Title

Low-to-Moderate Risk Transient Ischemic Attack Patients can be Safely Discharged from the Emergency Department to a Nurse Practitioner-Led Clinic

Author

Alfandy, Fnu

Publication Date

2022

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Low-to-Moderate Risk Transient Ischemic Attack Patients can be Safely Discharged from the Emergency Department to a Nurse Practitioner-Led Clinic

A dissertation submitted in partial satisfaction of the

requirements for the degree

Doctor of Nursing Practice

by

Fnu Alfandy

2022

ABSTRACT OF THE DISSERTATION

Low-to-Moderate Risk Transient Ischemic Attack Patients can be Safely Discharged from the Emergency Department to a Nurse Practitioner-Led Clinic

by

Fnu Alfandy

Doctor of Nursing Practice

University of California, Los Angeles, 2022

Professor Holli A. DeVon, Chair

Background: Unnecessary admissions fuel rising healthcare costs and take away resources from higher acuity patients without evidence of increased safety. **Objectives**: To determine if the care diversion for transient ischemic attack (TIA), from inpatient to a nurse practitioner (NP)-led specialty clinic, resulted in no increase in stroke incidence at 90 days. **Methods:** The sample included all adults (18 years or older) presenting to the emergency department (ED) with TIA at low-to-moderate risk for stroke. Risks were defined by the $ABCD^2$ score and non-invasive vessel imaging. Patients who met the criteria were discharged and evaluated by a stroke NP at the TIA clinic within seven days. These patients were compared to those who were admitted to the hospital prior to clinic launch. Chart reviews were conducted to determine stroke incidence at 90

days post TIA. Descriptive statistics were used to evaluate clinical variables, and Fisher's Exact test was used to assess difference in stroke rates. Patient satisfaction score was collected using the existing institutional survey. **Results:** Eighty-one participants were included, 40 in the clinic group and 41 in the admission group. The means ages in the clinic group and the admission group were 72.8 and 75.2 years, respectively (p=0.37). Females comprised 45% of patients in the clinic group, compared to 51.2% in the admission group (p=0.58). The mean $ABCD^2$ scores were 4.08 and 3.95 in the clinic and admission groups, respectively (p=0.63). The median clinic follow-up time was 6 days. There was no stroke incidence in the clinic group and one incidence in the admission group (p=1.0) within 90 days of index TIA. Patient satisfaction score with the NP was 92.6%. **Conclusion:** Referral to a NP-led clinic in patients with low-to-moderate risk TIA was equally safe as hospital admission.

The dissertation of Fnu Alfandy is approved.

Mary-Lynn Brecht

Suzette Cardin

Dong Sung An

Holli A. DeVon, Committee Chair

University of California, Los Angeles

2022

This dissertation is dedicated to my husband and constant support, Dennis Kaighn Constan, who propelled my interest and career in Nursing.

TABLE OF CONTENTS

List of Figures and Tables

ACKNOWLEDGEMENTS

I would like to acknowledge Holli A. DeVon, PhD, RN, FAAN, FAHA for the countless hours, meetings, and emails to refine and to finalize the project and this manuscript. Her dedication to mentorship is one that I hope to emulate with my students and mentees. I also would like to acknowledge the dissertation committee – Mary-Lynn Brecht, PhD, Suzette Cardin, PhD, RN, FAAN, and Dong Sung An, MD, PhD – for reviewing the manuscript and providing their invaluable recommendations. Donald Gardenier, DNP, FNP-BC, FAANP, FAAN's guidance and encouragement helped me focus on the goals of my professional development. I also would like thank Seymour Young, MD for his clinical and administrative support; Amanda Young, LVN for her contribution in data collection; Richard Reagin, BSN, RN, SCRN for his help in generating reports; and David Romness, MD for his support in the ED.

Lastly, I would be remiss if I did not acknowledge the exceptional UCLA DNP core team – Nancy Jo Bush, DNP, RN, MA, AOCN, FAAN, Theresa Brown, DNP, RN, ACNP-BC, AACC, FAANP, and Soo Kwon – who always provided high-quality education and a robust experience for their students.

VITA

EDUCATION

University of California, Los Angeles
Doctor of Nursing Practice – Anticipated completion – June 2022
University of Nevada, Reno
Post-Master Certificate – Adult Gerontology Acute Care Nurse Practitioner – December 2019
Thomas Jefferson University School of Nursing
Master of Science in Nursing – Adult Primary Care Nurse Practitioner – August 2012
Thomas Jefferson University School of Nursing
Bachelor of Science in Nursing – June 2011
Gwynedd-Mercy University
Bachelor of Science in Biology (minor in Chemistry and Mathematics) – May 2008

WORK EXPERIENCE

August 2016 – present, **Eisenhower Health**
Stroke Program Nurse Practitioner
September 2021 – present, **University of California, Los Angeles**
Graduate Teaching Apprenticeship
January 2020 – present, **University of Nevada, Reno Orvis School of Nursing**
Adjunct Faculty
January 2015 – August 2020, **St. Francis Medical Center**
Stroke Program Nurse Practitioner
July 2015 – August 2016, **Desert Regional Medical Center**
Neuro/Stroke Program Clinical Coordinator
August 2013 – January 2015, **Reading Health System**
Interventional Neuroradiology Nurse Practitioner
October 2012 – August 2013, **Neurology and Stroke Associates**
Neurology Nurse Practitioner

HONORS/AWARDS

- Awardee – UCLA Best DNP Scholarly Project Award, 2022
- Awardee – Eisenhower Health Nursing Professional Excellence Award for Exemplary Practice as an Advance Practice Nurse, 2022
- Recipient – Dr. Suzette Cardin Doctoral Fellowship, 2022
- Recipient – Dr. Suzette Cardin Doctoral Fellowship, 2021
- Recipient – Dr. Nancy Jo Bush DNP Scholarship, 2021
- Awardee – Eisenhower Stroke Program Advanced Practice Nurse of the Year, 2017
- Recipient – Thomas Jefferson University Dean's Scholarship, 2010 - 2012
- Dean's List – Thomas Jefferson University, 2010-2012
- Awardee – Leadership LIVE, a Leadership Development Program for Healthcare Professionals, 2011
- Inductee – Sigma Theta Tau International, Honor Society of Nursing, Delta Rho Chapter, 2011

PROFESSIONAL AND POSTER PRESENTATIONS

Risk of Stroke among Low-to-Moderate Risk Transient Ischemic Attack Patients Receiving Outpatient Care at a Nurse Practitioner-Led Specialty Clinic. UCLA Virtual Research Day: Building and Sustaining a Research Career. UCLA, Los Angeles, CA. May 2022.

Alcohol as Primary Prevention: The Relationship between Alcohol Consumption and Risk of Dementia in Older Adults. Master's Capstone Project. Thomas Jefferson University. Philadelphia, PA. August 2012.

The Role of Transforming Growth Factor β in Cancer Progression. The Southeastern Pennsylvania Consortium for Higher Education. Chestnut Hill College. Philadelphia, PA. April 2008.

CHAPTER ONE: INTRODUCTION

Transient ischemic attack (TIA) is defined as a transient episode of neurological symptoms or deficits caused by ischemia to the brain, spinal cord, or retina, without any evidence of infarction (Kernan et al., 2014). Individuals with TIA are at high risk for future ischemic events with up to 17.8% risk of stroke at 90 days post index event (Johnston et al., 2007). All patients with suspected TIA should receive timely evaluation to establish the diagnosis and to determine the underlying etiology (Mendelson & Prabhakaran, 2021). This evaluation should be performed within 48 hours following symptom onset due to the high incidence of stroke during this period (Kleindorfer et al., 2021). There is no consensus on the optimal setting in which all patients with TIA should be managed – inpatient versus outpatient (Ranta & Barber, 2016). Patients with abnormal diagnostic findings attributable to TIA who are amenable to urgent treatment (such as surgical intervention, endovascular treatment, intravenous anticoagulation, and others) are considered high risk and require hospital admission. Outpatient management at specialty clinics is a safe option for those absent of high risk clinical and diagnostic features for an impending stroke. The short-term and long-term safety of TIA clinics have been established in various settings (Chang et al., 2019; Hastrup et al., 2021; Hosier et al., 2016; Kapral et al., 2016; Majidi et al., 2017). Outpatient management of non-high risk TIA patients is cost-effective and associated with high-quality performance indicators (Hastrup et al., 2021; Hosier et al., 2016; O'Brien et al., 2014).

The demand for neurologists continues to rise and will outpace supply, as the aging population increases in the United States (U.S.). The most recent available study on neurologist shortage (Dall et al., 2013) projected an increase of neurologist demand from 11% in 2012 to 19% in 2025. The average wait time for new patients to be evaluated by a neurologist in 2012

was 35 business days – an increase from 28 days in 2010 (Craft et al., 2013). Neurologist shortfall extends to many neurology subspecialties, including stroke neurology (Leira et al., 2013). The impact of a neurologist shortage disproportionately affects rural communities with only 9% of U.S. physicians practicing in rural areas, but 20% of Americans living in rural areas (Harrington et al., 2020).

U.S. healthcare institutions are challenged to provide quality care for patients with TIA amid the high costs of healthcare and a neurologist shortage. Nurse practitioners (NPs) are well poised to bridge the healthcare gap by providing evidence-based TIA care in the outpatient setting. Studies have associated high quality care with the services that NPs provide, regardless of practice setting (Landsperger et al., 2016; Martin-Misener et al., 2015; Ortiz et al., 2018; Traczynski & Udalova, 2018). This observation was also noted with cardiovascular risk factor management (Harrington & Heidenreich, 2015; Virani et al., 2015).

This quality improvement (QI) project evaluated the implementation of an NP-led TIA clinic, to which TIA patients with low-to-moderate risk of stroke were referred from the emergency department (ED) instead of being admitted to the hospital. The goals of this initiative were to determine safety and patient satisfaction of diverting TIA patients from the inpatient to outpatient setting. The expectation was that the diversion of unnecessary TIA hospital admissions to an NP-led TIA clinic would result in a similar 90-day stroke rate compared to that of those who were admitted prior to the clinic launch.

CHAPTER TWO: THEORETICAL FRAMEWORK

Flaskerud and Winslow's vulnerable population conceptual model (VPCM) links three model concepts: (a) resource availability, (b) relative risk, and (c) health status (Flaskerud & Winslow, 1998). Resource availability is defined along both socioeconomic and environmental

resources axes that include income, employment, education, social support, marginalization, power differentials, healthcare quality, and differential access to care. Relative risk is viewed as the risk of the vulnerable population to be exposed to risk factors that are associated with poor health outcomes due to limited resources, compared to individuals without risk factor exposure secondary to adequate resources. The relative risk concept includes the use of health promotion services; exposure to stressful events; and lifestyle, behavior, and choices. The health status concept is defined as the prevalence of disease, as well as the rates of mortality and morbidity in a particular population.

Flaskerud and Winslow (1998) state that relationships exist between the three model concepts. These inter-model relationships are presented in Appendix A. The availability of resources (socioeconomic, environmental, or both) increases a population's exposure to risk factors. Risk factor exposure influences the health status of a population, which is defined as morbidity and mortality. Increased morbidity and mortality ameliorate a population's exposure to risk factors. Increased morbidity and mortality can also further exhaust resources availability.

Flaskerud and Winslow's VPCM is a viable model to ethically address the link between patients with TIA living in rural areas (vulnerable population), stroke (risk), stroke neurologist shortage (resource availability), and long clinic wait time that can lead to increased disability/morbidity and mortality (health status). This project's initiative aims to impact the link between the limited resource and health outcome concepts.

CHAPTER THREE: REVIEW OF LITERATURE

The literature search focused on TIA, outpatient management, and stroke risk. PubMed and Embase databases were employed to conduct the literature search was conducted using. Keywords used for the search included TIA, transient ischemic attack, clinic, clinic referral,

outpatient, outpatient management, nurse practitioner, advanced practice registered nurse (APRN), advanced practice nurse, advanced practice provider, emergency department, emergency department discharge, ED disposition, stroke, stroke rate, and stroke risk. Several versions of Boolean combinations using these keywords were performed, and the best-yielding combination for the pertinent result of interest was the following: (TIA OR "transient ischemic attack") AND (“clinic” OR "clinic referral" OR Outpatient OR "outpatient management") AND ("emergency department" OR "emergency department discharge" OR "ED disposition") AND (stroke OR "stroke rate" OR "stroke risk") AND (“nurse practitioner” OR “NP” OR “APRN” OR “advanced practice nurse” OR “advanced practice provider”). Limiting the search to full-text articles published within the last five years (2016-2021), twenty-eight articles were found in PubMed. Using articles (publication type) and 2016-2021 (publication years) as filters, an Embase search yielded twenty-four articles. The rationale for limiting the search to articles that were published in the past five years was to ensure that the patient management provided in the studies reflected the contemporary management recommended in the most recent clinical practice guidelines. Nine articles were chosen with the focus on clinical outcomes of patients with TIA who were discharged from the ED with clinic referral (see Table of Evidence).

A rapid clinic referral protocol in a single-center retrospective chart review study by Chang et al. (2019) facilitated evaluation of patients with TIA and minor stroke (TIAMS) within 24 hours of ED visit. One of the criteria of patient selection includes the National Institutes of Health Stroke Scale (NIHSS) score< 5 with the absence of disabling symptoms. Clinic attendance, as well as 90-day TIAMS recurrence and hospitalization, were evaluated. A total of 162 individuals were enrolled in the study. Two patients (1.3%) were rehospitalized upon clinic evaluation. Of the 66% of patients who retained the same final diagnosis following clinic

evaluation, 19.1% required rehospitalization (4.9% for recurrent TIA and 0.9% for recurrent stroke) at 90 days. None of the patients who were hospitalized received thrombolytic therapy, and none of the readmissions was deemed preventable. The initial and 90-day safety outcomes, as well as 90-day stroke rates, in the study were similar to those in large published trials and other trials that used different outpatient referral strategies. The investigators concluded that rapid clinic evaluation of TIAMS was both feasible and safe.

A longitudinal study by Condon et al. (2016) included 510 patients who received evaluation at an NP-staffed transitional stroke clinic (TSC) in Ohio following hospital discharge for stroke or TIA. The model included a phone call by a registered nurse (RN) within two weeks of discharge, clinic evaluation by an NP between two and four weeks, and a follow-up phone call at 30 and 90 days. The 30-day readmission rate was lower in cohort seen at the TSC (60.8% vs. 76.3%, p=0.021). The intervention did not have a significant impact on the 90-day readmission rate, but those who were admitted had a lower clinic show rate (67.5% vs. 76.4%, p=0.088). The investigators concluded that an NP/RN team and a comprehensive TSC model were associated with a reduced 30-day readmission rate for patients with stroke or TIA who were discharged home.

Hastrup et al. (2021) evaluated the 12-month performance of an acute stroke and TIA clinic in Denmark, which served as an initial point of evaluation before determining the need for subsequent hospitalization for those determined to be of high risk. In this prospective cohort study, stroke patients were compared to two reference populations - (hospitalized group at the same hospital [historic-matched] and at other comparable hospitals [contemporary-matched]) - on outcomes that included hospital length of stay, 30-day readmission, mortality, and care quality. TIA patients were compared only to contemporary-matched hospitalized controls due to

the unavailability of historic controls in the Danish Stroke Registry. Of the 1,076 patients evaluated at the clinic, 23.5% were subsequently admitted. Two-hundred fifty-one patients received clinic evaluation, and 171 patients had a final diagnosis of stroke and TIA. A total of 56% stroke patients were subsequently admitted to the stroke unit. The median hospital length of stay for these patients was shorter than the historic cohort, 1 vs. 3 days, with the adjusted length of stay ratio of 0.49. The clinic's patient readmission rate at 30 days was lower than that of the historic hospitalized cohort, 3.2% vs. 11.6%. The contemporary hospitalized controls for stroke and TIA patients yielded similar results. One patient considered to be low risk and not admitted did suffer from stroke within seven days. The investigators concluded that the outpatient acute stroke and TIA clinic protocol resulted in a shorter hospital length of stay, lower 30-day readmission rate, and a higher quality of care compared to an inpatient admission.

A single-center retrospective review study in Canada by Hosier et al. (2016) aimed to evaluate the performance of TIA management in the EDs of the Capital District Health Authority in Nova Scotia and to evaluate the effect of dedicated neurovascular clinic evaluation post-ED discharge. The study included 686 participants. Most patients underwent prompt evaluation with head computed tomography (CT) and electrocardiogram (ECG) - 88.3% and 86.3%, respectively. Of these participants, 35% underwent vascular imaging within 24 hours. Only 36% of patients were evaluated at the clinic, among whom 86.4% retained the TIA diagnosis and 4.2% had magnetic resonance imaging (MRI) evidence of stroke. At 90 days, 4.2% experienced stroke, myocardial infarction (MI), or vascular death. With adjustment of age, sex, risk factors, and symptoms, readmission risk for stroke, MI, or vascular death was lower in patients evaluated at the clinic compared to those who were not, AHR 0.28; 95% CI 0.08-0.99, p=0.048. The rates of antithrombotic and anticoagulation therapy were higher in patients seen at the clinic compared

to those who were not - 94% vs. 86.3%, $p<0.0001$; 85.7% vs. 47.6%, $p<0.0001$, respectively. The investigators suggested that the ED performance in TIA management met the national standards in certain aspects, although there were areas of improvement. Neurovascular clinic referral could have provided positive clinical impact, but ED referrals were underutilized.

A large multi-center registry/database review study by Kapral et al. (2016) showed that hospitalization rate at seven days was lowest in patients who were admitted, compared to those who were discharged with or without clinic referral – 0.9% vs. 8.2% vs. 8.3%, respectively. The one-year mortality rate was 7.9% among those who were admitted, 3.7% among those who were discharged with clinic referral, and 9.9% among those discharged without clinic referral ($p<0.001$). Patients who were admitted had a 1.7% chance of developing a new stroke/TIA, and 5.3% experienced clinical neurological worsening. Adjusting for age, sex, comorbidities, and other factors, the hazard mortality was similar in those who were admitted and not admitted (AHR 1.1; 95% CI 0.92-1.34), but lower in those referred to the clinic compared to those without clinic referral (AHR 0.49; 95% CI 0.38-0.64). The investigators concluded that patients who were admitted with TIAMS were more likely to receive timely recommended tests and treatments. The outcomes of patients who were discharged with clinic referral were associated with a better process of care and lower mortality compared to those discharged without clinic referral.

Majidi et al. (2017) randomized 100 patients in a single-center U.S. medical center to either inpatient (admission) or outpatient management of TIAMS who presented to the ED. A patient must have had an NIHSS score<4 to be included in the study. The primary outcomes included recurrent events (TIA or stroke) and clinical deterioration (in the stroke subgroup) within seven days of the initial event. The patients who were randomized to the outpatient-based

management were evaluated at the clinic within 72 hours. The average scores of the stroke risk stratifying scale, $ABCD^2$ (that include the patient's age, initial blood pressure, clinical features, symptom(s) duration, and diabetes history), were 4.1 and 4.2 in the inpatient and outpatient groups, respectively. Recurrence rates among patients with TIA were 11% and 9% in the inpatient and outpatient arms, respectively. None of the inpatient TIA patients developed stroke, while one TIA clinic patient developed stroke. Among patients with minor stroke, 21% of the inpatient group and 10% of the outpatient group developed neurological deterioration. None of these patients received acute interventional therapy, and admission was deemed medically justifiable. No deaths occurred in any group, and those who developed new events or clinical deterioration did not require acute intervention or change of management. The investigators suggested that routine admissions of patients with TIAMS may not yield positive short-term clinical outcomes.

A retrospective, descriptive, chart review study by McLain and Chance (2020) aimed to evaluate the 30- and 90-day readmission rates of 68 patients who were evaluated at an APRN-led TSC following hospital discharge for stroke or TIA. The mean time to clinic visit was 17.3 days; SD 9.4, range 1-49. The 30-day readmission rates were lower in the clinic group compared to the non-clinic group - 1.5% vs. 13.4%, respectively; OR= 0.096, p=0.003. The same observation was also noted in the 90-day readmission rates - 4.4% in the clinic group vs. 12.8% in the non-cinic group, OR= 0.313, p=0.058. The investigators concluded that an APRN-led TSC was feasible despite limited resources, and it might reduce the 30-day readmission rate after stroke or TIA.

A single-center prospective data study by O'Brien et al. (2016) aimed to evaluate the clinical outcome and financial impact of the institution's multidisciplinary, one-stop, point of care, rapid access TIA clinic. The study included a total of 405 patients referred to the clinic

from the ED with suspected TIA or minor stroke (TIAMS). The average ED to clinic presentation was 3.9 days. Forty-seven percent of the referred patients had a final diagnosis of TIA and 14% had MRI-proven minor stroke. The mean $ABCD^2$ score of the sample was 3. Average length of stay was 5.3 days prior to the intervention. The clinic intervention saved 2146.5 inpatient bed days (equivalent to approximately 1.2 million Australian dollars). The investigators suggested that a 4-day clinic follow-up may be safe, considering that patients in the study presented to the clinic between day one and day seven post-ED discharge. The intervention received a high patient satisfaction rate. The investigators concluded that a rapid "one-stop-shop" approach TIA clinic was highly cost-effective and could serve as a transferable model to other health districts in Australia.

Shapiro et al. (2021) assessed the feasibility and cost-effectiveness of outpatient evaluation of patients with TIAMS at the Rapid Access Vascular Evaluation-Neurology (RAVEN) clinic, which was associated with an urban quaternary academic medical center with Comprehensive Stroke Center (CSC) designation. Patients who met clinic referral criteria were discharged from the ED if they could be evaluated at the clinic within 24 hours. If the timeline could not be fulfilled, the patients were admitted. The institutional financial data were analyzed to evaluate the cost efficacy of this diversion of care to the outpatient setting. The clinic follow-up rate was 94% over one year. No clinical deterioration occurred during the care transition, and one clinic patient subsequently required hospitalization for further management and workup. The per-patient hospital cost in the admission group was $7,719 higher than that in the clinic group with a two-day average length of stay. The financial analysis revealed that the clinic approach averted $764,000 in cost of hospitalizations, as well as a total of 208 hospital bed days for the calendar year. The study finding suggested that rapid outpatient evaluation of patients with

TIAMS with absence of high-risk features or disabling deficits might be a feasible and more cost-effective alternative compared to admission by preventing hospitalization and conserving acute care resources.

Synthesis of Literature Review

The nine selected studies employed various study designs and methodologies. Five had retrospective chart review designs; three were prospective data reviews; and one was a prospective randomized control trial. All studies included patients with both stroke and TIA, except for the study by Hosier et al. (2016) that included only patients with TIA. The settings of the studies also varied from single- to multi-center in the U.S., Canada, Australia, and Denmark. It is worth noting that consideration should be given when reviewing data from universal health care settings, which can limit generalizability. This consideration also holds true in several of the reviewed studies conducted in quaternary, urban academic medical centers with CSC designation, which usually have well-established infrastructures and are well-resourced.

The selected studies had varying clinic logistics, such as clinic availability, follow-up time expectation, and clinic referral criteria. These clinics were staffed either by physicians – attending, resident, or both – or specialty-trained NPs. There was no available consensus regarding the ideal follow-up time, but clinic evaluation within seven days post ED discharge seems safe and feasible if radiologic studies, including brain MRI and vessel imaging, are performed prior to ED discharge to rule out significant findings that would otherwise require hospital admission. The reviewed studies suggest that the care provided at TIA clinics is a safe and more fiscally responsible option for the management of TIA, and the integration of an NP into the clinic is associated with quality care.

CHAPTER FOUR: METHODS

Project Design

This was a QI project with two-groups: those who were referred to the TIA clinic, the clinic group, compared to a cohort of patients who were admitted to the hospital prior to clinic implementation, the admission group. The project was deemed exempt for review by the Eisenhower Health (EH) and the University of California, Los Angeles (UCLA) Institutional Review Boards, as it did not meet the definition of human subject research.

Sample and Setting

The clinic group included all adults (18 years or older) who were discharged from the ED between October 1, 2020 and September 30, 2021 with suspected TIA and deemed to have low-to-moderate risk of future stroke (see Appendix B). The admission group included similar patients, who were admitted to the hospital from the ED before October 1, 2020. Patients were excluded if they left the hospital against medical advice (AMA) or were referred to hospice. The project was conducted at a 463-bed non-profit community-based teaching hospital located in Rancho Mirage, California. The hospital has a Joint Commission Primary Stroke Center designation. The institution's service area included cities that were considered rural and underserved.

Measures

The American Heart Association/American Stroke Association (AHA/ASA) $ABCD^2$ instrument includes age, blood pressure, clinical symptoms, duration of symptoms, and diabetes history (Easton et al., 2009). The score on this tool ranges from 0-7 with 0-3 classified as low risk, 4-5 as moderate risk, and 6-7 as high risk for future stroke (see Appendix C for scoring criteria). The 2-day, 7-day, and 90-day stroke risks associated with each risk category are listed

in Appendix D. Since an $ABCD^2$ score of greater than 5 is associated with a 90-day stroke rate up to 17.8% and considered high risk, only patients with an $ABCD^2$ score between 0 and 5 were included in the project.

Procedures

The minimal requirement of diagnostic workup to complete in the ED includes brain magnetic resonance imaging (MRI), head and neck vessel imaging [magnetic resonance angiography (MRA) or computed tomography angiography (CTA)], 12-lead electrocardiography (ECG), and routine laboratory testing. Patients with brain MRI findings consistent with stroke and those with symptomatic intracranial or extracranial disease noted on vessel imaging necessitated hospital admission according to the institutional protocol for further management. Possible non-stroke medical etiologies that could have explained stroke-like symptoms had to be ruled out prior to ED discharge. The patient's presenting symptoms also had to be resolved with return of baseline neurological status prior to discharge.

Patients who met the clinic referral criteria were discharged home from the ED to receive clinic evaluation within seven days. The clinic was located within an ambulatory EH Neurology Specialty Center facility and staffed by a stroke-trained NP one day per week. The EH specialty clinic staff were available during normal business operating hours, and they had direct access to the NP at any given business day. Chart reviews were conducted to determine the stroke incidence at 90 days post TIA.

An electronic referral order was placed by the discharging ED provider to refer any patient to the TIA clinic. Patients received an after-visit summary document that included the clinic information and the NP's name. The referral orders were electronically forwarded to the project leader and the clinic scheduler. The clinic scheduler contacted the patient to set up an

appointment within seven days post-discharge. The patients were also instructed prior to discharge to call the clinic for an appointment to optimize the follow-up rate.

Data Collection

Chart reviews were conducted to collect data on all variables. The same patient selection criteria used in the clinic group were also applied to select participants in the admission group. $ABCD^2$ scores that were not clearly documented in the patient's medical record were calculated manually by the project leader. Any incidence of stroke within 90 days post-TIA was recorded. Sources of this information included provider notes or/and brain imaging reports. Chart reviews also included scanned paper records from outside facilities. The project participants' demographic information was collected to establish participant characteristics. The primary outcome measures are presented in Appendix E. Patient satisfaction data was collected using the National Research Corporation Health consumer data that is utilized throughout the institution.

Data Analysis

Descriptive statistics, such as frequencies, percentages, means, and medians were performed to analyze baseline patient characteristics and stroke outcome at 90 days. Chi-square and Fisher's exact tests were used to compare the groups on demographic characteristics and outcomes as relevant to distributional characteristics. Any p-value <0.05 was considered statistically significant. All statistical analyses were conducted using IBM SPSS Statistics (Version 27) predictive analytics software. Patient satisfaction score of the NP provider was collected and shown as a percentage (0-100%).

CHAPTER FIVE: RESULTS

Demographic Characteristics

Figure 1 illustrates the flow diagram of the clinic group selection process. Fifty-six patients were discharged from the ED with a primary diagnosis of TIA between October 1, 2020 and September 30, 2021. A clinic referral was ordered for 43 patients, and 13 patients were found to be eligible for clinic referral during chart audits. Two patients did not come to their clinic appointment, and one followed up with their primary neurologist. Of the 53 patients who were evaluated at the clinic, 40 retained their TIA diagnosis while 13 were subsequently determined to have non-TIA diagnoses.

Table 1 illustrates the sample baseline demographic characteristics. Eighty-one participants were included in this project, 40 in the clinic group and 41 in the admission group. The mean age was 72.8 years in the clinic group and 75.2 years in the admission group (p=0.37). Females comprised 45% of the clinic group, compared to 51.2% in the admission group (p=0.58). The mean $ABCD^2$ scores were similar in both groups, 4.08 in the clinic group and 3.95 in the admission group (p=0.63).

Figure 1: *Clinic Group Sampling Flow Diagram*

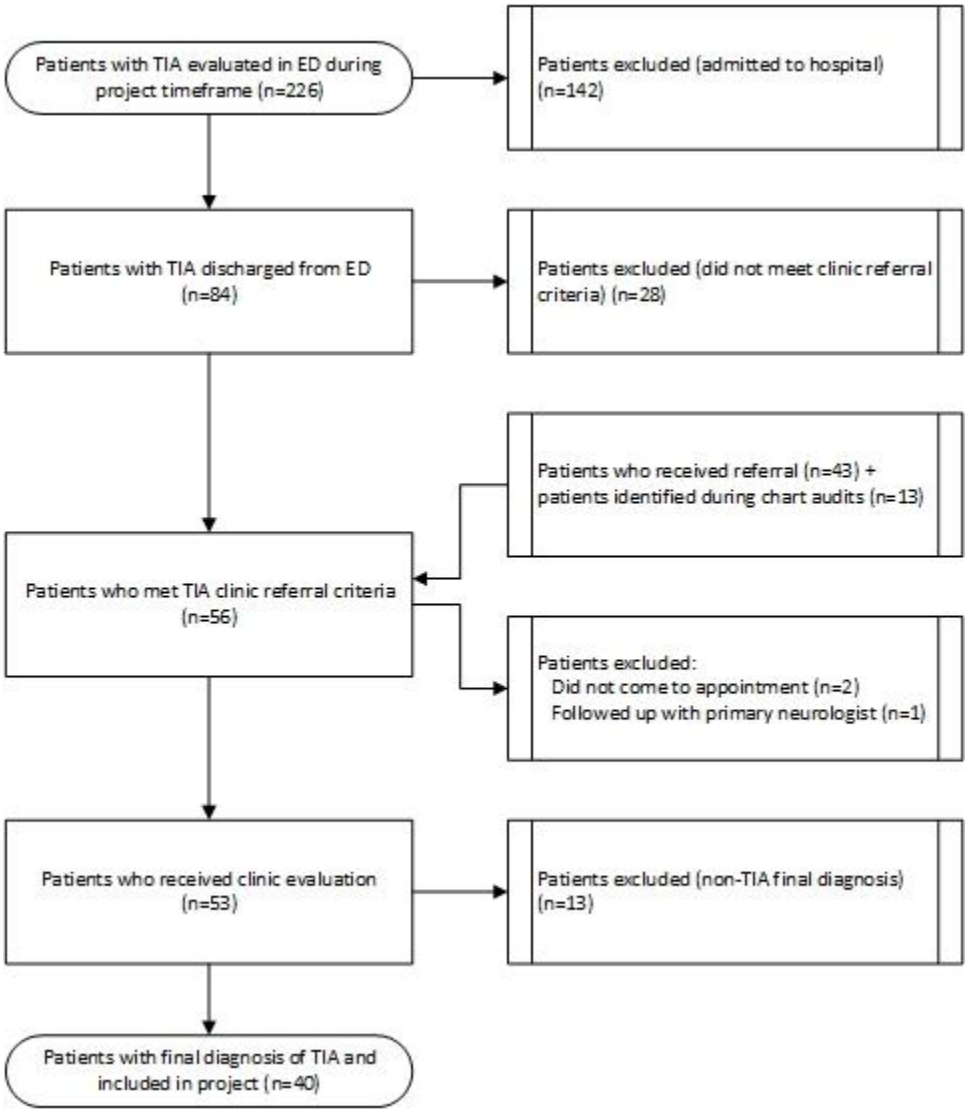


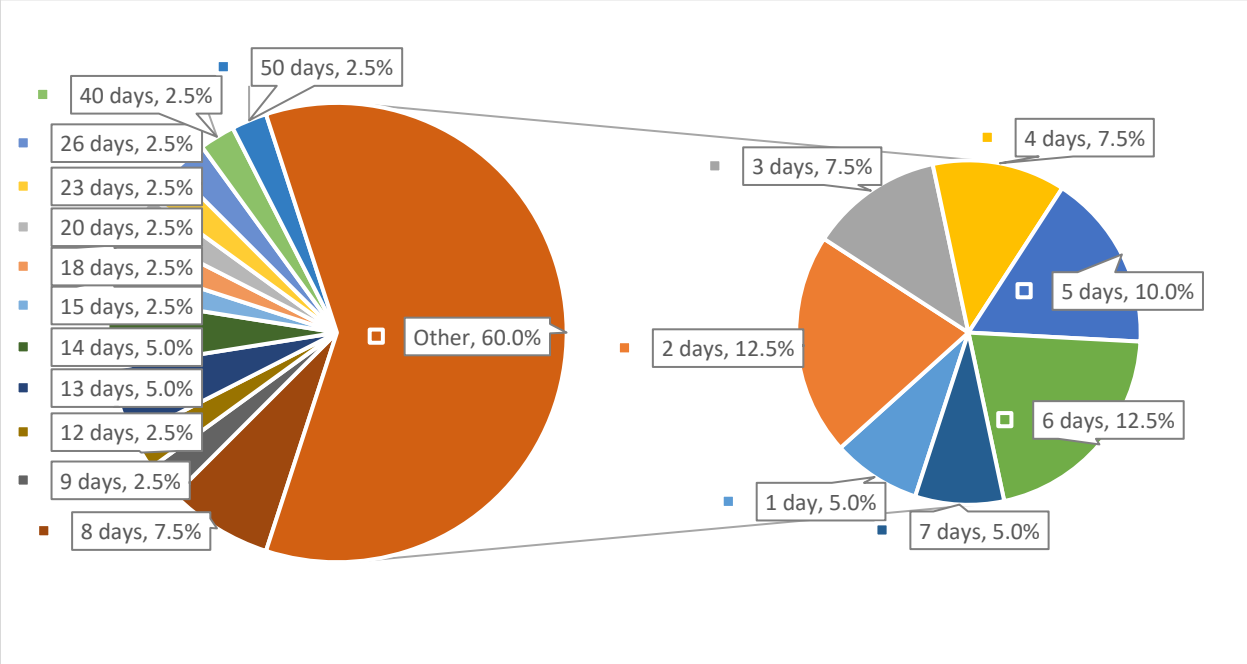
Table 1: *Sample Demographics and Characteristics*

	Clinic Group	**Admission Group**	***p*-value**
Sex			
Female	18/40 (45%)	21/41 (51.2%)	0.58
Male	22/40 (55%)	20/41 (48.8%)	0.58
Age, years, mean (SD)	72.8 (9.3)	75.2 (13.6)	0.37
$ABCD^2$ score, mean (SD)	4.08 (1.31)	3.95 (0.95)	0.63

Outcomes

Median, rather than mean, clinic follow-up times were computed because follow-up times were skewed (1 day-50 days). The median clinic follow-up time was six days, and 60% of participants in the clinic group received clinic evaluation within seven days. Figure 2 illustrates the breakdown of ED-to-clinic turnaround time in the clinic group. There were no strokes in the clinic group and one stroke within 90 days in the admission group (p=1.0 using Fisher's Exact test). The one stroke patient in the admission group was rehospitalized 47 days post index TIA. This event occurred despite a follow up visit with a neurologist at day 26 post TIA. Patient satisfaction rate with the clinic NP provider was 92.6%, which was higher than the hospital benchmark of 90%.

Figure 2: *Emergency Department (ED)-to-Clinic Turnaround Time*



CHAPTER SIX: DISCUSSION

The key finding of this QI project was that TIA patients with low-to-moderate risk of stroke who were managed at an outpatient NP-led specialty clinic did not have increased risk of

stroke at 90 days, compared to hospital admitted patients prior to clinic launch. None of the patients in the clinic group developed stroke, and one patient from the admission group was readmitted for stroke at day 47.

Different TIA clinic staffing models have been reported. Several of these studies evaluated the role and impact of NP-staffed clinics, but most included patients who were discharged with stroke or TIA following hospital admission. In these studies, NP-led stroke clinic management was associated with decreased 30-day readmission rate (Condon et al., 2016, Mclain & Chance, 2020), increased medication persistence rate (Buschnell et al., 2014), and decreased no-show rate (Trotter et al., 2021). One study used a mixed neurologist/stroke NP clinic staffing model to evaluate patients who were discharged home following a neurologist evaluation in the ED (Hosier et al., 2016). The investigators found that there was an increased use of antithrombotics, decreased stroke, MI, and vascular death at 90 days, and decreased readmission rate for stroke, MI, and vascular death associated with this clinic strategy. There is a paucity of literature examining the safety of NP-led clinics that provide care to patients with TIA. Prior studies have included patients who were admitted to the hospital for TIA prior to NP evaluation at the clinic or patients who were discharged from the ED following evaluation by an inpatient stroke team. The utilization of inpatient stroke services should be reserved for patients at high risk for stroke within 90 days. The findings are important for two reasons: (a) rural residents are negatively impacted by the neurologist shortage leading to excessive outpatient wait times, and (b) referral to an NP-led TIA clinic is safe and acceptable to the patient.

The clinic follow-up rate in this project was 94.6% (53/56). The follow-up rate in the literature ranges from 17% to 95.1% (Chang et al., 2019; McLain & Chance, 2020; O'Brien et al., 2016; Shapiro et al., 2021). Utilization of electronic health record (EHR) features that alerted

the project leader and clinic scheduler to all referrals contributed to this high follow-up rate. The high follow-up rate suggests that the patients referred to the clinic valued the care they received.

The TIA diagnosis was retained in 75.5% (40/53) of patients who received clinic evaluation. This finding was not unexpected, because a relatively high rate of false positive TIA diagnoses is well-documented in the literature when the diagnosis is given by a non-neurology provider. The rate of TIA misdiagnosis in a study by Sadighi et al. (2019) was up to 60% across all care settings (ED, inpatient, and outpatient).

Variability of the expected timeframe during which patients are evaluated at the clinic following the index event exists. The timeframe ranges between 24 hours (Chang et al., 2019) and 22 days (Hosier et al., 2016). The clinic referral protocol used in this project facilitated clinic evaluation within seven days. Sixty percent of patients in the clinic group received evaluation within this timeframe. The longest ED-to-clinic timeframe in this project was 50 days. Despite the delay in some initial clinic visits, none of the patients in the clinic group developed stroke within 90 days post TIA. This finding suggests that future studies are needed to evaluate the optimal ED-to-clinic timeframe. Future studies could also evaluate the financial impact of inpatient versus outpatient management of TIA at NP-led clinics.

Limitations

The clinic and admission comparator groups were not assessed during the same time period. Patients referred to the clinic were compared to a matched cohort of patients who were admitted prior to the launch of TIA clinic. The $ABCD^3$-I tool, a revision of the $ABCD^2$, has been demonstrated to be a better predictive tool than $ABCD^2$ score for assessing the risk of stroke post-TIA (Kiyohara et al., 2014; Song et al., 2013). The rationale for using $ABCD^2$ score instead of $ABCD^3$-I in the project was due to the fact that the $ABCD^2$ tool was already embedded in the

institution's EHR. The inclusion of brain MRI and vessel imaging (MRA/CTA) (in addition to $ABCD^2$ score) to the clinic referral criteria, however, should have generated similar stroke prediction power to that of the $ABCD^3$-I tool. Patients with Coronavirus disease 2019 (COVID-19) were excluded from the project because they were unable to have timely MRI testing.

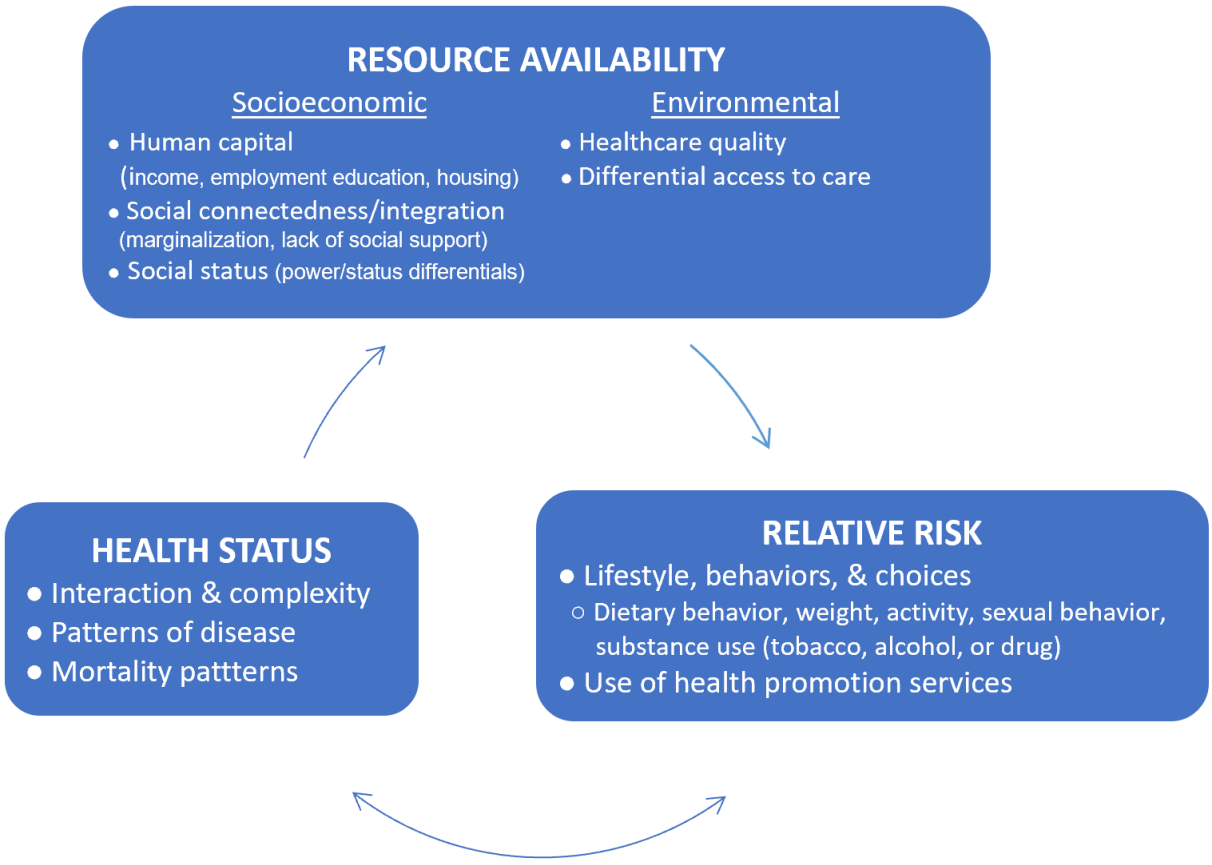
CONCLUSION

The QI project demonstrated that it was safe to discharge low-to-moderate risk patients with TIA from the ED to an NP-led TIA clinic.

APPENDICES

Appendix A

Application of Flaskerud and Winslow's VPCM to TIA Patients in Rural Communities



Appendix B

Clinic Referral Criteria

Risk Stratification	Inclusion Criteria
Suspected Diagnosis	Transient ischemic attack (TIA)
Magnetic Resonance Imaging (MRI)	Negative for acute infarct
Magnetic Resonance Angiography (MRA) or Computed Tomography Angiography (CTA)	Negative for significant and symptomatic stenosis
$ABCD^2$ Score	0-5
Symptom Resolution	Symptoms must resolve and patient must return to their baseline neurological status prior to hospital discharge

Appendix C

ABCD^2 Scoring Criteria

Criteria	Point(s)
Age ≥60 years	1
Systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg	1
Clinical features:	
Speech impairment	1
Unilateral weakness	2
Duration of symptom(s):	
10-59 minutes	1
≥60 minutes	2
History of diabetes mellitus	1

Appendix D

ABCD^2 Scores for Transient Ischemic Attack (TIA) Risk Stratification

ABCD^2 Score	Risk Category	Stroke Risk (%)		
		2 Days	7 Days	90 Days
0-3	Low	1.0	1.2	3.1
4-5	Moderate	4.1	5.9	9.8
6-7	High	8.1	11.7	17.8

Appendix E

Primary Outcome Measures

	Pre-intervention	Post-intervention
Baseline	• Medical record number (MRN) • Age • Gender • Race/ethnicity • $ABCD^2$ score • Primary diagnosis of transient ischemic attack (TIA) • Discharging unit (any) • Hospital status (inpatient or outpatient) • Date of admission • Date of discharge • Length of stay	• MRN • Age • Gender • Race/ethnicity • $ABCD^2$ score • Primary diagnosis of TIA • Discharging unit (emergency department [ED]) • Hospital status (outpatient) • Date of ED visit • Date of discharge • ED-to-clinic time (in days)
At 90 days	• Provider notes • Head imaging reports (computed tomography [CT], magnetic resonance imaging [MRI]) • TIA-to-stroke time (in days) • Date of rehospitalization • Rehospitalization discharge date • Length of rehospitalization stay	• Provider notes • Head imaging report (CT, MRI) • TIA-to-stroke time (in days) • Date of rehospitalization • Rehospitalization discharge date • Length of rehospitalization stay

TABLE OF EVIDENCE

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
Chang, B. P., Rostanski, S., Willey, J., Miller, E. C., Shapiro, S., Mehendale, R., Kummer, B., Navi, B. B., & Elkind, M. S. V. (2019). Safety and feasibility of a rapid outpatient management strategy for transient ischemic attack and minor stroke: The Rapid Access Vascular Evaluation-Neurology (RAVEN) approach. *Annals of Emergency Medicine, 74*(4), 562-571. http://dx.doi.org/10.1016/j.annemergmed.2019.05.025	Retrospective chart review study to assess the feasibility and safety of a rapid outpatient clinic evaluation of TIAMS	n= 162 patients with TIAMS, NIHSS ≤5, no disabling deficit, who were discharged from ED to clinic between December 2016 and June 2018 for clinic evaluation within 24 hours	Retrospective chart review of patients who met clinic referral criteria, was evaluated by a vascular neurologist at the clinic, and received routine 90-day phone calls as part of routine operations. The following rates/measures were tabulated: · Follow-up rate · Adverse events (stroke, death, hospitalization) rate during 24 care transition · Readmission frequency and reason · Final diagnosis · 90-day rate of neurological or cardiovascular events · 90-day rehospitalization rate	· 95.1% follow-up rate · 0 adverse event during care transition · 101 (66%) diagnosed with TIA (42) or minor stroke (59) · 2 TIAMs (1.3%) required hospitalization for stroke and vasculitis · 18 TIAMs (19.1%) were hospitalized (5 had recurrent TIA symptoms, and 1 had recurrent stroke) · None of readmissions were deemed preventable · No deaths amongst those with TIAMS at 90 days	Discussion: · Similar initial and 90-day safety outcomes to large published trials · Similar 90-day stroke rates to other trials using different outpatient referral strategies · Additional work-up was limited in 34% of patients with non-TIAMS Interpretation: Rapid outpatient referral strategy for selected TIAMS patients is safe and feasible Limitation: · Not generalizable due to single site cohort study at a quaternary academic medical center with Comprehensive Stroke Center designation with established infrastructure · Lost to follow-up rate of 8.9% in TIAMS patients and 13.2% in non-TIAMS patients at 90 days · Retrospective chart review design · No comparator group

Note: ED= emergency department; NIHSS= National Institute of Health stroke scale; TIA= transient ischemic attack; TIAMS= transient ischemic attack or minor stroke; ≤= less than or equal to.

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
Condon, C., Lycan, S., Duncan, P., & Bushnell, C. (2016). Reducing readmissions after stroke with a structured Nurse Practitioner/Registered Nurse transitional stroke program. *Stroke*, *47*(6),1599-1604. http://dx.doi.org/10.1161/STROKEAHA.115.012524	To determine whether an NP-led TSC is associated with a reduced 30-day and 90-day readmission rate of patients recently discharged home with acute stroke or TIA	n= 510 patients with stroke or TIA who were discharged home from a CSC in North Carolina and enrolled in a transitional coaching for stroke program, which includes follow-up phone calls and outpatient NP evaluations	Prospective, pre-and post-modification longitudinal study over a 3 years period. In phase I, only high-risk patients received phone calls by an NP within 7 days of discharge and were evaluated by an NP at the clinic within 2-4 weeks of discharge. All patients discharged home in phase II received a phone call by an RN within 2 days of discharge and were evaluated by an NP within 7-14 days. Chi-square test or Wilcoxon rank test were used. Outcome measures: 30- and 90-day readmission rates.	· More follow-up calls in phase II (88.9% vs. 55.7%, *p*=0.0001) · Decreased time to TSC in phase II (17 vs. 19 days, *p*=0.02) · 30-day readmission was lower in those seen at TSC (60.8% vs. 76.3%, *p*=0.021) · More 90-day readmission in those with lower TSC show rate (67.5% vs. 76.4%, *p*=0.088) · TSC visit was independently associated with a 48% reduced 30-day readmission (OR, 0.518; 95% CI, 0.272-0.986, *p*=0.045) · TSC visit was not significantly associated with 90-day readmission	Discussion: · Post-discharge calls decreased no-show rate, but did not affect readmission rate · TSC visit affected shorter-term readmission risk, and medical comorbidities are better predictors of 90-day readmission Interpretation: NP/RN team and a comprehensive TSC model is associated with a reduced 30-day readmission rate for patients with stroke or TIA who are discharged home Limitation: · Single center · Tertiary, academic center with CSC designation · Exclusion of patients who were discharged to a rehab facility · Observational design · Inability to track those readmitted to a different facility · Unmeasured risks for readmission

Note: CI = confidence interval; NP = nurse practitioner; OR = odds ratio; TIA= transient ischemic attack; TSC = transitional stroke clinic.

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
Hastrup, S., Johnsen, S. P., Jensen, M., Weitzel-Mudersbach, P. V., Simonsen, C. Z., Hjort, N., Møller, A. T., Harbo, T., Poulsen, M. S., Iversen, H. K., Damgaard, D., & Andersen, G. (2021). Specialized outpatient clinic vs stroke unit for TIA and minor stroke: A cohort study. *Neurology*, *96*(8), e1096-e1109. http://dx.doi.org/10.1212/WNL.0000000000011453	Prospective cohort study to evaluate the performance of acute stroke/TIA clinic prior to determining the need for admission	n= 1076 patients seen at the acute stroke/TIA clinic within a facility in Denmark	Prospective cohort study of all patients referred to the on-call 24/7 neurologist by a hospitalist/general practitioner for possible acute stroke/TIA and seen at the clinic where decision was made whether to continue outpatient management or to admit (using $ABCD^2$ tool and imaging as guide at the clinician discretion). Patients were compared to historic and contemporary matched, hospitalized controls. Outcome measures included final diagnosis, admission rate, rate of low vs. high risk of stroke/TIA, rate of recurrent vascular events within 7 days, length of hospital stay, readmission rates, mortality, and quality of care. Generalized linear model for LOS ratios comparison, multivariable Cox regression for readmissions, and binomial regression for performance measures were used. Statistical analyses were conducted using Stata 13.0.	· 23.5% were admitted · 510 (47.4%) with neurovascular diagnosis (215 strokes, 171 TIAs, 124 others) · 43.7% stroke and 70.8% TIA were discharged home from clinic - 79.1% of these were considered low-risk · Compared to historic stroke cohort, admission from clinic had: · Shorter hospital stay (median 1 vs. 3 days; ALOS ratio 0.49; 95%CI 0.33-0.71) · Lower readmission rate (3.2 vs. 11.6%; adjusted HR 0.23[0.09-0.59]) · Higher care quality (RR 1.30[1.15-1.47]) · 1 (0.6%) in the low risk category and not admitted had stroke within seven days.	Discussion: · Direct referral to stroke specialist prevent misdiagnosis · Triaging process was safe with a low rate of readmission at seven days Interpretation: · Outpatient acute minor stroke and TIA clinic as first point of contact (and subsequent admission for high risk patients) is associated with shorter LOS, lower 30 day readmissions, and higher care quality Limitation: · Non-randomized design · Differences among study cohorts

Note: ALOS= average length of stay; CI= confidence interval; HR= hazard ratio; LOS= length of stay; TIA= transient ischemic attack; RR= risk ratio.

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
Hosier, G. W., Phillips, S. J., Doucette, S. P., Magee, K. D., & Gubitz, G. J. (2016). Transient ischemic attack: Management in the emergency department and impact of an outpatient neurovascular clinic. *Canadian Journal of Emergency Medicine*, *18*(5), 331-339. http://dx.doi.org/10.1017/cem.2016.3	Retrospective chart review study to evaluate the performance of TIA management in the EDs and to evaluate the effect of dedicated neurovascular clinic evaluation post ED discharge	n= 686 patients who were discharged from any ED of the Nova Scotia Capital District Health Authority with a diagnosis of TIA, evaluated by a neurologist in the ED, referred for fasting lab and to the neurovascular clinic for neurologist/NP evaluation	Retrospective chart review of eligible patients discharged from the ED between January 1st, 2011-December 31st, 2012. Proportion of ED and ED plus clinic patients who received the recommended assessment and medication optimization. The 90-day readmission and mortality rates were evaluated using adjusted Cox proportional hazards models, Kaplan-Meier survival analysis, log-rank testing, and propensity matched analysis. SAS v.9.4 was used to perform statistical analysis.	· 51% referred, but 36% had clinic evaluation · 86.4% retained TIA diagnosis, 4.2% had MRI-proven stroke · Median time from TIA to clinic was 32 days (10-60 days IQR) for all patients and 22 days (9-52 days IQR) for those not seen by neurology in ED · 88.3% had head CT, 86.3% had ECG, but only 35% had prompt vascular imaging · Antithrombotic and anticoagulation rates were higher in patients seen at clinic (94% vs. 86.3%, $p<0.0001$; 85.7% vs. 47.6%, $p<0.0001$) · 4.2% experienced stroke, MI, or vascular death at 90 days · Readmission risk for stroke, MI, or vascular death was lower in clinic patients (AHR 0.28; 95% CI 0.08-0.99, $p=0.048$)	Discussion: · Clinic underutilization is similar to that in the more organized setting · Improved outcome with patients who received clinic care is likely multifactorial and may include timely investigation, initiation of appropriate therapy, and access to specialist Interpretation: · ED management met the national standards for diagnostic work-up and antithrombotic therapy · Vascular imaging and clinic referral were underutilized · Clinic follow-up was associated with reduced risk of stroke, MI, or vascular death Limitation: · Limited access to records outside of health system · Lack of information on patients with severe dementia or on palliative care, which may contribute to low clinic referral · Retrospective chart review design may affect reliability of documentation accuracy

Note: AHR= adjusted hazard ratio; CI= confidence interval; CT= computed tomography; ECG= electrocardiogram; ED= emergency department; IQR= interquartile range; MI = myocardial infarction; MRI= magnetic resonance imaging; NP= nurse practitioner; TIA= transient ischemic attack; RR= risk ratio; <= less than.

CITATION	PURPOSE	SAMPLE/ SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
Kapral, M. K., Hall, R., Fang, J., Austin, P. C., Silver, F. L., Gladstone, D. J., Casaubon, L. K., Stamplecoski, M. & Tu, J. V. (2016). Association between hospitalization and care after transient ischemic attack or minor stroke. *Neurology*, *86*(17), 1582-1589. http://dx.doi.org/10.1212/WNL.0000000000002614	Multi-center registry study to evaluate the care and outcome of patients with TIAMS who were discharged from the ED vs. admitted to the hospital	n= 8540 patients (18 years or older) in the Ontario Stroke Registry with TIAMS who presented to any participating hospital in Ontario, Canada between April 1st, 2008-March 31st, 2009 or April 1st, 2010-March 31st, 2011 with Canadian Neurological Scale >10 or NIHSS <3	Multi-center registry/database review of all patients discharged with TIAMS who meet the criteria. Processes of care and clinical outcome (recurrent TIA/stroke and death) were compared between those discharged from ED with clinic referral, those discharged from ED without clinic referral, and those admitted. Chi-square tests for categorical variables and one-way analysis of variance for continuous variables were used. Cox proportional hazards models were used to determine the effect of admission on hazard of death (adjusting for the characteristics of the patients, the index event, the care encounter, and the hospital), the cause-specific hazard of TIA/stroke, and the referral effect on the hazard of death. Chi-square tests were also used to compare patient proportions (with or without clinic referral) whose deaths were related to cardiovascular events instead of other causes.	· 46.7% admitted · Care processes were highest in those admitted, followed by those discharged with referral, then those discharged without it · 1-year mortality: 7.9% in those admitted, 3.7% in those discharged with referral, 9.9% in those discharged without referral (p<0.001) · 7-days hospitalization rates: 0.9% in those admitted, 8.2% in those discharged with referral, 8.3% in those discharged without it · 1.7% of admission group had new stroke/TIA and 5.3% had clinical worsening · Similar hazard mortality in those admitted and not admitted (AHR 1.1; 95% CI 0.92-1.34), but lower in those referred to the clinic compared to those without clinic referral (AHR 0.49; 95% CI 0.38-0.64) · 19% cardiovascular death had clinic referral vs. 30% without referral (p=0.045)	Discussion: · TIAMS admission had more likelihood of receiving tests and treatments · Clinic referral was associated with improved care processes and decreased mortality · To be effective, clinic evaluation should occur within 1 week of presentation Interpretation: · Patients admitted with TIAMS were more likely to receive timely recommended tests and treatments · Those discharged with clinic referral were associated with better process of care and mortality compared to those discharged without referral Limitation: · Lower frequency of true TIAMS in the cohort · Low generalizability due to an organized stroke system of care setting within a universal healthcare system

Note: AHR= adjusted hazard ratio; CI= confidence interval; ED= emergency department; NIHSS= National Institute of Health stroke scale; TIA= transient ischemic attack; TIAMS= transient ischemic attack or minor stroke; >= greater than; <= less than.

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
Majidi, S. Guerrero, C. R. L., Burger, K. M., & Rothrock, J. F. (2017). Inpatient versus outpatient management of TIA or minor stroke: Clinical outcome. *Journal of Vascular and Interventional Neurology*, *9*(4), 49-53.	Prospective randomized controlled trial to evaluate short-term clinical outcome associated with inpatient and outpatient management of patients with TIAMS	n= 100 patients with TIAMS and NIHSS ≤3, who presented to an ED of a stroke certified hospital in Reno, NV between September 1, 2013 and June 30, 2014 within 6 hours of symptoms onset	Eligible TIAMS patients were randomized in 1:1 fashion to either ED discharge with evaluation at stroke bridge clinic within 72 hours or hospitalization. New stroke, new TIA, death, and clinical deterioration (in minor stroke subgroup) within seven days of the index event were assessed.	· 46% of 41 TIA and 49% of 59 MS patients were randomized to inpatient management, while the rest were randomized to clinic. · Neurological worsening occurred in 21% of the admission group and 10% in the clinic group (p<0.3). None received interventional therapy. · TIA group had an 11% recurrence rate in the hospital compared to 9% in the clinic. 1 TIA clinic patient developed stroke, while none developed stroke in the hospitalized TIA group. · 21% MS patients who were admitted had neurological deterioration, compared to 10% in the outpatient arm. None received acute interventional therapy. · No death in any group · Those who developed new event/deterioration did not require acute intervention or change of management	<u>Discussion:</u> · No significant difference of early clinical outcomes of TIAMS who were managed inpatient vs. outpatient · Small percentage of cases developed recurrent TIAMS that did not result in change of clinical management <u>Interpretation:</u> · Routine admissions of patients with TIAMS may not provide positive short-term clinical outcome <u>Limitation:</u> · Small sample size · Single-center · Non-uniform diagnostic and therapeutic pathways

Note: ED= emergency department; MS= minor stroke; NIHSS= National Institute of Health stroke scale; NV= Nevada; TIA= transient ischemic attack; TIAMS= transient ischemic attack or minor stroke; RR= risk ratio; ≤= less than or equal to.

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
McLain, J. V., & Chance, E. A. (2020). The Advanced Practice Nurse will see you now. *Journal of Nursing Care Quality*, *35*(2), 147-152. http://dx.doi.org10.1097/NCQ.0000000000000414	To evaluate the impact of APRN-led transitional care clinic on 30-day and 90-day hospital readmission following stroke or TIA	n= 68 patients discharged home from a PSC in Ohio following stroke or TIA and received evaluation at an APRN-led transitional clinic	Retrospective, descriptive chart review of patients evaluated at the APRN-led transitional care clinic over 1 year period. Outcome measures included 30-day and 90-day rehospitalization rates. Pearson chi square, Fisher's exact test, and ANOVA comparisons were used.	· 403/899 patients met clinic criteria · 68/403 (17%) patients were evaluated at the clinic · Mean time to clinic was 17.3 days (SD= 9.4, range 1-49) · Lower 30-day readmission rate in clinic group than non-clinic group (1.5% vs. 13.4%, OR= 0.096, *p*=0.003) · Lower 90-day readmission rate in clinic group than non-clinic group (4.4% vs. 12.8%, OR= 0.313, *p*=0.058)	Discussion: · Low number of eligible patients due to limited resources · Average time-to-clinic time was similar to other APRN-led transitional care clinic studies · Average time-to-30 day readmission is longer than average time-to-clinic time Interpretation: · APRN-led transitional clinic for stroke and TIA patients discharged home can be implemented despite limited resources · APRN-led transitional clinic may reduce 30-day readmission rate Limitation: · Single site · Retrospective design · Potential erroneous coding · Relatively small sample size · Low follow up rate · Only included one year data · Only included patients who were discharged home · Lack of process to capture readmission at other institutions · Lack of ED visits or mortality data

Note: ANOVA = analysis of variance; APRN = advanced practice registered nurse; ED = emergency department; OR = odds ratio; SD = standard deviation; TIA= transient ischemic attack.

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
O'Brien, E. Priglinger, M. L., Bertmar, C., Day, S., Borsodi, C., Herkes, G., & Krause, M. (2016). Rapid access point of care clinic for transient ischemic attacks and minor strokes. *Journal of Clinical Neuroscience*, *23*, 106-110. http://dx.doi.org/10.1016/j.jocn.2015.04.032	Prospective chart review to evaluate the performance of rapid access TIA clinic	n= 405 patients who were referred from the ED of a tertiary teaching facility in Sydney, Australia with suspected TIA with resolution of symptom,· ABCD^2 score<4 in first 12 months (then all patients regardless of score) and evaluated by a neurologist or neurology nurse consultant at the clinic	Patients with unremarkable head CT (and basic labs) with suspected TIA were referred to the clinic that operates twice weekly where further work-up (including brain MRI) was obtained during clinic visit. Data was collected for 24 months, and outcome measures included: ED-to-clinic time, final diagnosis, number of referrals, number of saved bed days, patient satisfaction (and rate), blood pressures, glucose, cholesterol, and average weight loss. Two-sample t-tests were used to analyze the difference between the parametric continuous variables; paired t-tests to evaluate the difference in outcome variables across time; and chi-square tests for the differences between proportions of categorical variables. SAS v. 4.3 was used for all tests with a significance level of $p<0.05$ to be considered statistically significant.	· Average ED-to-clinic time: 3.9 days · Average ABCD^2: 3.0 · 47% patients with TIA, 14% with stroke, and rest with non-vascular diagnosis · 76 patients had follow-up · Those with follow-up had reduction of total cholesterol (4.1 mmol/L vs. 4.8 mmol/L, $p<0.0001$) and LDL (2.2 mmol/L vs. 2.8 mmol/L, $p<0.0001$) · No significant changes of glucose, BP, and average weight loss · 5 symptomatic high-grade carotid stenosis and 2 symptomatic moderate stenosis who underwent CEA within 24 hours · 2146 bed days saved · Calculated saving of AUD$1,180,575 within 24 months · 59% patient satisfaction response rate · Very high or high patient satisfaction rate in all aspects of clinic provision	Discussion: · Safe for patients to be seen at the clinic within 4 days post initial event · Patients who returned for follow up showed benefits of improved compliance and optimized risk factors management Interpretation: Rapid access TIA clinic is · Highly efficient · Safe · Cost-effective · Associated with high patient satisfaction Limitation: · Small sample · Single-center tertiary care facility · No comparator

Note: AUD= Australian dollar; BP= blood pressure; CEA= carotid endarterectomy; ED= emergency department; LDL= low density lipoproteins; MRI= magnetic resonance imaging; NIHSS= National Institute of Health stroke scale; TIA= transient ischemic attack; <= less than.

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Interventions, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
Shapiro, S. D., Boehme, A. K., Chang, B. P., Miller, E. C., Willey, J., & Elkind, M. S. V. (2021). Safety and hospital costs averted using a rapid outpatient management strategy for transient ischemic attack and minor strokes: The RAVEN Clinic. *The Neurohospitalist*, *11*(2), 107-113. http://dx.doi.org/10.1177/1941874420972236	Retrospective cohort analysis study to evaluate the feasibility and cost efficacy associated with expedited outpatient management of select patients with TIAMS.	n= 149 TIAMS patients with NIHSS≤ 5 and non-disabling deficits/high risk features were referred to clinic and n=50 patients were admitted in 2017 at an urban quaternary academic medical center in New York City with Comprehensive Stroke Center designation	Retrospective chart review for clinical information and institutional financial data for cost analysis were performed for patients who met the criteria. Patients who met clinic criteria were evaluated within 24 hours. Since the clinic operates during the weekdays, patients who could not be seen within 24 hours were admitted. Measurements obtained included clinic follow-up rate, total hospital cost, LOS, time spent in ED, total averted hospital cost. Means (with SD) and medians were calculated for continuous measures. Wilcoxon signed-rank sum and chi-square tests were performed with alpha of 0.05 considered to be significant. Per patient cost savings were used to calculate mean differences between groups, and linear regression was used for total hospital cost.	· 94% clinic follow-up rate · No clinical deterioration during care transition · 1 clinic patient required subsequent hospitalization · The admitted group had $7,719 (SD 354) more in hospital costs than clinic group with average LOS of 2 days · Clinic approach avoided $764,000 in hospital cost and 208 hospital bed days for the calendar year	Discussion: · Rapid clinic evaluation may be a safe alternative to admission · Outpatient costs are likely lower than hospital care, and cost saving maybe significant for those with high deductible health plans · Preserving inpatient beds and resources is critical in highly congested hospital particularly during health crises, and it increases availability for other cost-generating services Interpretation: Outpatient management of TIAMs without high risk features or disabling deficits may be feasible and more cost effective than admission by preventing cost of hospitalization and conserving inpatient beds Limitation: · Single-center retrospective design at an urban quaternary academic medical center with established stroke resources and infrastructure · Lack of outpatient cost data · Retrospective patient selection

Note: ED= emergency department; LOS= length of stay; NIHSS= National Institute of Health stroke scale; SD= standard deviation; TIAM= transient ischemic attack or minor stroke; ≤= less than or equal to.

REFERENCES

Bushnell, C., Aman, M., & Han, S. (2014). A new model for secondary prevention of stroke: Transition coaching for stroke. Frontiers in Neurology, 5, 219. http://dx.doi.org/10.3389/fneur.2014.00219

Chang, B. P., Rostanski, S., Willey, J., Miller, E. C., Shapiro, S., Mehendale, R., Kummer, B., Navi, B. B., & Elkind, M. S. V. (2019). Safety and feasibility of a rapid outpatient management strategy for transient ischemic attack and minor stroke: The Rapid Access Vascular Evaluation-Neurology (RAVEN) approach. *Annals of Emergency Medicine, 74*(4), 562-571. http://dx.doi.org/10.1016/j.annemergmed.2019.05.025

Condon, C., Lycan, S., Duncan, P., & Bushnell, C. (2016). Reducing readmissions after stroke with a structure Nurse Practitioner/Registered Nurse transitional stroke program. *Stroke, 47*(6),1599-1604. http://dx.doi.org/10.1161/STROKEAHA.115.012524

Craft, K., Donofrio, P., Shepard, K. M., Coleman, M., & Esper, G. J. (2013). Practice and payment trends in neurology in 2012. *Neurology® Clinical Practice, 3*(3), 233-239. http://dx.doi.org/10.1212/CPJ.0b013e318296f2ef

Dall, T. M., Storm, M. V., Chakrabarti, R., Drogan, O., Keran, C. M., Donofrio, P. D., Henderson, V. W., Kaminski, H. J., Stevens, J. C., & Vidic, T. R. (2013). Supply and demand analysis of the current and future US neurology workforce. *Neurology, 81*(5), 470-478. http://dx.doi.org/10.1212/WNL.0b013e318294b1cf

Easton, J. D., Saver, J. L., Albers, G. W., Alberts, M. J., Chaturvedi, S., Feldmann, E., Hatsukami, T. S., Higashida, R. T., Johnston, S. C., Kidwell, C. S., Lutsep, H. L., Miller, E., & Sacco. R. L. (2009) Definition and evaluation of transient ischemic attack: A scientific statement for healthcare professionals from the American Heart

Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. *Stroke, 40*(6), 2276–2293. http://dx.doi.org/10.1161/STROKEAHA.108.192218

Flaskerud, J. H., & Winslow, B. J. (1998). Conceptualizing vulnerable populations health-related research. *Nursing Research, 47*(2), 69-78. http://dx.doi.org/10.1097/00006199-199803000-00005

Harrington, R. A., Califf, R. M., Balamurugan, A., Brown, N., Benjamin, R. M., Braund, W. E., Hipp, J., Konig, M., Sanchez, E., & Joynt Maddox, K. E. (2020). Call to action: Rural health: A presidential advisory From the American Heart Association and American Stroke Association. *Circulation, 141*(10), e615-e644. http://dx.doi.org/10.1161/CIR.0000000000000753

Harrington, R. A., & Heidenreich, P. A. (2015). Team-based care and quality: A move toward evidence-based policy. *Journal of the American College of Cardiology, 66*(16), 1813-1815. http://dx.doi.org/10.1016/j.jacc.2015.08.016

Hastrup, S., Johnsen, S. P., Jensen, M., Weitzel-Mudersbach, P. V., Simonsen, C. Z., Hjort, N., Møller, A. T., Harbo, T., Poulsen, M. S., Iversen, H. K., Damgaard, D., & Andersen, G. (2021). Specialized outpatient clinic vs stroke unit for TIA and minor stroke: A cohort study. *Neurology, 96*(8), e1096-e1109. http://dx.doi.org/10.1212/WNL.0000000000011453

Hosier, G. W., Phillips, S. J., Doucette, S. P., Magee, K. D., & Gubitz, G. J. (2016). Transient ischemic attack: Management in the emergency department and impact of an outpatient

neurovascular clinic. *Canadian Journal of Emergency Medicine, 18*(5), 331-339. http://dx.doi.org/10.1017/cem.2016.3

Johnston, S. C., Rothwell, P. M., Nguyen-Huynh, M. N., Gilles, M. F., Elkins, J. S., Bernstein, A. L., & Sidney, S. (2007). Validation and refinement of scores to predict very early stroke risk after transient ischaemic attack. *Lancet, 369*(9558), 283-292. http://dx.doi.org/10.1016/S0140-6736(07)60150-0

Kapral, M. K., Hall, R., Fang, J., Austin, P. C., Silver, F. L., Gladstone, D. J., Casaubon, L. K., Stamplecoski, M. & Tu, J. V. (2016). Association between hospitalization and care after transient ischemic attack or minor stroke. *Neurology, 86*(17), 1582-1589. http://dx.doi.org/10.1212/WNL.0000000000002614

Kernan, W. N., Ovbiagele, B., Black, H. R., Bravata, D. M., Chimowitz, M. I., Ezekowitz, M. D., Fang, M. C., Fisher, M., Furie, K. L., Heck, D. V., Johnston, S. C., Kasner, S. E., Kittner, S. J., Mitchell, P. H., Rich, M. W., Richardson, D., Schwamm, L. H., & Wilson, J. A. (2014). Guidelines for the prevention of stroke in patients with stroke and transient ischemic attack: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke, 45*(7), 2160-2236. http://dx.doi.org/10.1161/STR.0000000000000024

Kiyohara, T., Kamouchi, M., Kumai, Y., Ninomiya, T., Hata, J., Yoshimura, S., Ago, T., Okada, Y., Kitazono, T., & Fukuoka Stroke Registry Investigators. (2014). $ABCD^3$ and $ABCD^3$-I scores are superior to $ABCD^2$ score in the prediction of short- and long-term risks of stroke after transient ischemic attack. *Stroke, 45*(2), 418–425. http://dx.doi.org/10.1161/STROKEAHA.113.003077

Kleindorfer, D. O., Towfighi, A., Chaturvedi, S., Cockroft, K. M., Gutierrez, J., Lombardi-Hill, D., Kamel, H., Kernan, W. N., Kittner, S. J., Leira, E. C., Lennon, O., Meschia, J. F., Nguyen, T. N., Pollak, P. M., Santangeli, P., Sharrief, A. Z., Smith Jr, S. C., Turan, T. N., & Williams, L. S. (2021). 2021 guideline for the prevention of stroke in patients with stroke and transient ischemic attack: A guideline from the American Heart Association/American Stroke Association. *Stroke, 52*(7), e364-e467. http://dx.doi.org/10.1161/STR.0000000000000375

Landsperger, J. S., Semler, M. W., Wang, L., Byrne, D. W., & Wheeler, A. P. (2016). Outcomes of nurse practitioner-delivered critical care: A prospective cohort study. *Chest, 149*(5), 1146-1154. http://dx.doi.org/10.1016/j.chest.2015.12.015

Leira, E, C., Kaskie, B., Froehler, M. T., & Adams, H. P. (2013). The growing shortage of vascular neurologists in the era of health reform: Planning is brain! *Stroke, 44*(3), 822-827. http://dx.doi.org/10.1161/STROKEAHA.111.000466

Majidi, S. Guerrero, C. R. L., Burger, K. M., & Rothrock, J. F. (2017). Inpatient versus outpatient management of TIA or minor stroke: Clinical outcome. *Journal of Vascular and Interventional Neurology, 9*(4), 49-53.

Martin-Misener, R., Harbman, P., Donald, F., Reid, K., Kilpatrick, K., Carter, N., Bryant-Lukosius, D., Kaasalainen, S., Marshall, D. A., Charbonneau-Smith, R., & DiCenso, A. (2015). Cost-effectiveness of nurse practitioners in primary and specialised ambulatory care: Systematic review. *BMJ Open, 5*, e007167. http://dx.doi.org/10.1136/bmjopen-2014-007167

McLain, J. V., & Chance, E. A. (2020). The Advanced Practice Nurse will see you now. *Journal of Nursing Care Quality*, *35*(2), 147-152. http://dx.doi.org10.1097/NCQ.0000000000000414

Mendelson, S. J., & Prabhakaran, S. (2021). Diagnosis and management of transient ischemic attack and acute ischemic stroke: A review. *Journal of American Medical Association, 325*(11), 1088-1098. http://dx.doi.org/10.1001/jama.2020.26867

O'Brien, E. Priglinger, M. L., Bertmar, C., Day, S., Borsodi, C., Herkes, G., & Krause, M. (2016). Rapid access point of care clinic for transient ischemic attacks and minor strokes. *Journal of Clinical Neuroscience, 23,* 106-110. http://dx.doi.org/10.1016/j.jocn.2015.04.032

Ortiz, J., Hofler, R., Bushy, A., Lin, Y., Khanijahani, A., & Bitney, A. (2018). Impact of nurse practitioner practice regulations on rural population health outcomes. *Healthcare, 6*(2), 65. http://dx.doi.org/10.3390/healthcare6020065

Ranta, A., & Barber, P. A. (2016). Transient ischemic attack service provision: A review of available service models. *Neurology*, *86*(10), 947-953. http://dx.doi.org/10.1212/WNL.0000000000002339

Sadighi, A., Stanciu, A., Banciu, M., Abedi, V., Andary, N. E., Holland, N., & Zand, R. (2019). Rate and associated factors of transient ischemic attack misdiagnosis. *eNeurologicalSci, 15*, 100193. http://dx.doi.org/10.1016/j.ensci.2019.100193

Shapiro, S. D., Boehme, A. K., Chang, B. P., Miller, E. C., Willey, J., & Elkind, M. S. V. (2021). Safety and hospital costs averted using a rapid outpatient management strategy for transient ischemic attack and minor strokes: The RAVEN Clinic. *The Neurohospitalist, 11*(2), 107-113. http://dx.doi.org/10.1177/1941874420972236

Song, B., Fang, H., Zhao, L., Gao, Y., Tan, S., Lu, J., Sun, S., Chandra, A., Wang, R., & Xu, Y. (2013). Validation of the $ABCD^3$-I score to predict stroke risk after transient ischemic attack. *Stroke*, *44*(5), 1244–1248. http://dx.doi.org/10.1161/STROKEAHA.113.000969

Traczynski, J., & Udalova, V. (2018). Nurse practitioner independence, health care utilization, and health outcomes. *Journal of Health Economics, 58*, 90-109. http://dx.doi.org/10.1016/j.jhealeco.2018.01.001

Trotter, T. L., Braunlin, J. L., Crump, G. M., Neff, J., Schwartz, C., Rotterman, M. M., & Shields, S. (2021). Utilization of Advanced Practice Providers in Advanced Practice Provider-led stroke clinic to expand outpatient stroke follow-up care. *Clinical Nurse Specialist, 35*(1), 23-30. http://dx.doi.org/10.1097/NUR.0000000000000566

Virani, S. S., Maddox, T. M., Chan, P. S., Tang, F., Akeroyd, J. M., Risch, S. A., Oetgen, W. J., Deswal, A., Bozkurt, B., Ballantyne, C. M., & Petersen, L. A. (2015). Provider type and quality of outpatient cardiovascular disease care: Insights from the NCDR PINNACLE Registry. *Journal of the American College of Cardiology*, *66*(16), 1803-1812. http://dx.doi.org/10.1016/j.jacc.2015.08.017