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# Effect of Stages of Prehospital Hypertensive Crisis and Length-of-Stay on Acute Stroke Readmission

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This is to certify that the doctoral dissertation by

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Walden University
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Abstract

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MBA, Washington University St. Louis, 2005

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Dissertation Submitted in Partial Fulfillment

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Abstract

Stroke is the second leading cause of mortality and the third leading cause of disability, affecting over 800,000 Americans annually. Traditional stroke research has focused on in-hospital settings, but not on prehospital stroke admissions, despite evidence that over 75% of acute stroke cases managed by emergency medical services involve prehospital hypertensive crises (HTN-C). HTN-C is classified into three systolic blood pressure (SBP) stages: Stage 1 (140–159 mm Hg), Stage 2 (160–179 mm Hg), and Stage 3 (≥180 mm Hg), the latter associated with organ damage. Hypertension correlates with longer hospital stays and more intensive interventions in hospitalized patients, but HTN-C alone is not associated with 30-day hospital readmissions. To date, there is no available research on the role of HTN-C and LOS on 30-day hospital readmissions in prehospital stroke cases while controlling for age, race, gender, and diabetes as a comorbidity. Secondary data consisting of 527 prehospital stroke cases from a Midwestern hospital between 2018 and 2022 were extracted from the Get with the Guideline Stroke database and predictors of 30-day hospital readmissions were analyzed using a binomial logistic regression model with SPSS v29. The study was guided by the patient-centered care model and Donabedian's conceptual framework. The results indicated that length of stay (OR = 1.072, 95% CI [1.011, 1.136], p = .019) was a positive predictor of 30-day hospital readmissions when controlling for patient age (OR = 1.019, 95% CI [1.001, 1.037] whereas HTN-C was not significant. These findings may help inform modifications to traditional in-patient stroke care interventions based on predictors specific to prehospital stroke admissions and create positive social change.

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## Dedication

This doctoral study is dedicated to my daughter, Katharine Ross; my wife, Dr. Claudia Vasquez Ross; and to all United States military veterans and their families. Their unwavering selflessness, sacrifice, commitment, and devotion to freedom serve as the enduring foundation that sustains our great democracy.

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# Chapter 1: Introduction to Study

In North America, approximately 2,150 people experience a stroke each day, with a stroke episode occurring every 40 seconds and a death every four minutes attributable to hypertensive crises (Myat et al., 2018). Hypertensive crisis (HTN-C) is characterized by an abrupt elevation in blood pressure that can trigger a stroke, encompassing a broad spectrum of clinical episodes involving variable blood pressure levels related to hypertension. It is classified into three stages: Stage 1 (SBP 140–159 mm Hg), Stage 2 (SBP 160–179 mm Hg), and Stage 3 (SBP ≥ 180 mm Hg) (GWTG-Stroke, 2023). According to Kumar et al. (2019), data suggested that one in six patients admitted for prehospital HTN-C experiences unplanned 30-day hospital readmissions, with HTN-C and stroke being among the most common causes of such readmissions. Currently, no research has explicitly examined the relationship between prehospital HTN-C and length of stay (LOS) as predictors of 30-day hospital readmissions (Kumar et al., 2019). The influence of LOS, stratified by stages of HTN-C, on readmission rates has not been previously studied. While extensive research has explored these variables within traditional inpatient settings, their roles in prehospital stroke cases remain unexamined. Notably, Cimino and Braun (2023) discussed the current and future landscape of prehospital care, emphasizing episodes of time-sensitive emergencies such as trauma, cardiac failure, stroke, bleeding, breathing difficulties, and systemic infections. However, they did not specifically include prehospital HTN-C or LOS as predictors of 30-day hospital readmissions. Understanding the key high-risk factors associated with readmission among prehospital stroke patients is essential. Gaining this insight has the potential to improve patient quality of life after a stroke, decrease LOS, and reduce risk-adjusted 30-day hospital readmissions. This knowledge can lead to more effective prehospital stroke management and better patient outcomes (Kumar et al., 2019).

## Background of Study

In the United States, HTN-C is associated with approximately 15–20% of hospital readmissions within 30 days and significantly contributes to the burden of cardiovascular disease (Kumar et al., 2019). Prior stroke-related research has focused on in-hospital settings, despite evidence that over 75% of acute stroke cases managed by emergency medical services (EMS) involve prehospital HTN-C (Xirasagar et al., 2020). Nearly 13% of prehospital patients presenting to the emergency department (ED) have been reported with stage 3 HTN-C systolic blood pressure, often experiencing delayed door-to-needle (DTN) times (Kumar et al., 2019). According to Kumar et al. (2019), LOS, defined as the duration of a single hospitalization, is a critical standard of care quality and an important predictor of high-risk 30-day readmissions. However, the impact of LOS stratified by stages of HTN-C on stroke readmissions remains underexplored and lacks translational data, highlighting a significant gap in current research. Kumar et al. also indicated that approximately 17% (or 1 in 6) patients diagnosed with HTN-C experience an unplanned hospital readmission within 30 days. Furthermore, the relationship between hospital quality metrics, such as LOS and readmission rates, and prehospital hypertensive crises has yet to be thoroughly examined, underscoring the need for more scholarly evidence to support evidence-based benchmarking. Xirasagar et al. (2020) investigated the relationship between blood pressure and in-hospital outcomes in patients with acute ischemic stroke, concluding that post-stroke hypertension is associated with poorer short-term outcomes, though findings across studies remain conflicting. The remainder of this chapter will outline the problem statement, research design, and methodology. These will be developed and justified within a framework grounded in the patient-centered care (PCC) Model and guided by Donabedian's conceptual framework, which evaluates healthcare quality across three domains: structure, process, and outcome (Alcock et al., 2020). Specifically, this model supports examining LOS as a process measure and risk-adjusted 30-day hospital readmissions as an outcome, providing a comprehensive approach to assessing the impact of health services. This chapter sets the foundation for Chapter 2, comprising the literature review, and prepares for the detailed discussion of methodology in Chapter 3.

## Problem Statement

Stroke is the second most common cause of mortality and the third most common cause of disability. Identifying high-risk readmission factors for prehospital admitted patients has the potential to dramatically improve the quality of life and recovery for post-stroke patients and elicit positive social change. Under the new Medicare compliance and quality-reporting guidelines, hospitals may incur excessive economic penalties for readmissions for treatment of the same illness if they occur within 30 days of patient discharge (James et al., 2023). According to the Centers for Medicare and Medicaid Services (CMS, 2023), readmission prevention is incentivized 10 times the amount when compared to other quality of care measures, such as LOS and mortality. Historically, most stroke-related research only focused on hospital inpatient environments and readmission risk factors, but little is known about prehospital-related outpatient HTN-C stroke cases relative to LOS and risk-adjusted 30-day readmissions.

## Purpose of the Study

The study aimed to evaluate whether the stratified stages of prehospital HTN-C blood pressures and length of stay (LOS) are significant predictors of 30-day hospital readmission for acute stroke.

## Research Questions and Hypotheses

Research Question 1: To what extent is prehospital-admitted stroke patient length of stay (LOS) associated with the risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes?

$H_0 1$: Prehospital admitted stroke patient LOS is not associated with risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_1 1$: Prehospital admitted stroke patient LOS is associated with the risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

Research Question 2: To what extent are prehospital stratified stages of HTN-C associated with the risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes?

$H_0 2$: Prehospital stages of HTN-C are not associated with the risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_1$2: Prehospital stages of HTN-C are associated with the risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

Research Question 3: To what extent are prehospital admitted stroke patient's length of stay (LOS) and stages of hypertensive crisis (HTN-C) associated with the risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes?

$H_0$3: Prehospital admitted stroke patient LOS and stages of hypertensive crisis (HTN-C) are not associated with risk-adjusted, 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_1$3: Prehospital admitted stroke patient LOS and stages of hypertensive crisis (HTN-C) are associated with the risk-adjusted, 30-day hospital readmissions, will controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

## Theoretical and Conceptual Frameworks

The theoretical framework for this study was a PCC Model, using the Donabedian Conceptual Theory, which evaluated health services and the impact on the quality of healthcare delivered (Alcock et al., 2020). The Donabedian principle used in the investigation helped to evaluate the value of care in three domains: structure, process, and outcome (Alcock et al., 2020). The model provided guidance when assessing the impact of the health services and when used appropriately, helped to evaluate length of stay as a measure of a process and readmission rate as an outcome. For example, during the research, the aim was to examine the transformative state of how healthcare is migrating away from a fee-for-service methodology and with a system designed around a reimbursement model of quality of care, which is metrics-driven and evidence-based. The clinical pathway involved prehospital HTN-C and LOS, which included a multidisciplinary approach, inclusive of hospital administrators, medical providers, ancillary personnel, and external stakeholders. The structural design of a Donabedian framework entailed the physical structure of a facility, medical equipment, staffing levels, staff productivity, staff training and education, licensing, accreditation, certifications, and compliance or internal standard operating procedures (Moayed et al., 2022). The process involves comprehensive steps in the medical delivery process or best practices that optimize high-quality, timely, cost-effective, and safe patient care (Moayed et al., 2022). As noted by Moayed et al. (2022), the process of a Donabedian approach can also embrace metrics, such as dashboards to track daily, weekly, and monthly trending of volume and revenue; expenses; turn-around times; incident reporting; and utilization of medical equipment, resources, and personnel. The study's outcome described the response to how the process was delivered, which could potentially influence the impact on the risk-adjusted 30-day hospital readmissions (James et al., 2023).

**Patient-Centered Care Model**

Alcock et al. (2020) discussed the relationship between the quality-of-care model and Donabedian theory relative to contemporary healthcare transformation. According to Alcock et al. (2020), the Donabedian framework embraces a Patient-Centered Care Model (PCC), which evaluates the quality of medical care from a three-tier perspective: structure, process, and outcome. The PCC model used throughout the research was meaningful in guiding the theoretical framework and process to determine if an association existed between prehospital hypertension crisis-related stroke, length of stay, and hospital readmissions. The overarching objective of the investigation was to facilitate the hypothesis and discover if the stratified stages of prehospital HTN-C and length of stay (LOS) were significant influences of the risk-standardized 30-day hospital readmissions. Furthermore, the last tier of the PCC model and Donabedian's theory explored the utilization of outcomes to assess the effectiveness of healthcare delivery. As noted by Alcock et al. (2020), structure can be defined as the level of professional knowledge, such as competency, training, education, capability, and proficiency of providers, administrators, and medical personnel. Historically, structure was recognized as the physical body of the organization, inclusive of regulatory and compliance requirements to help regulate patient care and day-to-day operations of a hospital, such as licensing and credentialing requirements for providers, HIPAA, Life Safety, FDA, ACR, OSHA, and Joint Commission Surveys. Moreover, the most notable regulatory agencies to control and enforce quality, compliance, licensing, and professional certifications in North America, are the Joint Commission, also known as the Joint Commission on

Accreditation of Healthcare Organizations (JACHO), American College of Radiology, Centers for Medicare and Medicaid Services, and Health Insurance Portability and Accountability Act (HIPAA). The process was based on the inclusion of strategy, utilization of resources, equipment, and the execution mechanism involved in the healthcare delivery process (Gai & Pachamanova, 2019). The outcome was the result of the output of the process, which illustrated the influence on the end-user's health and state of well-being. The outcome was viewed as the end-product or measurement and the metric that quantifies how well medicine is delivered based on national benchmarks (James et al., 2023). Hence, the mission of the Agency for Healthcare Research and Quality (AHRQ), National Committee for Quality Assurance, and the Patient-Centered Outcomes Research is to monitor the efficacy of processes and outcomes with an overarching goal of evidence-based outcomes that are centered around quality, safety, affordability, and patient satisfaction. Therefore, the PCC model helped guide a quality assessment principle to evaluate the efficiency of healthcare delivery and approach to patient care and helped to control the focus of the investigation between prehospital hypertension crisis-related stroke, length of stay, and hospital readmissions (Alcock et al., 2020).

**Donabedian Conceptual Theory**

The fundamental and philosophical aspect of Donabedian's theory during the research provides a framework on the quality of care and divestiture in the healthcare continuum of care (Alcock et al., 2020). This means that the Donabedian concept helped to analyze how healthcare is currently delivered in its present state during clinical decision-making, inclusive of three pillars centered on process, structure, and outcomes. As mentioned by Alcock et al. (2020), a Donabedian's principle, relative to quality is applicable in today's work environment because of the metamorphic and transformative nature of medicine, which is rapidly migrating from a fee-for-service to a value-based system that can be traced back to Donabedian's theory, especially as hospitals consider patient-centered quality indicators that are aimed toward safety, effectiveness, efficiency, patient-satisfaction, timeliness, and access-driven population health services. Quality measures related to these goals have become standard key performance metrics throughout the healthcare industry and medical facilities in our global community. Donabedian's principle also provides public and social awareness. It elevates social consciousness in human behavior regarding consumerism, emotional and ethical aspects of delivering quality healthcare, cost, and how medicine had evolved. For instance, Donabedian's philosophy is based on the premise of a trilogy of structure, process, and outcome. The structure of medicine can be described as the environment, qualifications of caregivers, and administrative construction at which care is given; the process defines the components and activities of delivering care; the outcome is the patient's status following treatment (James et al., 2023). Donabedian's approach toward the effectiveness of quality is evident in current scientific and medical practices, such as telemedicine, electronic medical records, and digital technologies that have reduced medical costs within our healthcare systems and improved the quality of care. Lastly, Donabedian's methodology advocated that the high quality of care should not only focus on structure, process, and outcome, but also should include a broader perspective of self-awareness

(James et al., 2023). Experts suggest that self-awareness toward better health choices, health education, along with a commitment to a proper diet, exercise, and stress management will help mitigate cardiovascular disease (Healthy People 2020).

Moreover, as the Donabedian principle guides the conformity of this research project, a more recent methodology is emerging throughout healthcare to embrace continued growth in new, cost-saving technologies that will move stroke treatment from inpatient to outpatient settings (Koren et al., 2018). The transformation of outpatient-focused stroke care and LOS are driven in part by consumer demands and risk-based quality payment methodology with a clinical value procedural approach to patient-centered meticulousness (Cyganska et al., 2019).

## Nature of the Study

The nature of the study was to determine if a relationship exist between pre-hospital hypertensive crisis systolic blood pressures (HTN-C), LOS, and 30-day hospital readmissions. The research study was quantitative in design and used retrospective secondary data collected from Get with the Guideline Stroke National Registry with data from over 1,700 hospitals and 2.5 million patient encounters of participants from GWTG-Stroke performance improvement initiatives (Heidenreich et al., 2022). The final data set employed quantitative evidence from GWTG-Stroke records from the period between 2018-2022, with licensing restrictions, for only one academic medical center in the Midwest. The independent variables (IDV) or predictor variables were represented by length of stay (LOS) and stratified stages of hypertensive crisis (HTN-C) for prehospital admitted stroke patients from the GWTG-Stroke Registry. The dependent variable (DV), the outcome variable, is the prehospital admitted stroke patient risk adjusted 30-day hospital readmissions (James et al., 2023). The confounding variables, such as age, gender, race, and co-morbidities, diabetes I and II, will be included in the investigation.

Diabetes is an important comorbidity due to the social burden and impact on high blood pressure and stroke (Glovaci et al., 2019). As a comorbidity, both diabetes, type I insulin-include, or type II non-insulin regulated information will be included during the study.

Stage 1 HTN-C is systolic blood pressure (SBP) between 140 and 159 mm/Hg, stage 2 HTN-C is SBP in the 160-179 mm/Hg range, and stage 3 is SBP of 180 mm/Hg or higher. Based on the guidelines from the American Heart Association (2022), blood pressure should be less than 185/110 to initiate stroke endovascular therapy, such as tissue plasminogen activator (tPA). Thus, patients admitted with stage 3 HTN-C must first receive anti-HTN management, which only delays stroke-specific medications. Any delay in initiating thrombolytics or door-to-needle (DTN) times, also known as the time of symptom onset to treatment time, had been shown to negatively impact patient outcomes, resulting in higher stroke-related mortality, length of stay, and risk-standardized 30-day hospital readmissions (James et al., 2023).

While most stroke-related research focused on the inpatient setting, prehospital hypertensive crises in the United State account for over 75% of acute stroke cases managed by emergency medical services (EMS) personnel (Luna et al., 2018). According to Kumar et al. (2019), 17% or 1 in 6 patients diagnosed with HTN crisis will encounter an unplanned, 30-day hospital readmissions. Length of stay (LOS), according to James et al. (2023), is defined as the duration of a single episode of hospital care, LOS is also a significant predictor of high-risk, 30-day hospital readmissions. The impact of LOS stratified by stages of HTN-C on readmissions had not been previously studied. Much work has been performed with these variables involving traditional admissions but not with prehospital stroke research. Thus, this investigation would be the first known study to do this. Therefore, this research will concentrate on prehospital hypertensive crisis patients from the GWTG-Stroke Registry and investigate whether the stratified stages of HTN-C and LOS are objective and measurable indicators for the risk-standardized, 30-day, risk adjusted 30-day hospital readmissions (Xirasager et al., 2020).

## Definition of Terms

The terms employed in this study were affiliated with the stratified stages of prehospital HTN-C and LOS as predictors of risk-adjusted 30-day hospital readmissions:

*Abrupt Brain Attack*: A disruption in blood supply to any brain region, also known as a stroke or cerebral vascular association (James et al., 2023).

*Agency for Healthcare Research and Quality (AHRQ)*: The objective of AHRQ, in conjunction with the U.S. Department and Human Services, is to construct scientific research that ensures that medicine is delivered in a safe, more effective, greater

quality, patient-centered, accessible, fair, and cost-effective manner for the benefit of consumers (Chou et al., 2022).

*Patient Protect and Affordable Care Act (PPAC)*: Enacted in 2010, the PPAC aimed to bend the cost curve by making healthcare insurance more affordable to all

Americans, expanding the Medicaid Insurance Exchange Program that provides coverage for adults whose income is 138% below the federal poverty level (FPL); PPAC supports innovative technological discoveries that improve the delivery of healthcare in more cost-effective ways (McGee et al., 2021).

*Algorithms*: A methodical process for problem solving (Hayashi et al., 2021).

*Angiotensin-Converting Enzyme Inhibitors (ACE)*: Blood pressure-lowering medication that works by relaxing or dilating the blood vessels. ACE inhibitor enzymes will stop the physiological production of Angiotensin II, a substance that constricts blood vessels, releases hormones, and raises BP. Narrowing of blood vessels will increase high BP and cause the heart to work harder (McGee et al., 2021).

*Angiotensin Receptor Blockers*: Elicits the relaxation of blood vessels will reduce BP and make it easier for the heart to pump blood, also known as stroke volume. Angiotensin II receptor blockers prevent the mechanism of action of angiotensin II which allows blood vessels to expand (Hayashi et al., 2021).

*Antiplatelet Drugs*: Pharmaceutical drugs that reduce the probability of blood platelets' clotting or coagulating (Hayashi et al., 2021).

*Artificial Intelligence:* A component of computer science that embraces the simulation of human intelligence, data science, and human behavior in the management and prediction of disease states (McGee et al., 2021).

*Autoregulation*: Autoregulation can be defined as the ability of the organ system (neurological, cardiac, and urinary) to maintain a constant blood flow regardless of the perfusion pressure (Silverman & Peterson, 2023).

*Binary Logistical Regression Model*: A model that is used to predict the probability between one or more predictor variable and a binary or dichotomous outcome variable (Schober & Vetter, 2021).

*Calcium Channel Blocker (CCB)*: CCBs block calcium from entering cells of the heart and blood vessel walls, which results in lowering of BP (Hayashi et al., 2021).

*Center for Medicare and Medicaid Services (CMS)*: A national agency within the Department of Health and Human Services that oversees the Medicare program and collaborates in strategic partnership with state and local governments to deliver Medicaid, Children's Health Insurance Program (CHIP), and Health Insurance Portability and Accountability Act (HIPAA) guidelines (CMS, 2023).

*Cholesterol Drugs* (statins): Cholesterol or lipid-lowering drugs that are designed to mitigate cardiovascular disease (Hayashi et al., 2021).

*Commercial Payers:* A bidirectional relationship between a third-party payer and hospital that provides in-network health insurance that covers specific medical expenditures and disability benefits to those insured (McGee et al., 2021).

*Comorbidities*: These are defined as the simultaneous presence of two or more chronic diseases in a patient (Hayashi et al., 2021).

*CVA*: The term cerebral vascular association refers to a cessation of blood flow to an area of the brain that deprives the brain of blood, oxygen, and nutrients (Babu et al., 2019).

*Diastolic Blood Pressure*: The term denotes the bottom number of a blood pressure reading, which measures the relaxation of the heart between beats (Heidenreich et al., 2022).

*Diabetes*: Diabetes, a chronic illness that causes excess blood sugar, can exacerbate high blood pressure by decreasing the elasticity of blood vessels, thus narrowing them and obstructing blood flow (Syed., 2023). Diabetes can cause a reduction in oxygen saturation and will increase the risk of elevated blood pressure that damages large and small blood vessels as well as capillaries (Glovaci et al., 2019).

*Disability Adjusted Life Years (DALY):* Is a metric that calculates the significance of comorbidity and manifests as a number of years lost because of sickness, disability, and pre-mature mortality, which impacts the overall life expectancy of an individual (Khurana et al., 2018).

*Diuretics*: Diuretics are also known as water pills, which are drugs designed to increase the quantity of water and salt excreted from the body during the process of urination (Syed., 2023).

*Donabedian Theory and Model*: A theoretical model of healthcare which provides a framework for analyzing healthcare delivery, such as quality, safety, affordability, efficiency, and patient satisfaction, based on structure, process, and outcome (Binder et al., 2021).

*Door-to-Needle Time*: The benefits of intravenous tissue plasminogen activator (tPA) in patients with acute ischemic stroke are time-dependent, and it had a door-to-needle (DTN) time with a treatment goal of 60 minutes or less (Bhatt et al., 2021).

*GWTG-Stroke*: Is an in-hospital quality improvement program that advances stroke care by promoting consistent adherence to the latest scientific treatment guidelines (Bhatt et al., 2021).

*Healthcare Cost Utilization Project (HCUP)*: HCUP is a federal database dispensary that stores healthcare surveillance information about standardized benchmarks, quality measures, cost, ICD-9 and 10 charges, and evidence-based outcomes (CMS, 2023).

*Health Insurance Portability and Accountability Act (HIPAA):* HIPAA was implemented to expand privacy guidelines and to protect patients' medical records and personal health information that is made available to hospitals, medical providers, and insurance companies (Chou et al., 2022).

*History and Physical (H & P)*: The initial clinical examination and evaluation of a patient to aid in the appropriate diagnosis and treatment plan (Hayashi et al., 2021).

*Health Insurance Technology and Economic for Clinical Healthcare (HITECH)*: The Health Information Technology for Economic and Clinical Health (HITECH) law was created as a component of the American Recovery and Reinvestment Act of 2009 to advance the implementation of meaningful use and integration of health information technology (Hayashi et al., 2021).

*Health Maintenance Organization (HMO)*: HMO is a medical plan that provides coverage for the services of providers and hospitals within a network of care; HMO-covered practitioners agree to a reduced payment schedule for members (Glovaci et al., 2019). Healthcare is rendered on a prepaid agreement with a fixed monthly charge.

*Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS*): Also known as H-caps, this represents a hospital's score based on a standardized survey designed around the patient's hospital experience that is specific to the quality of medical care received from providers and medical staff (CMS, 2023).

*Hospital Readmission Reduction Program (HRRP)*: The HRRP was founded in 2012 as a component of the Affordable Care Act (ACA). Under HRRP, hospitals are penalized if they fail to meet or comply with quality-of-care benchmarks, which are inclusive of risk-standardized, 30-day readmission rates and LOS for various comorbidities, such as hypertension and stroke (McGee et al., 2021).

*Hypertensive Crises (HTN-C*): Are abrupt increases in blood pressure. HTN-C may be classified into three stages. In stage 1 hypertension, systolic blood pressure (SBP) is between 140 and 159 mm/Hg; in stage 2 hypertension, SBP is 160-179 mm/Hg; and in stage 3 hypertension, SBP is 180 mm/Hg or higher. A critical component to stage 3 HTN-C is organ damage (Heidenreich et al., 2022).

*Hypertension Emergency (HTN-E)*: A subcomponent of HTN-C which involves an acute acceleration in blood pressure associated with progressive, end-stage organ injury (Heidenreich et al., 2022).

*Hypertension Urgency (HTN-U)*: Another subcomponent of HTN-C; however, the severe acceleration of BP is not associated with end-stage organ injury and is not life-threatening (Heidenreich et al., 2022).

*Indemnity Plan*: Reimburse patients for out-pocket healthcare expenses if provider or hospital visits are out of network. Also known as fee-for-service insurance (McGee et al., 2021).

*Intracerebral Hemorrhage (ICH*): Internal bleeding within the structure of the brain, which can be a life-threatening phenomenon (Heidenreich et al., 2022).

*In-patient Prospective Payment System (IPPS)*: Also recognized as Diagnosis-Related Group or DRG, IPPS provides payment based on inpatient admissions as well as diagnostic and non-diagnostic procedures performed by medical facility within three days of patient's admission (McGee et al., 2021).

*Joint Commission on Accreditation of Healthcare Organizations (JCAHO)*: Established in 1951, JCAHO is a private, not-for-profit, 501(c3) organization whose goal is to advance the quality of care in formalized healthcare facilities (Alcock et al., 2020).

*LACE Index*: The LACE index was implemented to forecast readmission liability as well as LOS mortality or unplanned, 30-day hospital readmission following discharge from the hospital (Rajagura, et al., 2022).

*Last Known Well*: A quality measure used by Get with the Guidelines Stroke to define symptom onsets from the last clinical episode of stroke care (Joint Commission National Quality Measures, 2018).

*Length of Stay (LOS)*: The duration of a single episode of hospitalization which is known to be an important predictor of (Xirasager et al., 2020). The average LOS is calculated as the number of discharge days divided by total discharges (including deaths).

*Medicare Payment Advisor Commission*: An impartial federal agency that provides the United States Congress with data based on public health policy, research, and examination regarding Medicare spending (CMS.gov, 2022). According to CMS.gov (2022), approximately 20% of all Medicare discharges experience hospital readmission within 30 days of release, with 12% of readmissions preventable.

*Machine Learning*: Patterns in data collection, prototypes, and applications that utilize methods to automatically learn from historical experiences without being explicitly scheduled (Hayashi et al., 2021).

*Medicare Value-Based Purchasing Program: A r*isk assessment tool developed to identify patients at considerable risk of hospital readmission, so they can be targeted for interventions aimed at reducing the rate of readmission. One such tool is the HOSPITAL score which uses seven readily available clinical variables to predict the risk of readmission within 30 days of discharge (Gai & Pachamonova, 2019).

*National Health and Nutrition Examination Survey (NHANES)*: A program of studies designed to evaluate the health and nutritional status of adults and children in North America. The survey is eccentric because it combines interviews and physical examinations (Benjamin et al., 2018).

*National Institutes of Health Stroke Scale (NIHSS)*: The NIHSS employs quantitative metrics and assessment techniques to evaluate stroke severity and neurologic deficit. NIHSS employs a 15-item stroke scale (Fowler et al., 2019). The assay evaluates acute cerebral infarction on the degrees of consciousness, language, neglect, visual-field loss, extraocular movement, motor strength, ataxia, dysarthria, and sensory loss. Ratings for each item are graded with 3 to 5 scores, with zero as normal.

*Point of Service (POS)*: A form of HMO, but usually beneficiaries pay no deductible; instead, they get charged a small co-payment when visiting a hospital or provider in a network (MD Clarity, 2022).

*Preferred Provider Organization (PPO)*: PPO members pay for medical services as needed, along with sponsor reimbursement to recipients. Providers and hospitals provide medical treatment to a select population or organization (Glovaci et al., 2019).

*Stroke:* It is characterized as a neurological deficit that affects the arteries leading to the brain (Xirasager et al., 2020)

*Patient-Centered Care Model (PCCM)*: PCCM is evidence-based healthcare that focuses on value-based clinical care and outcomes (Engle et al., 2022).

*Pathophysiology:* It is the physiology of an abnormality and disruption in the state of being involving the function and presence of disease (Heidenreich et al., 2022).

*Readmission:* Readmissions are defined as any readmission during the 30-day, the number of patients readmitted to the hospital within 30-days of being discharged after a previous hospital stay (Bhatt et al., 2021).

*30-day Risk-Standardized Risk adjusted 30-day hospital readmissions (RSSR*): Refers to the in-hospital patient quality reporting metric used by the Center for Medicare and Medicaid Services to evaluate financial incentives and utilization (James et al., 2023). According to CMS (2018), the observed 30-day readmission is divided by the expected readmission and then multiplied by the national readmission standard which equals 30-day hospital readmission. The observed-to-expected (O/E) ratio is inclusive of the ratio of the actual (observed) count of readmissions relative to the risk-adjusted (expected) count of readmissions.

*Stage 1 hypertension*: Systolic blood pressure (SBP) is between 140 and 159 mm/Hg, and diastolic pressure is between 80 and 89 mm/Hg (Heidenreich et al., 2022).

*Stage 2 hypertension*: Systolic blood pressure (SBP) of 160 mm/Hg or higher and diastolic pressure over 90 mm/Hg (Heidenreich et al., 2022).

*Stage 3 hypertension*: Systolic blood pressure (SBP) of 180 mm/Hg or higher and diastolic pressure over 110 mm/Hg (Heidenreich et al., 2022).

*Systolic Blood Pressure*: The term denotes the first reading of blood pressure, which measures the pressure in the blood vessels upon individual heartbeats (Heidenreich et al., 2022).

*Tissue Plasminogen Activator (tPA):* tPA is an enzyme made in the body that dissolves and breaks down blood clots (Glovaci et al., 2019).

*World Hypertension League Expert Committee*: A global organization that focuses on standardization and monitoring of hypertension research with specific concentrations and core metrics and indicators: (a) BP distribution, (b) prevalence of HTN, (c) awareness of the state of the disease, (d) antihypertensive drug therapy, (e) control of hypertension based on drug treatment (Ntaganda et al., 2022).

## Assumptions

The first assumption of the study was that no delineation existed between patients who had experienced an in-hospital hypertension crisis versus a prehospital hypertension crisis event. Appropriately recognizing a hypertensive emergency and distinguishing the disease from HTN-C or include chronic hypertension using accurate BP measurement standards, such as a relevant patient assessment, physical evaluation, and laboratory blood work, is essential to appropriate emergency triage and initial diagnosis (Heidenreich et al., 2022). Prehospital hypertensive crises in the United States account for over 75% of acute stroke cases managed by emergency medical services (EMS) personnel (Bhatt et al., 2021). As noted by Ashraf et al. (2022), of the 128,942 patients discharged without death, 13,768, or 10.68%, were readmitted back to the hospital within 30 days of discharge due to HTN crisis 19% of the time. Will LOS, according to Ashraf et al. (2022), is defined as the duration of a single episode of hospitalization and is an important predictor of high-risk, 30-day hospital readmissions, the impact of LOS stratified by stages of HTN-C on readmissions had not been previously studied. Thus, this study will focus on prehospital hypertensive crisis patients from the GWTG-Stroke Registry and investigate whether the stage of HTN-C and LOS are significant predictors for the risk-standardized, risk adjusted 30-day hospital readmissions. The second assumption is that secondary data collected by GWTG-Stroke (2023) is credible and generalizable. GWTG-Stroke collects voluntary patient-level information on characteristics, quality of care metrics, diagnostic examinations, bioinformatics, compliance with quality measures, in-hospital outcomes, and in-patient and prehospital admitted patients hospitalized with acute stroke and transient ischemic attack (TIA). Presently, over 1,700 hospitals participate in GWTG-Stroke performance improvement initiatives and data involves over 2.5 million patient encounters (Heidenreich et al., 2022). The third assumption is that the burden of prehospital HTN-C in relationship to the impact on LOS and effects on 30-day hospital readmission is unknown (Kumar, et al., 2022). As noted by GWTG-Stroke (2023), hypertension can be classified into the following three stages: stage 1 hypertension is systolic pressure between 140 and 159 mm/Hg and diastolic range of 90-99 mm/Hg; stage 2 hypertension is systolic pressure between 160 mm/Hg or higher and diastolic range of 100 mm/Hg or higher; stage 3 is called a hypertension crisis which is systolic pressure between 180 mm/Hg or higher and diastolic range of 110 mm/Hg or higher. However, earlier research data failed to clearly explain the different episodes of hypertension crisis. This study concentrated on the different tiers of hypertension crisis examining the effect on stroke-related, 30-day hospital readmission (Ashraf et al., 2023).

## Scope and Delimitations

The purpose of the study was to evaluate the stages of prehospital HTN-C and LOS, as predictors of 30-day hospital readmission for acute stroke (James et al., 2023). The hypotheses included the following: prehospital admitted stroke patients' LOS is associated with the risk-adjusted, 30-day hospital readmissions for prehospital admitted stroke patient's stage of HTN-C is associated with the risk-adjusted, 30-day hospital readmissions. Secondary data will be used from the National Stroke Registry compiled from healthcare facilities employing best practices of Get with the Guidelines–Stroke care for prehospital-admitted, acute stroke patients (GWTG-Stroke, 2023).

## Limitations

There was a limitation in the literature on prehospital HTN-C. The first limitation was the lack of historical data surrounding length of stay (LOS) and stages of prehospital HTN-C as predictors of high-risk, prehospital stroke patient readmissions (Ashraf et al., 2023). Previous research discussed the in-hospital patient experience that concentrated on comorbidities concerning relationship between stage 1, 2, and 3 hypertension crises, but it had inadequate information regarding the affiliation between prehospital HTN-C and LOS as significant predictors (James et al., 2023). The second limitation involved the inconsistent reporting of quality performance metrics which works in conjunction with effective monitoring, surveillance, and reporting data (Campbell et al., 2018). Identifying high-risk readmission factors for prehospital admitted patients have the potential to dramatically improve the quality of life for post-stroke patient recoveries and positive social change. Under the new Medicare compliance and quality-reporting guidelines, hospitals may incur excessive economic penalties with 30-day risk standardization metrics for Medicare patients. According to Hoffman and Yakusheva (2020), readmission avoidance is more strongly related to incentives from the Hospital Readmissions and Reductions program, such as LOS and mortality. Will most stroke-related research on readmission risk factors focused on the in-patient setting, little is known about the out-patient effects of prehospital HTN-C and the correlation between LOS and influence on risk-adjusted, 30-day readmission rate.

Overcoming both limitations would require active participation, full datasets, algorithms, and utilization of a nationwide, patient-centered stroke program that embraces a quality improvement agenda with a focus on evidence-based practice and process-driven outcomes (Albert et al., 2023). Therefore, the investigation included data from Get with the Guidelines Stroke National Registry, but I had a license restriction to only examine scientific data from Midwestern Hospital only. Get with the Guidelines Stroke is a program established by the American Heart Association and American Stroke Association (GWTG-Stroke, 2023). Currently, approximately 1,700 hospitals participate in GWTG-Stroke performance improvement initiatives and data involves over 2.5 million patient interactions (Heidenreich et al., 2022).

## Significance

The significance of the study was that it helped to elucidate high-risk readmission factors for prehospital admitted patients and the potential to dramatically improve the quality of life for post-stroke patient recovery and positive social change. The research will increase awareness surrounding value-based care in relationship to preventing 30-day hospital readmissions and concentrating on quality, patient safety, and performance metrics which are required for the new CMS reimbursement model (McCarthy & Pandey, 2018). Under the new Medicare compliance and quality-reporting guidelines, hospitals may incur excessive economic penalties with 30-day risk standardization metrics for Medicare patients (McCarthy & Pandey, 2018). As mentioned by McCarthy and Pandy (2018), hospital readmission prevention is incentivized 10 times the dollar amount when compared to other quality-of-care measures, such as LOS and mortality. Will most stroke-related research on readmission risk factors had focused on the inpatient settings, little is known about the outpatient effects of prehospital HTN-C and the correlation between LOS and influence on risk-adjusted, 30-day hospital readmissions.

## Summary

The study focused on prehospital HTN-C, which is also known as a hypertensive emergency (HTN-E) and Hypertension Urgency (HTN-U). HTN-C is an abrupt increase in blood pressure that can lead to a stroke. Currently, there is little evidence available about the causes and relationship between stratified hypertensive crisis in conjunction with LOS and the influence on 30-day hospital readmission. The term stratified refers to multiple BP levels with the potential of a vastly different physiological outcome at each stage of an HTN-C episode (James et al., 2023). For example, stage 1 hypertension involves a systolic blood pressure (SBP) between 140 and 159 mm/Hg, stage 2 hypertension is SBP of 160-179 mm/Hg, and stage 3 SBP of 180 mm/Hg or higher. Prior research concentrated on inpatient comorbidities and the association between stage 1, 2, and 3 hypertensions, with little or no mention of prehospital stroke. The hypothesis investigated whether the stratified stages of prehospital HTN-C and length of stay (LOS) are significant predictors of the 30-day, risk adjusted 30-day hospital readmissions. LOS is an important quality of care indicator and can be defined as the duration of a single episode of hospitalization, which is known to be an important predictor variable. The research employed retrospective, secondary, and quantitative data from Get with the Guidelines (GWTG) Stroke Registry. GWTG-Stroke collects patient-level information, quality of care metrics, bioinformatics, in-hospital outcomes, and measurements regarding prehospital admitted patients hospitalized with acute stroke. Presently, over 1,700 hospitals participate in GWTG-Stroke, and data involves over 2.5 million patient encounters. The independent variables (IDV) included LOS and stratified stage of HTN-C for prehospital admitted patients from GWTG-Stroke Registry. The dependent variable (DV) represented prehospital admitted stroke patients' 30-day hospital readmission. The theoretical framework embraced a Patient-Centered Care (PCC) Model in combination with Donabedian conceptual theory (Binder et al., 2021). Lastly, the study may contribute to social change by raising public awareness and expanding the body of knowledge regarding hypertension crisis and the relationship between LOS and risk-adjusted 30-day hospital readmissions.

# Chapter 2: Literature Review

## Introduction

The purpose of the literature review was to investigate whether the stratified stages of prehospital HTN-C and LOS are significant predictors for hospital 30-day risk-standardized readmission rate. According to Kumar et al. (2019), prehospital hypertensive crisis accounts for over 75% of acute stroke cases in North America, and 13% of patients who presented to the emergency department (ED) are known to have stage 3 HTN-C systolic blood pressure. The impact of HTN-C is known to elicit more stroke-related mortality, greater length of stay, and risk-standardized 30-day hospital readmissions (James et al., 2023). Length of stay (LOS) is an important prognosticator of high-risk, 30-day hospital readmissions (Kumar et al., 2019). The influence of LOS stratified by stages of HTN-C on readmissions had not been previously studied. Therefore, the investigation showed the relationship between LOS and stages of prehospital HTN-C as predictors of high-risk, prehospital stroke patient readmissions (James et al., 2023).

Presented in Chapter 2 was a literature review that supported the theoretical framework of the research problem and questions. Chapter 2 covered the following topics: (a) appropriateness of literature to investigative research questions, (b) data sources employed, (c) analysis of theory, (d) quality measures, metrics, and benchmarks to evaluate the effects of prehospital HTN-C and the correlation between LOS and influence on risk-adjusted, 30-day hospital readmissions.

## Literature Search Strategy

The literature used in the investigative research was from GWTG-Stroke Registry and other scholarly journals, academic institutions, and governmental agencies. Moreover, the study used a combination of primary sources of raw data, or the first-hand information assembled by researchers, to also include secondary data interpretation and analysis of the information from primary sources and experts. The research findings from this investigation helped to close the gap between stages 1, 2, and 3 prehospital HTN-C and LOS, and helped determine if there is an effect on the risk-adjusted 30-day hospital readmissions.

## Theoretical and Conceptual Foundation

The theoretical framework for this study was a PCC Model, using the Donabedian Conceptual Theory, which evaluated health services and the impact on the quality of healthcare delivered (Alcock et al., 2020). The Donabedian principle used in the investigation helped to evaluate the value of care in three domains: structure, process, and outcome (Alcock et al., 2020). The model provided guidance when assessing the impact of the health services and when used appropriately, helped to evaluate length of stay as a measure of a process and readmission rate as an outcome. For example, during the research, the aim was to examine the transformative state of how healthcare is migrating away from a fee-for-service methodology and with a system designed around a reimbursement model of quality of care, which is metrics-driven and evidence-based. The clinical pathway involved prehospital HTN-C and LOS, which included a multidisciplinary approach, inclusive of hospital administrators, medical providers, ancillary personnel, and external stakeholders. The structural design of a Donabedian framework entailed the physical structure of a facility, medical equipment, staffing levels, staff productivity, staff training and education, licensing, accreditation, certifications, and compliance or internal standard operating procedures (Moayed et al., 2022). The process involves comprehensive steps in the medical delivery process or best practices that optimize high-quality, timely, cost-effective, and safe patient care (Moayed et al., 2022). As noted by Moayed et al. (2022), the process of a Donabedian approach can also embrace metrics, such as dashboards to track daily, weekly, and monthly trending of volume and revenue; expenses; turn-around times; incident reporting; and utilization of medical equipment, resources, and personnel. The study's outcome described the response to how the process was delivered, which could potentially influence the impact on the risk-adjusted 30-day hospital readmissions (James et al., 2023).

## Literature Review Related to Key Variables and Concepts

The purpose of this quantitative study was to determine whether the stratified stages of prehospital HTN-C blood pressures and LOS are significant predictors of risk-adjusted 30-day hospital readmissions for acute stroke. Earlier research focused only on in-patient-related stroke episodes. In my research, I concentrated only on prehospital related stroke events, in relationship to stages of HTN-C BPs and LOS, and included comorbidities such as age, gender, race, and diabetes II, to determine if a correlation exists involving risk-adjusted 30-day hospital readmissions.

When examining prehospital cardiovascular-related diseases, such as stroke, it was important to consider if HTN-C as a significant predictor due to the increasing medical and financial burden that confronts many patients, healthcare providers, and hospitals in the United States and around the world. The specific causes of prehospital hypertensive crises (HTN-C) are unknown and can be precipitated by many factors, specifically, a well-known culprit, such as high blood pressure, which can be continuous or episodic in nature (Heidenreich et al., 2022).

In a study conducted by Chiou and Lang (2022), 15.48% of stroke patients were readmitted within 30 days of hospital discharge and 47.25% within one year. Hence, under the new CMS guidelines of the Hospital Readmissions Reduction Program, hospitals are incentivized to reduce LOS for certain medical conditions and to reduce avoidable readmissions, but they are also penalized based on poor performance and outcomes, such as an increase in unplanned 30-day hospital readmissions (CMS.gov, 2023).

As mentioned by Chiou and Lang (2022), the short-term effects of LOS may be explained by incomplete treatment during the index of hospitalization and suggest the need for a better quality of care and discharge planning. Conversely, long LOS would suggest a more complex injury or acuity level related to the severity of the stroke or comorbidities, with a recommendation of continuity and follow-up care. Hence, fundamentally, it is important to understand the basic concept of stratified blood pressure and how blood pressure operates due to the associated LOS and increased readmissions.

Systemic arterial blood pressure (BP) occurs because of the physiological acts between cardiac output (CO) and systemic vascular opposition, which creates arterial pressure (Kumar et al, 2019). In addition, variables, such as cardiac output, are also influenced by stroke volume (SV) and how fast the heart pumps, which is called heart rate (HR). Any variable that increases the pathophysiological course of CO, SV, or HR will elevate BP, which is also known as HTN. A subsequent increase in blood vessel resistance because of constriction of blood vessels by angiotensin II, a serum hormone that acts as a vasoconstrictor, and adrenergic hormones secreted by the cells will induce HTN-C, which is typically managed by ace-inhibitors to reduce BP (Kumar et al, 2019).

Moreover, one such reason associated with acute onset HTN-C can be correlated to a failed pathophysiological pathway involving failure in the autoregulatory system to maintain constant perfusion pressure to vital body organs (McGee et al, 2021). The autoregulation system, as seen in Figure 1 below, is a critical component in the pathophysiology elicitation of HTN-C. Autoregulation can be explained as the ability of the organ system (neurological, cardiac, and urinary) to maintain a constant blood flow regardless of the perfusion pressure (McGee et al., 2021). Once the perfusion pressure declines, the associated blood flow decreases temporarily, but it will usually adjust to a normal state shortly afterward.

In addition, this mechanism of action was based on homeostasis between peripheral vascular resistance and cardiac output that involves the cardiovascular, renal, neural, and endocrine systems. Hence, if autoregulation becomes impaired, such as during a stroke that is created by a Hypertensive-C event, then perfusion pressure declines and can subsequently elicit a decrease in blood flow as well as an increase in vascular resistance that usually leads to physiological stress and endothelial damage

(McGee et al., 2021).

In HTN-C, cerebral blood flow is not autoregulated, so, BP suddenly increases. A second cause of HTN-C can be linked to the activation of the renin-angiotensin system (RAS), which accounts for BP changes and can lead to vasoconstriction which can elicit a recurring cycle of ongoing damage and subsequent insufficient blood supply to the heart, brain, and lungs. Therefore, the RAS controls BP and maintains blood flow and homeostasis in the body.

Hemodynamically, if blood volume or sodium levels are low or potassium is elevated, then renin, an enzyme, is released to regulate the BP. Next, renin changes angiotensin that is manufactured in the liver to the hormone angiotensin or angiotensin-converting enzyme (ACE), which is made in the lungs and serves to break down angiotensin I into angiotensin II (McGee et al., 2021). Angiotensin II elicits blood vessel constriction and causes blood pressure to increase. Moreover, angiotensin II triggers the release of the hormone aldosterone in the adrenal glands, which then stimulates the kidney tubules to preserve salt and water as well as to expel potassium (McGee et al., 2021).

Collectively, both angiotensin II and aldosterone function together to elevate and restore the equilibrium of blood volume, blood pressure, and sodium and potassium levels in the blood. If the renin-angiotensin malfunctions, then HTN-C occurs. A third cause of HTN-C can be correlated to medication non-adherence, such as inappropriate dosing periods of taking antihypertensive medications as well as a disruption in refills of prescribed anti-hypertension drugs; these are common causes of include blood pressure episodes (Benjamin et al., 2018).

As noted by Benjamin et al. (2018), HTN-C can also occur due to serotonin syndrome, which can be a life-threatening illness that follows an ingestion of a medication or drug interaction and results in a subsequent release of serotonin that is combined with the activation of serotonin receptors. Serotonin syndrome sufferers can display clinical signs of fever, agitation, hyperactivity, shaking, and hyperhidrosis or body sweating, which is due to stimulation of the sympathetic nervous system that controls fight or flight response. The outcome is vasoconstriction, which elicits an increase in heart rate and stroke volume (Benjamin et al., 2018).

Another key component to consider when evaluating the causes of HTN-C is environmental exposures such as a diet that exceeds sodium intake of 2,300 mg per day; low consumption of high fiber foods such as fruits and vegetables; inadequate physical activity; and chronic and excessive alcohol consumption; these factors have shown to elevate BP (Benjamin et al., 2018). In addition, a recent investigation by Benjamin et al. (2018) that employed a comparative risk assessment model determined that in 2012 approximately 45.4% of American fatalities associated with CVD or stroke were due to poor dietary behavior, with HTN acting as a precursor to the cause of death.

Lastly, diabetes can cause high blood pressure and elevate blood sugar levels, which long-term, can decrease the elasticity of blood vessels and lead to their narrowing that results in obstruction of blood flow (Ashraf et al., 2022). Diabetes is twice as common in patients with high blood pressure, damage’s vascular structure and can cause a reduction in oxygen saturation will increase the risk of elevated blood pressure that damages large and small blood vessels as well as capillaries (Heidenreich et al., 2022).

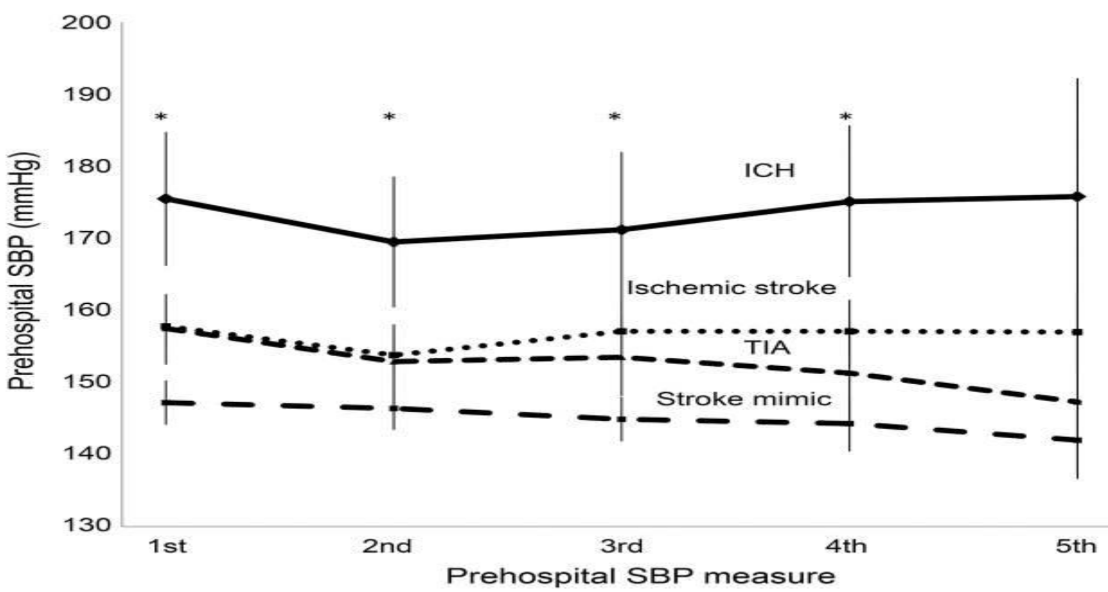
## Stages of Prehospital Hypertensive Crisis

According to Heidenreich et al. (2022), HTN-C involves a potentially fatal moment, where there is an abrupt rise in systolic blood pressure (SBP), with stage-3 SBP being of the most significant concerns, involving SBP blood pressures over 180 mm Hg. Stage 3 HTN-C usually requires an immediate reduction in BP to mitigate a new or progressive end-stage organ injury.

HTN-C may be characterized by a sudden rise in SBP over 180/120 mm HG, with associated end-stage organ disease (ESOD), which requires immediate parenteral medication and includes reduction in preventing long-term organ injury. Hence, not all patients with acute HTN-C have a history of high blood pressure and are known to have taken an anti-hypertension medication (McGee et al., 2021). In addition, a sizable number of patients observed with HTN-C express traditional signs of an acute HTN-C episode, such as difficulty breathing, chest discomfort, irregular heartbeat, or loss of consciousness (McGee et al., 2021). Therefore, diagnosing prehospital HTN-C is critical to preventing focal organ damage (specifically, damage to the eyes, brain, heart, and kidneys) and avoiding and minimizing unnecessary hospital stays. Distention and appropriate clinical classification of diagnoses are strongly encouraged to best facilitate treatment and manage outcomes, such as length of stay and hospital readmission. Moreover, in North America, HTN-C impacts at least 30% of the adult population with systolic blood pressure (SBP) over 130 mm Hg (Heidenreich et al., 2022). HTN-C can be broken down into three stages. As presented in Table 1, HTN-C SBP can be manifested at various stages, with stage 3 HTN-C presented the most clinical danger; stage 1 HTN-C is systolic blood pressure (SBP) between 140 and 159 mm/Hg, stage 2 HTN-C is SBP of 160-179 mm/Hg, and stage 3 is SBP of 180 mm/Hg or higher.

**Figure 1**

*Prehospital SBP Measure, Stage 3 HTN-C Presents the Greatest Threat During Intracerebral Hemorrhage Episode During a Stroke*




*Note*. Prehospital SBP Measure, stage 3 HTN-C presents the greatest threat during intra-cerebral hemorrhage episode during a stroke episode. Reprinted from Prehospital systolic blood pressure is higher in acute stroke compared with stroke mimics: Neurology, 86(10):2146-2153, by Gioia et al., 2016. Copyright 2016 by Neurology.

Figure 1 shows an illustration, which suggests that prehospital SBP usually presents the most significant threat and is more elevated during an intra-cerebral hemorrhage involving a CVA when BP is ≥ 170 mm Hg; in comparison, episodes with symptoms that resemble a stroke, also called stroke mimic, present with SBP of around 150 mm Hg, and transient ischemic attacks can occur when BP is at or over 160 mm Hg, but the BP can reveal variability in range (see Table 1).

**Table 1**

*Stratified HTN-C by Systolic Blood Pressure Levels*

| Blood pressure category | Systolic mm HG | Diastolic mm HG |
|---|---|---|
| Stage 1 hypertensive crisis | 140–159 | 80–89 |
| Stage 2 hypertensive crisis | 160–179 | 90 > |
| Stage 3 hypertensive crisis | 180 > | 120 > |

*Note*. HTN-C systolic blood pressures by stages.

Table 1 illustrates HTN-C systolic pressures by stages (Benjamin et al., 2018). As noted by Benjamin et al. (2018), the mortality rate attributed to HTN-C rose by 10.5%, and the actual number of high BP-related deaths increased by 37.5% between 2005-2015. Additionally, there are approximately 65 million or 30% of people in the Northern Hemisphere who are diagnosed with hypertension in an outpatient and primary care environment, but less than 2% will experience a hypertensive crisis (McGee et al., 2021). Moreover, HTN is the primary cause of stroke, a second leading cause of death, and it accounts for 12% of mortalities globally; it is also a significant contributor to long-term associated disability in the United States (Khurana et al., 2018).

**Figure 2**

*Physiological Findings and Diagnostic Considerations Impacting HTN-C and HTN-E*

Historical and physical findings associated with hypertensive emergencies

| Finding | Diagnostic consideration |
|---|---|
| Focal neurologic symptoms | Ischemic or hemorrhagic stroke |
| Fresh flame hemorrhages, papilledema, delirium | Hypertensive encephalopathy |
| Acute chest pain, back pain | Aortic dissection, myocardial infarction |
| Acute dyspnea | Pulmonary edema |
| Seizures, pregnancy | Eclampsia |
| Hematuria | Acute hypertensive nephrosclerosis |
| Headache, palpitations, sweating | Pheochromocytoma |

*Note*. Shows HTN- C and E involving systolic BPs that exceed 180 mm HG.

In 2013-2014, a study was conducted by Ashman et al. (2017) based on data from a 2013 National Ambulatory Medical Care Survey that reported that HTN becomes more frequent during advanced years of life, such that 7% of adults between 18 and 39 are diagnosed with HTN, and roughly  65% of adults over the age of 60 are confronted with the challenges of managing HTN, with 34% of outpatients being treated for stratified HTN. Even more significantly, the burden of stroke-related HTN-C contributes to four disability-adjusted life years loss per 1,000 people in North America (Khurana et al., 2018). Therefore, understanding the stratified nature of HTN-C is important as practitioners treat and diagnose patients in an outpatient healthcare delivery system. The definition of HTN-C is defined by a marked increase in SBP blood pressure ≥ 180 mm Hg or ≥ 110 mm Hg DBP.

Also, the criteria for HTN-C can be established if there is evidence of abrupt organ injury with a quantifiable disposition of hospital length of stay and admission or readmission (Heidenreich et al., 2022). Also, numerous patients identified with HTN-C do not display any specific signs and symptoms of cardiovascular disease, such as difficulty breathing, chest pain, dizziness, and loss of consciousness. However, the overall burden of HTN-C is not identified in the literature (McGee et al., 2021). Moreover, each year in North America, more than 145 million patients or 45% are treated in the ER for HTN-C (Miller et al., 2020).

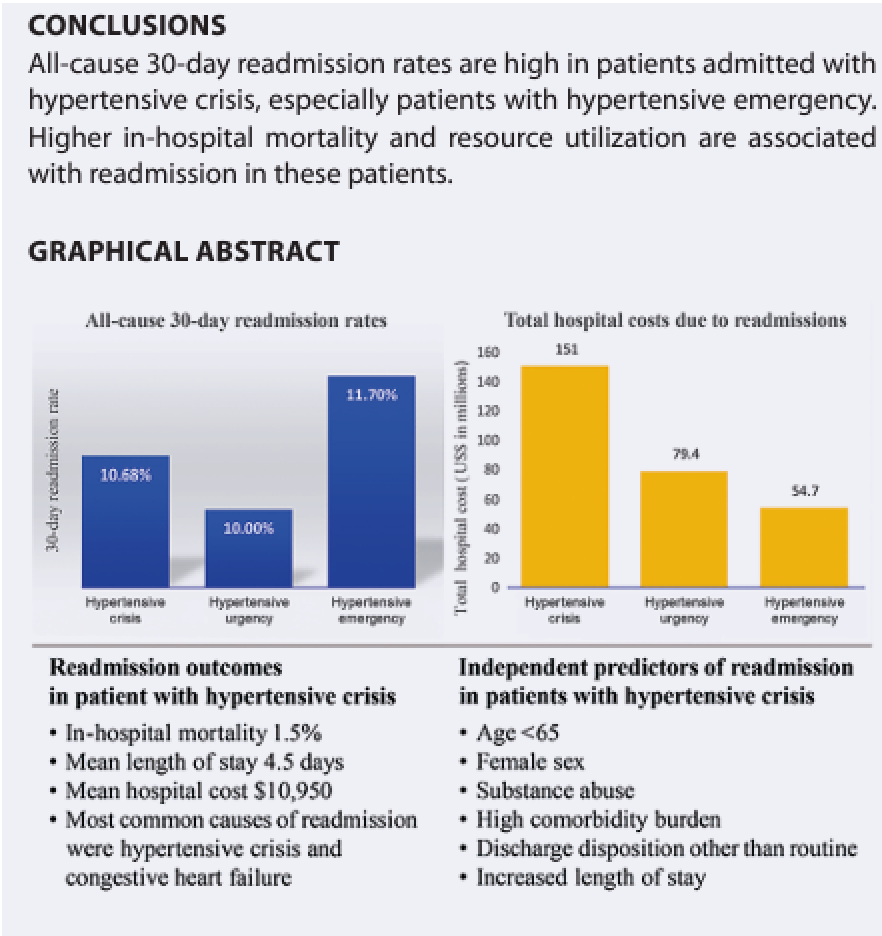
Furthermore, the acute nature of HTN-C can be manifested by targeted end-stage organ damage to the kidneys, heart, and cerebral vascular system (Heidenreich et al., 2022). The advanced stages of HTN-C involve an arterial pressure that exceeds 180 mm Hg or ≥ 110 mm Hg DBP, which is known as HTN-E or HTN-U; if it is left untreated, it can potentially cause damage to the urinary, cardiac, and vascular system (Heidenreich et al., 2022). Therefore, understanding the systemic nature and subcomponents of HTN-C, such as HTN-E and HTN-U, is important in the classifying of diseases, management of patient care, and predicting clinical outcomes.

As noted by Alley and Schick (2023), prehospital visits involving patients with known HTN-E are not documented, but it is estimated that approximately 30% of adults in the United States have HTN and at least 1-2% will have HTN-C, a definition that is inclusive of HTN-E and HTN-U. Despite the significance of HTN-C, the burden of this condition is filled with unclear and ambiguous data. Although the data collected by Heidenreich et al. (2022) is important, these investigators neglected to discuss with clarity the impact of the prehospital outcome, the nature of patient care management based on the acuity of the disease, and failed to quantify the number of patients presenting to EDs with HTN-C.

Currently, the only complete epidemiological study that is similar in context involved a Brazilian cohort; in the study, the researchers identified HTN-C to account for 0.3% of all prehospital and ER visits. Therefore, based on the latest trends, HTN-related hospitalization incidents increased by approximately 27% during the period between 2000 to 2011, as well as HTN-C-related prehospital visits from 2006 to 2012 by roughly 5.2% per annum, with subsequent increases from 20.5% to 25.7% each year (Heidenreich et al., 2022). Figure 3 below displays an analysis of occurrences involving HTN-C phenomena in North American ER departments between 2006 and 2013, which also depicts target organ injury (Miller et al., 2020). Also, illustrated in Figure 3, the data from 2022 shows that all associated episodes of 30-day readmission rates are higher involving admissions with hypertensive crisis and hypertensive emergency; with correlation higher in-hospital death rate and resource utilization (Ashraf et al., 2022). As mentioned by Ashraf et al. (2020) the mean in-hospital death rate associated with HTN-C and 30-day hospital readmission is 1.5%, mean LOS is 4.5 days, and mean cost is $10,950.

**Figure 3**

*Resource Utilization Associated With HTN-C BPs, LOS, and 30-Day Hospital Readmission*




*Note*. Resource Utilization Associated with HTN-C BPs, LOS and 30-day Hospital Readmission. Reprinted from Thirty-Day Readmission Rate Among Patients with Hypertensive Crisis: A Nationwide Analysis, American Journal of Hypertension, 35(10), p. 852, by Ashraf et al., 2022. Copyright 2022 by the American Journal of Hypertension.

According to Miller et al. (2020), approximately 33–50% of adults in North America that have HTN, and about 41–50% of these adults lack proper BP control. Additionally, there are over 145 million emergency room visits that occur throughout the United States, with a frequency of 45% of elevated BPs that are classified as HTN-C (Miller et al., 2020). The data is important because the management of chronic causes of readmission, such as comorbidities or high acuity levels, also known as case-mixed index, is suspected of exacerbating HTN-C if not managed accordingly and are crucial drivers to regulating 30-day hospital readmissions, control the quality of care, and bending the cost curve (Albert et al., 23).

Furthermore, reducing the frequency of 30-day hospital readmissions is deemed a priority for the Center for Medicare and Medicaid Services (CMS) and healthcare leaders across North America because many hospitals are embracing a value-based purchasing concept, which incentivizes providers for the quality of care they deliver to Medicare beneficiaries (Hoffman & Yakusheva, 2020). Moreover, by creating and implementing the hospital readmission and reduction program (HRRP), CMS can impose economic penalties on medical facilities with overly frequent 30-day hospital readmissions ratios of Medicare beneficiaries.

## LOS Analysis, Stratified Blood Pressures, and Prehospital HTN-C

As noted by McGee et al. (2021), many patients identified with HTN-C do not display any specific signs and symptoms of cardiovascular disease, such as difficulty breathing, chest pain, dizziness, and loss of consciousness. However, the literature does not vividly explain the overall burden of HTN-C. Additionally, each year in North

America, there are over 145 million patients, or approximately 45%, are treated in the ER for HTN-C (Miller et al., 2020). However, the challenges that continue to confront medical facilities relative to readmission following stroke are significant, but more knowledge is needed on factors influencing readmissions post-stroke.

**Hospital Score as a Predictor of 30-Day Readmission**

In the management of prehospital HTN-C in relationship to LOS and 30-day hospital readmissions across the Northern Hemisphere are working to mitigate hospital reoccurrence (Myat et al., 2018). As such, hospital readmission occurrence is a standard metric correlated to reimbursement and employed as a proxy for quality of care and sustained results. Each day in the United States a vast number of medical organizations assemble in a safety huddle to examine their readmission occurrences as a part of their daily operating procedure. Hospital readmissions are costly and are a frequent event in most medical institutions throughout North America. Hospitals concentrate on metrics such as 30-day hospital readmission because they are expensive, stressful on hospital resources, and present a significant concern for payers, providers, and executive leadership due to the emphasis on quality, which is driven by the Medicare Value-Based Purchasing Program (VBP).

Successfully achieving preventable quality indicators that link reimbursement to quality, safety, patient satisfaction, and evidence-based outcomes is the aim of high-performing healthcare systems (Hoffman & Yakusheva, 2020). According to Hoffman and Yakusheva (2020), approximately 20% of Medicare recipients are readmitted to a medical facility within 30 days of disposition, costing taxpayers around $20B annually (p.3). Utility tools, such as hospital scorecards and the LACE index, are useful in preventing, identifying, and targeting patients that experience an acute-care episode and possess a higher risk of readmission within 30 days of hospital discharge (Rajagura et al., 2022).

Moreover, VBP's mission is to incentivize medical providers and healthcare systems to lower readmissions by reducing payments and compensation to healthcare organizations with higher-than-expected 30-day hospital readmission indexes. Determining the associated risk of managing prehospital HTN-C, or essentially outpatients with HTN-C, is a complex endeavor due to missing medical records from historical perspective, poorly documented medical histories, noncompliance with taking anti-hypertension medications, and non-standardized treatment pathways to identify and treat HTN-C. Unfortunately, these missed internal operational clinical opportunities work to the disadvantage of delivering highly optimized patient care when managing HTN-C, which can elicit the risk-adjusted 30-day hospital readmissions (Myat et al., 2018).

Another practical risk assessment tool employed in the prediction of hospital readmission is the LACE index. The LACE index was implemented to forecast 30-day hospital readmission liability as well as LOS, mortality or unplanned 30-day hospital readmissions following discharge from the hospital (Rajagura et al., 2022).

The hospital scorecard predicts the probability of readmission based on the patient's experience and clinical outcomes. Conversely, the LACE index risk assessment procedure employs a risk assessment tool which is subjectively proven to be inferior when identifying patients exposed to the elevated risk of hospital readmission and complex comorbidities-associated risk factors that can aid in forecasting hospital readmissions. Rajagura et al. (2022) assessed that about 9-59% of spontaneous readmissions for high-risk patients were avoidable when appropriate care plans are employed before discharge, such as following up on interventions and preventive care, which can be time-consuming to the patient and expensive.

Prehospital stroke-related HTN in relationship to a risk-adjusted 30-day hospital readmissions is an important quality of care measurement. Based on an observation by Myat et al. (2018), the most frequent causes of 30-day spontaneous readmissions in stroke patients involved recurrent stroke at 33%, infections, specifically sepsis, aspiration pneumonia, and urinary tract infections (the latter three conditions collectively amounted to 14.5%) as well as cardiac conditions, such as dysrhythmia, congestive heart failure, angina, acute myocardial infarction, and HTN-related illness; these cardiac conditions collectively amounted to 10.4%. As we examine causes, there are also key factors associated with the change in readmission index mix and affiliated risk, such as factors associated with the influence of HTN: heart disease, cardiac failure, kidney disease, peripheral vascular disease, and diabetes (Myat et al., 2018).

In summary, a hospital scorecard is a viable tool in identifying patients at elevated risk of readmission during the 30-day, post-index hospitalization discharge. Consequently, the LACE Index is relevant but shown to show inferior results in the selection process of the readmission-vulnerable population in complex medical patients with a propensity for higher LOS (Rajagura et al., 2022).

**Management and Classification of Hypertensive Crisis**

HTN-C is one of the most frequently occurring chronic conditions confronting primary care providers and medical practitioners in North America due to mortality, morbidity, and comorbidities associated with the management of the disease; the comorbidities include diabetes, cardiovascular, and kidney disorders (Ashraf et al., 2022). Moreover, it had been noted by researchers and scholars, that prehospital SBP is usually more elevated during an acute stroke episode (with SBP being most extreme and involving acute hemorrhagic stroke) when compared to those patients who experience stroke-like symptoms, also known as stroke mimics (Ashraf et al., 2022).

In addition, patients with hyper-elevated BPs at the time of admission usually face a poor prognosis. However, the overarching challenges of treating HTN-C have been ambiguous, regardless of the availability or non-availability of resources throughout communities, because of how HTN-C is defined and managed by the various BP stratifications and different BP levels for HTN-C. Hence, for BPs greater than 115/75 mm Hg, for each incremental elevation of 20 mm Hg in SBP or 10 mm Hg in DBP, the liability of significant cardiovascular episode is multiplied twice (Ashraf et al., 2022).

Moreover, HTN presents challenges chronically when examining social determinants of population health, such as a precursor to comorbidities, which compounds other health illnesses, such as diabetes and other cardiovascular diseases. Other risk factors that exacerbate HTN-C, are dietary in scope, such as processed foods that are high in sodium, sugar, high alcohol intake, and lack of exercise. In addition, the growing numbers of retired baby boomers will create more of a burden of managing HTN because a recent trend shows that between ages 50-60, DBP tends to drop, but SBP perpetually continues to increase throughout the advanced years of human existence due to the physiological transformation of the arterial vascular system (Ashraf et al., 2022). Therefore, given the multi-component and clinical nature of HTN-C, special consideration is required for HTN-E and HTN-U. A clinical pathway should exist for each episode of care concerning the presence or absence of acute target organ injury (McGee et al., 2021).

Moreover, the legitimacy of the coding and stages of HTN-C is only as valid as the documentation in EMR, which depends on the clinician or healthcare provider. See the list below provides an illustration of the international classification of diseases (ICD-10) and diagnosis-related groups (DRG) of specific codes that are related to HTN-C, with associated targeted organ damage from an inpatient prospective payment methodology. This methodology is related to the quality-of-care measures and treatment of HTN-E and HTN-U, which are both considered HTN-C, meaning hypertension urgency versus hypertension emergency (Miller et al., 2020).

For instance, based on the Center for Medicare and Medicaid 2017 federal guideline, there are unique ICD-9 and ICD-10 billing codes for each HTN-C diagnosis based on the following episode. Arterial systolic BP can fluctuate throughout various times and hours of the day (Ashraf et al., 2022). HTN can be influenced by the type of physical activities being performed between morning, noon, and nighttime, so practitioners cannot easily diagnose a single elevated BP reading as HTN but require multiple BP assessments.

**Classification of Diseases (ICD-10) and Diagnosis-Related Groups (DRG)**

- ICD-10-CM Coding Center for Medicare and Medicaid for Hypertension, Cardiovascular Disease and Diabetes Type I & II.
- Important note: ICD-10-CM, classification, and definition of HTN
- I401, HTN, established diagnosis, benign
- I10, Primary HTN with no known etiology of hypertension
- I11, Hypertensive heart disease
- I12, Hypertensive chronic kidney disease
- I13, Hypertensive heart and chronic kidney disease
- I15, Secondary HTN, known etiology and underlying condition or cause
- I16.0 Hypertensive urgency, HTN-U, severely high BP but no organ damage, SBP exceeds 220 mm Hg and DBP is over 120 mm Hg
- I16.1 Hypertensive emergency, HTN-E, organ damage
- I16.9 Hypertensive crisis, unspecified, HTN-C
- E10 Type I Diabetes, insulin include
- E10 Type II Diabetes, noninsulin include

Management of HTN-C presents a challenge for medical providers in delivering empirical care in North America because of insufficient clinical data, inadequate evidence-based standards, and a need for randomized include trials (McGee et al., 2021). Current and retrospective data illustrate that the primary concerns of managing HTN-C rest with an appropriate identification between HTN-E and HTN-U, standardized methodology of treatment, identification of risk stratification, and prevention of focal organ damage (Ashraf et al., 2022).

For example, based on scientific data from a Medical Expenditure Panel Survey, a division of the Agency for Healthcare Research and Quality (2011), approximately 25.8% of adults over the age of 18 were counseled by a medical professional in an ambulatory setting and informed of having hypertension (Ashraf et al., 2022). Hence, HTN-U constitutes most cases of HTN-C involving BP in ED and outpatient settings, and BP usually can be managed without exposing patients to the danger of assertive BP reductions; high BP is usually included with anti-hypertension, oral medication (Ashraf et al., 2022). Hospital length of stay and readmission are usually noticeably short. On the other hand, HTN-U requires prompt identification, recognition, and treatment to mitigate acute, end-stage organ disease and adverse outcomes.

A study conducted by Ashraf et al. (2022) illustrated an emerging trend in hospitalization for HTN-E; in an investigation performed between 2002 and 2012, these researchers analyzed the cases of 15, 479 patients; 630 of the patients died during a hospital stay from stroke and trans-ischemic attack known as comorbidities that were exacerbated by HTN-E. However, there was an overall reduction in hospital mortality between 2002 and 2012, which can be linked to billing practices, standardized methodologies, and a formalized treatment approach to managing HTN-E (Ashraf et al., 2022).

Management of HTN-C begins with a thorough and complete evaluation of the patient that includes a qualitative assessment and an evaluation of quantitative data, otherwise known as a history and physical exam (Ashraf et al., 2022). HTN presents the most significant risk to cardiovascular disease and warrants tremendous scrutiny, which is why a complete physical evaluation that includes a personal evaluation, history and physical (H & P), and laboratory testing is mandatory (Ashraf et al., 2022).

When conducting a personal history, if possible, it is important to begin with an implicit assessment of the patient's H &P because of the environmental, genetic, social, and physiological influence of HTN-C. An understanding of prior HTN episodes is relevant because of the possible enhanced probability of recurrence of previous cardiovascular phenomena that can influence the methodology of treatment as well as assist with obtaining a better understanding of risk factors, especially if the patient is being treated for HTN, which will aid in the reinforcement of effective and current therapies, and assist in the employment of a viable treatment plan and choice of anti-hypertensive medications (Ashraf et al., 2022). For example, as noted by Ashraf et al. (2022), during a stroke or CVA event, patients who have experienced a previous cardiovascular attack should be treated with special attention when executing a plan of care, which includes the documentation of specific drug regimen in their treatment strategy. Hence, angiotensin receptor blockers, angiotensin-converting enzyme inhibitors, calcium channel blockers, and diuretics (water pills) as well as medications that lower low-density lipoprotein (LDL) cholesterol (statins) and antiplatelet drugs should be critically examined (Ashraf et al., 2022).

The pharmacological pathway for managing prehospital HTN-C starts with an accurate clinical diagnosis. According to McGee et al. (2021), a patient identified with HTN-C should be assessed clearly as either HTN-E or HTN-U, and a clear treatment plan should be developed. In the scenario involving HTN-U, BP regulation might include the implementation of minimal doses of oral anti-HTN drugs to slowly reduce the BP over the course of hours to days (McGee et al., 2021). As stated by McGee et al. (2021), the pharmaceutical therapy of choice for treating HTN-U includes oral labetalol which entails a 3 to 1 ratio of antagonism of non-selective beta coefficient-adrenergic and alpha-1 receptors as well as clonidine, alpha-2 agonist. In contrast, HTN-E mandates expeditious BP regulation involving intravenous, intramuscular, or subcutaneous injection of the anti-HTN drug with admission to an intensive care unit for observation, will lowering BP within minutes to an hour of roughly 20-25% in the first 60 minutes; this should be followed by achieving a target SBP of 160 mm Hg and DBP between 100 and 110 mm Hg over a 2 - 6-hour period (McGee et al., 2021). Hence, McGee et al. (2021), highlighted the implications of not returning the SBP to a baseline of 120 mm Hg and DBP of 80mmHg because, ironically, the research shows that extra BP lowering could induce CVA ischemia caused by abnormal brain blood flow autoregulation. Other first-line pharmacological agents for managing HTN-E include sodium nitroprusside, which is very fast acting (within a few seconds) when administered intravenously, and it causes an arterial and venous expansion of blood vessels; however, caution must be exercised to the potential for drug toxicity if a drug is given for more than 48 to 72 hours (McGee et al., 2021).

McGee et al. (2021), also recommended the use of anti-HTN drugs for best practice in treatment of HTN-C:

- Labetalol, IV for sustained cardiac output.

- Nitroglycerine, vasodilator.
- Nicardipine, a calcium channel blocker that increases vascular blood flow.
- Fenoldopam, a vasodilator that elicits urinary output with pulmonary edema.

**Physiological Impact of HTN-C, Brain, Heart, Kidneys, and Pulmonary**

Regardless of the frequency surrounding HTN, which impacts over 1 billion individuals globally, an insignificant number of patients will acquire HTN-C (McGee et al., 2021). Also, HTN is considered an adjustable risk factor for stroke. In North America, 1 in 3 adult patients suffer from known high BP, notably African Americans, who have the highest percentage of hypertensive-related cases (Kumar et al., 2019). In addition, 82% of adults possess knowledge of their diagnosis of HTN, and 52% have their BP under control (Kumar et al., 2019).

**Benchmarks, Quality of Care, Cost Measures**

When examining the benchmarks to compare them to how well prehospital HTN-C-related stroke and the relationship between length of stay and 30-day hospital readmissions are being managed year after year in North America, it is important to note that more scholarly research and clinical practice guidelines are merited. HTN is a major contributor to cardiovascular illness, particularly stroke, and presents a significant challenge for healthcare professionals throughout the medical community (Philip et al., 2021).

In addition, stroke is the second most common cause of mortality and the third most common cause of disability. According to Kirkland et al. (2018), HTN-C is the largest single cause of stroke and cardiovascular disease, which impacts one in three

American adults and costs $131B in the United States. Moreover, HTN regulation and preventive care continue to be key initiatives for countless public health professionals as a component of control costs. Furthermore, to reduce costs, in 2023, CMS expects providers and hospitals to implement internal operational policies that support a merit-based, incentive-payment system (MIPS), which provides medical practitioners with an incentive payment for the quality of care rendered.

MIPS is performance based, and the standard of care is guided by metrics, quality, increased patient satisfaction, safety, promotion of a healthy lifestyle, affordability, and interoperability (CMS, 2023). Due to the excessive cost and low quality associated with a fee-for-service payment system, the goal of the CMS Value Payment Program is to discourage the practice of a fee-for-service standard of practice and to embrace a quality-based approach to delivering patient care. Hence, a hospital value-based purchasing program promotes quality of care (value-based payment model), which emphasizes an evidence-based strategy that stresses quality, safety, lower cost, and prevention, which is the overarching mission of hospital executive leadership and practitioners (Alcock et al., 2020).

A quality-of-care approach, meaning quality assessment, is designed by CMS around improved outcomes of care. The approaches address the gap in care that is designed around the quality-of-care of a healthcare delivery system. Parameters such as lower cost, safety, and patient experience result in incentivized remunerations for the excellence of care provided to Medicare beneficiaries (Kirkland et al., 2018).

Kirkland et al. (2018) noted that CMS Hospital Readmission Reduction Program

(HRRP) punishes medical facilities for excessive hospital stays and risk-adjusted 30-day hospital readmissions and LOS for specific outcomes, such as HTN-C and stroke-related ailments. Hence, hospital quality programs are explicitly motivated by economic incentives to drive economic, operational, and technical efficiency (Lekoubou et al., 2018). For example, under the new Medicare compliance and quality-reporting guidelines, hospitals may incur excessive economic penalties when a patient is re-hospitalized within 30 days of discharge for Medicare patients (James et al., 2023).

According to the Centers for Medicare and Medicaid Services (CMS), readmission prevention is incentivized 10 times the amount compared to other quality of care measures, such as length of stay (LOS) and mortality. While most stroke-related research on readmission risk factors had focused on inpatient settings, little is known about the outpatient effects of prehospital HTN-C and the correlation between LOS and influence on risk-adjusted, 30-day readmission rate. Therefore, identifying high-risk readmission factors for prehospital admitted patients can dramatically improve the quality of life for post-stroke patient recoveries and positive social change.

Hospital performances are recorded for public comparison based on quality performance data and surveys by such organizations as the Leapfrog Group. The Leapfrog Group was implemented in 1999 due to a report by the Institute of Medicine which commented that approximately 98,000 people die in the United States because of medical negligence (Physician Leadership Journal et al., 2021). The Leapfrog Group provides comparative performance measures on U.S hospitals' score cards that include risk assessment, performance outcomes, and quality of care standards, such as LOS, 30-

day readmission rates, outcome metrics of comorbidities, such as HTN, stroke, and other chronic diseases with discipline towards population health. Scored cards can be profound, ambiguous, and complex in interpretation because of the ability to regulate risk adjustment in the patient selection process (Rajagura et al., 2022).

Furthermore, a major concern expressed by healthcare leaders is the ability to control risk and referral selection methodology of patients, which is strongly influenced by zip code, politics, and socioeconomic criteria. For instance, private and for-profit hospitals usually provide medical services to wealthier patients who are more educated; mostly homogenized, white cohorts; endowed with stronger economic means to cover their healthcare costs; and insured, which subsequently will yield a more positive scorecard (Rajagura et al., 2022).

There is also an unintended consequence. Despite their impressive performance measures, many for-profits medical organizations may also have patients who are in the worst of health, which can adversely impact the hospital's quality of care assessment. On the other hand, public and academic medical centers, level-one acute care facilities, community hospitals, and federally qualified health centers are exposed to greater socioeconomic disparity, heterogenous population, sicker patients, higher rates of the uninsured, significant number of Medicare and Medicaid recipients, and a larger population of Black and Hispanic ethnic groups, who will usually possess a higher rate of comorbidities that will reflect more negatively on the hospital's performance measures and score cards (Rajagura et al., 2022).

The social and economic ramification of HTN-C and stroke disproportionately impacts African Americans the hardest in North America due to underlying risk factors such as genetics, environment, and lifestyle (James et al., 2023). Moreover, the ability to better understand comorbidities and patients exposed to high risks, such as HTN-C and stroke, from a prehospital perspective is critical to improving performance measures, such as LOS and 30-day hospital readmission. After all, an institution's scorecard can be a significant predictor of the degree of risk based on the determined value of LOS and 30-day readmission (James et al., 2023).

Lastly, the capability to evaluate the influence, occurrences, and changes of HTN-C efficiently and effectively is significant if the disease process is to be globally understood (James et al., 2023). In a recent analysis by the World Hypertension League Expert Committee, suggestions of other key performance indicators were implemented to formalize the disclosure process of blood pressure evaluations for specificity, clarity, and consistency of diagnosis of HTN-C. The surveys provided standardized core measures and definitions in the assessment of HTN as well as population health. The performance indicators included the following: (a) mean systolic blood pressure, (b) hypertension, (c) assessment and awareness of hypertension, (d) drug treatment for hypertension, (e) drug treatment and methodology of HTN control, (f) missed appointments with HTN diagnosis, and (g) no blood pressure evaluation within 12 months after diagnosis of HTN (James et al., 2023).

Hence, the universal acceptance of a centralized blood pressure registry will help to promote the adoption of clinical benchmarks, utilization of a standardized approach to HTN management, and promotion of evidence-based strategies in treating HTN-C.

Moreover, 30-day hospital readmissions associated with stroke-related events serve as a meaningful quality of care metric (James et al., 2023).

According to James et al. (2023), hospital readmission is defined as any medical-related readmission during a 30-day, post-index hospitalization discharge period for an eligible patient population. These researchers studied the factors associated with frequent causes of readmission and how they relate to strokes by examining 319, 317 patients with acute ischemic stroke; they determined that 12.1% were readmitted within 30 days. Of these readmissions, 89.6% were unforeseen, with roughly 12.9% deemed as being avoidable within the 30-day window and potentially preventable, with HTN cumulative proportion weighted at 72.3% and LOS as a percentage of readmission 6.1% out of a sample size 38,625 (James et al., 2023).

The regulatory federal agencies, such as the Patient Protection and Affordable Care Act (PPACA) and the Health Information Technology for Economic and Clinical Health (HITECH), have recognized not only the need for quality control measures that evaluate the performance of hospitals and providers but also the economic impact that evolves from the unregulated control of HTN when assessed against national metrics (Wager et al., 2022). HTN-C is a significant contributor to cardiovascular disease (CVD), and stroke is a primary cause of the global burden of disease and a growing public health problem worldwide, which presents an economic challenge to hospitals, employers, and patients.

The impact and cost associated with the management of HTN-C between 2012-2013 was $316B (Kirkland et al., 2018). Fiscally, HTN management directly costs

Americans $51.2B annually. The financial liability associated with managing HTN-C involves not only direct medical costs and indirect fiscal implications, especially variable labor costs to employers as it relates to lost productivity hours from work (Kirkland et al., 2018). Variable costs are the expenditures associated with medical goods and services employed to mitigate, avoid, and manage sicknesses that are affiliated with HTN-C and stroke-related complications.

Wang et al. (2017) suggested that there are associated liabilities that are related to the diagnosis-related group (DRG), most notable are cost, radiology and laboratory testing, medications, rehabilitation care as well as an emergency room (ER) visit that progresses into a hospital admission or, conversely, outpatient visits that result in LOS or recurrent, 30-day hospital readmissions. These are direct costs associated with the short and long-term management of HTN-C episodes that are related to standard care for countless hospitals across the United States (Kirkland et al., 2018).

## Population Health and Vulnerable Groups

According to Kirkland et al. (2018), one-third of adults in many parts of the world and the United States, are burdened with HTN-C, which poses a population health concern. Regardless of increased awareness campaigns concerning HTN and HTN-C, evidence shows that many vulnerable groups are adversely impacted by genetic predisposition, environmental factors (e.g., poorly managed diets), lack of knowledge and compliance with medical advice, especially when it comes to prescription adherence by taking the appropriate dosages at intervals prescribed by practitioners for high BP control via anti-hypertension medications (Hamrahian et al., 2022).

In fact, a recent study by Hamrahian et al. (2022) found that out of 4,783 patients, about 28 % of cohorts neglected to either fill or refill their antihypertension medication prescriptions when directed by their medical provider, and some patients ceased taking their medication in a one-year period, which creates barriers to achieving a positive therapeutic outcome.

From a population health perspective, the frequency of occurrences involving cases of HTN-C seen in the ED from a prehospital viewpoint is undetermined due to the availability and reliability of previous scientific data in the definition of HTN-C (James et al., 2023). Moreover, a nationwide descriptive epidemiologic study of ER visits between 2006-2012 revealed that the overall rate of adult ER visits for acute onset HTN-C rose gradually over time as an incidence per million from 2006 to 2013: from 2 out of 1,000 adult ER visits to 6 out of 1,000 adult ER visits, respectively (Miller et al., 2020). The study concluded that, during this same time, patients ED-admissions declined, but HTN-C-associated ED visits increased. Regarding the investigation, the study did not discuss or delineate the stratified nature of prehospital HTN-C, which is also known as a hypertensive emergency (HTN-E) and Hypertension Urgency (HTN-U).

As stated earlier, HTN-C is an abrupt increase in blood pressure that can lead to a stroke. Hypertensive crisis may be classified into three stages. Stage 1 hypertension is SBP between 140- and 159-mm Hg; stage 2 hypertension is SBP 160 mm Hg or higher; and stage 3 SBP is 180 mm Hg or higher. However, by definition, according to Oliveros et al. (2020), the most vulnerable group exposed to HTN-C are elderly patients, with a median age of 66; 54.5% of them were female, 10.7% and 7.9% were Medicare and

Medicaid patients, respectively, and (%?) African Americans. The age-adjusted prominence of high BP among North American adults over the age of 20 years was calculated to be 34.0%, which represents 34.5% males and 33.4% females, with the data being reported by National Health and Nutrition Examination Survey (NHANES) conducted between 2011 to 2014. This equates to an estimated 85.7 million adults $\geq 20$ years of age who have HBP, 40.8 million males, and 44.9 million females (Benjamin et al., 2018).

The strategy for managing HTN continues to be a struggle despite well-documented approaches from healthcare practitioners in medical communities with challenges of include BPs presenting a significant onset to patients and providers alike (Oliveros et al., 2020).

Lastly, the research also articulated that African Americans are the most vulnerable population exposed to HTN because of frequent high blood pressure occurring at a younger age due to the genetic and phenotype nature of the disease. HTN is also more profound in scope and severity in African Americans in comparison to Whites (Oliveros et al., 2020). Furthermore, a greater proportion of Black people are easily influenced, possess a sensitivity to sodium in diets, and are overweight, which can elicit a greater propensity for HTN (Oliveros et al., 2020). African American patients with HTN are especially fragile when it comes to stroke and cardiovascular illnesses, comorbidities, and greater probability or 3-5 times greater vulnerability to complications from HTN-C, such as end-stage renal disease, than Whites and other Non-Black patients (Oliveros et al., 2020).

Blacks, like many diverse groups, may respond differently to various antihypertensive drugs and are likely to take multiple medications for HTN regulation based on their clinical diagnosis, various blood pressure elevations, and comorbidities, but they typically respond favorably to a class of calcium channel blockers and diuretics. Along with angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and β-blockers have proven to be a formidable treatment regimen for Black, White, and Non-Black patients (Oliveros et al., 2020).

## High Risk Factors

Regardless of the prominence surrounding HTN, clinical investigators have established that only a small segment of the population will acquire HTN-C (McGee et al., 2021). Hence, some experts are labeling HTN-C as a de novo phenomenon due to the origination, onset, and methodology of occurrence because many patients have no known history of HTN before experiencing an abrupt episode of HTN-C before taking antihypertension medication (McGee et al., 2021). Hence, Oliveros et al. (2020) recommended that a neo-adjunctive approach should be considered, such as a non-pharmacological, lifestyle techniques should be supported to reduce the risk of developing HTN-C. A non-pharmacological approach will consider dieting, exercise, stress management, weight loss, psychosocial, and regulation of one’s external environment. As noted in the previous paragraph, HTN-C can be broken down into two categories, HTN-E and HTN-U as defined by the presence or absence of acute target organ injury (Ashraf et al., 2022). Another important comment, not all patients with marked or acute increases in BP are identified with HTN-C, and the research is not well formulated. Therefore, possessing a current understanding of known associated risk factors of HTN-C is important for detection, diagnosis, and management. In an earlier systematic investigation conducted by Benenson et al. (2019), it was noted that the rate of HTN-C occurred more frequently in African American males between the ages of 40-50 years of age. In addition, outpatients with poorly include BPs and non-compliant patients who do not comply with the advice of their medical provider are also exposed to a greater risk of HTN-C (Benenson et al., 2019). The significance of Tisdale's research suggests that other possible underlying risk factors might exist that expose and make HTN patients more susceptible to HTN-C. In addition, it has been hypothesized that out-patients are more vulnerable to HTN-C due to poorly managed HTN and are exposed to a greater risk of HTN-C, but more scientific investigations are warranted to substantiate this theory. However, current research reveals that non-compliance to blood pressure-lowering regimens is known to enhance the probability of extreme and include HTN, which implies that inadequate HTN self-management may be a contributor to elevated risk factors for HTN-C (Ashraf et al., 2022). Furthermore, the known risk factors of HTN-C are important because of the correlation between hospital performance indicators which measure stroke outcomes regarding LOS and quality of care, as well as hospital readmissions. As postulated by Murray et al. (2021), 14% of patients with acute ischemic stroke were readmitted to the hospital within 30 days following discharge due to comorbidities with a re-hospitalization rate as high as 15%. Lastly, advancing education about the known risk components of HTN-C, as well as a consideration of socio-demographic and economic factors will aid in improving the systems of care, which concentrates on maximizing efficiency, quality, and patient satisfaction, otherwise known as a value-based approach to patient-centered care (Murray et al., 2021).

In (2022), Ashraf et al. commented in Circulation, as well as reported in Health People 2020, that the most notable modifiable risk factors for cardiovascular disease and stroke include the following: HTN control, reduction of cholesterol (low-density lipoprotein or unhealthy cholesterol), chronic cigarette usage, diabetes, inadequate diet, and sedentary lifestyle. Moreover, between 2011 and 2014, approximately 29.5% of adults over the age of 18 experienced hypertension, which accounts for about 75 million Americans, and 50.3% had sustainable BP under medical control (Murray et al., 2021).

## Frequency of 30-Day Hospital Readmission Associated With HTN-C

When analyzing the patterns of 30-day hospital readmission in relationship to prehospital stratified HTN-C, it is important to consider the correlation between LOS. As noted earlier, the driving consideration as to how long patients remain hospitalized is influenced in part by a CMS policy known as the Prospective Payment System (PPS), where the medical facility is paid a standard dollar amount for each hospital visit based on the case-mix component, disease type or DRG (CMS, 2023). The distinguishing principle of a PPS and Alternative Payment System methodologies are payment models that are designed around performance and evidence-based outcomes relative to how well a specific ailment is managed within an identified period in comparison to similar hospitals involving CMS patients (CMS, 2023). Moreover, the program known as Obama Care or The Patient Protection and Affordable Care Act assesses punitive damages for excessively high 30-day hospital readmissions, but ambiguity persists around unplanned hospital readmissions that are controllable (CMS, 2023). Hence, the DRG concept was implemented as an industry standard to evaluate costly comorbidities, such as HTN-induced stroke, to focus on quality-of-care measures, utilized resources in comparison to similar hospital types, patient classification, bed size in relationship to cost, and resource utilization (CMS, 2023). Hospitals with excessive 30-day readmission ratios were subjected to financial penalties of as much as 3% to improve the quality of care by reducing readmission occurrences. In addition, patients are confronted with ongoing follow-up care, post-operative procedures, and therapeutic care following a CVA attack (McGee et al., 2021). Lastly, there is also more of an emphasis on communities adopting a proactive approach to mitigating the occurrence of 30-day hospital readmission through the creation of partnerships with integrated stroke delivery networks, with the focus on persistent care and the rebuilding of patient's lives following a stroke (National Stroke Service Model, 2020). Hence, the National Stroke Service Model (2020), utilizes a defined and evidence-base pathway methodology, in order to prevent thousands of patients suffering from a stroke episode through better diagnosis and access to treatment around the clock with access to regional stroke providers and specialists.

## Medicare Compliance

Hypertensive-C induced stroke is the second most common cause of mortality and the third most common cause of disability (Benjamin et al., 2018). Even more so, HTN is the most frequent culprit identified in patients who experience an acute episode of stroke (Ashraf et al., 2022). Identifying high-risk factors of HTN-C in relationship to stroke will assist in engaging in cost-effective treatment strategies and benchmarking to motivate caregivers to enhance patient care, as well as discourage hospital readmissions and LOS. Quality control agencies are advocating that hospital readmissions constitute an increased financial liability to payers, hospitals, and patients and are often preventable (Hoffman & Yakusheva, 2022). Before 2012, medical organizations had very few financial incentives to lower readmission rates. Subsequently, with the implementation of the Affordable Care Act, Hospital Readmission Reduction Program (HRRP), and the Centers for Medicare & Medicaid Services initiated reduced payments to hospitals with high rates of readmission activity. Another objective of the HRRP is to promote a qualifiable mandate for a standard of improvement in hospitals to reduce readmission and length of stay. As such, the quality-of-care reporting agency, known as the Center for Medicare and Medicaid Services, had mandated that all hospitals that provide patient care report healthcare outcomes regarding disease management. Under the new Medicare compliance and quality-reporting guidelines, as well as the federal program, Medicare Hospital Readmission Reduction Program (HRRP), explicitly disciplines medical facilities with high re-occurrences of 30-day readmission events for specific comorbidities such as HTN-C and stroke-related episodes, which hospitals may incur excessive economic penalties with 30-day hospital risk-standardization metrics for Medicare patients (James et al., 2023).

According to the Center for Medicare and Medicaid Services, readmission prevention is incentivized 10 times the amount in comparison to other quality of care measures, such as length of stay (LOS) and mortality. Will most stroke-related research on readmission risk factors had focused on the in-patient setting, little is known about the out-patient effects of prehospital HTN-C and the correlation between LOS and influence on risk-adjusted 30-day hospital readmissions. Moreover, hospitals across North America have begun to assemble LOS and 30-day readmission committees and employ AI or machine learning to analyze, track, and record trends in LOS and 30-day hospital readmission metrics over time (Huang et al., 2022). However, scrutinizing risk- standardized 30-day readmissions as a quality benchmark may inadvertently neglect or even poorly address the issues surrounding social determinates of health for certain vulnerable patient populations because of socioeconomic risk factors (James et al., 2023).

Another composite measure being advocated by Medicare is the patient satisfaction score. The patient experience indicator is a key driver of how well the quality of care was delivered by physicians and hospital staff (CMS, 2023). Also known as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), it is a nationwide qualitative survey that was designed and implemented by CMS to evaluate the patient's experience will receiving medical care. Additionally, healthcare organizations continue to develop patient -satisfaction surveys and quality management programs for intra-organizational reasons; unfortunately, until CMS required HCAHPS guidelines and measures, there was no national database to analyze the performance of hospitals (CMS, 2023). As noted by James et al. (2023), medical organizations with substandard risk-adjusted patient satisfaction scores possess a greater chance of hospital readmission and mortality. Conversely, CMS (2017), had reported that hospitals with superior values stream standards of evaluating and implementing quality outcomes have favorable patient satisfaction scores and surveys.

In summary, In the interests of advocating performance-based outcomes, CMS had implemented quality-of-care measures (CMS, 2023). Hospital 30-day readmissions is a significant quality-of-care metric with known associated financial penalties to healthcare organizations with higher rates of standard benchmarks (James et al., 2023). Surveillance of high-risk factors of HTN-C in relationship to stroke will assist in implementing cost-effective treatment strategies and benchmarking to motivate caregivers to enhance patient care, as well as discourage hospital readmissions and LOS.

**Trends in Hypertensive Crisis: A Clinical Management Approach**

Wajngarten et al. (2019), mentioned that HTN-C remains the most common risk factor for stroke, based on data from 30 investigations, and reported in about 64% of patients with stroke and cardiovascular disease. Furthermore, 1 in 8 or 12.5% of CVA victims were re-hospitalized within 30 days of hospital discharges between 2010–period, with readmission disparities shown in significant proportions in non-academic medical facilities when compared to academic hospitals (Vahidy et al., 2018). According to Vahidy et al. (2018), the most contemporary trends in relationship to evidence-based practice will indicate a lack of inconsistent standards and meaningful universal definition of HTN-C. From a clinical management approach, HTN-C can be described as a significant and sudden intensity in systolic and diastolic BP that sometimes includes an acute and terminal organ injury to the kidneys, cardiovascular, brain, and pulmonary system (Ashraf et al., 2022). As noted by Wang et al. (2023), when the anatomical structures of the cerebral cortex, cardiovascular system, and urinary organs are impacted, a definitive course of clinical actions is recommended that reduce extreme SBP over 180 mm Hg in two hours, specifically the use of antihypertensive agents. However, due to limited research, there is no clear, established treatment pathway to managing HTN-C, and subsequently, it remains a challenge for ER providers (Wang et al., 2023). Furthermore, HTN-C can be categorized into two tiers: hypertensive emergency (HTN-E) and hypertensive urgency (HTN-U). The delineation between HTN-E and HTN-U is based on the existence of acute onset organ damage, which systematically involves abrupt damage to the heart, brain, kidneys, and pulmonary organs. Moreover, the management of BP stratifications for diagnosing HTN-C is not defined throughout the medical community, as well as a clear correlation between LOS and 30-day hospital readmissions. However, the current research will suggest that algorithms and standardization of clinical processes are critical, such as detection and diagnosis of HTN-C as a precursor in the manifestation of end-stage organ disease. Another important scientific point, based on observations of patients possessing severely high elevated BP, is that HTN-C can be identified as SBP greater than 180 mm Hg and DBP over 120 mm Hg (Wang et al., 2023). Experts have also observed that the best management technique for HTN-C should be long-term in scope when considering a care plan. Even more significant, the control of acute onset HTN-C by way of quickly reducing the BP should be conducted carefully, especially when using fast-acting BP medications and reserved for life-threatening events only (Wang et al., 2023). In addition, patients that are non-symptomatic and found by their caregivers to have HTN-U can be managed with minimal risk in an ambulatory setting without the use of aggressive BP-lowering medications. Conversely, patients presented to the ER with HTN-E should be hospitalized, given precipitous treatment, and professional observation (Wang et al., 2023). Likewise, it is also important to note the relationship between abrupt onset high BP and occupational stress, which is a typical observation in ER departments across North America. Furthermore, other trends reveal that regardless of major reductions in deaths and ongoing advancement in survival rates, the frequency of HTN-C continues to perpetuate in number. For example, approximately 18% of patients evaluated in the ER are admitted due to high BP, but in contrast to the rate of incidence for significant elevated BP, such as HTN-E, continues to be minuscule, representing approximately .02% of ER admissions for the adult population (Wang et al., 2023). As noted by Wang et al. (2023), HTN-C continues to be a chief diagnosis for many ER patients; the percentage of prehospital-related ED visits for treatment-associated HTN episodes represent roughly about 75% as categorized with HTN-U versus 25% diagnosed with HTN-E. HTN-C may influence some patients with a history of HTN of patients being managed therapeutically with anti-hypertension drugs. Hence, demographically, African Americans and elderly whites are the groups most impacted by HTN-C. Another trend confronting hospitals, medical professionals, and EMS personnel in relationship to prehospital events of HTN-C is non-compliance to antihypertension therapy, such as infrequent dosing that elicits out-of-control BP, which subsequently increases the susceptibility of HTN-C (Wang et al., 2023). The cessation of certain BP drugs, such as Clonidine, which works physiologically in conjunction with the sympathetic nervous system and can elicit an acute rise in HTN, which is also known as rebound hypertension. According to Wang et al. (2023), Clonidine works by reducing the HR and relaxing the cardiovascular blood vessels will lowering the BP, which should be titrated, usually .2 mg to1 mg an hour will be acting as an alpha-adrenoceptor agonist for patients that have resistant traits to antihypertension medications. However, as stated by Oliveros et al. (2019), the regulation strategies for HTN-C in older adults should take into consideration existing comorbidities psycho-social and economic factors, and care must be specific to each patient. Hence, non-medication lifestyle intercessions should be supported to lower the risk of developing HTN, such as an adjunctive approach to reduce the need for anti-hypertension medications (Oliveros et al., 2019). Examples of some adjunctive therapies may include high sodium consumption, sedentary lifestyle, low fiber, and high-fat diet, inadequate intake of fruits and vegetables, excessive, and chronic alcohol intake (Wang et al., 2023).

Another type of type of stroke is known as a transient ischemic attack minor stroke TIAMS. Wang et al. (2023) mentioned that TIAMS are frequently occurring events observed in the ER. TIAMS were previously diagnosed as Transient Ischemic Attacks (TIAs) in ER environments throughout North America but are now recognized under the name of TIAMS. Traditionally, TIAs are treated on an emergency basis, and then patients are admitted over the course of 72 – 96 hours for neurological and clinical evaluation (Wang et al., 2023). However, due to the economic pressures confronting hospitals, as well as DRG and bundled payments, numerous providers are perplexed with how to best manage TIAMS patients. Usually, the disposition for this population of cohorts is viewed as controversial because of clinical symptoms. The evidence suggests that some TIAMS patients may require clinical expertise and observation in an outpatient environment as an exception to hospital admission, whereas patients require hospital admission based on the severity of their clinical assessment. For example, according to Wang et al. (2023), 250,000 to 300,000 TIA episodes take place each year in North America, with an associated probability of a stroke in about 3.5% - 10% within two days of TIA, which increases the chances of relapse to approximately 17% in 90 days following an attack. Diagnostic medical imaging technology, such as CT angiography, magnetic resonance imaging, and CT perfusion, are useful diagnostic tools that show significant promise in forecasting 30-90 stroke re-occurrences, hospital readmission, LOS, as well as managing acute neurovascular associated risk (Wang et al., 2023). So, the clinical methodology for managing TIAMS is controversial in nature for a number of ER providers because of the over-arching objective to mitigate in-patient admission and reduce LOS for prehospital associated with HTN crisis and associated stroke.

Another trend associated with HTN-C can be correlated to the use of an illegal substance, such as opioids, cocaine, phencyclidine, or PCP, known as hallucination drugs, over-the-counter anabolic steroids, and amphetamines that create vasoconstriction effects, will triggering a rise in HR and BP (Ashraf et al., 2022). Other agents might include monoamine oxidase inhibitors or MAO, also known as antidepressants, which if congested with a certain class of food that is high in tyramine components, specifically aged processed cheese, fava carbohydrates, starches, sugar, cellulose, and soy sauces, is known to trigger HTN-C. Additionally, some patients are known to experience adverse effects from certain include substances due to the body's response following the reaction to certain medications which creates the activation serotonin syndrome that can elicit the release of serotonergic receptors, which may cause fever, elevated BP, and sweating

(Ashraf et al., 2022). Moreover, cancer treatment agents are also known to be culprits of inducing HTN-C, such as bevacizumab, which operates as an anti-vascular endovascular growth agent antibody (Ashraf et al., 2022). Multidrug interactions can exacerbate the opportunity for chemotoxicity HTN-C.

Other cancer-therapy drugs known to dramatically increase HTN are the tyrosine kinase inhibitors, known as sunitinib, sorafenib, and pazopanib will potentiate HTN-C because of the annihilation of nitric oxide, causing cellular malfunction, and renal dysfunction. Cancer patients that are vulnerable to cancer-accelerated HTN-C should be targeted for constant BP observation (Ashraf et al., 2022). Even more, subjects with an observed long-term history of HTN-C are possibly more resilient to acute HTN crisis as opposed to patients without any previous history of known HTN, which is known as de-novo, because of the unexplained origin of HTN-C. Researchers hypothesize that the anatomical nature of the endothelial cells contracts to regulate the size of the blood vessels that provide some essence of tissue protection during the event of HTN-C. Since time is the brain, the evaluation, diagnosis, and treatment of an acute stroke episode by prehospital personnel, such as paramedics, are crucial. Prehospital diagnostic algorithms, such as the stroke scale, have been improved significantly (Hayashi et al., 2021). Hence, the first crucial step in determining HTN-C is the initial screening and diagnosis because an excessive and chronic elevation HTN, along with other mitigating factors such as diabetes, a chronic comorbidity, is known to be a contributing factor of being at risk of a stroke about 2-4 times (Dal Canto et al., 2022). As stated by Del Canto et al. (2022), the best approach to addressing HTN-C during an acute state of ischemic stroke is not well defined in the literature. Paradoxically, there is no clear research from randomized include trials that antihypertensive agents lower the disability or death rate in patients with FTN-E (Dal Canto et al., 2022). However, research does consistently illustrate the physiological impact of HTN-C and diabetes, such as abnormal hyperlipidemia profiles that have been linked to vascular inflammation and endothelial dysfunction, which causes cardiovascular disease, particularly atherosclerosis (Guerra et al., 2021). As noted by Guerra et al. (2021), the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure initiated comprehensive guidelines to help establish a formal practice for diagnosing and recording HTN measurements, heart disease, and care plans, outpatient and residential BP observation and monitoring, BP therapies and drug treatments, as well as creative methodologies that concentrate on improving evidence-based practices in the discipline of cardiovascular disease. HTN-C can be manifested in various stages and caregivers should consider following the model of a standard of work for accurate BP assessments (Hayashi et al., 2021). BP should be classified as normal, elevated, and categorized in stages 1 or 2 HTN to manage HTN-C. For example, a base-line BP is defined as SBP of 120 mm Hg and DBP of 80 mm Hg; elevated BP represents a SBP range between120-129 mm Hg and DBP between 80 mm Hg; HTN stage-1 is SBP between 130-139 mm Hg and DBP 80-89 mm Hg, and HTN stage 2 is SBP greater than 140 mm Hg and DBP over 100 mm Hg (Hayashi et al., 2021). Prehospital and remote monitoring BP assessments are advised to validate the diagnosis of HTN and for the management of anti-hypertension therapy, along with medical consults. Hence, it is also important to evaluate BPs during various times of the day, such as morning, afternoon, evening, and night-time, to determine if obscure HTN exists, also known as masked HTN (Hayashi et al., 2021). In addition, some ethnic groups are more predisposed to developing HTN-C than others. Hayashi et al. (2021) commented that adults over 45 years of age who have not been diagnosed as hypertensive might experience what clinicians called the 40-year risk factor of acquiring HTN, which is 93% for Blacks, 92% for Latins and Hispanics, 86% for whites, and 84% for Asian Americans. Another important severity assessment tool and scoring methodology used to evaluate the impact of HTN-induced stroke is the National Institutes of Health Stroke Scale (NIHSS). The NIHSS is employed for assessing neurological deficits and is one of the most prominently used tools administered by healthcare providers in North America to determine the degree of neurological impairment following a stroke (Cummock et al., 2023). As noted by Cummock et al. (2023), the NIHSS was initially created as a bedside rating instrument for the implementation of exogenous clinical investigations and in the environment of stroke treatment, neurovascular and clinical testing to determine preventive techniques, rehabilitation plan, and recovery. Hence, insurance companies, third-party payers, state, and federal agencies require the submission of formal data on best-practice and evidence-based outcomes. Therefore, the NIHSS had become a gold standard for compliance organizations, particularly The Joint Commission, which is a mandated prerequisite for Comprehensive and Primary Stroke Centers (Cummock et al., 2023). Moreover, stroke centers are required to administer and document the NIHSS rating within 12 hours of a stroke episode, which is to be performed by a certified stroke practitioner. In addition, the intent of the NIHSS is to be administered by neurologists and non-neurologists alike, such as ED clinicians and healthcare practitioners, such as nurses, physicians, and clinical researchers. However, the NIHSS should include didactic clinical training to reinforce reproducibility and consistency when administering the scale to account for clinical deficits when examining the cohort's physical coordination, balance or physical impairment, neuro-sensory functionality, distal motor function, memory, cognition to accompany a formal neurological physical, as well as a detailed history and physical (Cummock et al., 2023). To determine the magnitude of a stroke, practitioners use a scoring scheme during the NIHSS process to assess the overall severity of the brain attack with an elevated score indicative of a more serious attack. Research shows the greater the numeric value will directly correlate to the impacted region of the brain that will reflect the severity of the stroke, which is usually revealed by such modality as a computerized tomography or magnetic resonance imaging exam (Cummock et al., 2023). Furthermore, the evidence shows that NIHSS metrics that are captured within the first two days after a CVA usually have a mutual relationship with clinical results within the first 12 months of treatment. However, a concern pointed out by practitioners is that the NIHSS is cumbersome and requires an inordinate amount of time to complete the assessment (Cummock et al., 2023). In fact, Cummock et al. (2023), mentioned that a face-to-face in-person assessment from start to completion of the NIHSS on average takes about 9.7 minutes to perform versus 6.5 minutes when compared to a remote telehealth evaluation. Therefore, a modified version, as depicted in appendix A and B, of the NIHSS was implemented as not only standard practice, but as best practice to support the full version of the NIHSS and to help providers determine the severity of an acute stroke, as well as to assess the degree of neurological impairment. The modified version of the NIHSS will concentrate specifically on the atypical components discovered during completing an assessment of an NIHSS exam (Cummock et al., 2023). The combined integration of an NIHSS and mNIHSS will help providers to analyze and determine the degree of neurological deficit that is caused by an abrupt brain attack. The analytical data illustrates that stroke victims with a NIHSS of less than four typically have better results with neurological movement and viability when compared to patients with a high NIHSS of 22 or greater, which possess a significant physical and mental disability. Clinicians also reported that certain features of the NIHSS revealed a reduction in inter-rater quality and reliability when assessing facial movement, lower extremity muscle coordination, level of mental state, and detecting speech defects or dysarthria (Cummock et al., 2023). As seen in Appendix A, as noted by Cummock et al. (2023), an important point of the NIHSS is that the assessment tool is highly complex, but prior research had shown the tool to have an appreciated scoring reliability between stroke specialists and health care providers as a viable neurological assessment tool. The modified NIHSS is less redundant, simpler, and less complicated (Cummock et al., 2023). Hence, in comparison to a modified prototype of the mNIHSS, the NIHSS had been shown to yield greater reliability with clinical outcomes but had not been recently adopted by the medical community. See appendixes A and B.

The modified NIHSS (mNIHSS) as seen in Appendix B, is a variation of the initial NIHSS scoring scale, which was designed to improve complexity and be more user-friendly, reduce redundancy, mitigate variability, reduce repetition, promote reliability, and validity (Cummock et al., 2023). Moreover, the modified NIHSS was created to conserve time will preserving the integrity of the NIHSS, such as the following data elements were sponged from the list includes Level of Consciousness (item 1a), Facial Palsy (Item 4), Limb Ataxia (Item 7), Dysarthria (item 10), Sensory item (item 8) was adjusted from 3 to 2. For example, Cummock et al. (2023) conducted a study that analyzed clinometric which compared the NIHSS against the mNIHSS, to measure the best outcome of reliability and validity (p. 515). The investigation enlisted the participation of 45 cohorts with a chief complaint of stroke or intra-cerebral bleed, with the clinical investigation being conducted on location at the University of California, San Diego, Stroke Center between September 2000 and March 2001. The research was performed by a team of NIHSS-credentialed neurologists who compared the NIHSS against the mNIHSS, Barthel Index, and mNIHSS (Cummock, 2023). The standard of measurement employed was the Cohen Kappa weighted score, which measures the degree of disagreement between two examiners. The higher the disagreement the higher the weighted score (Cummock, 2023). The investigation yielded large Kappa values during the comparison analysis. The assay revealed 10 or 66.67% of the 15 NIHSS Kappa scores versus 10 or 90.91% of 11 mNIHSS Kappa scores which resulted in the mNIHSS being more dependable than the NIHSS due to the exclusion of items with low kappa values (Cummock et al., 2023). Furthermore, the employment of correlation coefficients, such as Kappa values, helped to make the point that mNIHSS was as relevant as the NIHSS. Current research discovered more reliability and sustained validity by embracing a previously created mNIHSS. The resulting mNIHSS scale had a significantly higher Kappa ratio. The mNIHSS illustrated greater consensus among neurologists and showed to be more user-friendly and less cumbersome to use (Cummock et al., 2023).

Another technique that is embraced in the diagnosis of HTN-C-induced stroke is CT brain perfusion (CTP). Although different from traditional computerized tomography (CT) and magnetic resonance imaging (MRI), both modalities are still considered the gold standard when evaluating the effects of an acute brain attack. However, CTP is now considered a practical alternative to CT and MRI when evaluating cerebral vascular anatomy and physiology, as well as the functionality of the cerebral cortex following a hypertensive-induced stroke (Cummock et al., 2023). First, when discussing cerebrovascular disease, there are two categories of stroke, ischemic stroke, and hemorrhagic stroke (Hayashi et al., 2021). Ischemic stroke refers to deprived cerebral blood flow to various regions of the brain with limited oxygen and nutrients that is usually because of a clot or thrombosis and occurs in roughly 87% of patients that is often attributed to large vessel occlusion (LVO); will hemorrhagic stroke pertains to an overabundance of blood pressure within the intracavity of the brain and happens in about 13% of stroke victims, which is usually brought about by HTN-C (McGee et al, 2021). According to Katyal and Bhadkar (2021), CT brain perfusion (CTP) in conjunction with a neurological examination are used extensively by neuroradiologist as a pre- and post-stroke modality technique to assess the hemodynamic transformation in the cerebrovascular cortex, as well as examine brain tumors. Hence, the benefit of utilizing a non-contrast brain CT is that the procedure can be performed on a multi-slice CT scanner in less than two minutes. Unfortunately, CT can be inaccurate for assessing a stroke with abrupt onset within six hours, also known as hyperacute stroke, which makes it difficult for practitioners to determine the affected cortex of the brain, otherwise known as the penumbra, which can be reliably performed by a CTP study (Katyal & Bhadkar, 2021).

## Summary and Conclusion

In summary, the contention that systemic HTN-C is classified the same as the traditional definition of HTN is a misnomer and deserves a better understanding by medical providers within the U.S. healthcare delivery system because 65 million people are impacted by HTN-C each year. Also, the degree to which HTN-C is diagnosed or misdiagnosed had been shown to directly correlate to LOS and influence the propensity for hospital readmission if the disease is not evaluated appropriately (Heidenreich et al., 2022). Additionally, the most contemporary trends in HTN-C regarding a cogent clinical management approach will suggest that no formal meaning or universal definition of HTN-C exists. However, HTN-C can be described as a significant and sudden intensity in systolic and diastolic BP, which sometimes includes an acute and terminal organ injury to the kidneys, cardiovascular, brain, and pulmonary systems (Heidenreich et al., 2022). HTN-C can be categorized into two tiers: hypertensive emergency (HTN-E) and hypertensive urgency (HTN-U). The delineation between HTN-E and HTN-U is based on the existence of acute onset organ damage, which systematically involves abrupt damage or dysfunction to the heart, brain, kidneys, and pulmonary organs. Moreover, due to the limitation of epidemiological information, the relationship between stratification BPs for diagnosing HTN-C is not determined throughout the medical community. Therefore, further clinical research is warranted that will establish best practices across the healthcare spectrum, as well as promote a clear medical pathway that involves a standard of the work process in the identification and treatment of HTN-C (Heidenreich et al., 2022).

# Chapter 3: Research Method

## Introduction

Stroke is the second most common cause of death and the third most common cause of physical dysfunction and impairment, which affects over 800,000 North Americans each year (Jauch et al., 2019). Proactively recognizing high-risk readmission causes for prehospital admitted HTN-C patients will provide the ability to dramatically advance the quality of life for poststroke patient recovery and positive social change. Previous stroke-related investigations concentrated on inpatient settings, even though prehospital hypertensive crisis accounts for over 75% of acute stroke cases in the United States that are managed by first responders (Wajngarten & Silva, 2019). Almost 13% of prehospital patients that are presented to the ED are reported with stage 3 HTN-C of systolic BP over 180 mm Hg with delayed door-to-needle time (Cantone et al., 2021). Rachoin et al. (2020) noted that length of stay is defined as the duration of a single episode of hospitalization and is an important predictor of risk-adjusted 30-day hospital readmissions. The impact of LOS stratified by stages of HTN-C on readmissions had not been previously studied. Therefore, this research will concentrate on prehospital hypertensive crisis patients from the GWTG-Stroke Registry and investigate whether the stratified stages of HTN-C and LOS are objectives and measurable indicators for the risk-adjusted 30-day hospital readmissions.

Chapter 3 described the research methodology, evaluated the research design, methods, and procedures to conduct the investigation. Combinations of descriptive and inferential statistics were used to help establish credibility, reliability, and validity

(Frankfort-Nachmias & Nachmias, 2007). As seen below in Table 2, descriptive statistics were used to delineate between the IDV, DV, and data type (Creswell, 2014, p. 57).

**Table 2**

*Descriptive Statistics Delineating Between the IDV, DV, and Data Type*

| | Variable | Data type |
|---|---|---|
| HTN-C blood pressure, stages 1,2, and 3 | IDV | Nominal |
| LOS | IDV | Ratio |
| 30-day hospital readmission (binary) | DV | Nominal |
| Age | Co-IDV | Ratio |
| Gender | Co-IDV | Nominal |
| Race | Co-IDV | Nominal |
| Comorbidities - Diabetes I or II | Co-IDV | Nominal |

*Note*. Comorbidities age, gender, race, and diabetes I and II will be included in the investigation.

As seen in Table 2, descriptive statistics were employed to delineate between the IDV, DV, and expressed by specific data type. Stage 1 HTN-C is systolic blood pressure (SBP) between 140-159 mm Hg, stage 2 HTN-C is SBP 160-179 mm Hg, and stage 3, to be SBPs greater than 180 mm Hg. The hospital LOS was calculated by subtracting the number of days between the admission date and the discharge date. The IDV for LOS and HTN-C was characterized as a ratio scale because of a true zero value used to express LOS and HTN-C levels of stratified blood pressures. Both LOS and HTN-C BP were expressed as predictor variables and the DV or outcome variable to be binary in nature (Creswell, 2014). The inferential measurements included a logistic regression analysis with a correlation coefficient because of the change in the coefficient involving the log odds of $y = 1$ for a one-unit increase in x (Creswell, 2014). Moreover, Teddlie and

Tashakkori (2009) commented that logistic regression is a statistical method used to show the relationship between one or more predictor variables (IDVs) and the binary dependent variable (Creswell, 2014). The odds ratio will show if a binary correlation exists between two variables X and Y in a data set and will be expressed as either yes or no or 0 or 1. The data from the research included independent variables HTN crisis BPs and LOS, along with the dependent variable, 30-day hospital readmission. In SPSS, the data was re-coded in data view where the IDVs were re-coded as predictors and expressed as follows: (140 through 159 = 1), (160 through 179 = 2), and (180 through highest = 3). The DV was expressed as dichotomous or binary; 0 = no hospital remission within 30 days and 1 = yes, readmitted within 30-days of hospital discharge and the calculations were performed in the variable view feature. In addition, measures of central tendencies, such as mean, median, mode, range of variance, and standard of deviation, will be considered for descriptive measurements. Additionally, chapter three will include research methodology, research design and approach, variables, research questions, and hypothesis, levels of measurement, setting and sample, G-Power sample size analysis, power analysis, threats to validity, and ethical consideration.

## Research Design and Rationale

The research study was quantitative in design and used retrospective secondary data collected from Get with the Guideline Stroke National Registry with data from over 1,700 hospitals and 2.5 million patient encounters of participants from GWTG-Stroke performance improvement initiatives (Heidenreich et al., 2022). The final data set employed quantitative evidence from GWTG-Stroke records from the period between

2018-2022, with licensing restrictions, for only one academic medical center in the Midwest.

The research focused on predictor variables, which included hospital length of stay from prehospital admitted stroke patients and levels of HTN-C blood pressures, which examined the effect on 30-day hospital readmissions. The outcome dependent variable represented 30-day hospital readmission and was expressed as binary variable because there were only two possible outcomes, as 0 = no and 1 = yes for 30-day hospital readmission. Furthermore, the logistic regression model was used to help predict the log odds of the DV and the probability of the outcome binary DV (Frankfort-Nachmias & Nachmias, 2007). The logistic regression model was also used to analyze the three RQs that analyzed the outcome DV 30-day hospital readmission and a set of continuous IDVs or predictor variables that prompted a yes or no response or outcome. The outcome variable was coded as 1 or 0 (Teddlie & Tashakkori, 2009). The degree of variability was expressed by deploying an analysis tool, known as a goodness of fit test or Hosmer-Lemeshow test that illustrated how well the predictor probability aligned with the model of observed binary outcomes. The F test was employed to evaluate the significance of the model by examining if at least one of the IDV was significantly related to the outcome or DV (Teddlie & Tashakkori, 2009).

## Variables

The independent variables (IDV) or predictor variables were represented by length of stay (LOS) and stratified stages of hypertensive crisis (HTN-C) for prehospital admitted stroke patients from the GWTG-Stroke Registry. The dependent variable (DV), the outcome variable, is the prehospital admitted stroke patient risk adjusted 30-day hospital readmissions (James et al., 2023). Possible confounding variables, such as age, gender, race will be used but include co-morbidities diabetes I and II in the investigation.

Diabetes is an important comorbidity due to the social burden and impact on high blood pressure and stroke (Glovaci et al., 2019). As a comorbidity, both diabetes, type I insulin-include, or type II non-insulin regulated information will be included during the study.

**Research Question and Hypothesis**

RQ1: Is there an association between prehospital admitted stroke patient LOS and risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities of type I diabetes and type II diabetes?

$H_0$: There is no association between prehospital admitted stroke patient LOS and risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_a$: There is an association between prehospital admitted stroke patient LOS and risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities of type I diabetes and type II diabetes.

RQ2: Is there an association between prehospital admitted stroke patient HTN-C associated with risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities?

$H_0$: There is no association between prehospital admitted stroke patient HTN-C associated with risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_a$: There is an association between prehospital admitted HTN-C associated with risk-adjusted 30-day hospital readmissions, will control for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

RQ3: Is there an association between prehospital admitted stroke patient LOS and stratified stages of HTN-C associated with risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities of type I diabetes and type II diabetes?

$H_0$: There is no association between LOS and prehospital admitted stroke patient HTN-C associated with risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_a$: There is an association between LOS and prehospital admitted HTN-C associated with risk-adjusted 30-day hospital readmissions, will include age, gender, race, and comorbidities of type I diabetes and type II diabetes.

To answer the research questions and evaluate their corresponding hypotheses, a multiple logistic regression analysis with a correlation coefficient was used as the statistical model. A logistical regression test was employed in each RQ to analyze to examine if a correlation was present between one binary DV and multiple IDV and if a causal relationship existed between the confounding variables and IDV (Creswell, 2014, p. 162). As stated by Thomas (2020) a confounding variable is an undetermined third variable that can potentially influence the outcome of an investigation. A logistic regression analysis and coefficient were embraced for each Research Question (RQ) to describe the association between the explanatory (independent variable) and response (dependent variable). The independent variables were represented by LOS and the various levels of high blood pressure, which was nominal to explain the delineation between stage 1, stage 2, and stage 3 HTN-C blood pressures. The dependent variable will be the risk-standardized 30-day hospital readmission. Notably, the risk-adjusted 30-day hospital readmission is a CMS quality of care metric, which was expressed as well as an observed 30-day hospital readmission and divided by the expected readmission and then multiplied by the national 30-day hospital readmission standard, which equaled the 30-day hospital readmission (James et al., 2023). Therefore, it is important to note that during the investigation, the logistic regression model was shown to be binary as a depiction of the DV and used a set of continuous IDVs to help predict a yes or no outcome. The logistic regression helped to determine the estimated maximum probability of a change in the odds ratio between the log odds y variable, which equals 1 and unit increase in the x variable. Hence, the odds ratio depicted the strength or direction between the predictor and outcome variable (Schober & Patrick, 2021). For example, if a positive correlation is shown along with a low p-value, then a positive relationship exists between the predictor variables (LOS and systolic BP) and the outcome variable (30-day hospital readmission). Conversely, if the odds-ratio has a negative correlation and high p-value, then a negative effect exists, with a poor or no association between the predictor variable and outcome variable (Saini & Singh, 2020). Lastly, retrospective secondary information was collected from Get with the Guideline Stroke National Registry.

## Methodology

The methodology employed a binomial logistic regression analysis for RQ 1 and 2, using a total of five predictor variables, which included LOS as an IDV and four covariables of age, gender, race, and diabetes (type I or II) as a comorbidity. As denoted in Table 3, the minimum group of people needed for the sample size will be 92 subjects. Research question 3, used a binomial logistic regression analysis and included six predictor variables, 2 IDV, LOS, and HTN-C, and four covariables, age, gender, race, and comorbidity of type I or type II diabetes. The confounding variables, such as age, gender, race and type I and type II diabetes. As depicted in Table 5, the minimum group of people needed for the sample size will be 98 subjects.

## Levels of Measurement

The levels of measurement for the research were expressed by using stratified blood pressure levels to demonstrate HTN-C that were categorical. Each level of stratified HTN-C blood pressure was classified as either stage 1, stage 2, or stage 3 HTN-C. For example, stage 1 HTN-C SBP will be between 140-159 mm/Hg, stage 2 HTN-C SBP between 160-179 mm/Hg, and stage 3 HTN-C SBP 180 or higher mm/Hg (Heidenreich et al., 2022). LOS was conveyed on an ordinal scale. Descriptive statistics were used to compare each explanatory or IDV, LOS, and stratified BPs, which involved categorical data against the DV, a ratio scale against risk adjusted 30-day hospital readmissions. This strategy permitted the use of a comparative analysis approach of the descriptive data to LOS to show if an association existed between IDV and DV (Teddlie& Tashakkori, 2009).

Categorical data displayed the range of HTN-C of prehospital stratified HTN-C blood pressures for each group for descriptive purposes of stage 1 HTN-C as SBP between 140-159 mm/Hg, stage 2 HTN-C SBP is 160-179 mm/Hg, and stage 3 HTN-C SBP was 180 or higher mm/Hg.

## Setting and Sample

The research concentrated on prehospital HTN-C data only. Inpatient HTN-C information was excluded from the investigation. Hospitals that were registered as active members of the American Heart Association GWTG-Stroke was used as participants of the study (GWTG-Stroke, 2023). As commented by GWTG-Stroke (2023), the advantage of utilizing data from GWTG-Stroke was that consumers and medical facilities alike benefit from the vast number of published clinical cases and establish best practices for the medical community about stroke management. GWTG-Stroke collects voluntary patient-level information on characteristics, benchmarking against other facilities, quality of care metrics, diagnostic examinations, bioinformatics, compliance to quality measures, in-hospital outcomes, and in-patient and prehospital admitted patients hospitalized with acute stroke and transient ischemic attack (TIA; GWTG-Stroke, 2023). Presently, there are over 1,700 hospitals that participate in GWTG-Stroke performance improvement initiatives and data involves over 2.5 million patient encounters (Heidenreich et al., 2022). The disadvantages of using data from

GWTG-Stroke include the possibility of human error and process, which would reduce the investigation's internal validity, reliability, and credibility (Creswell, 2014, p. 160). According to GWTG-Stroke (2023) submission of stroke performance metrics, data are reported through an interactive evaluation and reporting system known as the Patient Management Tool (PMT). The eligibility criteria for retrieving patient records from the PMT stroke repository would involve the participating hospital being an active member of the American Heart Association (AHA), with authorization to access the stroke data would coming from the active hospital principal investigator (Heidenreich et al., 2022). The principal investigator (PI) must email GWTG-stroke requesting permission to access their data. As a contingency plan, arrangements were made with a secondary hospital if my request is denied by the PI. However, a signed permission agreement from the data partner(s) was granted by the IRB for approval. Furthermore, the eligibility criteria for submitting stroke data to the PMT repository would include the following: stroke data from the patient's medical record is voluntary, so nonvoluntary data would be ineligible; only stroke measures for specific modules identified by the hospital will be displayed in the PMT; the participation period for public reporting information into GWTG-Stroke each year is late spring. So, data reported outside of late spring is excluded; data from non-GWTG-stroke programs are ineligible; there must be a minimum of 30 records reported within each module and each performance measure requires a minimum of six records. There are no follow-up interviews. So, if the volume is too low, the report will not be displayed in the PMT (GWTG Stroke, 2023).

In summary, the data sample focused on the out-patient effects of prehospital HTN-C stroke patients and the correlation between LOS and influence on risk-adjusted 30-day readmission rate. Identifying high-risk readmission factors for prehospital admitted patients had the potential to dramatically improve the quality of life for post-stroke patient recoveries and positive social change. Also, the stroke quality improvement initiatives for standardizing treatment of HTN-C are provided by the GWTG-Stroke program and are an extension of the evidenced-based efforts of the AHA/ASA and akin to the overarching mandates of Medicare and Medicaid program to influence the quality, safety, mitigate cost, and advance patient care and experience (Hoffman & Yakusheva, 2020). Moreover, the data collection process will exercise feasibility, reliability, and credibility using a formalized process with articulated standards and benchmarks. Finally, to nullify bias, all eligible subjects employed in the research will be selected from the GWTG- Stroke registry (2023), which contains over 1.7 million case files from active AHA hospitals and all insurance payer types, regardless of socioeconomic class.

## Power Analysis and Sample Size Calculation

### Power Analysis

According to Creswell (2014), there are three inputs and specific parameters that can determine sufficient and credible sample sizes. They are the G-Power analysis, group sample size calculations, and effect size, which were all used in the investigation and comprised in the logistics regression analysis (Table 2). Also, the inputs and various parameters were used in the research and revealed in the F-test, Logistic Regression with a Fixed Model, and $R^2$ Deviation from Zero. The Analysis Output included A priori, which included the computed required sample size, effect size, alpha level (α), and statistical power. The effect size was illustrated as a quantitative value that was measurable in scope and magnitude between two variables (Creswell, 2014, p. 159).

Also, the alpha level (α) was reflected in the data as the probability value or p-value. Frankfort-Nachmias et al. (2015) commented that in hypothesis assessing a p-value < .05 is statistically important, statistically nonsignificant, and fails to reject or accept the null hypothesis. Therefore, the purpose of the alpha level was to determine the statistical significance of the investigation (p. 145).

Lastly, the statistical power was shown to be inversely proportional to beta coefficient, 1-β, or the chance of inadvertently making a Type II error. A Type II error is a false-positive error (Creswell, 2014, p. 159). Hence, the formula for calculating statistical power is 1- Beta coefficient (β) and can be impacted by how large the sample size of the research. Also, larger effects are more sensitive to detection than smaller effects, and larger sample sizes provide more sensitivity than smaller sample sizes (Creswell, 2014, p. 159). The beta coefficient power for this research was 80%, which indicates an 80% chance of avoiding a Type II error. Additionally, a two-tailed test was calculated for this investigation and illustrated a maximized numerical effect in both directions, which also determined the critical areas of distribution, and provided more statistically significant data (Creswell, 2014, p. 158). A one-tailed test can only test effects in one direction and can lead to an error when determining statistical significance and being avoided during this research. The F-test was used in the calculation to compare two X and Y variables and to find statistical significance (Creswell, 2014, p. 145). See

Table 4 below for the minimum group sample size calculation (Faul et al., 2007). Finally, the degrees of freedom (DF), which refers to the number of values in a calculation that contains the freedom to vary, is the total number of observations less the number of IDV constraints in relationship to the observations (Frankfort-Nachmias et al., 2014).

**Sample Size Calculation**

Before conducting the research, a sampling strategy was conducted in order to select an appropriate population sample size for each specific research question, as well as to achieve a valid statistical analysis, and determine if a statistically significant coefficient existed (Frankfort-Nachmias & Nachmias, 2014). Also, each research question and hypothesis were shown to be different in scope, influenced by a predictor variable(s) and covariables, but contain a sample size that is distinct to the individual RQ as outlined below.

Research Question 1, a binomial logistic regression analysis, will have a total of five predictor variables, which include LOS as an IDV and four covariables of age, gender, race, and diabetes (type I or II) as a comorbidity.  As denoted in Table 3, the minimum group of people needed for the sample size will be 92 subjects.

Research Question 2, also a binomial logistic regression analysis, will have five predictor variables including 1 IDV, prehospital HTN-C, and four covariables, age, gender, race, and diabetes type I and diabetes type II as comorbidities. As depicted in Table 3, the minimum group of people needed for the sample size will be 92 subjects.

Research Question 3, a binomial logistic regression analysis, will have six predictor variables including 2 IDV, LOS, and HTN-C, and four covariables, age, gender, race, and comorbidity of type I or type II diabetes. The confounding variables, such as age, gender, race and type I and type II diabetes. As depicted in Table 5, the minimum group of people needed for the sample size will be 98 subjects.

Moreover, covariates such as age, gender, race, and comorbidities diabetes type I or II were included as IDVs involving hypertension crisis and LOS. Historically, covariates such as age, gender, race, and diabetes have been known to influence inpatient acuity of disease and can impact the DV that is relative to 30-day hospital readmission (Rachoin et al., 2020).

The DV represented a binary categorical or nominal variable, because of the Yes or No values for a logistical regression to represent 30-day hospital readmissions.

The following sample sizes were used for each Research Question (RQ). Control the right sample size helped to establish validity and statistical reliability when addressing the research questions and evaluating their corresponding hypothesis (Frankfort-Nachmias & Nachmias, 2007).

The parameters and group size calculation for Research Question (RQ), 1-3 were presented in Table 4.

**Table 3**

*Power Analysis for RQ1 and RQ2*

| Input parameters | |
|---|---|
| F- tests | Logistic regression analysis: Fixed model, $R^2$ deviation from zero |
| Analysis | A priori: Compute the required sample size |
| Input | Tail(s) = 2 |
| | Effect size $f^2 = 0.15$ |
| | $\alpha$ err prob = 0.05 |
| | Power (1-$\beta$ err prob) = 0.8 |

| | |
|---|---|
| | Tail(s) Number of predictors 5 |
| Output | Noncentrality parameter δ = 2.8722813 |
| | Critical t = 2.006647 |
| | Df = 52 |
| | Total sample size = 92 |
| | Actual power = 0.804803 |

**Table 4**

*Power Analysis Calculation for RQ3*

| Input parameters | |
|---|---|
| F-tests | Logistic regression: Fixed model, $R^2$ deviation from zero |
| Analysis | A priori: Compute the required sample size |
| Input | Tail(s) = 2 |
| | Effect size $f^2 = 0.15$ |
| | $\alpha$ err prob = 0.05 |
| | Power (1-$\beta$ err prob) = 0.8 |
| | Tail(s) Number of predictors 6 |
| Output | Noncentrality parameter $\delta$ = 2.8722813 |
| | Critical t = 2.006647 |
| | Df = 52 |
| | Total sample size = 98 |
| | Actual power = 0.804803 |

Tables 3 and 4 displayed power analysis calculations for RQ 1, RQ 2, and RQ 3, with a minimum sample size of 92 and 98, respectively, so the minimum sample size will be 98 for all three research questions and the common dataset (Creswell, 2014, p. 161). Logistics regression was most appropriate because of the dichotomous response DV (Creswell, 2014, p. 161). Also, logistic regression was used during the research to show the relationship between the two continuous IDVs involving LOS and HTN-C and the DV risk-adjusted 30-day hospital readmissions (dichotomous). The IDVs were expressed as parameters during the calculation of the DV outcomes (Creswell, 2014, p. 169). The assumption was used during the logistic regression to display a logistic relationship between one binary dependent variable and two multiple variables with IDV being continuous. The two predictor variables included the IDV LOS and stratified HTN-C blood pressures. The DV represented risk-adjusted 30-day hospital readmissions.

The length of stay was calculated as the number of days the patient was admitted by subtracting the date of discharge or index (end date or expected date of discharge) minus the date of hospital admission (beginning date or observed date).

In summary, G-Power was used to calculate the sample size for each Research Question (RQ). Based on the G-Power computation, RQs 1-3. There was a minimal sample size of 98 subjects for all three RQs. RQs 1-2 will also have five predictor variables that included HTN-C, age, gender, race, and co-morbidities type I diabetes and type II diabetes. RQ3 had six predictor variables, which was LOS, HTN-C, age, gender, race, and but includes the comorbidities of type I diabetes and type II diabetes.

## Data Analysis Plan

The final data set employed quantitative evidence from GWTG-Stroke (2023) records by an academic medical center in the Midwest. The data was used to access prehospital stroke occurrences between 2018-2022. The data collected from GWTG-S did allow for comparison between groups and multiple hospitals and benchmarking against other medical institutions. I did not have to contact each provider for permission. Approval of the GWTG-S database was authorized by an academic medical center in the Midwest and there was no cost. The data analysis strategy embraced using descriptive statistics and functions of SPSS version 29 for computing output. The descriptive analysis computations checked for odds of ratio, positive correlation and a low p-value effect for statical significance. Other assumption tests included inferential predictions to check for normality using the F-test and determining p-value, outcome variable function, and multiple logistic regression analysis and correlation coefficient

(Creswell, 2014, p. 162). As noted above, retrospective evidence was employed from the GWTG-Stroke records with authorized permission by an academic medical center in the Midwest. The prehospital stroke data ranged between 2018-2022. The data was saved into an Excel format for import into SPSS version 29. The following data analysis strategy below was used to address the following research questions. Special notes, confounding variables, such as age, gender, race, and diabetes I and diabetes II will be used in the study. Diabetes is an important comorbidity because of the social burden and significant impact on high blood pressure (Glovaci et al., 2019). As a comorbidity, diabetes was classified as type I insulin-dependent or type II non-insulin regulated for the research (Glovaci et al., 2019).

Research Question 1: Is there an association between prehospital admitted stroke patient LOS and risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and type I diabetes and type II diabetes?

$H_0$: There is no association between prehospital admitted stroke patient LOS and risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_1$: There is an association between prehospital admitted stroke patient LOS and risk-adjusted 30-day hospital readmissions when controlling for age, gender, race and comorbidities of type I diabetes and type II diabetes.

DV: risk-adjusted 30-day hospital readmissions. The data scale was a categorical scale because of the dichotomous relationship between the predictor variables. The risk-adjusted 30-day hospital readmissions was defined as an observed 30-day readmission that was divided by the expected readmission and then multiplied by the national readmission standard benchmark, which equals the risk-adjusted 30-day hospital readmissions. The observed-to-expected (O/E) ratio was inclusive of the ratio of the actual (observed) count of readmissions in relationship to the risk-adjusted (expected) count of readmissions.

IDVs: Length of stay and HTN-C. The data scale LOS as continuous and HTN-C as binary because of the dichotomous relationship between the outcome variable. According to Rachoin et al. (2020), hypertension crisis represents 67% of morbidities and is a strong determinant of LOS. The average LOS for HTN-C-associated stroke was from 4.2 days to 17.5 days, due to stroke subtypes (hemorrhagic versus ischemic), socioeconomics, and comorbidities (Jackson & Chari, 2019).

Covariates: age (35 to 100); gender (male or female); race (Caucasian, African American, Hispanic, Asian, Indian); comorbidities (diabetes type I or II).

Research Question 2: Is there an association between prehospital admitted stroke patient HTN-C associated with risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes?

$H_0$: There is no association between prehospital admitted stroke patient HTN-C associated with risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

$H_1$: There is an association between prehospital admitted HTN-C associated with risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

DV: Risk-adjusted 30-day hospital readmissions. The data scale was a nominal scale because of the binary and dichotomous, Yes or No response. As noted earlier, the risk-adjusted 30-day hospital readmissions is a CMS quality of care measure. The risk-adjusted 30-day hospital readmissions were defined as an observed 30-day hospital readmissions that was divided by the expected readmission and then multiplied by the national readmission standard rate, which equaled the risk-adjusted 30-day hospital readmissions. The observed-to-expected (O/E) ratio was inclusive of the ratio of the actual (observed) count of readmissions in relationship to the risk-adjusted (expected) count of readmissions.

IDVs: Stratified HTN-C blood pressures. The data scale was nominal because of the order associated with the categorial values involving the different HTN-C stages. According to Heidenreich et al. (2022), hypertension crisis represents 67% of morbidities and is a strong determinant of LOS. The average LOS for HTN-C associated hemorrhagic and ischemic stroke varies from 2 days to 17.5 days (Jackson & Chari, 2019).

Covariates: age (35 to 100); gender (male or female); race (Caucasian, African American, Hispanic, Asian, Indian); comorbidities (diabetes type I or II).

Research Question 3: Is there an association between prehospital admitted stroke patient LOS and stratified stages of HTN-C associated with risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes?

$H_0$: There is no association between LOS and prehospital admitted stroke patient HTN-C associated with risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and the comorbidities of type I diabetes and type II diabetes.

$H_1$: There is an association between LOS and prehospital admitted HTN-C associated with risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and the comorbidities of type I diabetes and type II diabetes.

DV: Risk-adjusted 30-day hospital readmissions. The data scale was a ratio scale because of the comparison between two or more numbers. As mentioned previously, the risk-adjusted 30-day hospital readmissions is a CMS quality of care measure. The risk-adjusted 30-day hospital readmissions were defined as an observed 30-day readmissions that was divided by the expected readmission and multiplied by the national readmission standard, which equals the risk-adjusted 30-day hospital readmissions. The observed-to-expected (O/E) ratio was inclusive of the ratio of the actual (observed) count of readmissions in relationship to the risk-adjusted (expected) count of hospital readmissions.

IDVs: Stratified HTN-C blood pressures. The data scale was nominal because of the categorical order of HTN-C blood pressures.

Covariates: age (1 to 101); gender (male or female); race (Whites, Blacks, Hispanics, and Asians); comorbidities (diabetes type I or II).

## Threats to Validity

Validity can equate to investigative discoveries' overall credibility, truthfulness, and reliability. As noted by Creswell (2014), threats of validity can be internal or external inferences that can inadvertently impact the truthfulness of the research outcome. External threats examined during this study involved the credibility of conclusions surrounding generalization (p. 169). One example used to minimize an external threat was a sampling model of a cross-population, which was representative of the aggregate group to be studied (Creswell, 2014, p. 169). A sampling model with an appropriate sample size could increase the opportunity for generalizability, reduce the possibility of selection bias, and preserve statistical validity. Another framework for considering generalizability is a proximal similarity model, which considers a cohort's location, environment, and time as a construct for determining generalizability (Frankfort-Nachmias et al., 2015). In a proximal similarity model, similar groups were assembled in a nearby location based on specific criteria to create generalizability. For example, when researching the relationship between LOS and prehospital HTN-C stroke patients, it was important to establish the reproducibility of effects relative to hospital readmission.

Internal validity assumes that the research outcome is valid, objective, and true (Creswell, 2014, p. 170). Internal validity established credibility between the cause and effect of the IDV being manipulated and DV, which was being measured. Of course, confounding variables were considered as a potential impact on the DV. The IDV included LOS and stratified stages of HTN-C for prehospital admitted patients from the GWTG-Stroke Registry. The DV represented risk-adjusted 30-day hospital readmissions

(James et al., 2023). The confounding variables include age, gender, race, and diabetes I and diabetes II that will be included in the research.

## Summary

Chapter 3 described the research methodology used to evaluate and assess the problems within the investigation. A quantitative strategy was employed to evaluate the research questions and hypotheses. The investigation focused on the length of stay from prehospital admitted stroke patients with variable levels of HTN-C blood pressure, consisting of stages 1, 2, and 3 hypertensions, and the effect on stroke patients with risk-adjusted 30-day hospital readmissions. I embraced predictive statistics, specific to a logistic regression analysis and coefficient correlation to validate the correlation between one binary DV and two IDV. Covariates such as age, gender, race, and comorbidities such as diabetes type I or II will be used in the investigation due to the direct or indirect effect on the IDV involving hypertension crisis and LOS, as well as any possible observed impact on DV relative to risk-adjusted 30-day hospital readmissions. The levels of measurement for the research were expressed by using various levels of stratified blood pressure to demonstrate HTN-C as nominal and LOS as ordinal. G-Power 3.1 software was utilized to calculate the appropriate sample size for the investigation. The research evidence was collected from GWTG-Stroke records between 2018-2020 and saved into an Excel format for import into SPSS version 29. Chapter 4 included the research results, interpretation, and an explanation of the data analysis.

# Chapter 4: Results

## Introduction

The purpose of this quantitative study was to determine whether the stratified stages of prehospital HTN-C SBP and LOS are significant predictors of 30-day hospital readmissions for acute stroke. Earlier research focused only on in-patient-related stroke episodes, but no study has yet investigated if a correlation exists between prehospital-related HTN-C SBP and LOS on risk-adjusted 30-day hospital readmissions. I used retrospective evidence from the GWTG-Stroke records for an academic medical center in the Midwest between 2018-2022. prehospital stroke HTN-C SBP data included Stage 1 HTN systolic BP (140-159 mm/Hg), Stage 2 HTN systolic BP (160-179 mm/Hg), and Stage 3 HTN systolic BP (≥ 180 mm/Hg), the latter which can damage vital body organs. The statistical analysis tool for the study was SPSS version 29. Research Questions 1 and 2 (RQ 1 and RQ 2) used a binary regression analysis, and research question 3 (RQ 3) employed a binomial logistic regression analysis to predict the probability involving binary outcomes and explanatory independent variables (IDVs). The independent variables in RQ 1 and 2 were represented by the continuous variable LOS and the various levels of HTN-C systolic BPs were nominal to delineate between stage 1, stage 2, and stage 3 HTN-C blood pressures. The dependent variable was expressed as a dichotomous association for 30-day hospital readmission and represented by a yes or no response. The risk-adjusted 30-day hospital readmission, a CMS quality of care metric, by definition, was expressed as an observed 30-day readmission, which was divided by the expected readmission and then multiplied by the national readmission standard rate. SPSS version

29 was the statistical tool used to examine the descriptive data for the prehospital stroke output. The interpretation of the statistical results of the logistical regression test were based on the p-values, positive coefficients, and odds ratio. Other assumption tests included inferential predictions to check for normality using a Kolmogrov-Smirnov test. The inclusion criteria will exclude age, gender, race, and type I and type II diabetes in the analysis.

The research questions and hypotheses were as follows:

Research Question 1: To what extent is the prehospital admitted stroke patient length of stay (LOS) associated with the risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes?

Ho: Prehospital admitted stroke patient LOS is not associated with the risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes.

$H_1$: Prehospital admitted stroke patient LOS is associated with the risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes.

The independent variables included length of stay and stratified stages of HTN-C for prehospital admitted patients. The dependent variable represented prehospital admitted stroke patient 30-day hospital readmission. Confounding variables, such as age, gender, race, included comorbidities (diabetes I and diabetes II). Diabetes will be included because of the known influence on stroke and cardiovascular disease. Glucose data will be included on the Prehospital Stroke Data Form, to diabetes I or type II diabetes type II is present and whether both classifications were included for the purpose of this investigation.

Research Question 2: To what extent is prehospital stratified stages of HTN-C associated with the risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes?

$H_0$: Prehospital stages of HTN-C are not associated with the risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes.

$H_1$: Prehospital stages of HTN-C are associated with risk-adjusted 30-day hospital readmissions, when controlling for gender, race, and comorbidities type I diabetes and type II diabetes.

The independent variables included a length of stay and stratified stages of HTN-C for prehospital admitted patients. The dependent variable included prehospital admitted stroke patient risk-adjusted 30-day hospital readmissions. Confounding variables, such as age, gender, race and comorbidities type I diabetes and type II diabetes.

Research Question 3: To what extent is prehospital admitted stroke patient length of stay (LOS) and stages of hypertensive crisis (HTN-C) associated with the risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes?

$H_0$: Prehospital admitted patient LOS stroke and stages of hypertensive crisis (HTN-C) are not associated with the risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes.

$H_1$: Prehospital admitted patient stroke LOS and stages of hypertensive crisis (HTN-C) are associated with the risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

The independent variables included length of stay and stratified stages of HTN-C for prehospital admitted patients. The dependent variable included prehospital admitted stroke patient risk-adjusted 30-day hospital readmissions. Confounding variables, such as age, gender, race, and comorbidities type I diabetes and type II diabetes.

Chapter 4 provides an account of the data collection methods and an analysis of the results of each research question.

## Data Collection

Walden University formally granted approval to conduct research on November 16, 2023. The IRB approval number, 09-08-23-0415160, was granted to study the Effect of Stages of Prehospital Hypertensive Crisis and Length-of-Stay on Acute Stroke Readmission. The research partner and data use agreement for this investigation were in collaboration with a Midwestern hospital. The data use agreement (DUA) was authorized by a Midwestern hospital, signed, and approved on November 16, 2023, and sent to the Walden University's IRB department. The DUA permitted the formal authorization and sharing of retrospective secondary data from the American Heart Association (AHA) Get with the Guideline Stroke between January 1, 2018, to December 31, 2022. Walden University's IRB did oversee the capstone data analysis and reporting of results.

**Initial Collection of Secondary Data**

The initial data collection was acquired from a GWTG-S database from a Midwestern hospital. A Data Use Agreement was obtained prior to my access to the raw data from GWTG-S. The inclusion criteria represented the following: data must be prehospital based information from a prehospital stroke patient based on a standardized case report form with coded data that identifies the mode of transport, either EMS or emergency transport from home or scene, air transport or mobile stroke unit, documentation of prehospital patient's clinical diagnosis, demographics, vital signs, and blood glucose to rule out diabetes I or II (see Appendix D). As noted earlier, the secondary prehospital HTN-C stroke data was retrieved from GWTG-S database from a midwestern hospital between January 1, 2018, to December 31, 2022, and initially included 5,503 cases, but after adjustments for missing data and accounting for the imbalance of information, the total cases for the investigation were 527.

**Data Cleaning and Discrepancies**

The number of patient cases identified in the original data count was 5,503, but 254 cases had incomplete data, such as no gender identity or missing systolic blood pressure reports. Also, due to an imbalance of data, a process known as down sampling was performed to take many 30-day hospital readmission cases coded as = 0 or no, to balance the dataset with the minority cases of 30-day hospital readmission cases coded as

= 1 or yes. SPSS randomly selected 33% of the majority 30 day = 0 cases (1447) which yielded 441 cases and then merged with 30 days =1 cases (86) for a new merged dataset of 1533 cases and 16% 30-day =1 cases (86/527). So, the final sample size was only 527 cases as shown in Table 6 (GWTG-S, 2023). The final dataset exceeded the required minimum sample size of 98 for the research questions. The dependent variable original data for 30-day hospital readmission was coded as a dichotomous variable with either no or yes which was recoded as 0 or 1, respectively. The predictor variable stages of HTN-C systolic BPs were coded into risk categories as follows: 1 = SBP 140-159 mm Hg as Stage 1 HTN, 2 = SBP 160-179 mm Hg as Stage 2 HTN, 3 = SBP > 180 mm Hg as Stage 3 HTN. For gender, female was coded as 0 and male as 1. Race included the following coding: Whites = 1, African Americans = 2, Hispanics = 3, and Asians = 4.

## Results

### Descriptive Statistics

Table 5 provided descriptive statistics about the number of cases that were broken down by year between 2018 and 2022. In 2019, the prehospital patient census was impacted by COVID.

**Table 5**

*Descriptive Statistics for Prehospital HTN-C Stroke Cases by Year, 2018–2022*

| 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1,650 | 482 | 255 | 276 | 2,586 |

*Note*. Midwestern hospital data from GWTG-Stroke program 2018-2022.

Table 6 displays a frequency of statistics by gender. There were 527 prehospital stroke cases with 61.9% (n = 326) males and 38.1% (n = 201) females (GWTG-S, 2023). There was a 100.0% gender representation.

**Table 6**

*Frequency Statistics by Gender*

| | Frequency | Percent |
|---|---|---|
| Males | 326 | 61.9 |
| Females | 201 | 38.1 |
| Total | 527 | 100.0 |

Table 7 (below) provides a frequency of race by participants of prehospital stroke patients. Whites represented 60.2% (n = 317), African Americans 19.5% (n = 103), Hispanics 18.8% (n = 99), Asians 1.5% (n = 8).

**Table 7**

*Frequency by Race Participated*

| | N | % |
|---|---|---|
| White | 317 | 60.2% |
| African American | 103 | 19.5% |
| Hispanic | 99 | 18.8% |
| Asian | 8 | 1.5% |
| Total | 527 | |

**Table 8**

*Frequency Statistics of Prehospital Stroke Data*

| | | Systolic BP (mm Hg) | Age (Years) | Length of Stay (Days) |
|---|---|---|---|---|
| N | Valid | 527 | 527 | 527 |
| | Missing | 0 | 0 | 0 |
| | Mean | 144.22 | 62.31 | 5.78 |
| | Std. Deviation | .533 | .789 | .268 |
| | Minimum | 130 | 12 | 0 |
| | Maximum | 186 | 101 | 58 |

Table 8 described the prehospital stroke data, such as age in years, length of stay in days, HTN-C systolic blood in mm Hg. The minimum systolic BP was 130mm Hg, minimum age was 12, and minimum LOS was 0 days. The mean age was 62.31 and maximum age 101. In the United States, age is significant predictor of 30-day hospital readmissions for prehospital related stroke. As noted by Hirayama et al. (2018), age-related differences were discovered as a primary reason of 30-day hospital readmissions for acute ischemic stroke, specifically with age ranges between 65-74.

The mean length of the stay was 5.78 days and the maximum days 58 days. The mean LOS was 5.78 days, which aligns with the national U.S. benchmark of 6.28 days (Lorio et al., 2024).

The average systolic blood pressure was 144.22 mm Hg ranging from a minimum of 130 to a maximum of 186 mm Hg (GWTG-S, 2023). Hypertension crisis or emergency with blood pressures greater than 180 mm HG comorbidities disease and socioeconomic risk factors were found to be significant predictors of 30-day hospital readmissions (Kumar 2019).

Table 9 shows a frequency of HTN-C systolic blood pressures by various stages. There were 527 patients, 384 had stage 1 HTN-C 384 (72.9%), 133 had stage 2 HTN-C 133 (25.2%), and 10 had stage 3 HTN-C 10 (1.9%).

**Table 9**

*Frequency of HTN-C Systolic Blood Pressures*

| | N | % |
|---|---|---|
| Stage 1 HTN-C 130-149 mm HG | 384 | 72.9% |
| Stage 2 HTN-C 150-179 mm HG | 133 | 25.2% |
| Stage 3 HTN-C 180-300 mm HG | 10 | 1.9% |
| Total | 527 | 100% |

**Table 10**

*Frequency Statistics of Diabetes Type I and II Prehospital Stroke*

| | *N*<br>527 | % |
|---|---|---|
| Diabetes I | 37 | 7.0% |
| Diabetes II | 57 | 10.8% |
| No Diabetes | 433 | 82.2% |

Table 10 shows the frequency of diabetes type I and type II. Both diabetes I and diabetes II are comorbidities known to have an influence on HTN-C and data were included in the research (Tsanani et al., 2021). The majority of admitted patients had no diabetes while those with diabetes (18%) consisted of type I diabetes (7.0%) and type II diabetes (10.8%).

**Primary Analysis Overview**

I used a binary logistic regression model for Research Questions 1, 2, and binomial logistic regression for Research Question 3 to determine if there is an association between the predictor variables prehospital HTN-C BPs, LOS, and outcome variable 30-day hospital readmission. Confounding variables were included, such as age, gender, race, and type I diabetes and type II diabetes. There are five predictor variables for RQ 1 and 2. The five predictor variables include: 1) age, 2) gender, 3) race, 4) diabetes, and 5) length of stay or HTN-C SBP level.

There are six predictor variables for Research Question (RQ 3). The following six variables should be considered when performing the binary logistic regression analysis. The six variables for RQ 3 go as follows: 1) age, 2) gender, 3) race, 4) diabetes I and II, 5) length of stay, and 6) HTN-C blood pressures.

The four confounding variables, such as age, gender, race, and diabetes I and diabetes II were included. Diabetes is an important comorbidity known to cause a social burden and have a significant impact on high blood pressure and cardiovascular disease. (Tsanani et al., 2021).

**Table 11**

*Study Variables, Parameters, and Data Set Coding Integration From GWTG-S to SPSS*

| Variables | Data coding Type | Variable |
|---|---|---|
| Length of Stay | Continuous, Number of Days Ratio | IDV |
| HTN-C BP | Stage 1 (130-149 mm Hg) Nominal<br>Stage2 (150-179 mm Hg).<br>Stage 3 (> 180 mm Hg) | IDV |
| 30-day hospital readmissions | Dichotomous, Yes or No Nominal | DV |
| Age | Continuous, 1-101 Ratio | Co-variable |
| Gender | Binary, Female 0, Male 1 Nominal | Co-variable |
| Race | Race (coded from 1-4), Nominal<br>Whites 1, Blacks 2, Hispanics 3, Asians 4 | Co-variable |
| Diabetes | Type II diabetes coded as 2 Nominal<br>Type I diabetes coded as 1,<br>No diabetes coded as 0 | Co-variable |

*Note*. LOS is coded in days, which is the date of admission minus the date of discharge.

Table 11 reflects the parameters from GWTG-S, along with the integrated data sets that were migrated into SPSS version 29 by age, gender, arrival date/time, blood pressure (diastolic) initial, blood pressure (systolic) initial, diabetes types, discharge date/time, hospital identification (ID), unique participate identification, such as P001, and so forth for anonymity, length of stay, patient gender identity, patient identified sexual orientation, race, days of readmission, and ethnic groups, which were coded from 1-4 from Table 11. Type I diabetes was coded as 1 and type II diabetes coded as 2, and No diabetes coded as 0. The 30-day hospital readmissions are coded as yes/no whether the patients were readmitted to the hospital within 30-days of being discharged after a previous hospital stay (Schober & Vetter, 2021). As a part of the inclusion criteria and assumption, age, race, gender, type I and type II diabetes will be included as covariables.

**Statistical Assumptions of Binomial Logistic Regression Model**

The key variables of the binomial logistic regression will be used as the following (Harris, 2021):

1. Binary Outcome Variable: The dependent variable will be binary (dichotomous), coded as 0 and 1.
2. Independence of Observations: Each observation will be independent; the data for one subject should not influence another. One or more independent variables.
3. Model Specification: independence of observations and the dependent variable should have mutually exclusive and exhaustive categories.
4. There will be a linear relationship between any continuous independent variables and the logit transformation of the dependent variable.
5. Absence of Highly Influential Outliers: Outliers or influential points will be checked, as they can unduly affect the model estimates.

**Research Question 1**

**Research Question 1**: To what extent is the prehospital admitted stroke patient length of stay (LOS) associated with the risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities of diabetes I and diabetes II?

**Table 11**

*Binary Logistic Regression Variables, LOS, Age, Diabetes, Gender, Race, and 30-day Hospital Readmissions*

**Variables in the Equation**

| | | B | S.E. | Wald | df | Sig. | Exp(B) | 95% C.I. for EXP(B) Lower | 95% C.I. for EXP(B) Upper |
|---|---|---|---|---|---|---|---|---|---|
| Step 1[a] | Gender Recode(1) | 20.375 | 2828.148 | .000 | 1 | .994 | 705799227.768 | .000 | . |
| | Diabetes Recode | | | .000 | 2 | 1.000 | | | |
| | Diabetes 1 | -.881 | 7069.115 | .000 | 1 | 1.000 | .415 | .000 | . |
| | Diabetes Recode | 4.090 | 7182.429 | .000 | 1 | 1.000 | 59.762 | .000 | . |
| | Race Recode | | | .000 | 3 | 1.000 | | | |
| | Race 1, Whites | -21.045 | 5848.823 | .000 | 1 | .997 | .000 | .000 | . |
| | Race 2, Blacks | -20.941 | 3827.380 | .000 | 1 | .996 | .000 | .000 | . |
| | Race 3, Hispanic | -20.623 | 12982.127 | .000 | 1 | .999 | .000 | .000 | . |
| | Length of Stay | .068 | .029 | 5.316 | 1 | .021 | 1.070 | 1.010 | 1.133 |
| | Age | .018 | .009 | 4.065 | 1 | .044 | 1.018 | 1.000 | 1.036 |
| | Constant | -22.031 | 2828.148 | .000 | 1 | .994 | .000 | | |

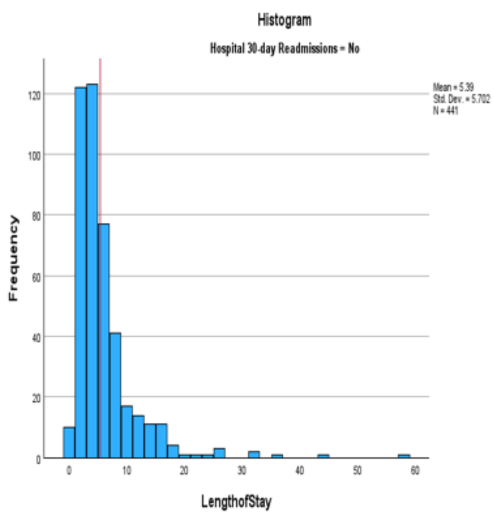
a. Variable(s) entered on step 1: Gender Recode, Diabetes Recode, Race Recode, Length of Stay, Age.

Table 12 shows a binary logistic regression of gender, race, age, and diabetes 1 and 2, LOS and 30-day hospital readmissions. Both age (p-value .044) and LOS (p-value .021) have significant p-values, with 1.8% and 7.0% positive effect, respectively. Gender had a p-value of .994 and is not statistically significant, with no effect on 30-day hospital readmissions. Race had a p-value of .997 and is not statistically significant, with no positive impact on 30-day hospital readmissions. Diabetes type I has a beta coefficient of -881, 95% CI, and a p-value of 1.00, which is not statistically significant, with no positive influence on hospital 30-day readmissions. Diabetes type II showed a p-value of 1.00 and is not statistically significant, at the 95% CI, and is not a positive indicator of risk-adjusted 30-day hospital re-admissions. Stages of HTN-C are not a significant predictor, with p-values for HTN-C 1, a p-value of .456, HTN-C 2, a p-value .811, and HTN-C 3, a p-value of .229.

**Figure 4**

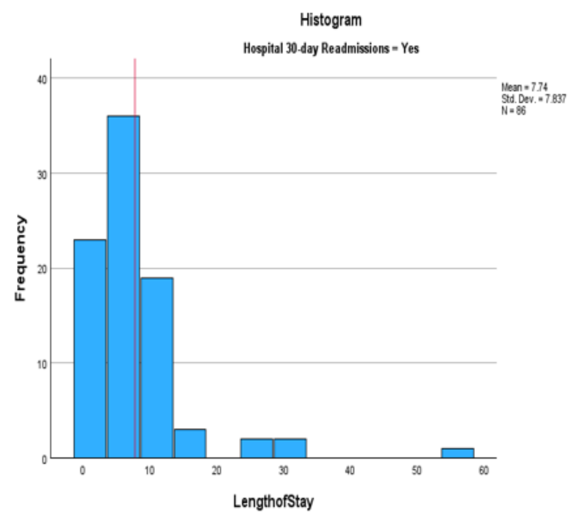
*Histogram Analysis of LOS and 30-day Hospital Readmissions*

**Exhibit A**




Mean 5.39, no hospital readmissions within 30 days.

**Exhibit B**




Mean 7.74, yes hospital readmissions within 30 days.

Figure 4 shows a histogram analysis of LOS and 30-day hospital readmissions. Histogram A shows no distribution and a mean LOS of 5.39 days and population of 441, with no hospital readmissions within 30 days of the initial discharge. Histogram B shows the yes distribution, with a mean LOS of 7.74 days and population size of 86, with yes of being re-admitted within 30 days of hospital discharge. The long right tail represents a small number of patients with extended hospitalization. The histogram shows a positive correlation between LOS and 30-day Hospital distribution between No and Yes readmissions.

**Table 12**

*Hosmer and Lemeshow Tests HTN-C Systolic Blood Pressure, and 30-day Hospital Readmission*

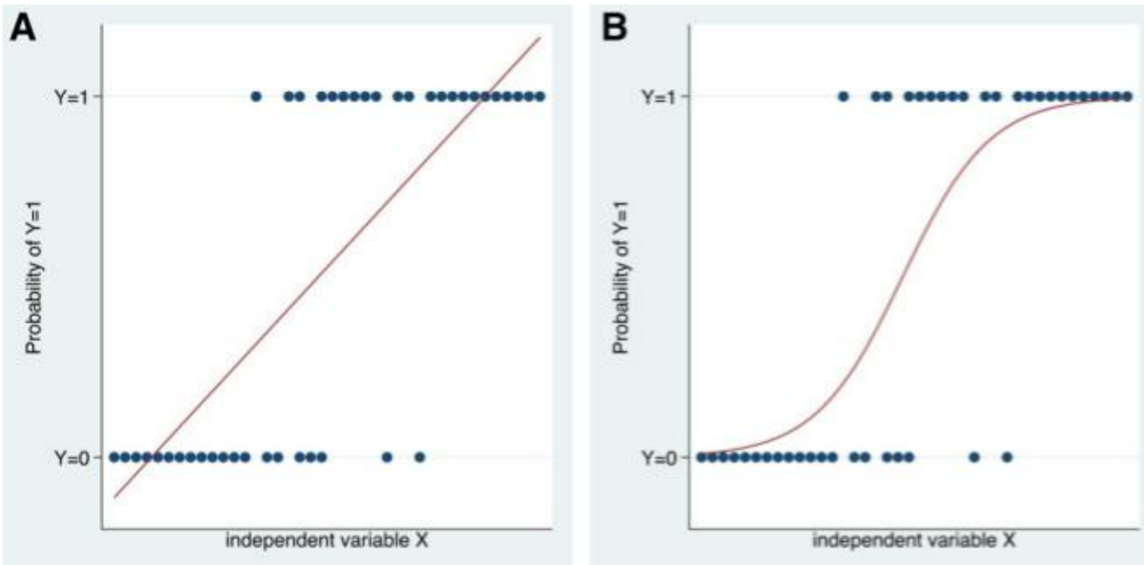
| Step | Chi-square | df | Sig. |
|---|---|---|---|
| 1 | 15.007 | 8 | .059 |

*Note.* Hosmer-Lemeshow model shows a p-value of .059 and the model is a good fit.

Table 13 reflects a Hosmer-Lemeshow model illustrating the significance of the relationship between the observed and predicted values and how well the logistic regression model fits the data. Also, in a Hosmer-Lemeshow model, a high p-value, greater than 0.05 means the model fits the data well and there is no significant difference between what the model predicts and occurs (Wilson et al., 2024). Conversely, a low p-value with this model suggests a poor fit, suggesting the model's predictions are significantly different from the observed response. The Chi-square significance level of 15.007 was observed. P-value .059 > .05, which is indicative of the model fitting the data well.

**Figure 5**

*Hosmer-Lemeshow Goodness of Fit Model*




Schober and Vetter (2021). Copyright 2021 by the Journal of Analgesia.

Figure 5 shows a Hosmer-Lemeshow analysis that examines goodness of fit in the case of a binary outcome (Schober & Vetter, 2021). The purpose of the Hosmer-Lemeshow test is to examine whether the observed outcome of 30-day hospital readmissions matches the predictor variables. For example, if $p > 0.05$ is a Good Fit because predictions are close to the actual outcome (Wilson et al., 2024). The Output from the Hosmer-Lemeshow test showed Chi-square to be 7.68, degrees of freedom 8 and a p-value of .059. or $p = .059 > 0.05$ and the model fits the data well or acceptable. There is no evidence to reject the null hypothesis of good fit between the observed (30-day hospital readmission) and the predicted (HTN-C systolic pressure). Also, Figure 4 shows a demonstration of the connection between a continuous independent variable X (length of stay and HTN-C blood pressures) and a binary outcome variable Y (30-day hospital readmission), that accepts values 0 = no and 1 = yes.

**Table 13**

*Test of Normality Distribution Kolmogrov Smirnov for 30-Day Hospital Readmissions*

| Tests of Normality | | | |
|---|---|---|---|
| | Kolmogorov-Smirnov[a] | | |
| | Statistic | df | Sig. |
| Hospital 30-day Readmissions | .531 | 5503 | <.001 |

Table 14 shows data from a Kolmogrov-Smirnov test with a p-value of .001 to be statistically significant and is not normally distributed. The data points between the independent variables (HTN-C BPs and LOS) and dependent variable (30-day hospital readmissions) are independent of one another and have a continuous distribution. The null hypothesis is rejected; the data deviates from normality and is not normally distributed.

**Table 15**

*Test of Normality, Descriptives, Hospital 30-day Readmissions*

| Descriptives | | | | |
|---|---|---|---|---|
| | | | Statistic | Std. Error |
| Hospital 30-day readmission | Mean | | .10 | .004 |
| | 95% Confidence Interval for Mean | Lower Bound | .09 | |
| | | Upper Bound | .11 | |
| | 5% Trimmed Mean | | .05 | |
| | Median | | .00 | |
| | Variance | | .088 | |
| | Std. Deviation | | .296 | |
| | Minimum | | 0 | |
| | Maximum | | 1 | |
| | Range | | 1 | |
| | Interquartile Range | | 0 | |
| | Skewness | | 2.720 | .033 |
| | Kurtosis | | 5.400 | .066 |

*Note.* The normal distribution table shows that 10% of the population were readmitted within 30 days of hospital discharge.

Table 15, based on the descriptive data, not a normal distribution with 10% of population readmitted within 30 days of hospital discharge. The skewness is represented as positive, with an asymmetry of 2.72% and the outlier for kurtosis was 5.4%.

$H_1$: Prehospital admitted stroke patient LOS is associated with risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes.

The alternative hypothesis is true because there is a relationship between LOS and 30-day hospital readmissions. The length of stay had a positive effect on 30-day hospital readmissions [OR = 1.072, 95% CI (1.011, 1.136), p = .019. The odds ratio revealed that LOS had a positive effect of 7.2% on risk-adjusted 30-day hospital readmissions. The p-value of .019 is statistically significant.

$H_0$: There is no association between prehospital admitted stroke patient LOS and risk-adjusted 30-day hospital readmission when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes.

The null hypothesis is false because there is an association between LOS and risk-adjusted 30-day hospital readmissions. The length of stay had a positive effect on 30-day hospital readmissions [OR = 1.072, 95% CI (1.011, 1.136), p = .019. The odds ratio revealed that LOS had a positive effect of 7.2% on risk-adjusted 30-day hospital readmissions. The p-value of .019 is statistically significant.

**Research Question 2:** To what extent are stages of HTN-C systolic BPs associated with the risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities diabetes I and diabetes II?

**Table 16**

*Binary Logistic Regression Variables, HTN-C, Age, Diabetes, Gender, Race, and 30-day Hospital Readmissions*

**Variables in the Equation**

| | | B | S.E. | Wald | df | Sig. | Exp(B) | 95% C.I. for EXP(B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper |
| Step 1[a] | Gender Recode(1) | 20.435 | 2872.807 | .000 | 1 | .994 | 749386631.910 | .000 | . |
| | Diabetes recodes | | | .000 | 2 | 1.000 | | | |
| | Diabetes 1 | -.646 | 7160.639 | .000 | 1 | 1.000 | .524 | .000 | . |
| | Diabetes 2 | 3.879 | 7279.864 | .000 | 1 | 1.000 | 48.370 | .000 | . |
| | Race Recode | | | .000 | 3 | 1.000 | | | |
| | Race 1, Whites | -21.045 | 5873.717 | .000 | 1 | .997 | .000 | .000 | . |
| | Race 2, Blacks | -20.923 | 3844.430 | .000 | 1 | .996 | .000 | .000 | . |
| | Race 3, Hispanic | -20.717 | 12980.917 | .000 | 1 | .999 | .000 | .000 | . |
| | Age | .021 | .009 | 5.332 | 1 | .021 | 1.021 | 1.003 | 1.039 |
| | Stages HTN-1 | | | 1.447 | 2 | .485 | | | |
| | Stages HTN-2 | -.196 | .360 | .296 | 1 | .587 | .822 | .406 | 1.665 |
| | Stages HTN-3 | .921 | .901 | 1.045 | 1 | .307 | 2.512 | .430 | 14.679 |
| | Constant | -21.828 | 2872.807 | .000 | 1 | .994 | .000 | | |

a. Variable(s) entered on step 1: Gender Recode, Diabetes Recode, Race Recode, Age, Stages HTN-C.

Table 16, the results of binary logistic regression analysis revealed that stages of Systolic HTN-C blood pressures are not a significant predictor of 30-dy hospital readmissions, with p-values for HTN-C 1, a p-value of .485, HTN-C 2, a p-value .587, and HTN-C 3, a p-value of .307.

$H_0$: Prehospital admitted stroke patient HTN-C systolic BPs are not associated with risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities diabetes I and diabetes II.

This assumption is true, and I accept the null hypothesis, and the alternative hypothesis is false.

$H_1$: There is an association between prehospital admitted HTN-C associated with risk-adjusted 30-day hospital readmissions, when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes.

This assumption is false, and I accept the null hypothesis. The results showed that HTN-C systolic BPs are not a significant predictor of 30-dy hospital readmissions, with p-values for HTN-C 1, a p-value of .485, HTN-C 2, a p-value .587, and HTN-C 3, a p-value of .307.

**Research Question 3:** To what extent is prehospital admitted stroke patient length of stay (LOS) and stages of hypertensive crisis (HTN-C) associated with the risk-adjusted 30-day hospital readmissions when controlling for age, gender, race, and comorbidities type I diabetes and type II diabetes

**Table17**

*Binary Logistic Regression Variables, LOS, HTN-C, Age, Diabetes, Gender, Race, and 30-day Hospital Readmissions*

**Variables in the Equation**

| | | B | S.E. | Wald | df | Sig. | Exp(B) | 95% C.I. for EXP(B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper |
| Step 1[a] | Gender recodes | 20.349 | 2824.505 | .000 | 1 | .994 | 687484079.210 | .000 | . |
| | Diabetes recodes | | | .000 | 2 | 1.000 | | | |
| | Diabetes 1 | -.889 | 7059.075 | .000 | 1 | 1.000 | .411 | .000 | . |
| | Diabetes 2 | 4.072 | 7174.691 | .000 | 1 | 1.000 | 58.701 | .000 | . |
| | Race Recode | | | .000 | 3 | 1.000 | | | |
| | Race 1, Whites | -20.998 | 5846.761 | .000 | 1 | .997 | .000 | .000 | . |
| | Race 2, Blacks | -21.037 | 3788.475 | .000 | 1 | .996 | .000 | .000 | . |
| | Race 3, Hispanic | -20.601 | 12983.878 | .000 | 1 | .999 | .000 | .000 | . |
| | Age | .019 | .009 | 4.267 | 1 | .039 | 1.019 | 1.001 | 1.037 |
| | Length of Stay | .069 | .030 | 5.457 | 1 | .019 | 1.072 | 1.011 | 1.136 |
| | Stages HTN-1 | | | 1.572 | 2 | .456 | | | |
| | Stages HTN-2 | -.088 | .366 | .057 | 1 | .811 | .916 | .448 | 1.876 |
| | Stages HTN-3 | 1.077 | .896 | 1.444 | 1 | .229 | 2.937 | .507 | 17.018 |
| | Constant | -22.091 | 2824.505 | .000 | 1 | .994 | .000 | | |

a. Variable(s) entered on step 1: Gender Recode, Diabetes Recode, Race Recode, Age, Length of Stay, Stages HTN-C.

Table 17, the results of binary logistic regression analysis showed the predictor length of stay had a positive effect on 30-day hospital readmissions [OR = 1.072, 95% CI (1.011, 1.136), p = .019. The odds ratio revealed that LOS had a positive effect of 7.2%

on risk-adjusted 30-day hospital readmissions. The p-value of .019 is statistically significant. Systolic HTN-C blood pressures are not a significant predictor of 30-day hospital readmissions, with p-values for HTN-C 1, a p-value of .485, HTN-C 2, a p-value .587, and HTN-C 3, a p-value of .307.

$H_0$: Prehospital admitted patient LOS and stages of hypertensive crisis (HTN-C) are not associated, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

For LOS, the null hypothesis is false because there is an association between LOS and 30-day hospital readmissions [OR = 1.072, 95% CI (1.011, 1.136), p = .019. For HTN-C systolic BPs the alternative hypothesis is true. Systolic HTN-C blood pressures are not a significant predictor of 30-day hospital readmissions, with p-values for HTN-C 1, a p-value of .456, HTN-C 2, a p-value .811, and HTN-C 3, a p-value of .229.

$H_1$: Prehospital admitted patient stroke LOS and stages of hypertensive crisis (HTN-C) are associated, when controlling for age, gender, race, and comorbidities of type I diabetes and type II diabetes.

For LOS, the alternative hypothesis is true because there is an association between LOS and risk-adjusted 30-day hospital readmissions [OR = 1.072, 95% CI (1.011, 1.136), p = .019. For HTN-C systolic BPs the alternative hypothesis is false. Systolic HTN-C blood pressures are not a significant predictor of 30-day hospital readmissions, with p-values for HTN-C 1, a p-value of .456, HTN-C 2, a p-value .811, and HTN-C 3, a p-value of .229.

Table 12, comorbidities diabetes type I with a p-value of 1.00, and OR = .411 at the 95% CI, and diabetes II, with a p-value of 1.00, and OR 58.7, which is not statistically significant. Diabetes type 1 and 2 are shown to have no impact on 30-day hospital readmissions (Schober & Vetter, 2021).

## Summary

Chapter 4 provided the statistical results for the research questions in the investigation. A binary logistic regression analysis was used to test the hypothesis in RQs 1, 2, and 3. The results revealed that Systolic HTN-C blood pressures are not a significant predictor of 30-day hospital readmissions, with p-values for HTN-C 1, a p-value of .456, HTN-C 2, a p-value .811, and HTN-C 3, a p-value of .229. The predictor length of stay had a positive effect on 30-day hospital readmissions [OR = 1.072, 95% CI (1.011, 1.136), p = .019. The odds ratio revealed that LOS had a positive effect of 7.2% on risk-adjusted 30-day hospital readmissions. The p-value of .019 is statistically significant. Age also emerged as a significant predictor (OR = 1.019, 95% CI [1.001, 1.037], p = .039). Comorbidities diabetes type I revealed a p-value of 1.00, and OR = .411 at the 95% CI, and diabetes II, with a p-value of 1.00, and OR 58.7, which is not statistically significant. Diabetes type 1 and 2 are shown to have no impact on 30-day hospital readmissions. Gender had a p-value of .994 and is not statistically significant, with no effect on 30-day hospital readmissions. Also, race had a p-value of .997 and is not statistically significant, with no positive impact on 30-day hospital readmissions. The normality test showed a non-normal distribution of the data for 30-day hospital readmission, with a mean of 10% of the population being readmitted for prehospital related stroke within 30-days of discharge. The skewness is represented as positive, with an asymmetry of 2.72% and the outlier for kurtosis was 5.4%. The Kolmogrov-Smirnov test (Normality test) revealed 30-day hospital readmissions with a p-value of .001 to be statistically significant. The Hosmer-Lemeshow examines if the observed outcomes match the predicted probability. So, $p>0.05$ is a good fit. The Chi-square significance level of 7.608 was observed. P-value $.473 > .05$, which is indicative of the model fitting the data well.

# Chapter 5: Discussion, Conclusions, and Recommendations

## Introduction

The purpose of this quantitative study was to determine whether the stratified stages of prehospital HTN-C blood pressures and LOS are significant predictors of risk-adjusted 30-day hospital readmissions for acute stroke. Earlier research focused only on in-patient-related stroke episodes. In my research, I concentrated only on prehospital related stroke events, in relationship to stages of HTN-C BPs and LOS, and included comorbidities such as age, gender, race, and diabetes II, to determine if a correlation exists involving risk-adjusted 30-day hospital readmissions. I discovered and agreed that a relationship does exist involving the predictor variables age and LOS, which does influence 30-day hospital readmission. Also, according to Ridden et al. (2025), the incident of stroke does magnify with age. Age was found to be multifaceted in shaping the vascular risk factor involving prehospital stroke, relative recovery and associated risk factors such as smoking, alcohol, and psychosocial related stress (Ridden et al., 2025). Additionally, LOS is influenced by multiple reasons, such that early events shape both stroke severity in the arrival and efficiency of treatment. Moreover, from an economic perspective, LOS is also governed by performance measures that are established by Center for Medicare and Medicaid Services that influences the length of time of hospital stay (Rachoin et al., 2020). My research found the mean LOS for prehospital related stroke to be 5.78 days, which compares to the national geometric mean of 5.37 days (Rachoin et al., 2020). The study literature described hypertensive crisis (HTN-C) to be classified into three stages of systolic blood pressure with Stage 1 HTN (140-159 mm/Hg), Stage 2 HTN (160-179 mm/Hg), and Stage 3 HTN (≥ 180 mm/Hg) which can lead to vital body organ. My study revealed that systolic HTN-C blood pressures are not a significant predictor of 30-day hospital readmissions, with p-values for HTN-C 1, a p-value of .485, HTN-C 2, a p-value .587, and HTN-C 3, a p-value of .307. Lastly, comorbidities diabetes type I revealed a p-value of 1.00, and OR = .411 at the 95% CI, and diabetes II, with a p-value of 1.00, and OR 58.7, which is not statistically significant. Diabetes type 1 and 2 are shown to have no impact on 30-day hospital readmissions.

Also, prior literature discussed hospital readmission occurrence as a standard quality of care metric, which is correlated to how well care is delivered against the hospital's scorecard as a measure of performance by hospitalist (Rajagura et al., 2022). My data revealed that as a quality-of-care measure, the mean length of stay in relationship to risk-adjusted 30-day hospital readmissions was 5.78 days, which closely aligns with the national U.S. benchmark of 6.28 days as a predictor or all-causes of stroke and impact on hospital 30-day readmissions range between 10% to 60% (Kurtz et al., 2022). Also, the odds ratio revealed that for every 1 day increase in LOS, the odds of 30-day hospital readmission increase, by 7.2%. The Wald test was 5.457, which is also indicative of a positive influence of 30-day hospital readmissions. In comparison, my research findings align with the national standards.

## Interpretation of the Findings

The findings from my study are similar to prior research, but different because my research focused specifically on prehospital stroke, in relationship to HTN-C, LOS, and influence on 30-day hospital readmissions. For example, earlier research from Rachoin et al. (2020) concentrated on inpatient with a lower length of stay and readmission risk to evaluate if patients with a lower length of stays were readmitted more frequently to the hospital. Their study concluded that inpatients with a higher LOS were older and had a higher probability of being readmitted to the hospital within 30-day. From my research, the binary logistic regression analysis revealed age to be a positive predictor, with a p-value of .039 and is statistically significant, beta coefficient is 1.019, 95% CI. The Wald test has a value of 4.267 and is a significant predictor on prehospital stroke and risk-adjusted 30-day hospital readmissions. In addition, unlike Rachoin et al. (2020), their investigation focused on the impact of age on inpatients hospital readmission. My investigation concentrated on prehospital related stroke events of outpatients, which examined HTN-C systolic BPs and general LOS, and the impact on risk-adjusted 30-day hospital readmission. My results showed that as the LOS to have a positive effect on 30-day hospital readmissions. However, both studies summarized that LOS, whether short or general, does present the significant impact on 30-day hospital readmission. As stated by Rachoin et al. (2020), there are contributing factors that influence LOS, such as socioeconomic status, disparity in care, as well as social determinants of health. As noted by Ikeme et al. (2022), the quality of how stroke care is delivered, disproportionally impacts racial minority groups when compared to Whites. Specifically, education, income or employment status, trust in the healthcare system, or social support network, which can often affect access and frequency of how often healthcare is used by minority groups, in contrast to Whites. For example, my investigation revealed that White males were more prone to using the healthcare system and compromised 60.2% versus African

American males 19.5% of respondents that notified emergency medical service personnel of a suspected prehospital stroke episode (Ikeme et al., 2022).

Additionally, the research findings are significant because patients with a high case-mix index or complex clinical conditions, such as stroke, diabetes, or cardiovascular disease that undergo a hospital LOS experience a higher probability of risk-adjusted 30-day hospital readmissions (Rachoin et al., 2020). Additionally, based on Kaplan Meyer data, readmission rates were 9.7% higher when patients are discharged within 30 days of readmissions, and 30.5% higher at 1 year following initial hospital discharge (Zou et al., 2023). Moreover, as LOS increased, due to incomplete rehabilitation from early discharge or prolonged hospitalization, which can result in hospital-acquired infections, both impacted risk-adjusted 30-day hospital readmissions (Rachoin et al., 2020). Also, the severity of illness, social determinants of health, insurance type, diagnosis related group - stroke, case mix index, discharge plan of care, and characterization of prehospital stroke episode whether ischemic stroke, intracerebral hemorrhage, or subarachnoid hemorrhage will influence the mean LOS and days of hospitalization (Patel et al., 2022).

Also, Ashraf et al. 2022 investigation examined the relationship between HTN-C and risk-adjusted 30-day hospital readmission only, and there was no mention of LOS. Their research revealed that 10.68% of patients were readmitted within 30 days, and 19% were due to HTN-C. My research examined HTN-C BPs to have no effect on 30-day hospital readmission and LOS to have a positive impact on hospital readmissions and that 7.2% of patients would be readmitted to the hospital within 30 days following discharge.

Additionally, Richard et al. (2023) studied prehospital protocoling, stroke screening, emerging technologies used by emergency medical service personnel, and the evaluation and treatment of a patient with a suspected stroke, as well as barriers to deploying processes in care. As noted earlier in my research, effective prehospital care begins with accurate data, the employment of reliable telecommunication systems, and communication with providers and caregivers who are receiving primary stroke. Richard's results concluded that equipment limitations, severe time constraints, and equipment limitations for managing a suspected stroke vary widely across the United States and subsequently often interfered with data collection when assessing a prehospital stroke patient. I agree with these findings. During my research of the record analysis, I discovered that important stroke information was missing from the case report, such as no gender identity, age, or race.

Lastly, Teisan et al. (2023), conducted a 20-year study to examine LOS reduction and impact on risk-adjusted 30-day hospital readmissions in older patients over 79 years of age. The study concluded that a slow reduction in LOS in older patients over 79 is associated with a higher 30-day readmission occurrence. The findings suggested that careful pre-discharge planning is warranted in older people (Teisan et al., 2023). My research included confounding variables such as age, gender, and diabetes 1 and 2 analysis for prehospital stroke. Additionally, my research concluded that HTN-C BPs and LOS have a moderate influence and that 7.2% of patients would be readmitted to the hospital within 30 days following discharge. Moreover, LOS was shown to have a positive correlation, and logistic relationship exists between risk-adjusted-day hospital readmissions and LOS. Meaning as LOS increases, so does the tendency for 30-day hospital readmissions, with increased hospital readmission time. As noted in Figure 4, the histogram analysis of LOS and 30-day hospital readmissions delineated the No distribution of having a mean LOS of 5.39 days and population of 441, with no hospital readmissions within 30 days of the initial discharge. The Yes distribution showed a mean LOS of 7.74 days and population size of 86, with yes of being readmitted within 30 days of hospital discharge. The long right tail represented a small number of patients with extended hospitalization. Stroke patients who were readmitted within 30-days showed a longer hospital LOS on the readmission when compared to their initial or index admission. Stroke patients that were readmitted within the 30 days of discharge often had longer hospital stays for the following reasons: greater clinical severity at readmission, possible functional decline after the index hospital hospitalization, complex comorbidities, discharge planning challenges, lack of psychosocial and care giver support requiring longer case management, and a more cautious discharge approach by providers and administrators due to financial penalties from CMS (Dhaliwal & Dang, 2024).

During the data analysis and compilation phase of the investigation, I often found important clinical and patient care information missing from the standardized case report that was collected by EMS personnel. Therefore, the research data was insufficient at this time of the research, relative to prehospital HTN-C and LOS in relationship to the effects on 30-day hospital readmission (Wang & Zhu, 2022). For example, during the course my investigation, I discovered that prehospital secondary data that was collected by the scribe or first responders was missing important data fields or incomplete information, because the data was manually entered into the standardized case report from GWTG-S (Get with the Guidelines Stroke Overview, 2023). Certainly, automation and digital integration of information such as the use of mobile health technology, such as a Rover device or iPad can provide ease of inputting information into standardized case report with integration into the hospital's EMR system, would help to mitigate such errors (Alotaibi et al., 2023). Hence, the data from the standardized case report form should contain or code for the mode of transport, either EMS or emergency transport from home or scene, air transport or mobile stroke unit; documentation of the prehospital patient's clinical diagnosis, demographics, vital signs, and blood glucose to rule out diabetes I or II (Get with the Guidelines Stroke Overview, 2023; Appendix D). Also, the number of patients identified in the original data count was 5,503, with 527 cases eligible for the investigation shown in Table 7 (GWTG-S, 2023). The sum of missing cases was 254 due to incomplete data, missing data points, such as no gender identity or missing systolic blood pressure reports. Therefore, to advance prehospital emergency stroke care, more formalized, digital and automated information, accurate administrative, and clinical data are needed across the healthcare continuum, which will help for more credible research in relationship to prehospital HTN-C stroke and LOS relative to risk-adjusted 30-day hospital readmission encounters (Alotaibi et al., 2023).

Furthermore, the Donabedian theory and patient center care model were foundational in providing a more in-depth understanding of healthcare quality and yielding a theoretical framework to addressing the care of stroke patients with hypertension crises, focusing on outcomes like hospital LOS and risk-adjusted 30-day hospital readmissions (Binder et al., 2021). As stated by Binder et al. (2021), the healthcare model provided a comprehensive and multi-discipline structure for analyzing healthcare delivery, such as quality, safety, affordability, efficiency, and patient satisfaction. Donabedian's theory focused on three key dimensions, as well as a change in thinking for evaluating and improving healthcare quality based on a structure, process, and outcome (Duncan et al., 2020). For example, Structure entails the physical and organizational infrastructure of healthcare settings, such as appropriate staffing levels, equipment, and hospital policies. Prehospital stroke care includes the availability of specialized EMS or mobile stroke units, access to timely diagnostic imaging, tissue-type plasminogen activator utilization, endovascular therapy, and hypertension crisis management protocols (Duncan et al., 2020). Process involves the methods and practices through which care is delivered. The clinical interventions, treatment adherence, and communication among healthcare providers. During hypertension crisis management, process elements could include timely administration of antihypertensive medications, continuous monitoring of blood pressure, and coordination of care between neurologists, cardiologists, and hospital staff. Finally, is Outcome, which involves the output or results from HTN-C management, duration or lower LOS, and lower hospital risk-adjusted 30-day hospital readmissions (Duncan et al., 2020).

The Patient Center Care Model (PCC) emphasized treating patients as active members in their care, respecting their preferences, personal needs, values, belief systems, and preferred language (Nelson et al., 2024). Therefore, by using Donabedian's theory and the PCC model collectively, healthcare systems can focus both on the structural and process improvements necessary for better outcomes in stroke care and prehospital hypertension management, will ensure that care is customized to the patient's individual needs and preferences (Nelson et al., 2024).

Finally, the findings of this research are anticipated to promote positive social change by enhancing quality of life, reducing LOS, and lowering the risk-adjusted 30-day hospital readmissions for post-stroke patient recoveries. Lastly, three research questions were discussed during the investigation. Retrospective secondary prehospital data was used from GWTG-S, which was then analyzed for all three research questions.

For RQ 1 and 2, I employed a binary regression analysis and RQ 3 a logistic regression analysis, to determine if a relationship exists between the explanatory independent variables (IDVs) and response DV. As mentioned earlier, a patient-centered care (PCC) Model, a Donabedian Conceptual Theory, guided the research (Binder et al., 2021). Furthermore, three research questions were discussed during the investigation. Retrospective secondary prehospital data was used from GWTG-S. The data was then analyzed for all three research questions.

## Limitations of the Study

There was little or no prehospital HTN-C systolic BPs data available that had investigated conventional prehospital stroke care. Moreover, the definition of what constitutes hospital readmission and discharge planning around stroke care varies across hospitals relative to LOS is confusing within the text and scope of 30-day hospital readmission, but with opportunities to improve the quality of care surrounding stroke (Dhaliwal & Dang, 2024). However, there is consistency within the literature review on how many hospitals have introduced interventions to managing HTN-C, reducing hospital LOS, and risk-adjusted 30-day hospital readmissions, but generalizable metrics are lacking on evidence-based practice to managing prehospital HTN-C related stroke, LOS, and hospital risk-adjusted 30-day hospital readmissions (Carey et al., 2021).

Additional limitations of the research included insufficient and consistent scientific data that addresses prehospital HTN-C and LOS in relationship to the effects on risk-adjusted 30-day hospital readmission occurrence. As mentioned earlier, I found there was important clinical and patient care information missing from the standardized case report that was collected by EMS personnel. Therefore, the research data was insufficient at this time of the research, relative to prehospital HTN-C and LOS in relationship to the effects on risk-adjusted 30-day hospital readmissions (Wang & Zhu, 2022). For example, during the course my investigation, I discovered that prehospital secondary data that was collected by the scribe or first responders was missing important data fields or incomplete information, because the data was manually entered onto the standardized case report from GWTG-S (Get with the Guidelines Stroke Overview, 2023). Therefore, more formalized, digital and automated information, accurate administrative, and accurate clinical data are needed for more credible research in relationship to prehospital HTN-C stroke and LOS relative to risk-adjusted 30-day hospital readmission encounters (Alotaibi et al., 2023).

## Recommendations

The research findings suggested that prehospital HTN-C impacted White American males the most. According to the data, the most impacted group by size, relative to length of stay were Whites (*n* = 317) or 6.02 days, African Americans (n = 103) or 5.12 days, and Hispanics (n = 99) or 5.79 days (Rachoin et al., 2020). Gender represented 61.9% (n = 326) were males, 5.94 days, and 38.1% (n = 201), 5.51 days were females. Age was discovered to be a positive indicator of risk-adjusted 30-day hospital readmissions, with a p-value of .039 and is statistically significant, Wald test of 4.267, and has a beta coefficient of .019 and odds ratio of 1.019, 95% CI.

My analysis suggests that there is no association between stratified HTN-C systolic BPs, but LOS does have a positive impact on 30-day hospital readmissions. Future recommendations would include better maximization of digital technology, automation, and less manual paper documentation, which had a greater propensity for human errors, to enhance administrative and clinical efficiency involving prehospital hypertensive crisis stroke episodes. Hence, these efforts would elicit higher effectiveness, efficiency, and safe care, as well as mitigate time delays. Additionally, control heterogeneity and variability in the data collection process are paramount for predicting prehospital HTN-C stroke outcomes relative to LOS and risk-adjusted 30-day hospital readmission outcomes.

## Implications

The positive social change implications may help to improve public education and awareness, quality of life, reduce length of stay, research and policy development, and lower the risk-adjusted 30-day hospital readmissions for post-stroke patient recoveries.

Early identification and treatment of prehospital stroke are important to improving stroke outcomes and ultimately will accelerate hospital arrival times, allowing for timely administration of treatments like thrombolysis or thrombectomy that will lead to better outcomes and mitigate LOS. As noted earlier, the most impacted group by size, relative to length of stay were Whites (*n* = 317) or 6.02 days, African Americans (n = 103) or 5.12 days, and Hispanics (n = 99) or 5.79 days (Rachoin et al., 2020). As stated by Jamil and Patoli (2021), length of stay is a metric based on the reduced number of days that varies from prescribed treatment that is determined by CMS, in accordance with the diagnosis related group (DRG). According to Ashcroft (2022), longer LOS can be related to disease severity or more complex conditions and shorter LOS due to disparities in access to preventive care or higher rates of premature discharges. As mentioned earlier, HTN-C is a life-threatening condition, that impacts 45.6% adults in North America, and accounts for 10.8% of risk-adjusted 30-day hospital readmissions and had a mean risk adjusted 30-day hospital readmissions of 4.5 days following hospital discharge (Ashcroft et al., 2022).

Previous stroke-related research focused on in-patient settings; there had been no research that focused on prehospital HTN-C stroke and LOS and the influence on risk-adjusted 30-day hospital readmissions. My research found there to be no correlation between stages of HTN-C SBPs, suggestive of other vascular risk factors involving the cause and burden of stroke such as smoking, alcohol use, and psychosocial (Reddin, et al., 2025) . The results were surprising because in North America, prehospital hypertensive crisis accounts for over 75% of acute stroke cases in the United States managed by emergency medical services (EMS) personnel. Moreover, in the United States, HTN-C is associated with approximately 15–20% of hospital readmissions within

30 days and significantly contributes to the burden of cardiovascular disease (Kumar et al., 2019).

## Conclusion

There is no data available that has researched prehospital hypertensive crisis systolic blood pressure, and LOS in relationship to risk-adjusted 30-day hospital readmissions. The investigation revealed a positive association between the predictors age, and LOS, which does influence 30-day hospital readmissions. The logistic regression model showed that prehospital predictors HTN-C systolic blood pressures did not impact 30-dayhospital readmissions and LOS, as well as age were positive indicators of risk-adjusted 30-day hospital readmissions. The odds ratio revealed that as LOS increases, the odds of 30-day hospital readmissions increased by 7.2% higher odds of the outcome. Meaning, for each 1-unit increase in the predictor LOS, the odds of the outcome increase by 7.2%. LOS had a p-value of .019 and is statistically significant at the 95% CI. The beta coefficient was .069 and does have a positive effect on 30-day hospital readmissions. The upper limit of the distribution curve is 1.011 and lower end is 1.136. Age had a p-value of .039 and is statistically significant at the 95% CI. The beta coefficient was .019, odds ratio 1.019. The upper limits of the distribution curve were 1.001 and lower end 1.037. Therefore, age and LOS are shown to be predictors of hospital risk-adjusted 30-day readmissions for prehospital stroke.

Also, when managing strokes, control for optimal hospital LOS, discharge planning, and medication management can all effectively help to manage prehospital related stroke and reduce extended hospital LOS and prevent the reoccurrence of 30-day hospital readmission (Ashraf et al., 2022). As mentioned earlier, the potential predictors of risk-adjusted 30-day hospital readmissions are hospital LOS and HTN-C blood pressure or cardiovascular disease, which was revealed to be a predictor of 30-day hospital readmissions. Also, the economic driver for hospital LOS is influenced by CMS that penalizes medical facilities for unrelated hospital readmissions that occur within 30-days of disposition or discharge. High readmissions occurrence also adversely impacts a hospital's quality of care metrics of Leapfrog standing of how well they deliver care. As shown in the research data, the patient that experienced an initial three-day LOS in the hospital, experienced over 30 days in the hospital on readmission, especially for stroke and other complicated comorbidities. Hence, there is a positive correlation between 30-day hospital readmission and LOS. The findings are significant because patients with a high case-mix index or complex clinical conditions, such as a stroke or cardiovascular disease, which undergo a hospital LOS experience a higher probability of hospital 30-day readmissions. Lastly, the finding implies that more proactive methods are needed for managing prehospital related stroke of all ranges, as well as optimal LOS may reduce the occurrence in 30-day hospital readmissions and possibly mitigate the episode of a stroke and risk-adjusted 30-day hospital readmissions.

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# Appendix A: NIH Stroke Scale

| Category | Score/Description | | Date/Time Initials | Date/Time Initials | Date/Time Initials | Date/Time Initials | Date/Time Initials |
|---|---|---|---|---|---|---|---|
| **1a. Level of Consciousness** (Alert, drowsy, etc.) | 0 = Alert<br>1 = Drowsy<br>2 = Stuporous<br>3 = Coma | | | | | | |
| **1b. LOC Questions** (Month, age) | 0 = Answers both correctly<br>1 = Answers one correctly<br>2 = Incorrect | | | | | | |
| **1c. LOC Commands** (Open/close eyes, make fist/let go) | 0 = Obeys both correctly<br>1 = Obeys one correctly<br>2 = Incorrect | | | | | | |
| **2. Best Gaze** (Eyes open - patient follows examiner's finger or face) | 0 = Normal<br>1 = Partial gaze palsy<br>2 = Forced deviation | | | | | | |
| **3. Visual Fields** (Introduce visual stimulus/threat to pt's visual field quadrants) | 0 = No visual loss<br>1 = Partial Hemianopia<br>2 = Complete Hemianopia<br>3 = Bilateral Hemianopia (Blind) | | | | | | |
| **4. Facial Paresis** (Show teeth, raise eyebrows and squeeze eyes shut) | 0 = Normal<br>1 = Minor<br>2 = Partial<br>3 = Complete | | | | | | |
| **5a. Motor Arm - Left**<br>**5b. Motor Arm - Right**<br>(Elevate arm to 90° if patient is sitting, 45° if supine) | 0 = No drift<br>1 = Drift<br>2 = Can't resist gravity<br>3 = No effort against gravity<br>4 = No movement<br>X = Untestable (Joint fusion or limb amp) | Left | | | | | |
| | | Right | | | | | |
| **6a. Motor Leg - Left**<br>**6b. Motor Leg - Right**<br>(Elevate leg 30° with patient supine) | 0 = No drift<br>1 = Drift<br>2 = Can't resist gravity<br>3 = No effort against gravity<br>4 = No movement<br>X = Untestable (Joint fusion or limb amp) | Left | | | | | |
| | | Right | | | | | |
| **7. Limb Ataxia** (Finger-nose, heel down shin) | 0 = No ataxia<br>1 = Present in one limb<br>2 = Present in two limbs | | | | | | |
| **8. Sensory** (Pin prick to face, arm, trunk, and leg - compare side to side) | 0 = Normal<br>1 = Partial loss<br>2 = Severe loss | | | | | | |
| **9. Best Language** (Name item, describe a picture and read sentences) | 0 = No aphasia<br>1 = Mild to moderate aphasia<br>2 = Severe aphasia<br>3 = Mute | | | | | | |
| **10. Dysarthria** (Evaluate speech clarity by patient repeating listed words) | 0 = Normal articulation<br>1 = Mild to moderate slurring of words<br>2 = Near to unintelligable or worse<br>X = Intubated or other physical barrier | | | | | | |
| **11. Extinction and Inattention** (Use information from prior testing to identify neglect or double simultaneous stimuli testing) | 0 = No neglect<br>1 = Partial neglect<br>2 = Complete neglect | | | | | | |
| | TOTAL SCORE | | | | | | |

# Appendix B: Modified Stroke Scale

Illustrates a modified version of the mNIHSS

The levels of stroke severity as measured by the NIH stroke scale scoring algorithm:

- 0 = no stroke
- 1-4 = minor stroke
- 5-15 = moderate stroke
- 15-20 = moderate/severe stroke
- 21-42 = severe stroke

Appendix C: Get With the Guidelines Stroke Case Report Form

American Heart Association®
Mission:Lifeline®
Stroke

# PREHOSPITAL CARE MEASURES

JANUARY 1, 2023

Prehospital Case Report Form Updated January 2023

**Contents**

## 1. Door-in-Door-Out Times Prior to Transfer for Acute Therapy for Patients Transported to First Hospital by EMS

**Patients with a confirmed diagnosis of Ischemic stroke who were transported to your hospital by EMS grouped by time spent in the ED prior to transfer to a higher-level stroke center (e.g. PSC, CSC, etc.) for time-critical therapy.**

| Initial Patient Population | Coding Instructions |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population who were transported to your hospital by EMS and who were transferred to a higher-level stroke center for time-critical therapy. | **Same as initial patient population**<br>**AND**<br><br>**How patient arrived at your hospital:** = EMS from home/ scene<br>**AND**<br><br>**Patient Not Admitted: =** Yes, not admitted<br>**AND**<br><br>**Reason Not Admitted =** Transferred from your ED to another acute care hospital<br>**AND**<br><br>**Transport from your hospital to another acute care facility:** = Evaluation for IV alteplase up to 4.5 hours<br>OR = Post Management of IV alteplase (e.g. Drip and Ship)<br>OR = Evaluation for Endovascular thrombectomy |
| **Exclusions: (Always remove from denominator)** | **Coding Instructions** |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial<br><br>Missing or invalid Times in Calculations. | **Patient location when stroke symptoms discovered** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:** = Transfer from another hospital<br>**OR**<br><br>**Elective Carotid Intervention:** = Yes<br>**OR**<br><br>**Clinical Trial:** = Yes<br>**OR**<br><br>**Arrival Date/Time** = null, Unknown, or only MM/DD/YYY<br>**OR**<br><br>**Discharge Hospital Times:** is blank, Unknown, or only MM/DD/YYY<br>OR = Negative times (Arrival date/time > Discharge date/time) |
| **Exceptions: (Remove from denominator if present and numerator is not met)** | |
| None. | N/A |
| **Numerator** | **Coding Instructions** |
| **REPORT AS:**<br>***Per patient:*** Time in minutes from arrival at the referring center ED to discharge from the referral center ED. | **Discharge Date/time** MINUS **Arrival Date/Time** |
| **GRAPHICAL DISPLAY** | |

| *Per patient population:* | **Discharge Date/ Time MINUS Arrival Date/ Time** |
|---|---|
| Time from arrival at the referral center to discharge from the referral center for all patients in the denominator. | Plot bars as a percent of total denominator after all exclusions are applied<br><br>**Group 1:** 0 -15 Minutes<br>**Group 2:** 16 - 30 Minutes<br>**Group 3:** 31 - 45 Minutes<br>**Group 4:** 46 - 60 Minutes<br>**Group 5:** 61 - 75 Minutes<br>**Group 6:** 76 - 90 Minutes<br>**Group 7:** 90 - 105 Minutes<br>**Group 8:** 105 – 120 Minutes<br>**Group 9:** > 120 Minutes<br><br>Report the mean, median, standard deviation and range.<br><br>Total of all 9 bars will = 100%. |

## 2. Documentation of Time Last Known Well

**Percentage of confirmed stroke patients transported to your hospital by EMS and for whom a time "Last Known Well" (LKW) of Stroke Symptoms was documented.**

| Initial Patient Population | Coding Instructions |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population. | **Same as initial patient population** |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial<br><br>LKW is Unknowable | **Patient location when stroke symptoms discovered:** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:**<br>= 3 [Transfer from another hospital]<br>**OR**<br><br>**Elective Carotid Intervention:** = yes<br>**OR**<br><br>**Clinical Trial**: = Yes<br>**OR**<br><br>**LKW Unknowable:** = unknowable |
| **Exceptions: (Remove when numerator is not met)** | |
| None | N/A |
| **Numerator** | |

| | |
|---|---|
| Patients with documentation of date and time of last known well or date and time of discovery of stroke symptoms by prehospital care providers. | **Date/Time of LKW per EMS:** = is not NULL **AND** in MM/DD/YYYY HH:MM format |
| **GRAPHICAL DISPLAY:** | |
| | |

## 3. Documentation of Time of Discovery of Stroke Symptoms

**Percentage of confirmed stroke patients transported to your hospital by EMS and for whom a time "Time of Discovery" of Stroke Symptoms was documented.**

| Initial Patient Population | Coding Instructions |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br>**Final clinical diagnosis related to stroke** = Ischemic Stroke<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified) |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population. | **Same as initial patient population** |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br>Transferred patients from hospice or different hospital<br>Elective Carotid Intervention<br>Clinical Trial<br>Patients where TOD of Stroke Symptoms is Unknowable | **Patient location when stroke symptoms discovered:** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br>**How patient arrived at your hospital:** = Transfer from another hospital<br>**OR**<br>**Elective Carotid Intervention:** = Yes<br>**OR**<br>**Clinical Trial**: = Yes<br>**OR**<br>**TOD of Stroke Symptoms Unknowable:** = Unknowable |
| **Exceptions: (Remove when numerator is not met)** | |
| None | N/A |
| **Numerator** | |
| Patients with documentation of date and time of discovery of stroke symptoms by prehospital care providers. | **Date/Time of Discovery of Stroke Symptoms as Documented by EMS**: = is not NULL **AND** in MM/DD/YYYY HH:MM format |
| **GRAPHICAL DISPLAY:** | |

| | |
|---|---|
| | **Group 1: Arrival date/Time - EMS Arrived at Patient)** is between 46 and 60 minutes<br><br>**Group 1: Arrival date/Time - EMS Arrived at Patient)** is between 61 and 75 minutes<br><br>**Group 1: Arrival date/Time - EMS Arrived at Patient)** is between 76 and 90 minutes<br><br>**Group 1: Arrival date/Time - EMS Arrived at Patient)** is between 91 and 105 minutes<br><br>**Group 1: Arrival date/Time - EMS Arrived at Patient)** is between 106 and 120 minutes<br><br>**Group 1: Arrival date/Time - EMS Arrived at Patient)** is greater than 120 minutes |

## 5. Evaluation of Blood Glucose

**Percentage of confirmed stroke patients transported to your hospital by EMS and for whom blood glucose was evaluated by EMS.**

| Initial Patient Population | Coding Instructions |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population. | **Same as initial patient population** |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered:** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:** = Transfer from another hospital<br>**OR**<br><br>**Carotid Intervention:** = Yes<br>**OR**<br><br>**Clinical Trial**: = Yes |
| **Exceptions: (Remove from denominator if numerator is not met)** | |

| | |
|---|---|
| Documented reason(s) for why blood glucose level could not be measured prior to hospital arrival. | **Blood Glucose Level:** = glucometer not available<br>OR = [patient refused |
| **Numerator** | |
| Patients whose blood glucose was evaluated by EMS prior to hospital arrival. | **Blood Glucose level:** is NOT null<br>**OR**<br><br>**Blood Glucose level:** = too high<br>OR = too low |
| **GRAPHICAL DISPLAY:** | |
| | |

## 6. Identification of Suspected Strokes- Rate Based

**Percentage of confirmed stroke patients transported to your hospital by EMS and identified as suspected strokes.**

| Initial Patient Population | Coding Instructions |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit]<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = 4 Subarachnoid Hemorrhage<br>OR = 5 Intracerebral Hemorrhagic<br>OR = 6 Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population. | **Same as the initial patient population.** |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered:** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:**<br>OR = Transfer from another hospital<br>OR = Transfer from Hospice<br>**OR**<br><br>**Elective Carotid Intervention:** = Yes<br>**OR**<br><br>**Clinical Trial**: = Yes |
| **Exceptions: (Remove from denominator if present and numerator is not met)** | |
| None | N/A |
| **Numerator** | |

| | |
|---|---|
| | **Categorical graph: Create 5 groups**<br><br>**Group 1**: 0 - 5 minutes<br>**Group 2:** 6 - 10 minutes<br>**Group 3:** 11 - 15 minutes<br>**Group 4:** 16 - 20 minutes<br>**Group 5:** 21 - 25 minutes<br>**Group 6:** 26 – 30 minutes<br>**Group 7:** > 30 minutes |

## 8. On-Scene Time ≤ 15 Minutes for Suspected Stroke - Rate

**Distribution of times for suspected stroke patients transported to your hospital by EMS. Based on AHA Guidelines, the goal for EMS on-scene time is ≤ 15 minutes.**

| Initial Patient Population | Coding Instructions |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population identified as suspected strokes by EMS. | Same as initial patient population.<br>**AND**<br><br>**EMS Provider Primary Impression of Stroke:** = Yes |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial<br><br>Missing or invalid times | **Patient location when stroke symptoms discovered** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:** = Transfer from another hospital<br>OR = Transfer from Hospice<br>**OR**<br><br>**Elective Carotid Intervention:** = Yes<br>OR<br><br>**Clinical Trial**: = Yes<br>OR<br><br>**EMS Unit Arrived on Scene:** = Blank, Unknown, or just MM/DD/YYY<br>OR<br><br>**EMS Unit Left Scene:** = Blank, Unknown, or just MM/DD/YYY<br>OR<br><br>Negative time: **EMS Unit Arrived on Scene** > **EMS Unit Left Scene** |
| **Exceptions: (Remove from denominator if present and numerator is not met)** | |
| None | N/A |

## 10. Stroke Screen Performed and Reported Distributed

**Distribution of Stroke Screens Used for Patients Transported to your Facility.**

| **Initial Patient Population** | **Coding Instructions** |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population. | **Stroke screen used:** = screening tool selected (BE FAST, CPSS, DPSS, FAST, LAPSS, MEND, MASS, Med PACS, mLAPSS, OPSST, ROSIER, Stroke screen tool used, but tool used is unknown, or Other) |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered:** = Stroke occurred after hospital arrival-In ED/Obs/Inpatient<br>**OR**<br>**How patient arrived at your hospital:** = Transfer from another hospital<br>OR = Transfer from Hospice<br>**OR**<br>**Elective Carotid Intervention:** = Yes<br>**OR**<br>**Clinical Trial**: = Yes |
| **Exceptions: (Remove from denominator if present and numerator is not met)** | |
| None | N/A |
| **Numerator** | |
| Prehospital Screening tool used, and outcome documented | **13 Groups:**<br>**Group 1:** Stroke screen tool used, but tool used is unknown<br>**Group 2:** CPSS<br>**Group 3:** DPSS<br>**Group 4:** FAST<br>**Group 5:** LAPSS |

| | |
|---|---|
| | **Group 6:** MASS<br>**Group 7:** Med PACS<br>**Group 8:** mLAPSS<br>**Group 9:** OPSST<br>**Group 10:** ROSIER<br>**Group 11:** Other<br>**Group 12:** BE FAST<br>**Group 13:** MEND<br><br>Plot bars as a percent of total denominator after all exclusions are applied. Total of all 13 bars will not = 100%. |
| **GRAPHICAL DISPLAY:** | |
| Stroke Screen Selected as a distribution, displayed as percentage. | |

## 11. Stroke Severity Screen Performed and Reported- Rate Based

**Percentage of confirmed stroke patients transported to your hospital by EMS and for whom a validated regional or national severity screen tool was used with documentation of the outcome.**

| Initial Patient Population | Coding Instructions | Comments |
|---|---|---|
| **Include:** | | |
| All patients age 18 years and older with a final clinical diagnosis of acute ischemic stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified | |
| **Denominator** | | |
| **Include:** | | |
| All patients in the initial patient population. | **Same as initial patient population** | |
| **Exclusions: (Always remove from denominator)** | | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered:** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:** = Transfer from another hospital<br>OR = Transfer from Hospice<br>**OR**<br><br>**Elective Carotid Intervention:** = 1 Yes<br>**OR**<br><br>**Clinical Trial**: = Yes | |
| **Exceptions: (Remove from denominator if present and numerator is not met)** | | |
| None | N/A | |
| **Numerator** | | |

| | |
|---|---|
| Severity Screen completed with documentation of severity score. | **Stroke Severity Scale Used:** = (CPSSS/CSTAT, FAST ED, LAMS, MPSS, RACE, VAN, Other, or Severity scale used, but tool used is unknown)<br>**AND**<br><br>**Severity Score Documented:** is NOT null.<br><br>**OR**<br><br>**{Stroke Severity Scale Used: =** VAN<br><br>**AND**<br><br>**Positive for LVO? =** Positive or Negative} |

## 12. Stroke Severity Screen Performed and Reported- Distribution

**Distribution of Stroke Severity Screen Performed of confirmed stroke patients transported to your hospital by EMS and for whom a validated regional or national severity screen tool was used.**

| Initial Patient Population | Coding Instructions |
|---|---|
| **Include:** | |
| All patients age 18 years and older with a final clinical diagnosis of acute ischemic stroke transported to your hospital by EMS. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic)<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | |
| All patients in the initial patient population. | **Stroke Severity Scale Used: =** (CPSSS/CSTAT, FAST ED, LAMS, MPSS, RACE, VAN, Other, or Severity scale used, but tool used is unknown) |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or different hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered:** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:** = Transfer from another hospital<br>OR = Transfer from Hospice<br>**OR**<br><br>**Elective Carotid Intervention:** = Yes<br>**OR**<br><br>**Clinical Trial**: = 1 Yes |
| **Exceptions: (Remove from denominator if present and numerator is not met)** | |
| None | N/A |
| **Numerator** | |

Calculate time difference:
**First pass Date/Time** MINUS **EMS Arrived at Patient** for each patient:

**Group 1:** (**First pass Date/Time – EMS Arrived at Patient)** is ≤ 30 minutes

**Group 2:** (**First pass Date/Time - EMS Arrived at Patient)** is between 30 and 60

**Group 3:** (**First pass Date/Time -** Date/time **Date/time First medical contact)** is between 60 and 90

**Group 4:** (**First pass Date/Time - EMS Arrived at Patient)** is between 90 and 120

**Group 5: (First pass Date/Time - EMS Arrived at Patient)** is between 120 and 150

**Group 6:** (**First pass Date/Time - EMS Arrived at Patient)** is between 150 and 180

**Group 7:** (**First pass Date/Time - EMS Arrived at Patient)** Is between 180 and 210

**Group 8:** (**First pass Date/Time - EMS Arrived at Patient)** Is between 210 and 240

**Group 9:** (**First pass Date/Time - EMS Arrived at Patient)** Is between greater than 240.

**[Group 10: Documented Reasons for Delay in Performing Mechanical Endovascular Reperfusion Therapy:** = Yes
**AND**
**Reasons for Delay in MER Therapy:** = Social/religious
OR = Initial refusal
OR = Care-team unable to determine eligibility
OR =Management of concomitant emergent/acute conditions such as cardiopulmonary arrest, respiratory failure (requiring intubation)
OR = Investigational or experimental protocol for thrombolysis]

**Plot bars as percent of (total denominator after all exclusions are applied + patients excluded due to missing or invalid times).**

| | | |
|---|---|---|
| None | None | |
| | | |
| ***Per patient:***<br><br>Time in 30-minute intervals for patients fro<br>medical contact to administration of IV alte<br>first hospital. | Calculate the difference:<br>**IV t-PA initiated at this hospital (Date/Time)** MINUS **EMS Arrived at Patient** for each patient:<br><br>**Group 1: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is less than or Equal to 30 Minutes<br><br>**Group 2: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is between 30 Minutes and 60 Minutes<br><br>**Group 3: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is between 60 Minutes and 90 Minutes<br><br>**Group 4: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is between 90 Minutes and 120 Minutes<br><br>**Group 5: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is between 120 Minutes and 150 Minutes<br><br>**Group 6: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is between 150 Minutes and 180 Minutes<br><br>**Group 7: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is between 180 Minutes and 210 Minutes<br><br>**Group 8: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is between 210 Minutes and 240 Minutes<br><br>**Group 9: (IV t-PA initiated at this hospital (Date/Time) - EMS Arrived at Patient)** is greater than 240 minutes<br><br>**Statistics:** mean, standard deviation, median and range of tim<br>Known Well by EMS to IV alteplase initiated at this hospital (Da | |
| | | |
| ***Per patient population:*** | | Note: All graphs to displayed as percentages. |

## 15. Hospital Pre-Notification with Triage Findings [Coverdell and West Region only]

**Percentage of stroke transports where prehospital care providers called in a stroke alert prenotification to the receiving hospital.**

| Initial Patient Population | |
|---|---|
| All patients age 18 years and older with a final clinical diagnosis of stroke who were transported to the hospital by prehospital care providers. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = 2 Ischemic Stroke |



| | |
|---|---|
| | OR = TIA<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | **Data Elements for Calculation** |
| All patients in the initial patient population. | **Same as initial patient population**<br>**AND**<br><br>**EMS Provider Primary Impression of Stroke:** = Yes |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or another hospital<br><br>Negative time difference<br><br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br><br>**How patient arrived at your hospital:** = Transfer from a different hospital<br>OR = Transfer from Hospice<br>**OR**<br>**Negative time:** EMS Arrival time > EMS Scene Departure time<br><br>**Elective Carotid Intervention:** = Yes<br>OR<br>**Clinical Trial**: = Yes |
| **Exceptions: (Remove from denominator if present and numerator is not met)** *Note: In the PMT, this is achieved via enabling rules or parent/child relationships between variables)* | |
| None. | N/A. |
| **Numerator** | |
| Patients with advanced notification of the hospital by prehospital care providers. | **Prenotification Notification of stroke patient**: = Yes<br>**AND**<br>**Information Provided by EMS in pre-notification call:** = Blood Glucose value<br>Or = blood pressure<br>Or = Pre-hospital Stroke Screen<br>Or = Time of LKW per Prehospital Care Provider<br>Or = Seizure Activity<br>Or = O2 < 94% |
| **Display of Graphs** | |

## 16. Hospital Pre-Notification with Triage Findings- Distribution [Coverdell and West Region only]

Distribution of information provided to the receiving hospitals of stroke transports where prehospital care providers called in a stroke alert prenotification to the receiving hospital.

| Initial Patient Population | |
|---|---|
| All patients age 18 years and older with a final clinical diagnosis of stroke who were transported to the hospital by prehospital care providers. | **Age:** ≥ 18<br>**AND**<br><br>**How patient arrived at your hospital:** = Air Transport<br>OR = EMS from home/scene<br>OR = Mobile Stroke Unit<br>OR = Transfer from outpatient facility<br>**AND**<br><br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = TIA<br>OR = Subarachnoid Hemorrhage |

| | |
|---|---|
| | OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | **Data Elements for Calculation** |
| All patients in the initial patient population. | **Same as initial patient population**<br>**AND**<br>**EMS Provider Primary Impression of Stroke:** = Yes<br>**AND**<br>**Prenotification of stroke patient** = Yes |
| **Exclusions: (Always remove from denominator)** | |
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or another hospital<br><br>Negative time difference<br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>**OR**<br>**How patient arrived at your hospital:** = Transfer from a different hospital<br>OR = Transfer from Hospice<br>**OR**<br>**Negative time:** EMS Arrival time > EMS Scene Departure time<br>**OR**<br>**Elective Carotid Intervention:** = 1 Yes<br>OR<br>**Clinical Trial:** = Yes |
| **Exceptions: (Remove from denominator if present and numerator is not met)** *Note: In the PMT, this is achieved via enabling rules or parent/child relationships between variables)* | |
| None. | N/A. |
| **Numerator** | |
| Patients with advanced notification of the hospital by prehospital care providers.<br><br>Distribution of "Information provided by EMS in pre-notification call", displayed as a single bar for each variable. | **5 Groups:**<br><br>**Information Provided by EMS in pre-notification call**<br>**Group 1:** Blood Glucose Value<br>**Group 2:** Blood Pressure<br>**Group 3:** Pre-hospital Stroke Screen<br>**Group 4:** Time of LKW per Prehospital Care Provider<br>**Group 5:** Seizure Activity<br><br>Plot bars as a percentage of the total denominator after all exclusions are applied and label with number of patients. The total of all 5 bars will not = 100% |

## 17. Use of Thrombolytic Checklist [Coverdell Only]

**Percentage of stroke patients transported by prehospital care responders with thrombolytic check completed.**

| | |
|---|---|
| **Initial Patient Population** | |
| All patients age 18 years and older with a final clinical diagnosis of stroke who were transported to the hospital by prehospital care providers. | **Age:** ≥ 18<br>**AND**<br>**How patient arrived at your hospital:** = Air Transport<br>OR = 1 [EMS from home/scene]<br>OR = 10 [Mobile Stroke Unit]<br>**AND**<br>**Final clinical diagnosis related to stroke:** = Ischemic Stroke<br>OR = TIA<br>OR = Subarachnoid Hemorrhage<br>OR = Intracerebral Hemorrhagic<br>OR = Stroke not otherwise specified |
| **Denominator** | |
| **Include:** | **Data Elements for Calculation** |
| All patients in the initial patient population. | **Same as initial patient population.** |

| Exclusions: (Always remove from denominator) | |
|---|---|
| Stroke occurred after hospital arrival (in ED/Obs/inpatient)<br><br>Transferred patients from hospice or another hospital<br><br>Elective Carotid Intervention<br><br>Clinical Trial | **Patient location when stroke symptoms discovered** = Stroke occurred after hospital arrival--In ED/Obs/Inpatient<br>OR<br><br>**How patient arrived at your hospital:** = Transfer from a different hospital<br>OR<br><br>**Elective Carotid Intervention:** = Yes<br>OR<br><br>**Clinical Trial**: = Yes |
| **Exceptions: (Remove from denominator if present and numerator is not met)** *Note: In the PMT, this is achieved via enabling rules or parent/child relationships between variables)* | |
| None. | N/A. |
| **Numerator – Display under GWTG Enhanced Version & Special Initiative Measures** | |
| Patients for whom a thrombolytic check list was used by prehospital care providers. | **Thrombolytic Checklist used:** = Yes |

Specifications Manual for Joint Commission National Quality Measures

Hom » Time Last Known Well

**Release Notes:** Data Element Version

**Data Element** *Time Last Known Well*
**Collecte** ASR-IP-1 ASR-OP-STK

**Definition:** stroke or at his or her baseline state of health.

**Suggested Collection** At what time was the patient last known to be well or at his

**For** **Length** - HH-MM (with or without colon) or UTD
**Ty** Ti
**Occurs:**

The time prior to hospital arrival at which the patient was last known to be without the signs and symptoms of the current

**Allowable Values:**
HH = Hour
MM =
UTD = Unable to Determine

Time must be recorded in military time format. With the
' If the time is in the a.m..
' If the time is in the p.m., add 12 to the clock time hour

Examples:
Midnight = 00:00
Noon = 12:00
5:31=
5:31=

11:59 am = 11:59 11:59 pm = 23:59

**Note:**

00:00 = midnight. If the time is documented as 00:00 11-24-20xx, review supporting documentation to determine if the *Date Last Known Well* should remain 11-24-20xx or if it should be converted to 11-25-20xx.

When converting Midnight or 24:00 to 00:00, do not forget to change the *Date Last Known Well*.
Example:
Midnight or 24:00 on 11-24-20xx = 00:00 on 11-25-20xx

**Notes for**

- **Abstraction:** The *Time Last Known Well* must be a time prior to the patient's *Arrival Time*. Do not use times after hospital arrival for *Time Last Known Well*.
- For times that include "seconds," remove the seconds and record the time as is.
  Example:
  15:00:35 would be recorded as 15:00
- If the *Time Last Known Well* is unable to be determined from medical record documentation, select "UTD."
  **EXCEPTION:**
  If the only *Time Last Known Well* is documented as a time immediately before hospital arrival without a specific time range in minutes, e.g., "symptoms started just prior to ED arrival," and no other documentation mentioning time last known well is available in the medical record, use the *Arrival Time* for *Time Last Known Well*.
- The medical record must be abstracted as documented (taken at "face value"). When the time documented is obviously in error (not a valid time) **and** no other documentation is found that provides this information, the abstractor should select "UTD." Example: Documentation indicates that the *Time Last Known Well* was 3300. No other documentation in the medical record provides a valid time. Since the *Time Last Known Well* is outside of the range listed in the Allowable Values for "Hour," it is not a valid time, and the abstractor should select "UTD."
  **Note:** Transmission of a case with an invalid time as described above will be rejected from the CMS Clinical Warehouse and the Joint Commission's Data Warehouse. Use of "UTD" for *Time Last Known Well* allows the case to be accepted into the warehouse.

- If the *Time Last Known Well* is documented as one **specific time** and entered as *Time Last Known Well* on a "Code Stroke" form or stroke-specific electronic template, enter that time as the *Time Last Known Well*. Documentation of *Time Last Known Well* on a stroke-specific form or template should be selected regardless of other times last known well documented elsewhere in the medical record.

**EXCEPTIONS:**

  - ANY physician/APN/PA documentation that *Last Known Well* /onset of signs/symptoms is
  - unknown/uncertain/unclear takes precedence over specific time on "Code Stroke" form.

Crossing out of a specific time on a Code Stroke Form and a specific time documented on the same or different Code Stroke Form, use the specific time that is not crossed out.

A specific time on a Code Stroke Form and another time reference documented, e.g., <8 hours, on the same or different Code Stroke Forms, use the specific time.

  - Multiple specific times on the same or different Code Stroke Forms, use abstraction guidelines for multiple
  - Times Last Known Well.

Unable to determine if a form is a Code Stroke Form,

  - continue to review the medical record for *Time Last Known Well* documentation in other sources.

- A Code Stroke Form is used by the stroke team or ED
- staff to document the acute stroke process.
- See the inclusion list for acceptable terms used for a
- Code Stroke Form. The list is not all-inclusive.

*Time Last Known Well* on a Code Stroke Form may be documented by a nurse.

If the *Time Last Known Well* is documented as being a specific number of hours prior to arrival (e.g., felt left side go numb 2 hours ago) rather than a specific time, subtract that number from the time of ED arrival and enter that time as the *Time Last Known Well*.

- If the *Time Last Known Well* is noted to be a range of time prior to ED arrival (e.g., felt left side go numb 2-3 hours ago), assume the maximum time from the range (e.g., 3 hours), and subtract that number of hours from the time of arrival to compute the time last known well.

- If the time is noted to be "less than" a period prior to ED arrival, assume the maximum range.

  Example:
  *Time Last Known Well* less than one hour ago. Subtract one hour from the time of arrival to compute time last known well.

- If both the *Time Last Known Well* and the time of symptom onset are documented, select the *Time Last Known Well*.

  Examples:
  - H&P states, "Patient watching TV with family and complained of blurred vision in both eyes at 8:30 PM." ED MD notes, "Patient normal at 8:30 PM." *Time Last Known Well* is 2030.
  - "Patient was doing well at 4:30 PM – noticed difficulty speaking around 6 PM." *Time Last Known Well* is 1630.
  - Patient normal at 2200 before going to bed. Awoke at 0200 with headache and took two aspirin before returning to sleep. OK at 0700 and went to work. Felt confused, unable to speak without slurring at 0800. *Time Last Known Well* is 0700.

- If the only time documented is time of symptom onset without mention of when the patient was last known well, use the time of symptom onset for time last known well.

  Example:
  "Sudden onset headache one hour before ED arrival," documented by ED MD. Arrival time 19:24. No other documentation referencing time last known well available in medical record. *Time Last Known Well* is 18:24.

- If there are multiple times of last known well documented in the absence of the *Time Last Known Well* explicitly documented on a "Code Stroke" form, use physician documentation first before other sources, e.g., nursing, EMS.

  Example:
  "Patient last seen normal this morning at 1000" per H&P. ED nurse documented 09:50 as time last well. *Time Last Known Well* is 1000.

- If multiple times last known well are documented by different physicians or by the same provider, use the earliest time documented.

- If there is documentation of one or more episodes of stroke symptoms **AND** documentation of symptom resolution between episodes, use the time of the most recent (last) episode prior to arrival, regardless of if all symptoms resolved prior to arrival.

Examples:

- "Patient reported right hand paresthesia two days ago that resolved spontaneously after a few minutes. New onset of symptoms today around 0700 involving right arm and right leg." *Time Last Known Well* is 0700.
- "Wife states that he was having trouble with slurred speech and confusion yesterday. Symptom free this morning. Return of symptoms with facial droop noted around noon." *Time Last Known Well* is 1200.
- "Wife noticed slurred speech at 8:30 last night. Without symptoms LOS this morning. Wife noticed slurred speech again at 0900 during breakfast conversation." *Time Last Known Well* is 0900.
- "Wife noticed slurred speech at 8:30 last night. Symptom-free this morning. Came to ED to get checked out." *Time Last Known Well* is 2030.

**Suggested Data Sources:**

- Emergency department record
- History and physical
- Nursing flow sheet
- Progress notes
- Medication administration record (MAR)
- Transfer sheet
- Ambulance record
- Code Stroke form/template
- IV flow sheets

**Additional Notes:**

Guidelines for Abstraction

| Inclusion | Exclusion |
|---|---|
| Signs and Symptoms of Stroke<br>• Sudden numbness or weakness of the face, arm, or leg, especially on one side of the body<br>• Sudden confusion, trouble speaking or understanding<br>• Sudden trouble seeing in one or both eyes<br>• Sudden trouble walking, dizziness, loss of balance or coordination Sudden severe headache<br><br>Code Stroke Form<br>• Stroke Activation Form<br>• Stroke Alert Form<br>• Stroke Assessment Form<br>• Stroke Intervention Form<br>Stroke Rapid Response Form<br>• Thrombolysis<br>• Checklist tPA<br>Eligibility Form | Code Stroke Form<br>• Stroke Education Form<br>• Core Measure Form |

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Appendix E: G-Power Sample Size Calculation RQ 1 and 2

Power Analysis Calculation for RQ1 and RQ 2 with a Minimum Sample Size of 92 Group Members

| Input Parameters | |
|---|---|
| F- tests | Logistic regression: Fixed model, $R^2$ deviation from zero |
| Analysis | A priori: Compute the required sample size |
| Input | Tail(s) = 2 |
| | Effect size $f^2 = 0.15$ |
| | $\alpha$ err prob = 0.05 |
| | Power (1-$\beta$ err prob) = 0.8 |
| | Tail(s) Number of predictors 5 |
| Output | Noncentrality parameter $\delta = 2.8722813$ |
| | Critical t = 2.006647 |
| | Df = 52 |
| | Total sample size = 92 |
| | Actual power = 0.804803 |

Appendix F: G-Power Sample Size Calculation RQ 3

*Power Analysis Calculation for RQ3 with a Minimum Sample Size of 98 Group Members*

| Input Parameters | |
|---|---|
| F- tests | Logistic regression: Fixed model, $R^2$ deviation from zero |
| Analysis | A priori: Compute the required sample size |
| Input | Tail(s) = 2 |
| | Effect size $f^2 = 0.15$ |
| | α err prob = 0.05 |
| | Power (1-β err prob) = 0.8 |
| | Tail(s) Number of predictors 6 |
| Output | Noncentrality parameter δ = 2.8722813 |
| | Critical t = 2.006647 |
| | Df = 52 |
| | Total sample size = 98 |
| | Actual power = 0.804803 |