcare, including improving patient experience, improving populations' health, and reducing health care costs (Berwick et al., 2008). Large vessel occlusive cerebrovascular accidents have a detrimental effect on mortality and morbidity rate, negatively impacting healthcare costs from extended hospital stays and patient experience. Morbidity and mortality rates increase with every second that passes without treatment for cerebrovascular accidents (Khalessi et al., 2019). An accurate screening tool to identify large vessel occlusions allows prompt medical intervention to decrease patient mortality and morbidity.

Problem Statement

A large vessel occlusive cerebrovascular accident can be detrimental to an individual's quality of life and can drastically affect patient morbidity and mortality. Thrombectomy of an LVO performed within six hours of symptom onset showed a reduced disability within ninety days (Khalessi et al., 2019). Even the slightest delay in the care for an LVO patient can affect their quality of life. One of the four local emergency medical agencies currently utilizes a prehospital screening tool for the early identification of an LVO. The remaining three emergency medical agencies currently utilize the CPSSS screening tool. While the CPSSS screening tool can accurately identify a suspected CVA, the scale does not accurately identify a potential large vessel occlusion (Daneault et al., 2019). The lack of implementation and education of the RACE scale for emergency medical services can lead to a delay in prehospital notification, activation of stroke alert response team, and intervention; thus, increasing patient morbidity and mortality.

Purpose Statement

The purpose of the quality improvement process is to standardize Rapid Arterial Evaluation Scale (RACE) utilization in the prehospital setting among all four local emergency medical services serving the medical center. Emergency medical services should be thoroughly trained and competent in recognizing and pre-notification to the receiving facility about the LVO. Using the RACE scale in the pre-hospital setting ensures the patient is immediately taken to a stroke center and provided immediate life-saving interventions. Early identification and pre-notification can reduce the door to alteplase administration time and door to needle time. The project lead will conduct evidence-based education and implement the RACE scale with assistance from the stroke coordinator and the medical center's local emergency medical agencies to improve patient morbidity and mortality.

Section II. Evidence

Literature Review

A detailed search was completed in Cumulative Index to Nursing and Allied Health Literature (CINAHL), ProQuest, and PubMed databases. A master literature search document was used to track databases searched, keyword searches, limits, results, and inclusion and exclusion criteria. Searches were conducted in each database to yield additional results. Limitations applied to all database searches included the articles from 2016 to present, English language, and full text. An initial search of the identified databases was conducted using the search term "identifying large vessel occlusion or LVO AND prehospital setting," yielding thirty-two results. Another search was conducted using the search term "identifying large vessel occlusion or LVO," yielding 674 results. Of the 674 results generated, search terms were narrowed to project specificity to include "identifying large vessel occlusion or LVO AND prehospital setting," generating twenty-eight results, and "large vessel occlusion or LVO AND rapid arterial occlusion evaluation tool," generating thirteen results. Search terms "RACE scale" and "rapid arterial occlusion evaluation," yielded an additional six results.

Abstracts were read in entirety for inclusion and exclusion of articles. Inclusion criteria included direct relation to the clinical topic of large vessel occlusion identification in the prehospital setting and/or rapid arterial occlusion evaluation, and evidence Level III and above using the Melnyk Evidence Model (Melnyk & Fineout-Overholt, 2015). Exclusion criteria included no direct relation to the clinical topic, greater than five years of publication, and duplicate articles. A total of five studies were retained from the PubMed database, one article from CINAHL, and no articles from ProQuest after inclusion and exclusion criteria were applied. Articles retained were read in their entirety. An additional search was conducted in Google

Scholar to include an additional article. Seven articles have currently been retained after the completion of the review (see Appendix A). Continual literature searches were conducted throughout the project course.

Current State of Knowledge

Stroke is the leading cause of disability worldwide and the second leading cause of death globally (Bandeira et al., 2019). Reperfusion therapy for an acute ischemic stroke is time-sensitive. The development of acute stroke care planning is recommended for all healthcare systems to include rapid identification of suspected stroke, initial emergency care to include administering intravenous alteplase, and comprehensive stroke centers for endovascular therapy to which rapid transport can be facilitated. Identifying acute ischemic strokes in the prehospital setting is vital to ensure fast and appropriate triage to optimize reperfusion therapy. A major significant challenge in the prehospital setting is developing a quick and efficient triage protocol to ensure rapid identification of acute ischemic stroke and prompt recognition of large vessel occlusion using standardized prehospital scales. Intravenous alteplase remains the first line of treatment of acute ischemic stroke if initiated within four and half hours of symptom onset, even in considering mechanical thrombectomy (Filho & Samuels, 2020). Individuals suffering from a large vessel occlusive acute ischemic stroke are considered for mechanical thrombectomy within the twenty-four hours of symptom onset regardless of intravenous alteplase administration. Research has shown the benefits of recanalization and improved outcomes in large vessel occlusive patients with early intravenous alteplase administration before thrombectomy (Bandeira et al., 2019).

Current Approaches to Solving Population Problem(s)

Clinical presentation of a large vessel occlusive cerebrovascular accident is typically more severe than the presentation of a small vessel ischemic stroke due to the larger area of hypoperfusion, presenting the opportunity to differentiate the two using an evidence-based prehospital screening tool (Davis et al., 2017). Limited data exists of a single efficient prehospital screening scale for acute ischemic stroke. The Cincinnati Prehospital Stroke Severity Scale (CPSSS), Los Angeles Motor Scale (LAMS), and the Rapid Arterial Occlusion Evaluation (RACE) have been the most studied scales in the prehospital setting (Bulsara et al., 2018). Significant variation exists among CPSSS, LAMS, or the RACE tool in emergency medical services to identify acute ischemic strokes.

The CPSSS has been associated with higher rates of identifying non-large vessel occlusive cerebrovascular accidents (Daneault et al., 2019). The RACE scale and LAMS tool have a higher predictive value for identifying large vessel occlusion (Davis et al., 2017). In the prehospital setting, the RACE had a specificity of sixty-eight percent and ninety percent in hospital settings at identifying large vessel occlusion. The LAMS scale had a specificity of sixty-three percent in the prehospital setting and eighty-six percent in the hospital setting at identifying large vessel occlusion. The higher rate of specificity to identify large vessel occlusion in both the prehospital and hospital setting with the RACE scale led to implementing the RACE scale for emergency medical services serving the project site.

Evidence to Support the Intervention

The current tool used by three of the emergency medical services serving the medical center is the Cincinnati Prehospital Stroke Severity Scale (CPSSS). Discussion with the medical center’s stroke coordinator revealed a lack of efficiency in identifying acute ischemic stroke and

specifically, large vessel occlusions with the current method used by local emergency medical services. The CPSSS tool is associated with high over triaging rates and incorrectly triaging stroke patients (Daneault et al., 2019). A study completed by Adams et al. (2019) of the RACE scale to correctly identify large vessel occlusion in the prehospital setting in suburban and rural emergency medical services revealed a sixty-six percent sensitivity and seventy-two percent specificity. The use of the RACE scale in the prehospital setting also reduced the time to groin puncture for thrombectomy by approximately thirty minutes for patients taken directly to a comprehensive stroke center (Ebinger et al., 2018).

Evidence-Based Practice Framework

Education by the project lead with assistance from the project site's stroke coordinator regarding the proper use of the RACE scale can decrease the identified gap and improve prompt recognition of acute ischemic LVO cerebrovascular accidents. After education, implementation will begin. It is expected for emergency medical technicians to additionally perform the RACE screening on all suspected stroke patients to assess for a potential LVO. For healthcare organizations to maintain balance and accreditation, they must respond to an ever-changing environment and adapt through the implementation of evidence-based care (French et al., 2016).

The framework used for the implementation of the RACE scale in local emergency medical services is Lewin's Change Theory. Kurt Lewin's (1951) Change Theory is a three-step model for change. The three-step approach includes unfreezing, creating problem awareness, changing/moving, and refreezing (Lewins, 1951). Lewin's Change Theory is based on adapting to an ever-changing environment to maintain balance (French et al., 2016). Step one unfreezing, is achieved by identifying the need for an evidence-based scale to identify large vessel occlusion in the pre-hospital setting. Changing and/or moving will be completed by educating local

emergency medical services on the RACE scale's use and the benefits of the RACE scale to identify large vessel occlusion. Integrating a new practice will be achieved by the standardization of the RACE scale among the local emergency medical agencies.

Ethical Consideration & Protection of Human Subjects

African Americans are roughly twice as likely to suffer from a cerebrovascular accident than whites (Center for Disease Control and Prevention [CDC], 2020). They have the highest mortality rate resulting from a stroke. Hispanics, American Indians, and Alaska Natives are also at an increased risk of a cerebrovascular accident. While a cerebrovascular accident can occur at any age, the risk of having a stroke doubles every ten years after fifty-five. Women are at a greater risk of a cerebrovascular accident than men and are more likely to die as a result.

The RACE scale is a five-item scale screening for facial palsy, arm motor impairment, leg motor impairment, head and gaze deviation, and aphasia-agnosia ranging from normal/mild, moderate, or severe impairment (Davis et al., 2017). The RACE scale is equal and fair to each individual in the prehospital setting with presenting signs and symptoms of a possible cerebrovascular accident. To ensure emergency medical technicians are screening efficiently with the RACE scale, it is vital to provide education on what qualifies as normal/mild, moderate, and severe deficits. There is no potential harm to the targeted population since the RACE scale is a screening tool to identify possible large vessel occlusive stroke. If identified as a possible large vessel occlusion the diagnostic workup will immediately begin on arrival to the facility before administering intravenous alteplase or mechanical thrombectomy. There is little to no potential for harm to individuals during project implementation.

Preparation for the following project's approval process included completing the Collaborative Institute Training Initiative (CITI) modules to ensure ethical equality is provided throughout the project course. The CITI modules provided education regarding regulatory and ethical issues for research involving human subjects. The project was submitted for review to the medical center's quality team to determine if an Institutional Review Board (IRB) was needed. The quality team deemed the project as a quality improvement project and stated no Institutional Review Board (IRB) review was needed. In addition, the affiliated university required completion and a review of the university self-certification quality worksheet. The affiliated university deemed the project as a quality improvement project and reported no further IRB review was required, in accordance with federal regulations as the project does not constitute research.

Section III. Project Design

Project Site and Population

The project site is a medical center located in northeastern North Carolina. The project site is a certified primary stroke center that offers medical care, treatment, and stabilization of patients suffering from cerebrovascular accidents. However, the project site is not a comprehensive stroke center and cannot provide surgical intervention for large vessel occlusion (LVO) such as mechanical thrombectomy. Administration of intravenous alteplase for a large vessel occlusion can be performed at the project site. Transfer of the patient to a comprehensive stroke center for mechanical thrombectomy is to be initiated if an LVO is identified.

The target population for the project includes emergency medical responders from four local emergency medical agencies: Station A, Station B, Station C, and Station D serving the medical center. The emergency medical agency's staff members have a variety of emergency medical experience ranging from basic to a paramedic level. These individuals are responsible for screening patients suffering from a possible cerebrovascular accident and transporting them to the nearest emergency medical center for treatment. Any emergency medical responder with proper training can screen a patient for a possible cerebrovascular accident. A pre-hospital stroke alert can only be activated and the patient transported by an emergency medical technician at the paramedic level due to the high acuity of the emergency.

Description of the Setting

Station A currently serves two local counties to the medical center and is the largest emergency medical service included in this quality improvement project. Station B and Station C serve multiple surrounding counties to the medical center and therefore can transport patients to another hospital, other than the medical center at the patient's request. Station D is the furthest station at approximately 45 minutes to one hour from the medical center and currently is the only

station implementing the RACE scale. The medical center's emergency department currently treats an estimated 20 to 25 cerebrovascular accident patients every month.

Description of the Population

The population includes emergency medical technicians from four local emergency medical services that currently transport patients to the medical center for treatment from five surrounding counties. Emergency medical responders are responsible for responding to 911 emergent calls to assess and provide first-aid and lifesaving interventions to patients. Emergency medical services employees have emergency medical experience ranging from basic to paramedic emergency medical technician level. Station A currently employs approximately 96 emergency medical technicians including supervisors and community medics. Station B has an estimated 25 emergency medical technicians staffed. Station C employee count is currently unknown as some of Station C's district stations and employees do not serve the medical center but rather another unidentified medical center. Station D has an estimated 20 emergency medical technicians on staff. Professional training of the individuals includes certifications of cardiopulmonary resuscitation, advanced cardiovascular life support, pediatric advanced life support, and prehospital trauma life support. Education will be provided to emergency medical technicians, shift captains, and supervisors that have direct patient contact.

Project Team

The project team includes the project lead, the stroke coordinator, and the project champion from the medical center. The stroke coordinator has a bachelor's degree in nursing and clinical background in travel nursing specializing in a medical intensive care unit. The stroke coordinator has been in her current role for the last two years at the medical center. The stroke coordinator provided guidance and assistance with the education and implementation of the

RACE scale and will assist with evaluating stroke logs during the project implementation period. The magnet coordinator has a master's degree in nursing leadership and administration and has served as the medical center's magnet coordinator for the last two years. The magnet coordinator serves as the project site champion, providing guidance and assistance with the institutional review board approval process and oversee the project at the medical center.

The university faculty serves as an advisor to the project lead and oversees and guides the project. The faculty member has a doctorate of philosophy in nursing and has been a part-time faculty member for the university for five years. She is certified as a nurse executive and serves as a magnet appraiser with the American Nursing Credentialing Center. She has served in numerous leadership roles throughout her nursing career and has numerous publications and presentations.

The project lead has a bachelor's degree in nursing and four years of clinical nursing background in emergency medicine as a staff nurse and unit coordinator. She has also served as a stroke champion for the department and is currently enrolled in a Doctorate of Nursing program with a concentration in family nurse practice. The project lead will be responsible for planning, implementing, data collection and analysis, and disseminating findings.

Project Goals and Outcome Measures

The project goal is to standardize the Rapid Arterial Occlusion Evaluation Scale (RACE) utilization among emergency medical services serving the medical center. Outcome measures include the utilization of the RACE scale, completion of the RACE scale by the emergency medical technician, the RACE scale score, and if an LVO is identified.

Description of the Methods and Measurement

The RACE scale is a five-item scale used in the prehospital setting to identify acute stroke patients with large vessel occlusion (see Appendix B) (Carrera et al., 2017). The scale includes screening for facial palsy, arm motor strength, leg motor strength, gaze deviation, aphasia, and agnosia. A score of five or higher is an indicator of large vessel occlusion. The RACE scale has a sixty-six percent sensitivity and seventy-two percent specificity to correctly identify large vessel occlusion when implemented in the prehospital setting (Adams et al., 2019).

Utilization of the Rapid Arterial Occlusive Scale by the emergency medical agencies will be tracked throughout the implementation period. Completion of the RACE scale by the emergency medical respondent will also be tracked. The utilization and accuracy of completion of the RACE scale will be tracked for each emergency medical agency to identify challenges and barriers to implementing the scale (see Appendix C).

An assessment tool providing communication of the current problem(situation), background, analysis (assessment), and recommended action (SBAR) will be used as an operational tool to evaluate the process and communicate effectively with the site champion and stroke coordinator (Shahid & Thomas, 2018). Use of the SBAR method will provide clarity of the assessment and recommended changes and/or improvements needed to provide improved effectiveness (See Appendix D).

Discussion of the Data Collection Process

A screening form was designed through collaboration with the project lead and emergency medical technicians from Station A (see Appendix E). The screening form included the patient's initials, date, emergency agencies, vital signs, blood glucose, RACE scale, and the RACE scale score. Vital signs and blood glucose level were added to the screening forms as

these are pertinent information needed when alerting the medical center of an incoming stroke alert. Emergency service technicians were instructed to leave completed screening forms at a designated location in the emergency department compliant with patient privacy regulations. Printed copies of the RACE scale screening form in addition to an electronic copy were distributed to the four emergency medical agencies. Additional copies were also placed beside the collection box in the medical center's emergency department. A binder recording all prehospital stroke alerts is also kept at the medical center's emergency department secretary desk. This binder is reviewed daily by the stroke coordinator and was reviewed weekly by the project lead. A weekly review of the stroke alert log binder allowed verification if a RACE scale was not completed before arrival at the medical center. A chart audit was conducted on all stroke alert patients presenting to the medical center by the project lead with supervision from the stroke coordinator.

Data reviewed and collected included the date of the stroke alert, emergency medical agency, utilization of the RACE scale, accuracy of completion, RACE scale score, and if an LVO occurred (See Appendix C). Data was entered into a database for analysis of trends, barriers, and challenges in implementation. Data was collected throughout the implementation period from March 2021 to June 2021. Collection and review of data occurred every week for twelve weeks. An SBAR was utilized monthly to communicate with the stroke coordinator barriers to the implementation of the RACE scale, and suggestions for improvements, if necessary. Data was presented using a combination of graphs and charts.

Implementation Plan

Education of the Rapid Arterial Occlusive Evaluation (RACE) scale was completed using a PowerPoint presentation. The PowerPoint presentation consisted of ten slides discussing the

project's purpose, an overview of large vessel occlusions, the importance of the RACE scale, how to use the RACE scale, and a patient scenario. The presentation was created by the project lead and reviewed by the stroke coordinator before distribution to the local emergency services. The original proposal of a classroom-style education was initially planned for Stations A, B, and C; however, due to COVID restrictions of the agencies, an alternative education plan was developed by the project lead and stroke coordinator. The PowerPoint presentation was sent via email to the responsible educator for each emergency medical agency who agreed to the revised education plan. The emergency medical responders of each agency were given approximately one week to review the presentation and discuss questions and or concerns with the project lead and stroke coordinator before implementation. Implementation began the following week, after the distribution of the presentation. Although a paramedic level emergency medical responder can only activate a pre-hospital stroke alert, education was completed for all staff members ranging from basic to paramedic level for screening purposes.

Brief education was also provided to the medical center's emergency medical staff, specifically the registered nurses, on the significance of the RACE scale score if five or higher. Data collection on the utilization of the RACE scale was conducted every two weeks to evaluate for barriers and challenges. Monthly virtual meetings occurred between the project lead, stroke coordinator, and the emergency medical agencies to address questions, concerns, barriers, and challenges.

Timeline

Detailed planning and approval of the project occurred from September 2020 through January 2021. Education was provided to the four emergency medical services in March 2021. Implementation occurred over twelve weeks, starting March 2021 to June 2021. Data analysis

and dissemination of findings occurred in Summer 2021. Dissemination of findings will be presented at the organizational project site as well as the affiliated university. See Appendix F for a more detailed timeline.

Section IV. Results and Findings

Results

The overall intent of the project was to standardize the utilization of the Rapid Arterial Occlusion Evaluation (RACE) scale among four local emergency medical agencies servicing the medical center. Approximately 156 emergency medical service technicians were educated on the importance and utilization of the RACE scale. Education was also provided to approximately 50 emergency department staff that included registered nurses, licensed practical nurses, emergency care technicians, and providers.

During the implementation period, twenty stroke alerts were transported by emergency medical services to the medical center. Eighteen (90%) patients were transported by Station A, two (10%) patients were transferred from Station B and zero patients were transferred from Stations C and D (see Appendix G). Of the total twenty patients, sixteen (80%) had prehospital RACE scale screening completed by emergency service technicians. Fourteen of the sixteen patients (88%) were found to have RACE scale scores less than five. None of the fourteen patients had a large vessel occlusion. Two of the sixteen patients (11%) had a positive RACE scale screening, with a score greater than five (see Appendix H). Diagnostic imaging confirmed a positive large vessel occlusive CVA for both of the positively screened patients. Of the two identified LVO's, only one patient was a candidate for mechanical thrombectomy services. The patient that underwent mechanical thrombectomy services met the medical centers quality metric of transfer time in less than two hours from arrival to a comprehensive stroke center. Previously, none of the LVO patients in 2020 met the medical center's transfer time goal of less than two hours. Prehospital stroke patients were only received from two of the four local emergency medical agencies; Station A and Station B. Emergency service stations C and D either did not

receive a suspected stroke alert dispatch over the last twelve weeks or transported the suspected stroke patients to a closer medical facility.

Discussion of Major Findings

The RACE scale had a specificity of sixty-eight percent when completed in the prehospital setting (Davis et al., 2017). During the project implementation, emergency service personnel screened sixteen of the twenty prehospital stroke alerts utilizing the RACE scale. Two of the sixteen screened patients scored positive for a suspected LVO with scores greater than five, while the remaining fourteen scored below five. The two positive screened patients were diagnosed with a large vessel occlusion during their admission however, only one was a candidate for mechanical thrombectomy services. The patient that underwent mechanical thrombectomy was transferred under the project site's quality metric goal of two hours. This patient however was not within the alteplase administration guidelines recommendation and did not receive anticoagulation before transfer. The patient was reported to have a good overall outcome. The remaining fourteen patients with a RACE score of less than five had no indication of an LVO on diagnostic imaging.

The RACE scale was thoroughly and accurately completed by emergency service technicians for the sixteen screened patients. A RACE score equal to or greater than five has an accuracy of 75% in identifying an LVO when utilized correctly (Afreen et al., 2019). During project implementation, when utilized by emergency medical technicians in the prehospital setting the RACE scale had a 100% accuracy in identifying and excluding an LVO. Utilization of the RACE scale in the prehospital setting can lead to the identification of an LVO for prompt treatment and intervention to reduce increased patient morbidity and mortality from an LVO.

Section V. Interpretation and Implications

Costs and Resource Management

The cost associated with project implementation was estimated at $1,625.00. The cost included: personnel time for research, project design, education of emergency medical service technicians, and printing cost for the RACE scale screening tool (see Appendix I). If project implementation were not conducted by the project lead, the medical center's stroke coordinator would be responsible for education and implementation of the RACE scale among emergency service personnel. Education and implementation conducted by the medical center's stroke coordinator would have added to her multiple job responsibilities, potentially resulting in project delay and decreased follow-up.

Large vessel occlusive cerebrovascular accidents have a detrimental effect on mortality and morbidity; thus, negatively impacting healthcare cost and patient experience. Ten minutes of earlier mechanical thrombectomy treatment can lead to an average net monetary benefit of $10,593 from a health care perspective and $10,915 from a societal perspective (Almekhlafi et al., 2020). From a nationwide perspective, ten minutes of early treatment to mechanical thrombectomy for LVO can lead to an average of $242 million from a health care perspective and $249 million from a societal perspective. Early identification, recognition, and treatment of large vessel occlusive cerebrovascular accidents can decrease patient mortality and morbidity, leading to decreased healthcare costs, and improved patient's quality of life.

Implications of the Findings

Standardizing the utilization of the RACE scale in the prehospital led to early identification and treatment of two large vessel occlusions. Continued utilization of the RACE scale screening in the prehospital setting can lead to early recognition and prompt treatment of

suspected LVO patients. Improving this process will decrease patient transfer times, improve patient overall health outcomes, and decrease patient morbidity and mortality rates.

Implications for Patients

Cerebrovascular accidents are the fifth leading cause of mortality in American (Khalessi et al., 2019). Almost half of all acute ischemic strokes are large vessel occlusive cerebrovascular accidents which have a significantly higher risk of morbidity and mortality. Ten minutes of earlier treatment to mechanical thrombectomy can lead to an estimated thirty-nine days of disability-free life and an estimated 106 additional days of functional independence (Almekhlafi et al., 2020). The gain of functional independence and reduced disability from earlier treatment can result in a decrease in hospital stay, physical and occupational therapy, rehab/assisted living facility stay, and health care costs.

Implications for Nursing Practice

Standardizing the utilization of the RACE scale among emergency medical service technicians exemplifies the importance of the advanced practice nurse partnership in leading quality initiatives to improve patient outcomes and overall healthcare. The interprofessional relationship established by the advanced practice nurse, stroke coordinator, and emergency service personnel was the foundation for project success. The continued interprofessional relationship between emergency department staff and emergency medical technicians can allow effective patient handoff and immediate intervention and treatment on arrival to the medical center. The RACE scale can also be utilized by nursing staff in the emergency department setting for patients arriving by private vehicle versus an ambulance. Utilizing the RACE scale to screen for facial palsy, arm motor impairment, leg motor impairment, head and gaze deviation, and aphasia-agnosia ranging from normal/mild, moderate, to severe impairment can rule in or rule

out suspected large vessel occlusion. A score of five or greater has high suspicion of large vessel occlusive cerebrovascular accident and increased morbidity and mortality rates. A score of five or less has low suspicion of large vessel occlusive cerebrovascular accident. However, it does not entirely rule out an LVO and still has potential for an acute ischemic or hemorrhagic CVA.

Impact for Healthcare System(s)

Screening all suspected stroke patients for an LVO in the prehospital setting allows for prompt recognition, identification, treatment, and notification of receiving medical center. Early identification and treatment of an LVO can decrease patient morbidity and mortality. Decreased transfer times to a comprehensive stroke center for surgical intervention can also result from prehospital recognition of a potential LVO. An estimated project cost of $1,625.00 is a minor cost compared to millions of dollars of healthcare cost from delayed treatment. Large vessel occlusive cerebrovascular accidents have a detrimental effect on mortality and morbidity; thus, negatively impacting healthcare cost and patient experience and can lead to extended hospital stay and rehabilitation. An estimated 4.2 days of disability-free life can result from every minute of earlier treatment of an LVO with mechanical thrombectomy (Almekhlafi et al., 2020). Every minute of treatment for an LVO is crucial to improved patient outcomes, decreased hospital stay, and decreased cost of healthcare.

Sustainability

The project is sustainable for the identified emergency medical agencies after implementation. The emergency medical agencies have been provided a file copy of the RACE screening form for continued utilization to screen all suspected stroke patients before arrival at the medical center. Close follow-up regarding utilization and completion of the RACE scale will continue to be monitored by the medical center's stroke coordinator. Continued utilization of the

RACE scale in the prehospital setting leads to prompt recognition and intervention of suspected stroke patients potentially suffering from a severe large vessel occlusion. Annual education of the RACE scale will be included in the annual stroke education provided to emergency medical service technicians by the stroke coordinator. New employee education for emergency medical service technicians will be the responsibility of the emergency service educational supervisor. Education of newly employed emergency department staff at the medical center will be the responsibility of the stroke coordinator and emergency department nurse educator. It is recommended for RACE scale education to be incorporated into the yearly stroke education completed by emergency department staff.

Dissemination Plan

The project lead disseminated the project and outcomes at the project site and affiliated university. Dissemination of project findings at the project site occurred in July 2021 and included emergency medical agency personnel from the four identified sites, the stroke coordinator, site champion, and leadership personnel. A poster presentation was presented at the affiliated university to include the College of Nursing faculty and university faculty. A final copy of the project paper was submitted to the university Scholarship repository for public access. The project may also be presented and shared with professional colleagues at the organizational stroke symposium in Fall 2021.

Section VI. Conclusion

Limitations and Facilitators

Several limitations were identified during the course of this project. An initial barrier to this project was the restrictions caused by the COVID-19 pandemic. These restrictions were a barrier to conducting large educational sessions for the emergency medical service technicians. Education on the importance and utilization of the RACE scale in the prehospital setting was initially planned to be presented in a face-to-face classroom setting. Due to the COVID restrictions, education was completed instead by the education supervisors of the emergency medical service agencies who distributed the PowerPoint among their staff.

One face-to-face classroom experience was conducted with approximately twenty-five emergency medical service technicians at Station A. A virtual WebEx education was conducted with emergency medical staff at Station B. Station C was unable to arrange a virtual or classroom setting education; therefore, the only education was the distribution of the educational PowerPoint. Station D currently implements the RACE scale; therefore, verification of the current process and the importance of the utilization of the RACE scale was completed.

Another identified limitation was the inability of emergency medical service technicians to chart the results of the RACE scale in their current electronic health record (EHR). A RACE screening form was designed by the project lead with collaboration from emergency medical service technicians and distributed among the emergency medical services to address the identified barrier. The completed screening forms were returned to a designated privacy-compliant area for collection and review by the project lead.

During the beginning of implementation, it was identified that Station B was transferring suspected LVO patients directly to a comprehensive stroke center and bypassing the project site.

Station B would bypass the medical center with suspected LVO patients, leading to a delay in alteplase administration time. Transferring of suspected LVO patients can lead to unnecessary transfers if mechanical thrombectomy is not medically indicated, multiple comorbidities, risk/benefit ratio, no large vessel occlusion identified on imaging, and inaccurate scoring. While the policy of Station B transferring suspected LVO patients to a comprehensive stroke center could not be changed during implementation, it is currently being evaluated by the stroke coordinator and the organizational stroke program director. Station B, however, was still educated on the utilization of the RACE scale for all suspected stroke patients and not just suspected LVO patients. Due to this restriction, the utilization of the RACE scale could be tracked for Station B. However, patient outcomes and prognosis could not be tracked for directly transferred stroke patients. Station C did not transport a suspected stroke alert patient over the last twelve weeks to the medical center; therefore utilization of the RACE scale of this agency could not be verified.

Another limitation identified was the project duration. Twelve weeks of data tracking in a rural area medical center also did not provide time to monitor the utilization of the RACE scale. Only two positive patients were identified during the twelve weeks and only one was a candidate for thrombectomy services. While the accuracy of the RACE scale was identified with the fourteen patients screened, a larger patient population and additional patients suffering from an LVO would have been beneficial to the project outcomes. An additional limitation of the project site was the inability to perform mechanical thrombectomy and having to transfer patients with an identified large vessel occlusion to a comprehensive stroke center for further management.

Currently, there are limited studies regarding the use of the RACE scale in the prehospital setting. Although, the current published studies provide sufficient evidence regarding the RACE

scale for screening and identifying a large vessel occlusion. While only one patient was a candidate for mechanical thrombectomy services, transfer time was under the project site's quality metric of two hours from arrival to the facility.

Facilitators of the project include emergency medical technicians from the four emergency medical agencies, emergency medical agencies educational staff to include educators and supervisors, project site stroke coordinator, and site champion. The medical center's stroke coordinator provided the expertise of cerebrovascular accidents and support with interprofessional collaboration between the project lead, emergency medical services, and the medical center. Collaboration with emergency medical technicians regarding a sufficient, easy-to-use screening tool handout provided support for project success. This screening tool will continue to be utilized despite the conclusion of the project until the RACE scale is built into the electronic health system.

Recommendations for Others

Recommendations to replicating the standardization of the RACE scale among emergency medical service agencies in the prehospital setting include the understanding of the emergency medical stations' electronic health records (EHR). The current patient EHR utilized by multiple emergency medical agencies utilize does not have an accurate RACE assessment tool. The current stroke scale that is frequently used, the Cincinnati Prehospital Stroke Severity Scale, only specifies positive or negative screening of cerebrovascular accidents. The RACE scale screening tool is recommended to be added into the EHR system utilized by emergency medical service technicians. Until then, it is recommended that emergency medical technicians continue to utilize the printed screening form. Another recommendation is that the project lead understands each emergency medical service station's current stroke alert process and the

medical center(s) in which the service station serves. Weekly follow-up regarding the project process is suggested to address challenges and barriers early.

Recommendations for Further Study

The use of the RACE scale in the prehospital setting can further research the RACE scale's accuracy to identify an LVO. Currently, limited studies are suggesting the RACE scale accurately identifies large vessel occlusive cerebrovascular accidents. The project can also be replicated for standardizing the utilization of the RACE scale in the prehospital among other emergency medical service agencies. Further research can also be conducted on prehospital identification of LVO and the effects of facility transfer times to a comprehensive stroke center.

Final Thoughts

Standardizing the utilization of the RACE scale in the prehospital setting allows for prompt recognition and intervention of suspected LVO patients. Utilizing the RACE scale screening tool in the prehospital setting can improve patient outcomes and decrease patient morbidity and mortality. Screening in the prehospital setting using the RACE scale led to accurately identifying two patients suffering from a large vessel occlusion. Of these two patients, one was a candidate for thrombectomy services and was transferred from the project site in less than two hours. Prompt recognition and intervention for the patient contributed to her overall outcome and decreased morbidity and mortality rates. While no patients were received from Station C and Station D, it was verified that Station A and B were utilizing the RACE scale screening tool in the prehospital setting with the exception of four prehospital screening fallouts. Utilization of the RACE scale among Station D had been verified by the stroke coordinator previously before the conduction of this project.

References

Adams, A., Aiken, M., Crocker, K., Crowe, R., Dickson, R., Gleisberg, G., Mason, C., Nichols, T., Panchal, A., & Patrick, C. (2019). Performance of the race scale for the prehospital identification of large vessel occlusion stroke in a suburban/rural ems service. *Prehospital Emergency Care, 23*(5), 612-618. http://doi.org/10.1080/10903127.2019.1573281

Afreen, E., Bafna, K., Burgess, R., Castonguay, A.C., Cole, K., Jumaa, M.A., Korsnack, A., Kung, V., Lindstrom, D., Parquette, B., Saalahuddin, H., Saju, L., Shawvery, J., Slawski, D.E., Tietjen, G. & Zaidi, S. (2019). Long-term implementation of a prehospital severity scale for EMS triage of acute stroke: a real-world experience *Journal of NeuroInterventional Surgery 12*(1). http://dx.doi.org/10.1136/neurintsurg-2019-014997.

Almekhlafi, M., Brown, S., Demchuk, A., Dippel, W.J., Goyal, M., Hill, M., Hunink, M., Jovin, A., Krunz, W.., Majoie, C., Menon, B., Mitchell, P., Muir, K., Saver, J. & White, P. (2020). Public health and cost consequences of time delays to thrombectomy for acute ischemic stroke. *The HERMES Collaborators Neurology, 95*(18). http://doi.org/10.1212/WNL.0000000000010867

American Heart Association. (2020). *Target: Stroke-When seconds count.* https://www.heart.org/en/professional/quality-improvement/target-stroke/learn-more-about-target-stroke

Bandeira, D., Lima, F., Mont'Alverne, F. & Nogueira, R. (2019). Pre-hospital assessment of large vessel occlusion strokes: Implications for modeling and planning stroke system care. *Frontiers Neurology, 10*. http://doi.org/10.3389/fneur.2019.00955

Berwick, D., Nolan, T., Whittington, J. (2008). The triple aim: Care, Health and cost. *Health Affairs 27*(3). http://doi.org/10.1377/hlthaff.27.3.759

Bulsara, K., Kent, D., Leung, L., Lichtman, J., Reeves, M., Smith, E., Towfighi, A., Whiteley, W. & Zahuraanec, D. (2018). Accuracy of prediction instruments for diagnosing large vessel occlusion in individuals with suspected stroke: A systematic review for the 2018 guidelines for the early management of patients with acute ischemic stroke. *Stroke, 49*(3). http://doi.org/10.116/str.0000000000000160

Carrera, D., Campbell, B., Cortes, J., Davalos, A., Gorches, M., Jimenez, X., Millan, M., Perez de la Ossaa, N., & Querol, M. (2017). Predictive value of modifications of the prehospital rapid arterial occlusion evaluation scale for large vessel occlusion in patients with acute stroke. *Journal of Stroke and Cerebrovascular Disease, 26*(1), 74-77. http://doi.org/10.1016/j.strokecerebrovasdis.2016.08.032

Center for Disease Control and Prevention. (2020). *Family history and other characteristics that increase risk for stroke.* https://www.cdc.gov/stroke/family_history.htm

Daneault, N., Deschaintre, Y., Gioia,L., Jacquin, G., Labrie, M., Nehme, A., Odier, C., Poppe, A., Ross, D. & Stapf, C. (2019). Cincinnati prehospital stroke scale for ems redirection of large vessel occlusion stroke. *Canadian Journal of Neurological Sciences, 46*(6), 684-690. http://doi.org/10.1017/cjn.2019.242

Davis, S., Campbell, B., Churilov, L., Coote, S., Dewey, H., Pesvaneto, L., & Zaho, H. (2017). Large vessel occlusion scales increase delivery to endovascular centers without excessive harm from misclassifications. *Stroke, 48*(3). http://doi.org/10.116/strokeaha.116.016056

Ebinger, M., Endres, M., Nolte, C., Schlemm, L. (2018). Impact of prehospital triage scales to detect large vessel occlusion on resources utilization and time to treatment. *Stroke, 49*(2). http://doi.org/10.116/strokeaha.117.019431

Filho, J. & Samuels, O. (2020). Mechanical thrombectomy for acute ischemic stroke. *UpToDate.* https://www.uptodate.com/contents/mechanical-thrombectomy-for-acute-ischemic-stroke?search=Mechanical%20thrombectomy%20for%20acute%20ischemic%20stroke&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1

French, E., Murphy, P., Pearsall, T., & Wojciechowski, E. (2016). A case review: Integrating lewins theory with leans system approach for change. *The Online Journal of Issues in Nursing, 21*(2). http://doi.org/10.3912/OJIN.Vol21No02Man04

Kerndt, C.C., Nicolas, D., & Reed, M. (2020). Alteplase. *Statpearls Publishing; 2021 Jan.* http://www.ncbi.nlm.nih.gov/books/NBK499977/

Khalessi, A., Olson, S., Pannell, J., Rennert, R., Santiago-Dieppa, D., Steinberg, J., & Wali, A. (2019). Epidemiology, natural history, and clinical presentation of large vessel ischemic stroke. *Neurosurgery, 85*(1). http://doi.org/10.1093/neuros/nyz042

Lewin, K. (1951). *Field Theory in Social Science.* Harper & Row.

Melnyk, B.M. & Fineout-Overholt, E. (2015). "Box 1.3: Rating system for the hierarchy of evidence for intervention/treatment questions" in *Evidence-based Practice in Nursing & Healthcare: A Guide to Best Practice, 3,* 11. Philadelphia, PA: Wolters Kluwer Health.

Perez de la Ossa, N. (2020). Rapid arterial occlusion evaluation (RACE) scale for stroke. *MD Calc.* https://www.mdcalc.com/rapid-arterial-occlusion-evaluation-race-scale-stroke#why-use

Shahid, S. & Thomas, S. (2018). Situation, background, assessment, recommendation communication tool for handoff in health care- A narrative review. *Safety in Health, 4*(7). http://doi.org/10.1186/s40886-018-0073-1

Appendix A

Literature Matrix

Authors	Year Pub	Article Title	Theory	Journal	Purpose and take home message	Design/Analysis/Level of Evidence	IV DV or Themes concepts and categories	Instr. Used	Sample Size	Sample method	Subject Charac.	Comments/critique of the article/methods GAPS
Adams, A., Aiken, M., Crocker, K., Crowe, R., Dickson, R., Gleisberg, G., Mason, C., Nichols, T., Panchal, A., & Patrick, C.	2019	Performance of the race scale for the prehospital identification of large vessel occlusion stroke in a suburban/rural ems service.	N/A	*Prehospital emergency care, 23*(5), 612-618.	Assess the performance of the RACE scale in the prehospital setting for detecting LVO stroke, following implementation at a large suburban/rural agency in the U.S.	L III Restrospective Analysis	Concepts: 911 emergency calls, EMS provider's impression of a stroke.	RACE Scale	440 patients	Standardized form completed by the receiving hospitals.	911 emergency calls with an EMS provider primary or secondary impression of a stroke treated by the agency between 6/1/2016-11/1/2017.	RACE score ≥5 for both LVO and ICH demonstrated sensitivity: 63%, specificity: 77%, PPV: 47% and NPV: 86%.
Afreen, E., Bafna, K., Burgess, R., Castonguay, A.C., Cole, K., Jumaa, M.A., Korsnack, A., Kung, V., Lindstrom, D., Parquette, B., Saalahuddin, H., Saju, L., Shawvery, J., Slawski, D.E.,	2019	Long-term implementation of a prehospital severity scale for EMS triage of acute stroke: a real-world experience	N/A	*Journal of neurointervential surgery volume 12 (1)*	To report our long-term experience of a US countywide emergency medical services (EMS) acute stroke triage protocol using the Rapid Arterial oCclusion Evaluation (RACE) score.	L III Prospective Cohort Analysis	cnocepts: baseline characteristics, time metrics, treatments, final diagnosis, and angiographic and clinical outcomes.	RACE Scale	2635	suspecvted stroke patients screened with race by Lucas County EMS personnel	all consecutive patients triaged within Lucas County, Ohio by the EMS with (1) a RACE score ≥5, taken directly to an endovascular capable center as RACE-alerts and a RACE score <5, taken to the nearest hospital as stroke-alerts.	A RACE cut-off point of ≥5 demonstrated a sensitivity, specificity, negative predictive value, and positive predictive value of 0.77, 0.75, 0.97, 0.25, respectively, for patients with LVO eligible for MT. The accuracy of this cut-off point was 75.3%.

Authors	Year Pub	Article Title	Theory	Journal	Purpose and take home message	Design/Analysis/Level of Evidence	IV DV or Themes concepts and categories	Instr. Used	Sample Size	Sample method	Subject Charac.	Comments/critique of the article/methods GAPS
Almekhlafi, M., Brown, S., Demchuk, A., Dippel, W.J., Goyal, M., Hill, M., Hunink, M., Jovin, A., Krunz, W.., Majoie, C., Menon, B., Mitchell, P., Muir, K., Saver, J. & White, P.	2020	Public health and cost consequences of time delays to thrombectomy for acute ischemic stroke.	Markov model analysis	*The HERMES collaborators neurology, 95(18).*	To determine public health and cost consequences of time delays to endovascular thrombectomy (EVT) for patients, health care systems, and society.	L I Meta Analysis	Concepts: public health and cost consequences of time delays to endovascular thrombectomy (EVT)	Markov model analysis	7	Markov model analysis of 7 Randomized Control Trials	Trials within the Highly Effective Reperfusion Evaluated in Multiple Endovascular Stroke Trials (HERMES) collaboration	Every 10 minutes of earlier treatment resulted in an average gain of 39 days of disability-free life. The cumulative lifetime costs for patients with earlier or delayed treatment were similar due to the shorter life expectancy for patients with delayed treatment. Later treatment was associated with higher morbidity-related costs but over a shorter time span due to the patients shorter life expectancy. The shorter life expectancy for patients with delayed treatment resulted in similar lifetime costs compared to patients with early treatment. Every 10 minutes of earlier treatment increased the net monetary benefit by $10,593 and by $10,915 taking health care and societal perspectives, respectively. Any time delay to endovascular treatment reduces the quality adjusted life years and decreases the economic value of care provided by this intervention. Policies are urgently needed to implement efficient prehospital triage and acclerated in-hospital workflow.
Bulsara, K., Kent, D., Leung, L., Lichtman, J., Reeves, M., Smith, E., Towfighi, A., Whiteley, W. & Zahuranec, D.	2018	Accuracy of prediction instruments for diagnosing large vessel occlusion in individuals with suspected stroke: A systematic review for the 2018 guidelines for the early management of patients with acute ischemic stroke	N/A	*Stroke, 49*(3).	Systematically review evidence for the accuracy of LVO prediction instruments	L I Systemic Review	Accuracy of LVO prediction instruments: CPSSS, LAMS, RACE, NIHSS	N/A	36 studies	Medline, Embase, and Cochrane databases were searched on October 27, 2016. Study quality was assessed with the Quality Assessment of Diagnostic Accuracy-2 tool.	Prospective or retrospective cohort studies, cross-sectional studies, clinical trials, or systematic reviews, excluding case reports and case series. Either suspected stroke or presumed ischemic stroke with brain imaging. Adults 18 years and older. Performed in prehospital or emergency room setting. LVO presence or absence. An LVO prediction instrument was applied and was associated with the presence or	The NIHSS is the optimal LVO prediction instrument in the hospital emergency department. The CPSSS, LAMS, and RACE, can be used in the prehospital setting, without clear evidence for superiority of 1 scale over the others. Need for more prospectively designed studies to compare the accuracy of different LVO prediction instruments administered by EMS in the prehospital setting for suspected stroke patients.

Authors	Year Pub	Article Title	Theory	Journal	Purpose and take home message	Design/Analysis/Level of Evidence	IV DV or Themes concepts and categories	Instr. Used	Sample Size	Sample method	Subject Charac.	Comments/critique of the article/methods GAPS
Carrera, D., Campbell, B., Cortes, J., Davalos, A., Gorches, M., Jimenez, X., Millan, M., Perez de la Ossaa, N., & Querol, M.	2017	Predictive value of modifications of the prehospital rapid arterial occlusion evaluation scale for large vessel occlusion in patients with acute stroke	N/A	*Journal of stroke and cerebrovascular disease, 26*(1)	Can simplification of the Rapid Arterial oCclusion Evaluation (RACE) scale maintain its high perfomance to identify patients with LVO.	L III Prospective Cohort	Did one of the seven simpler versions of the RACE scale accurately identified a LVO.	RACE, NIHSS. Seven simpler versions of the RACE scale were designed and retrospectively recalculated for each patient.	341 patients	Seven simpler versions of the RACE scale were designed and retrospectively recalculated for each patient.	Suspected stroke patients admitted to the emergency department	The us of the original RACE scale for prehospital assessment of patients with suspected stroke is recommended over the use of simplified versions. The RACE scale is recommended for the easy use and high performance to predict the presence of a LVO. Use of a simplified RACE scale reduces the predictive value.
Danealt, N., Deschaintre, Y., Gioia,L., Jacquin, G., Labrie, M., Nehme, A., Odier, C., Poppe, A., Ross, D. & Stapf, C.	2019	Cincinnati prehospital stroke scale for ems redirection of large vessel occlusion stroke	N/A	*Canadian journal of neurological sciences, 46(6)*	Can a high Cincinnati Prehospital Stroke Scale (CPSS) score identify an LVO. The EMS redirection protocol based on high scoring CPSS accelerated endovascular treatment.	L III Restrospective Analysis	Concepts: CPSS score, final diagnosis, presence of LVO, use of reperfusion therapy	CPSS	440 patients	Patients transported to a comprehensive stroke center with a doccumented CPSS score	All suspected stroke patientstransported by EMS to the Emergency Department of the Centre Hospitalier de l'Université de Montréal between February 2016 and June 2017.	Utilization of a high CPSS score as an LVO triage tool was also associated with high patient volume and high rates of non-LVO ischemic stroke and ICH, resulting in an overall low positive predictive values for LVO detection.

Authors	Year Pub	Article Title	Theory	Journal	Purpose and take home message	Design/Analysis/Level of Evidence	IV DV or Themes concepts and categories	Instr. Used	Sample Size	Sample method	Subject Charac.	Comments/critique of the article/methods GAPS
Davis, S., Campbell, B., Churilov, L., Coote, S., Dewey, H., Pesvaneto, L., & Zaho, H.	2017	Large vessel occlusion scales increase delivery to endovascular centers without excessive harm from misclassifications.	N/A	*Stroke, 48*(3).	Setting in which LVO triage scale misclassifications can occur and the consequences of these misclassifications.	L III Prospective Cohort Analysis	Concepts: Large Vessel Occlusion (LVO), Rapid Arterial Occlusion Evaluation (RACE), Los Angeles Motor Scale (LAMS), Field Assessment Stroke Triage for Emergency Destination (FAST-ED), Prehospital Acute Stroke Severity scale (PASS), and Cincinnati Prehospital Stroke Severity Scale (CPSSS)	Five LVO triage scales (RACE, LAMS, FAST-ED, PASS, and CPSSS	565 patients	Data was collected from ambulance-initiated stroke alerts at 2 stroke centers. Patients were separated into 2 groups: typical (LVO with predefined severe syndrome and non-LVO without) or atypical presentations.	Ambulance-initiated code stroke alerts at the emergency departments of 2 major stroke centers in Melbourne, Australia.	Diagnostic ratio were highest for RACE and FAST-ED and lowest for CPSSS. The negative predictive values were similar for all scales.
Ebinger, M., Endres, M., Nolte, C., Schlemm, L.	2019	Impact of prehospital triage scales to detect large vessel occlusion on resources utilization and time to treatment.	N/A	*Stroke, 49*(2)	Impact of prehospital stroke severity scales to detect large vessel occlusion (LVO) on resource use and time to reperfusion treatment for stroke patients.	L I Randomized Control Trial	IV: geogrpahical location from CSC, RACE Score. DV: time to groin puncture. Time to thrombolysis, use of secondary transfers	RACE Scale	100	100 individual instances of patients developing acute stroke–like symptoms potentially treatable with thrombolysis or EVT were simulated at random locations within the defined geographical environments.	Each patient was assigned a stroke severity score between 0 and 9 as measured by RACE Scale; probability to alert EMS; an onset-to-alarm time or last seen well time; probability to have a known contraindication to thrombolysis; and probabilities to have either LVO, AIS without LVO, hemorrhagic stroke, or	Implementation of a prehospital triage strategy based on a RACE cutoff score ≥5 is associated with more patients with suspected acute stroke at comprehensive stroke centers and less patients at primary stroke centers. Mean time to groin puncture is reduced by 29.6 minutes, while mean time to thrombolysis does not change significantly. The total number of secondary transfers is reduced by 60.9%.

Appendix B

RACE Scale

Rapid Arterial oCclusion Evaluation (RACE) Scale

An EMS Assessment Tool for Acute Ischemic Stroke

(Sensitivity 85%, Specificity 68%)

Test Item	Score = 0	Score = 1	Score = 2	Patient Score
Facial Palsy	Absent	Mild	Moderate/Severe	
Arm Motor	Normal/Mild	Moderate	Severe	
Leg Motor	Normal/Mild	Moderate	Severe	
Head/Gaze Deviation	Absent	Present	N/A	
Aphasia* (if right hemiparesis)	Performs Both Tasks	Performs 1 Task	Performs Neither Tasks	
Agnosia+ (if left hemiparesis)	Patient Recognizes Arm and Impairment	Unable to Recognize Arm or Impairment	Unable to Recognize BOTH Arm and Impairment	
			TOTAL SCORE = (0-9)	

*Aphasia: Ask the patient to: 1. "Close your Eyes" AND 2. "Make a Fist"

+Agnosia: Ask the patient and evaluate recognition of deficit:

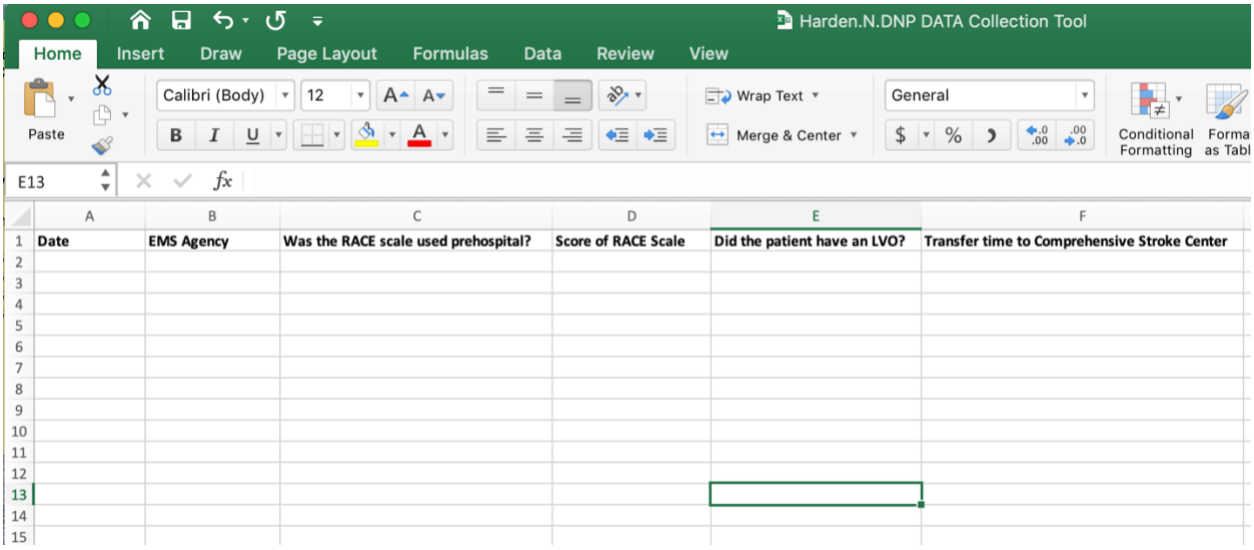
1. While showing paretic arm: "Whose arm is this?"
2. Ask patient: "Can you lift both arms and clap?"

If RACE Score = 5 or greater, patient may have an ischemic stroke with a large vessel occlusion

Reference:
Natalia Pérez de la Ossa, et al. (2014). Design and Validation of a Prehospital Stroke Scale to Predict Large Arterial Occlusion: The Rapid Arterial Occlusion Evaluation Scale. *Stroke*, 45, 87-91. Retrieved from http://stroke.ahajournals.org/content/45/1/87.full

Appendix C

Data Collection Tool



Appendix D

SBAR Communication Tool

Situation	
Background	
Assessment	
Recommendation	

Appendix E

RACE Scale Screening Form

Date _____ *Please place completed forms in the designated basket at the ER charge desk*

Pasquotank Perquimans Currituck Gates

Patient Initials: _____ BP: _____ BS: _____

Age: _____

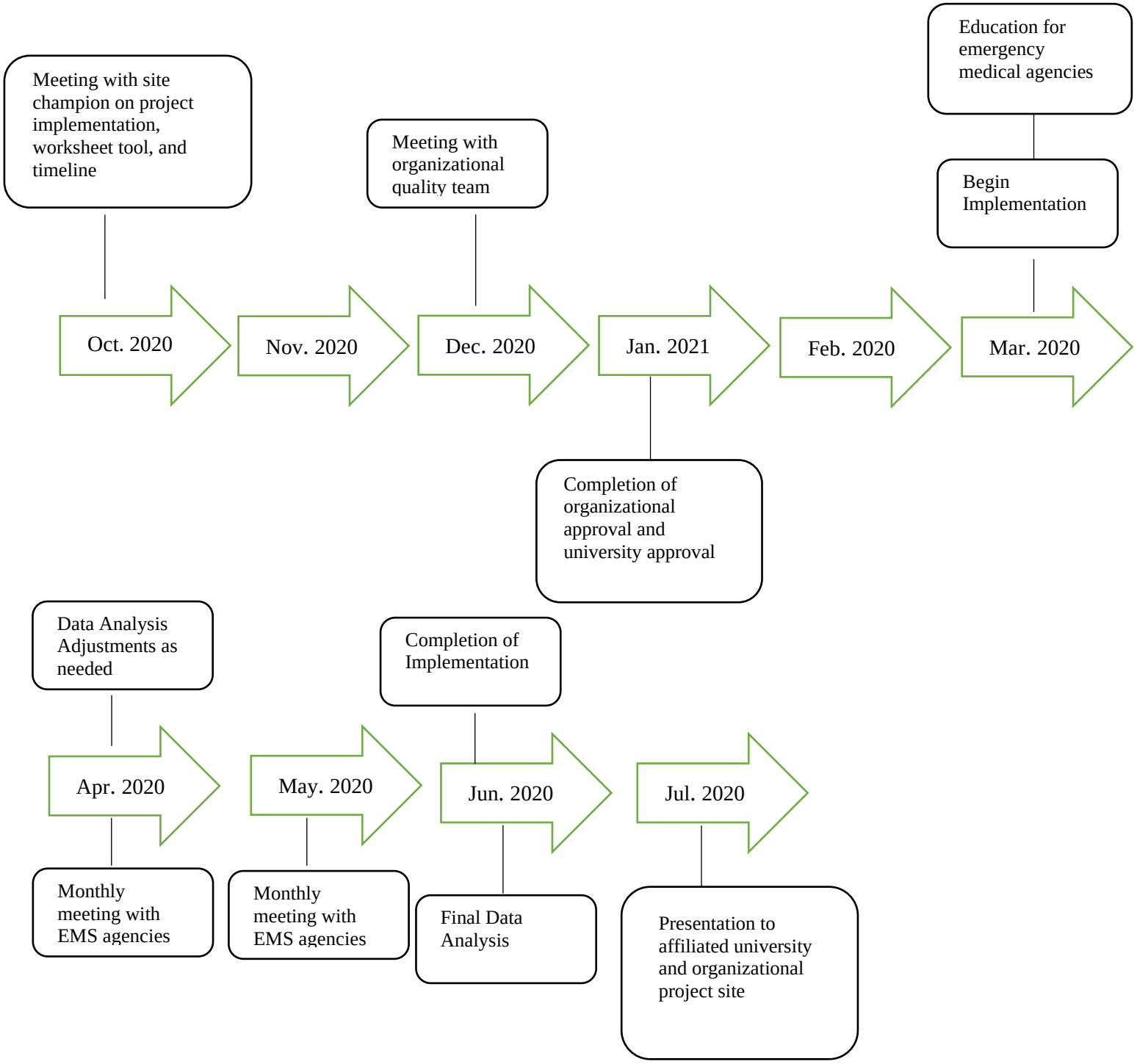
ITEM	INSTRUCTION		SCORE
FACIAL PALSY	Ask the patient to show their teeth	Absent (symmetrical movement) Mild (slightly symmetrical) Moderate to severe (completely asymmetrical)	0 1 2
ARM MOTOR FUNCTION	Extending the arm of the patient 90 degrees (if sitting) or 45 degrees (if supine)	Normal to Mild (limb upheld more than 10 seconds) Moderate (limb upheld less than 10 seconds) Severe (patient unable to raise arm against gravity)	0 1 2
LEG MOTOR FUNCTION	Extending the leg of the patient 30 degrees (if supine)	Normal to Mild (limb upheld more than 5 seconds) Moderate (limb upheld less than 5 seconds) Severe (patient unable to raise the leg against gravity)	0 1 2
HEAD AND GAZE DEVIATION	Observe eyes and cephalic deviation to one side	Absent (eye movements to both sides were possible and no cephalic deviation was observed) Present (eyes and cephalic deviation to one side was observed)	0 1
APHASIA *If right hemiparesis*	Ask the patient to close their eyes and make a fist	Normal (performs both tasks correctly) Moderate (performs one task correctly) Severe (performs neither task)	0 1 2
AGNOSIA *If left hemiparesis*	Hold up the patients left arm and ask the patient whose arm is this? Can you move your left arm?	Normal (performs both tasks correctly) Moderate (performs one task correctly) Severe (performs neither task)	0 1 2

RACE Score: _____

Cincinnati Stroke Scale Score: _____

Appendix F

Project Timeline



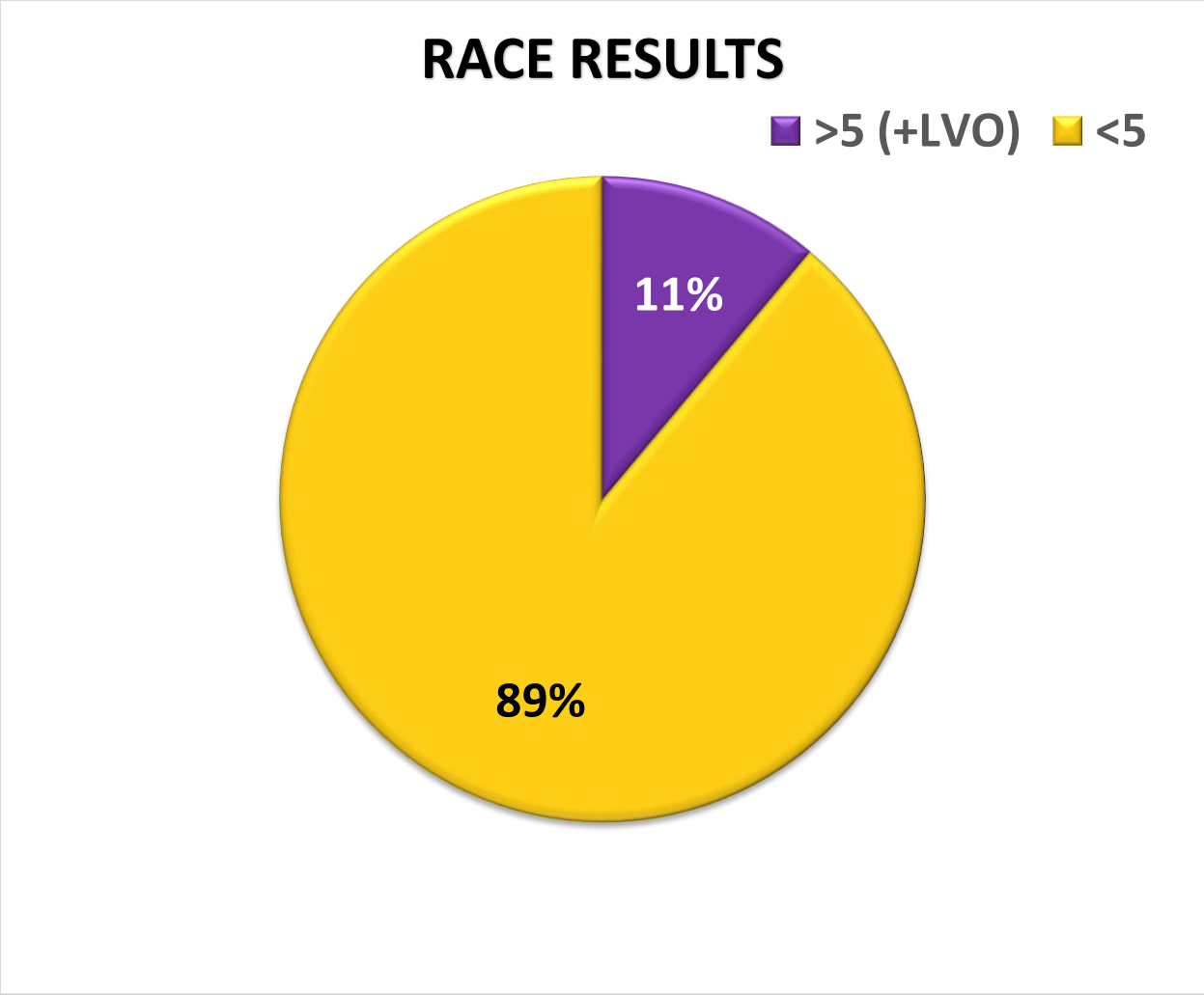
Appendix G

Utilization by Agency

Agency	Completed RACE	Stroke Alerts
Station A	15	18
Station B	1	2
Station C	0	0
Station D	0	0

Appendix H

RACE Results



Appendix I

Project Budget

Item	Unit Cost	Quantity	Total
Personnel time for research, project design, and education of emergency medical service technicians	**$32.00/hour**	**50**	**$1,600.00**
Printed RACE Screening Tool	**$0.25**	**100**	**$25.00**
TOTAL			**$1,625.00**

Appendix J

Doctor of Nursing Practice Essentials

	Description	Demonstration of Knowledge
Essential I ***Scientific Underpinning for Practice***	**Competency** – Analyzes and uses information to develop practice **Competency** -Integrates knowledge from humanities and science into context of nursing **Competency** -Translates research to improve practice **Competency** -Integrates research, theory, and practice to develop new approaches toward improved practice and outcomes	• The DNP project was based upon research and evidenced-based practice guidelines of screening for large vessel occlusions. • The framework for implementation was based on Lewin's Change Theory. • New approaches to improving practice among emergency medical service agencies were identified and implemented as a result of the DNP project.
Essential II ***Organizational & Systems Leadership for Quality Improvement & Systems Thinking***	**Competency** –Develops and evaluates practice based on science and integrates policy and humanities **Competency** –Assumes and ensures accountability for quality care and patient safety **Competency** -Demonstrates critical and reflective thinking **Competency** -Advocates for improved quality, access, and cost of health care; monitors costs and budgets **Competency** -Develops and implements innovations incorporating principles of change **Competency** - Effectively communicates practice knowledge in writing and orally to improve quality **Competency** - Develops and evaluates strategies to manage ethical dilemmas in patient care and within health care delivery systems	• The quality improvement project required continuous interprofessional collaboration among EMS personnel, ED staff, and the organization. • Education on the RACE scale was provided among EMS personnel and the emergency department staff. • Patient outcomes and cost of health care were advocated through the integration of the RACE scale to screen for LVO. • Data tracking was completed weekly by the project lead with collaboration with the stroke coordinator and site champion. • Barriers to implementation were addressed using the SBAR model and collaboration among the

		stroke coordinator and the EMS agency.
Essential III ***Clinical Scholarship & Analytical Methods for Evidence-Based Practice***	**Competency** - Critically analyzes literature to determine best practices **Competency** - Implements evaluation processes to measure process and patient outcomes **Competency** - Designs and implements quality improvement strategies to promote safety, efficiency, and equitable quality care for patients **Competency** - Applies knowledge to develop practice guidelines **Competency** - Uses informatics to identify, analyze, and predict best practice and patient outcomes **Competency** - Collaborate in research and disseminate findings	• Literature was critically synthesized to determine the best evidenced-based practice for identifying LVO in the prehospital setting. • The RACE scale was identified as the best practice screening tool for the DNP project. • Utilization of the RACE scale in the prehospital setting promotes patient safety, improves patient care and health outcomes, and provides equitable quality care to all suspected stroke patients. • Informatics was used to track, trend, and analyze project data. • Project findings were disseminated among the project site organization, EMS agencies, and the university.
Essential IV ***Information Systems – Technology & Patient Care Technology for the Improvement & Transformation of Health Care***	**Competency** - Design/select and utilize software to analyze practice and consumer information systems that can improve the delivery & quality of care **Competency** - Analyze and operationalize patient care technologies **Competency** - Evaluate technology regarding ethics, efficiency and accuracy **Competency** - Evaluates systems of care using health information technologies	• Education on the RACE scale was provided among EMS personnel and the emergency department staff. • Education was provided through a combination of PowerPoint presentation, Webex, and one small face-to-face classroom. • The RACE scale was implemented in the prehospital among four local emergency medical agencies for 12 weeks • A screening form was designed in collaboration amongst EMS personnel

		and the project lead to provide efficiency, effective usage, and adherence to the utilization of the RACE scale. • The project site's electronic health record was accessed and utilized to assess, track, and trend patient data. • Data was recorded on an excel spreadsheet file for tracking.
	Description	**Demonstration of Knowledge**
Essential V ***Health Care Policy of Advocacy in Health Care***	**Competency**- Analyzes health policy from the perspective of patients, nursing and other stakeholders **Competency** – Provides leadership in developing and implementing health policy **Competency** –Influences policymakers, formally and informally, in local and global settings **Competency** – Educates stakeholders regarding policy **Competency** – Advocates for nursing within the policy arena **Competency**- Participates in policy agendas that assist with finance, regulation and health care delivery **Competency** – Advocates for equitable and ethical health care	• Advocated for a prehospital screening tool to readily identify large vessel occlusions. • Led a quality improvement project to standardize the utilization of the RACE scale among EMS agencies serving the medical center. • Prehospital identification of an LVO leads to decreased patient morbidity and mortality. • Implemented a new screening tool among three of the four EMS service agencies to current patient care practice. • Sustainability of a continued screening tool of the EMS agencies to screen and identify LVO in the prehospital setting.
Essential VI ***Interprofessional Collaboration for Improving Patient & Population Health Outcomes***	**Competency**- Uses effective collaboration and communication to develop and implement practice, policy, standards of care, and scholarship **Competency** – Provide leadership to interprofessional care teams **Competency** – Consult intraprofessionally and interprofessionally to develop systems of care in complex settings	• Interprofessional collaboration amongst EMS personnel, emergency department staff, project lead, stroke coordinator, and site champion were pertinent to the sustainability of the project.

		• An interprofessional collaboration led to the implementation of the RACE scale amongst four local EMS agencies serving the project site.
Essential VII ***Clinical Prevention & Population Health for Improving the Nation's Health***	**Competency**- Integrates epidemiology, biostatistics, and data to facilitate individual and population health care delivery **Competency** – Synthesizes information & cultural competency to develop & use health promotion/disease prevention strategies to address gaps in care **Competency** – Evaluates and implements change strategies of models of health care delivery to improve quality and address diversity	• Early identification and intervention of an LVO CVA in the prehospital setting are evidenced-based health guidelines. • Implementation of the RACE scale leads to decreased patient morbidity and mortality. • Standardizing the utilization of the RACE scale among the EMS agencies allows for early identification and prompt recognition of an LVO CVA improving patient care.
Essential VIII ***Advanced Nursing Practice***	**Competency**- Melds diversity & cultural sensitivity to conduct systematic assessment of health parameters in varied settings **Competency** – Design, implement & evaluate nursing interventions to promote quality **Competency** – Develop & maintain patient relationships **Competency** –Demonstrate advanced clinical judgment and systematic thoughts to improve patient outcomes **Competency** – Mentor and support fellow nurses **Competency**- Provide support for individuals and systems experiencing change and transitions **Competency** –Use systems analysis to evaluate practice efficiency, care delivery, fiscal responsibility, ethical responsibility, and quality outcomes measures	• Data outcomes were tracked weekly to monitor project progress and address barriers. • Interprofessional collaboration among EMS personnel, project lead, and stroke coordinator through the utilization of RACE scale education. • Continual follow-up meetings among EMS agencies were conducted monthly during project implementation. • Follow-up among EMS personnel and the stroke coordinator was also conducted immediately if a RACE scale was not utilized in the prehospital setting.

		• Weekly meetings were conducted among the stroke coordinator and site champion.