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The Role of Nursing Education in Enhancing Stroke Identification and Improving Patient Outcomes: A Systemic Literature Review

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The Role of Nursing Education in Enhancing Stroke Identification and Improving Patient Outcomes: A Systematic Literature Review

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Dedication

I would like to dedicate this thesis to my family for the unwavering support they have given me over the years. To my parents, who have guided me along the way, constantly pushing me to do my very best in the pursuit of knowledge and happiness. Their belief in me, even during moments of self-doubt, has been my greatest support.

To my loving husband, who has been my rock and number one supporter throughout my academic journey. His encouragement and understanding have sustained me through long nights of studying and writing. This accomplishment is as much his as it is mine.

Lastly, I dedicate this thesis to the countless patients who have crossed my path, each one leaving a unique mark on my professional and academic growth. Their stories, challenges, and resilience have been the inspiration behind this work. It is my hope that this thesis contributes in some small way of improving the lives of those I have had the privilege to serve and those I will serve one day.

Thank you all for being my pillars of strength and motivation. This thesis stands as a testament to the love, support, and inspiration I have received from each of you.

Abstract

Background: Stroke is a global health concern, contributing significantly to disability and death. Timely diagnosis and treatment are pivotal for improved patient outcomes. The potential of nursing education to enhance stroke symptom recognition and patient outcomes warrants exploration.

Methods: A comprehensive literature search was conducted using electronic databases using specific keywords. Articles meeting these guidelines were used: peer-reviewed, published between 2010 and 2022, hospital-based, and nursing education-focused.

Results: The substantial impact on morbidity and mortality from strokes reinforces the urgency of early intervention. Despite established guidelines and protocols, suboptimal stroke recognition and treatment persist due to shortcomings in nurses' neurological assessments and a lack of stroke identification education. Additional studies emphasize the potential of stroke competency programs aligned with guideline adherence. Additionally, quality improvement initiatives prioritizing education and process streamlining demonstrated positive outcomes, augmenting inpatient stroke recognition and quality of care. Evidence-based nursing education interventions boost nurse confidence and practice, while hybrid simulation training effectively enhances nursing competence in managing acute stroke cases.

Discussion: The synthesized literature underlines the crucial role of nursing education in stroke identification and outcomes. Education programs and interventions demonstrate an enhancement in nurses' recognition of stroke symptoms, adherence to protocols, and overall patient care. These studies support the continuous enhancement of stroke care through effective educational strategies, in which future research should focus on implementing evidence-based education for optimal stroke care and patient outcomes.

The Role of Nursing Education in Enhancing Stroke Identification and Improving Patient Outcomes: A Systematic Literature Review

Stroke is a significant health problem affecting millions of people worldwide and is a leading cause of disability and death in many countries (Benjamin et al., 2019; Feigin et al., 2016). For patients to have better results and experience less long-term disability, it is essential to diagnose and treat strokes early (Jaunch et al., 2013). Although studies suggest that nurses may not always conduct prompt and accurate neurological assessments on hospitalized patients, they are crucial in diagnosing stroke symptoms and initiating appropriate care (Warren et al., 2021). Given the importance of prompt stroke recognition and treatment, it is essential to explore how nursing education can enhance nurses' ability to identify stroke symptoms to improve patient outcomes.

This literature review aims to determine how nursing education impacts stroke identification and patient outcomes. Specifically, this review will examine the existing literature on how nursing education programs can improve nurses' ability to recognize stroke symptoms and whether this enhanced knowledge translates into improved patient outcomes. Additionally, this review will point out gaps in the literature and recommend areas for further study. By investigating the role of nursing education in stroke identification and patient outcomes, this study aims to provide valuable insights for nursing educators, clinicians, and policymakers and contribute to the ongoing efforts to improve stroke care.

Review of Literature

Stroke is a leading cause of mortality and morbidity worldwide, with significant social, economic, and healthcare implications (Jaunch et al., 2013). Early identification and treatment of stroke are critical for improving patient outcomes and reducing disability. However, delayed or

missed identification of stroke in hospitalized patients can result in suboptimal treatment and poor clinical outcomes. Despite the availability of guidelines and protocols for stroke identification, there is evidence suggesting that neurological assessments by nurses in the hospital setting may be inadequate, leading to potential delays in stroke recognition and treatment initiation (Warren et al., 2021). Therefore, a comprehensive review of the literature on the current state of neurological assessments for hospitalized patients is warranted to identify the gaps and challenges in practice and to inform strategies for improving stroke identification and patient outcomes.

Identification

It is essential to evaluate the level of stroke knowledge among inpatient nurses since 10% of strokes occur in hospitalized patients, and nurses are usually the first to identify symptoms (Adelman et al., 2014). In a study conducted at a large academic medical center, nursing staff underwent a comprehensive online stroke survey, exploring outcome expectations, self-efficacy in recognizing stroke symptoms, and stroke knowledge. This study addresses the existing issue of unrecognized stroke symptoms in hospitalized patients, resulting in delayed care and poor outcomes. The importance of rapid stroke identification was highlighted by outcome expectations, and participants demonstrated their stroke knowledge by naming three stroke warning signs and symptoms. Stroke knowledge was deemed adequate if staff could name at least two stroke warning signs. Clinical experience, educational experience, nursing unit, and personal knowledge of stroke patients were not associated with stroke knowledge; instead, greater self-efficacy in identifying stroke symptoms and higher ratings for the importance of rapid identification were associated with stroke knowledge (Adelman et al., 2014).

This retrospective analysis titled "Delays in the identification and assessment of in-hospital stroke patients" looks into patients who experienced strokes while admitted to a tertiary care comprehensive stroke center, aiming to examine the timing and factors associated with delays, the utilization of stroke interventions, and the incidence of large vessel occlusion (LVO) on vascular imaging. The primary objectives were to identify factors associated with delays from the last known normal to symptom identification and to assess the use of stroke interventions. Despite these cerebrovascular attacks occurring in the hospital setting, previous studies have shown the presence of extended delays from the patient's last known normal to assessment and treatment. Because of this, the purpose was to better understand and address the delays in diagnosing and treating in-hospital stroke. The hospital stroke team's call log was used to identify those who had a stroke while hospitalized over a 26-month period, with data extending until October 2019 (Cummings et al., 2022).

A study titled "A successful quality improvement project for detection and management of acute stroke in hospitalized patients" was published in 2020 and aimed to ameliorate the recognition of and quality of care for inpatient strokes. This analysis took place at an urban comprehensive stroke center. The goals of this study were to prioritize staff education, simplify the in-hospital stroke (IHS) process, empower the staff to activate the code for a stroke, ensure sufficient support and teamwork, identify definite quality metrics, and provide feedback communication. To achieve these goals, a new stroke protocol was implemented, which consisted of alerting a specialized team and clearing the computed tomography (CT) scanner. There was also implementation of staff education, case review, and discussion of opportunities for process improvement. The new stroke protocol included a 1-tier activation process, helping to empower the nurses to activate the stroke response. Nurses were educated on using the Face,

Arms, Speech, and Time (FAST) assessment to identify common stroke symptoms. Educational methods for nurses also included an online module with the following objectives: understanding the role of the bedside nurse in early stroke recognition, how to use the FAST assessment, and describing the stroke protocol activation for suspected stroke. This new protocol led to a marked increase in stroke cases identified, rapid evaluation, and a high utilization rate of acute stroke therapies (Drogemueller et al., 2020).

In a study published in July 2020, all consecutive inpatient acute ischemic strokes over a ten-year period were recorded (Kamal et al., 2020). This cross-sectional study aimed to provide data on care delivery and results for this specific client population by comparing the meantime from last known neurologically intact to symptom detection. Eligibility for acute treatment of patients based on their physical location in the hospital was also examined. First, the time between the patient being last known neurologically intact to the detection of symptoms was compared based on the patient's physical location within a hospital. It was then compared to the level of care received when they were established to be showing the signs and symptoms of a stroke. The areas of quicker stroke recognition include the ER and ICU, demonstrating how better nurse-to-patient ratios and increased stroke symptom knowledge among nursing staff may lead to quicker stroke recognition. These patients were also more likely to be eligible for acute treatment, leading to better outcomes. Overall, this study demonstrated that better nurse-to-patient ratios and increased knowledge about stroke symptoms for nurses can lead to quicker recognition of neurological deficits (Kamal et al., 2020).

Interventions & Educational Methods

In 2017, Christina Anne Case published a quality improvement project to design and apply an intervention for bedside nurses on how evidence-based guidelines are used for stroke

care with the aim of supporting an evidence-based culture in the clinical setting. The purpose was to increase nurses' confidence in the use of standardized order sets at the point of care. This study occurred at a 286-bed hospital appropriated by the Joint Commission as a primary stroke center. A total of 89 bedside nurses from four different units were presented with a poster presentation that tied the American Heart Association's and American Stroke Association's current clinical guidelines to standardize stroke care. Participants were surveyed on their stroke care confidence before and after the presentation. Based on current clinical evidence, there was a significant rise in confidence in the capability of standardized stroke care. In addition, it was shown that they were more confident in implementing certain nursing interventions when they were taught how those interventions were evidence-based (Case, 2017).

In an additional study published in December 2016, the main focus was on applying a stroke competency program with adherence to stroke guidelines to improve the nurses' knowledge about strokes. This study aimed to examine if a tailored, multi-faceted stroke competency program would affect the awareness and adherence of nurses in the care of stroke patients. It was found that there were deficits in the knowledge of the NIHSS (Appendix C) and adherence to the completion of the guidelines. Nurses were also measured on patient and family stroke education, along with dysphagia screening. The program included bundled implementation strategies, including printed educational materials, educational outreach, and local opinion leaders. A pretest/posttest program design was used, with 88 experienced nurses participating. Documentation audits were used to measure nursing adherence, and an author-developed assessment measured their knowledge. By implementing this stroke competency program, there were notable improvements in adherence to stroke guidelines and significant improvements in nursing knowledge about these guidelines. It was also found that using multiple

education strategies, rather than just one, was more effective when translating the guidelines into practice (Reynolds et al., 2016).

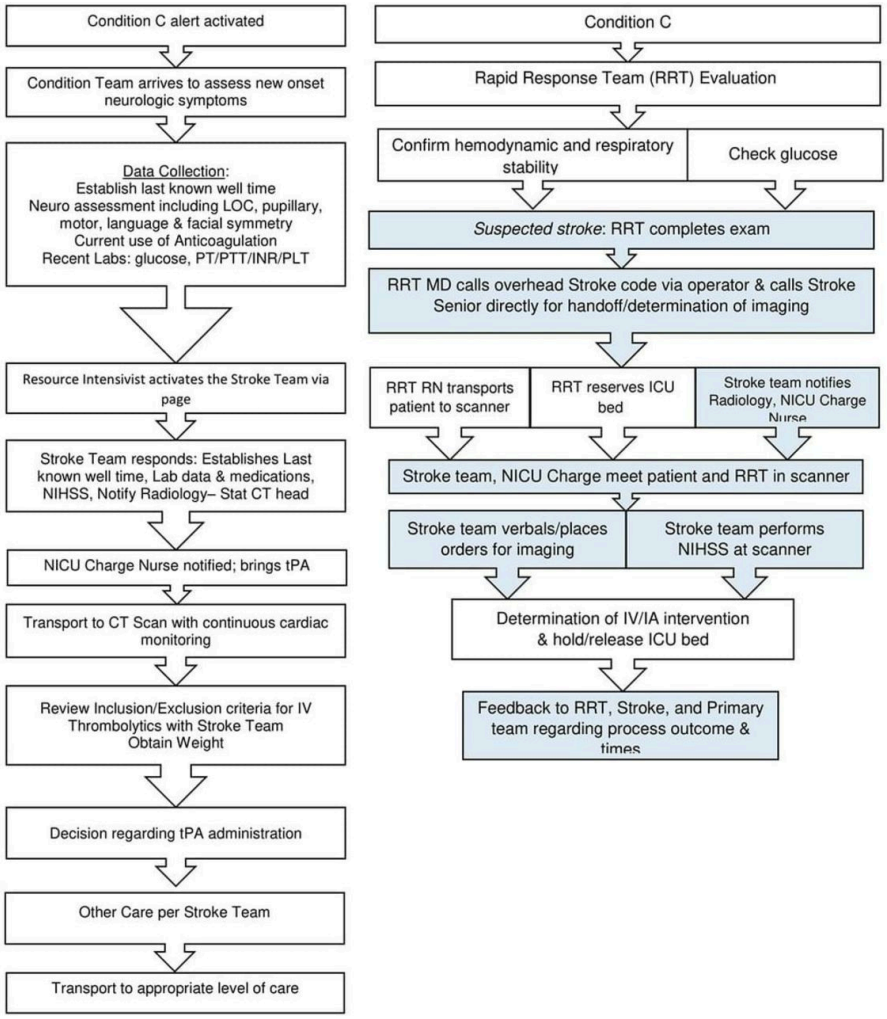
A hybrid simulation pilot study published in 2017 aimed to increase nurses' confidence in caring for patients with acute stroke through education and training. With a purpose of improving nurses' understanding of patients with acute stroke and neurological deterioration, repetition and teamwork were key points. This study took place at the University of Missouri Health System with 37 participating neuroscience nurses, using a hybrid simulation that combined lecture and a simulation manikin. During the simulation, the patient presented with stroke-like symptoms, which were then identified as an intracranial hemorrhage. Later, the patient experienced a neurological change, and the group was required to recognize the need for a focused resuscitation. A five-point Likert questionnaire was administered to the nurses pre- and post-simulation, assessing nurses and their comfort regarding caring for patients with acute strokes. There was a reported improvement in understanding and handling patients with acute stroke and neurological deterioration after participating in the hybrid simulation (Newey, 2017).

A comprehensive stroke center hypothesized that a guided revision of a formalized stroke response protocol could improve diagnosis, provider communication, reduce stroke mimic cases, and decrease the time taken to treatment (Manners et al., 2019). To guide the new protocol, stroke response activations between 2013 and 2016 were retrospectively analyzed, including 136 cases in the pre-implementation group. Subsequently, from 2016 and 2017, there were 69 cases qualified for the post-implementation group. Aiming to improve the diagnosis and time to treatment, the plan was to replicate the response used for community-onset strokes presenting to the emergency department with rapid imaging, simultaneous data gathering, IV placement, and neurological examination (Manners et al., 2019). Dedicated stroke education to critical care

fellows was completed prior to the initiation of the new protocol. Formal training included stroke symptoms and treatment algorithms for both ischemic and hemorrhage strokes through a lecture series, including a review and demonstration of using the rapid arterial occlusion evaluation (RACE) scale (Appendix C). This scale was selected to heighten sensitivity to large vessel occlusion, given its ease of use. To improve communication, a dedicated telephone was carried by the stroke team. With an emphasis on rapid imaging, the transport of patients to the scanner was dictated by the rapid response team, allowing the neurology team to meet the patient directly in the radiology department to complete the examination and review of clinical information. Overall, there were reduced response calls for stroke mimics, recognition to imaging times, and treatment times (Manners et al., 2019). Shown below in Figure 1 are flow charts of both the pre- and post-implementation in-hospital stroke code protocols.

Figure 1

Pre- and Post-Implementation In-hospital Stroke Code Protocols



Outcomes

The urgency of effective stroke education becomes abundantly clear when considering the time-sensitive nature of reperfusion therapies. This importance is highlighted in a retrospective cohort study published in 2014 looking at the time-dependent effectiveness of thrombolytic therapy for acute ischemic stroke. Intravenous administration of thrombolytic therapy can be used within 4.5 hours after the onset of stroke symptoms, and studies show that

better treatment outcomes are strongly time-dependent. This study used the Modified Rankin scale (Appendix B), which measures the degree of neurologic disability and was used at discharge. It distinguishes between a “favorable outcome” (score of 0 or 1) and an “unfavorable outcome” (score of 2-6). The utilization of this scale reinforces the need for determining the severity of neurologic disability. The most favorable outcomes (score of 0 or 1) occurred when patients were treated within the first 1.5 hours of symptom onset. Patients treated with thrombolytic therapy beyond the recommended time of 4.5 hours had a higher mortality risk (Gumbinger et al., 2014). By being readily equipped with both the knowledge and skill set required for early stroke recognition, nurses become instrumental in bridging the gap between recognition and timely intervention. Nursing education helps enable prompt intervention and improves the chances of favorable treatment outcomes.

A comprehensive study aimed to assess the impact of the timing of mechanical thrombectomy procedures on the long-term functional outcomes of stroke patients was conducted at a comprehensive stroke center with patients divided into two groups: those treated during regular work hours (on-hours) and those treated after hours, weekends, and holidays (off-hours). These findings uncovered several important insights into the relationship between the timing of thrombectomy procedures and patient outcomes, further highlighting the importance of rapid stroke recognition and effective nursing education. The off-hours patients were shown to have longer “door-to-groin” times and were less likely to have favorable outcomes than patients who had the thrombectomy procedure performed on-hours (Almallouhi et al., 2019). This disparity emphasizes the need for nurses to be aware of the intricacies in stroke care, as this study has shown how patient outcomes are strongly tied to the timing of reperfusion therapy. By increasing awareness and skills through ongoing education, nurses play a critical role in reducing

delays to reperfusion therapy, ultimately leading to improved functional outcomes and overall enhanced quality of care for patients.

Theoretical Framework

In 1985, Icek Ajzen created the Theory of Planned Behavior and introduced a concept about the perceived behavioral control of individuals. This theory states that behavior is driven by intentions established on attitude towards behavior, subjective norms, and perceived behavioral control. Specifically, for nurses, this theory can help predict the nurse's actions during risk-conducive situations. For example, this would be the decision to call for a rapid response for prominent stroke symptoms. Four factors based on this theory influence individual control and decision-making: the belief that this behavior will result in benefits, having the approval of others, having appropriate skills, and having the necessary resources available (Grech & Grech, 2021).

The Theory of Planned Behavior can improve stroke education for inpatient nurses by improving decision-making in emergent situations. Based on this theory, the best way to educate nurses on neurological emergencies would be to explain the health benefits for patients resulting from changes in assessment and activation behaviors. These health benefits from this specific scenario could include an increased quality of life and reduced mortality risk. Having the approval of others, like the charge nurse or management, to call a rapid response for a suspected stroke will also increase the likelihood of that specific nurse performing that rapid response. If the nurse is well-educated on stroke assessment and recognition, they can be more confident in their ability to initiate a neuro rapid response. When necessary resources, like a stroke team or cleared CT scans, have known availability, the chances of the nurse calling a neuro rapid response will increase based on this theory (Grech & Grech, 2021).

Methodology

The aim of this literature review is to investigate the impact of nursing education on stroke identification and patient outcomes. A comprehensive search of relevant literature was conducted by searching The University of Alabama in Huntsville electronic catalog, including articles on PubMed, CINAHL, and Cochrane Library. The search was limited to articles published in English between 2010 and 2022. The following keywords were used: "stroke," "cerebrovascular accident," "nursing education," "nursing intervention," and "patient outcomes." The search was limited to studies conducted in hospitalized patients. Articles were included if they met the following criteria: (1) they were published in a peer-reviewed journal; (2) they were conducted in hospitalized patients; (3) they investigated the impact of nursing education or timing on stroke identification or patient outcomes; (4) they were published between 2010-2022. Data were extracted from each article using a standardized data extraction form. The following information was collected: study design, sample size, interventions, outcomes, and key findings. Data were synthesized using a thematic analysis result.

Results

This review included a study titled "Stroke Awareness Among Inpatient Nursing Staff at an Academic Medical Center" by Adelman et al. (2014), which assessed the level of stroke knowledge among inpatient nurses. The study surveyed 875 respondents, primarily nurses, to evaluate their ability to recognize stroke warning signs and symptoms. More than 85% of respondents could correctly report at least two stroke warning signs and symptoms. Surprisingly, clinical experience, educational background, nursing unit, and personal knowledge of stroke patients were not significantly associated with stroke knowledge. Instead, greater self-efficacy in

identifying stroke symptoms and higher ratings for the importance of rapid identification were linked to better stroke knowledge.

An article titled “Strokes Occurring in the Hospital: Symptom Recognition and Eligibility for Treatment in the Intensive Care Units versus Hospital Wards” by Haris Kamal et al. (2020) investigated the timing of stroke recognition in patients who experienced in-hospital stroke. There were 53 patients identified who came to the hospital for other reasons but ended up suffering from an ischemic stroke. Only 4 patients had initial brain imaging done within 25 minutes from symptom recognition, which is the recommended time by the American Heart Association. Forty-two patients underwent brain imaging within 6 hours of acknowledgement, 11 received intravenous thrombolysis within the first 4.5 hours, and over a quarter of patients had a delay in symptom recognition or treatment due to initial misdiagnosis. Patients admitted to the ICU or ED were 44% more likely to have earlier stroke recognition than those admitted to regular floors. One contributing factor to this disparity is the lower nurse-to-patient ratio in these specialized units, enabling nurses to dedicate more focused attention to each patient. This enhanced observation and lower workload facilitate quicker identification of stroke symptoms, prompt initiation of reperfusion therapies, and greater outcomes for patients (Kamal et al., 2020).

A quality improvement project article, “Promoting Evidence-Based Practice at a Primary Stroke Center” by Christina Anne Case (2017), focuses on designing a targeted nursing education intervention on using current evidence-based guidelines for stroke care. Nurses from 4 units experienced the educational intervention. A pre- and post-intervention survey measured their self-perceived likelihood of performing an ordered intervention based on whether they were confident that the order was evidenced-based. Also measured was their self-perceived confidence in explaining how the standard order sets are created from current evidence. The nurses report a

significant increase in perceived confidence in explaining how current order sets reflect current evidence-based practice. There was also an increase in the likelihood of performing the nursing interventions when they were confident that they were evidence-based compared with if they were unsure if the order was evidence-based.

A study titled “Implementation of a Stroke Competency Program to Improve Nurses’ Knowledge of and Adherence to Stroke Guidelines” by Reynolds et al. (2016) aimed to determine if a stroke competency program would increase knowledge of and adherence to evidence-based stroke care. The majority of participating nurses (n=88) had around ten years of experience in nursing and were baccalaureate prepared. Prior to program implementation, adherence to the documentation of neurological assessments at the appropriate frequencies was 88.6%, and after the program, 90.5%. Dysphagia screening documentation increased from 71% to 75%. When measuring follow-up assessment scores and frequency knowledge, there was a correlation with those who scored higher tended to have more experience. In identifying potential barriers to consistent stroke care, 84% reported a lack of knowledge of the required activities as a barrier, which then decreased to 65% after the follow-up assessment. Lastly, difficulty in understanding the requirements was reported by 49% and decreased to 34% in the follow-up assessment (Reynolds et al., 2016).

In “A New Strategy in Neurocritical Care Nurse Continuing Stroke Education: A Hybrid Simulation Pilot Study” by Christopher Ryan Newey et al. (2017), a combination of lecture and high-fidelity manikin is used to educate nurses. A total of 37 nurses participated, with the majority having 0-5 years of experience and 83.8% having prior critical care experience. There were six questions, with agreements pre-simulation ranging from 65.7-85.7%. Post-simulation, the agreements increased to 81.1-91.9%. For pre-simulation responses, 57.1-68.6% agreed with

the questions, and 2.9-17.1% strongly agreed. Post-simulation, the responses increased to 40.5%-56.8% agreement and 24.3-40.5% strongly agreed (Newey, 2017). All responses are listed in Table 1 below.

Table 1

Nursing Responses Pre- and Post-Simulation

A		Pre-simulation		Post-Simulation		P-value
		Disagree (%)	Agree (%)	Disagree (%)	Agree (%)	
1)	I am prepared to care for real patients with intracerebral hemorrhage.	0.0	85.7	5.4	81.1	0.06
2)	I have an understanding of the pathophysiology of intracerebral hemorrhage.	5.7	68.6	5.4	83.8	0.55
3)	I have an understanding of the medications used in treating intracerebral hemorrhage.	5.7	68.6	8.1	86.5	1.00
4)	I am confident in my decision-making skills when treating intracerebral hemorrhages.	5.7	68.6	5.4	81.1	0.76
5)	I am confident in determining what to tell other healthcare providers when treating intracerebral hemorrhages.	5.7	65.7	2.7	81.1	0.31
6)	I am confident that I will be able to recognize and predict change in my real patient's condition.	2.9	85.7	5.4	91.9	0.72

B	Pre-simulation		Post-Simulation		P-value
	Agree (%)	Strongly Agree (%)	Agree (%)	Strongly	

					Agree (%)	
1)	I am prepared to care for real patients with intracerebral hemorrhage.	68.6	17.1	40.5	40.5	0.0001
2)	I have an understanding of the pathophysiology of intracerebral hemorrhage.	62.9	5.7	56.8	27.0	0.0001
3)	I have an understanding of the medications used in treating intracerebral hemorrhage.	65.7	2.9	51.4	35.1	0.0001
4)	I am confident in my decision-making skills when treating intracerebral hemorrhages.	57.1	11.4	43.2	37.8	0.0001
5)	I am confident in determining what to tell other healthcare providers when treating intracerebral hemorrhages.	54.3	11.4	56.8	24.3	0.08
6)	I am confident that I will be able to recognize and predict change in my real patient's condition.	68.6	17.1	51.4	40.5	0.0004

In a retrospective analysis titled "An Interdisciplinary Approach to Inhospital Stroke Improves Stroke Detection and Treatment Time" by Jody Manners et al. (2019), it was hypothesized that a guided revision of a formal stroke response system could improve diagnosis and time to treatment. There were 205 total cases split between the pre-implementation phase (136) and the post-implementation phase (69). After protocol initiation, the number of stroke mimics was reduced from 52% to 33%. The average time between the stroke response being called to the stroke team assessment was reduced from 9.7 minutes to 5.1 minutes, and the average time to imaging decreased by 7.6 minutes, with average time to treatment also being reduced from 45.7 minutes to 19.8 minutes. Furthermore, the implementation of the new

protocol not only demonstrated significant improvements in stroke detection and reperfusion times but also played a crucial role in enhancing stroke education within the healthcare system. The interdisciplinary approach used facilitated a more comprehensive understanding of stroke symptoms among nurses, reducing mimics and improved timing in recognition and to imaging (Manners et al., 2019).

A retrospective cohort study titled “Time to Treatment with Recombinant Tissue Plasminogen Activator and Outcome of Stroke in Clinical Practice: Retrospective Analysis of Hospital Quality Assurance Data with Comparison with Results from Randomized Clinical Trials” by Christoph Gumbinger et al. (2014) aimed to study the time-dependent effectiveness of thrombolytic therapy for acute stroke. Providing valuable insight into the impact of treatment timing on patient outcomes, this study shows just how important nursing education is in optimizing these critical timeframes. The study population consisted of 49% women with an average age of 73.5 years. Among these, 36% were over 80 years old, making the use of thrombolytic therapy potentially off-label. The average time to tPA treatment was 140 minutes. The primary endpoint, the modified Rankin score (Appendix B) at discharge, revealed a positive outcome with thrombolytic treatment. The odds ratios increased from 1.3 for treatment within 3.0-4.5 hours to 2.5 for treatment within 90 minutes. For patients treated after 4.5 hours, the odds ratio for a lower modified Rankin score was 1.25, which is still favorable but not as favorable as quicker therapies. In-hospital mortality increased in patients treated after 4.5 hours (Gumbinger et al., 2014). Nursing education becomes vital in this context, as it empowers nurses to recognize stroke symptoms and promptly initiate time-sensitive interventions. A thorough understanding of this study’s findings can guide nursing practices toward more effective and timely assessments.

In a retrospective study, “Impact of Treatment Time on the Long-Term Outcome of Stroke Patients Treated with Mechanical Thrombectomy” by Eyad Allmallouhi et al. (2019), the long-term functional outcome of stroke patients treated with mechanical thrombectomy during work hours versus after-hours is assessed. This study sheds light on the critical relationship between treatment timing and patient outcomes. A significant proportion of patients were treated off-hours, constituting 116 patients (59% of the total sample). For on-hours, there were 80 patients (41%). The average age was 66.1 years old, but the off-hours average was 64.1 years and on-hours was 69.1 years. The statistical analysis demonstrated that the probability of achieving a favorable outcome at discharge was notably lower for off-hours patients since there was an increased amount of time from stroke recognition to receiving the reperfusion therapy, with a decrease of 12.6%. Similarly, 90 days post-discharge, patients treated off-hours had an 18.7% lower probability of achieving a favorable outcome. These results show that longer periods of time to reperfusion therapy lead to poorer outcomes, emphasizing the importance of early stroke recognition (Allmallouhi et al., 2019). By prioritizing nursing education for quick stroke recognition, patients will benefit from quicker identification and intervention, leading to improved outcomes, reduced disability, and increased chances of recovery.

Discussion

Stroke, a significant global health concern, demands immediate recognition and evaluation to mitigate its debilitating effects and to improve patient outcomes. Nursing education plays a pivotal role in facilitating early stroke recognition, therefore enhancing timely action and quality of care provided. This discussion section dives into the literature reviewed, highlighting the role of nursing education in stroke identification and its subsequent impact on patient outcomes.

The reviewed literature highlights the importance of nursing knowledge and preparation in recognizing stroke symptoms. Adelman et al. (2014) demonstrated that nursing staff's stroke knowledge was critical in prompt symptom recognition. However, it is notable that traditional markers such as clinical experience and educational background did not correlate with stroke knowledge. Instead, self-efficacy in identifying stroke symptoms and a heightened urgency for rapid identification were associated with better stroke knowledge. This suggests that beyond simple education, instilling a sense of importance and confidence in nursing staff can significantly contribute to improved stroke recognition. Likewise, the study by Cummings et al. (2022) emphasized the need for quick stroke recognition in the hospital setting, where timing is crucial. Extended delays in recognizing strokes in surgical patients were revealed and correlated with procedural factors such as anesthesia and intubation. It is recommended to use short-acting anesthetics to expedite post-surgical neurological assessments. It is also important for nurses to closely monitor these patients post-operatively for any neurological changes since they are at increased risk of experiencing stroke. A study by Kamal et al. (2020) suggests improved nurse-to-patient ratios lead to quicker stroke recognition. This is evidenced by the fact that the ICU and ER recognized symptoms more promptly than other units due to fewer patients.

Recognizing the interventional need, several studies focused on educational programs and their impact on stroke care. Case (2017) produced a quality improvement project that involved presenting poster presentations and increasing nurses' confidence in evidence-based care. Utilizing this method showed an increase in confidence in capability in stroke care. Drogemueller et al. (2020) implemented a stroke protocol, including educating nurses on using the FAST assessment to identify stroke symptoms. The outcome included a marked increase in the identification of stroke cases, rapid evaluation, and high utilization of acute stroke therapy.

Similarly, Reynolds et al. (2016) introduced a multi-faceted stroke competency program that significantly improved adherence to stroke guidelines and enhanced nursing knowledge. Utilizing several educational strategies proved more effective in translating guidelines into practice. In another study on education methods by Newey et al. (2020), a hybrid simulation program was implemented to increase nurses' confidence in caring for acute stroke patients. This approach, combining lecture and simulation, was effective in improving nurses' understanding of stroke and their ability to manage stroke patients, therefore contributing to improved patient outcomes.

Along with educational methods, Drogemueller et al. (2020) also simplified the current stroke protocol. A one-tier activation was implemented, and upon activation, a specialized team was alerted, and a CT scanner was cleared. Likewise, Manners et al. (2019) also made revisions to the stroke response protocol, focusing on rapid imaging, communication, and neurological exams using the rapid arterial occlusion evaluation (RACE) scale (Appendix C). This plan reduced calls for stroke mimics, improved recognition to imaging times, and allowed for faster reperfusion times. These approaches for both studies highlight the significance of streamlining protocols and processes in achieving better stroke outcomes.

The reviewed literature also accentuates the critical importance of time in stroke care. Gumbinger et al. (2014) emphasized the time-dependent effectiveness of thrombolytic therapy and demonstrated that quicker treatment led to more favorable outcomes. Similarly, Almallouhi et al. (2019) discussed the impact timing for thrombectomy procedures, revealing that off-hours procedures led to longer "door-to-groin" times and less favorable outcomes. These findings underscore the need for rapid response and efficient protocols to optimize patient outcomes that can be achieved through effective nursing education.

Implications to Nursing Practice

The findings from this literature review show how crucial timely stroke identification is to improving patient outcomes. Nurses are at the frontline when it comes to stroke recognition, often the first to encounter patients experiencing symptoms. Because of this, their level of knowledge, self-efficacy, and adherence to evidence-based guidelines significantly influence the quality of care provided. By focusing on timing, recognition, ongoing education, training, and interdisciplinary communication, nursing practice can be enhanced to improve the early identification of stroke symptoms, reduce delays in care, and increase the utilization of appropriate interventions.

A key to enhancing patient outcomes is prompt recognition of stroke symptoms. It is important to analyze the level of stroke knowledge among inpatient nurses, as they are typically the first to identify symptoms in the hospital setting (Adelman et al., 2014). This suggests that nurses' self-efficacy and the recognition of the importance of timely stroke identification play a vital role in improving stroke knowledge. Additionally, in-hospital strokes are often associated with surgical patients, so it is recommended to use short-acting anesthetics to ensure accurate post-surgical neurological assessments (Cummings et al., 2022). Furthermore, it is important to stress the significance of staff education and standardized processes. Implementing a one-tier activation system using the FAST assessment can enhance the recognition and quality of care for inpatient strokes (Drogemueller et al., 2020). Also, nurse-to-patient ratios and increased stroke symptom knowledge among nurses are essential in facilitating timely stroke recognition. This shows the need for improved nurse education to reduce delays in recognizing inpatient strokes (Kamal et al., 2020). These studies collectively emphasize the urgency of prompt stroke identification to enhance patient outcomes.

To continually enhance evidence-driven patient care, it is vital to provide registered nurses with education on evidence-based practice guidelines. This approach can significantly boost nurses' confidence using these guidelines to improve stroke care. The findings show the need for healthcare institutions to prioritize ongoing education for their nurses, equipping them with the latest guidelines and promoting a culture of continuous patient care improvement (Case, 2017). Additionally, tailored, multi-faceted stroke competency programs can improve nurses' adherence to guidelines and stroke knowledge. The findings show that using several educational methods can significantly improve guideline adherence and stroke knowledge, highlighting the importance of bridging gaps in nursing knowledge and practice to improve patient outcomes (Reynolds et al., 2016). Incorporating simulation and training into ongoing nursing education can enhance nurses' confidence in managing acute stroke cases. Combining hands-on experience through simulations along with classroom lectures was shown to be effective in improving understanding of and ability to manage acute stroke situations (Newey et al., 2017). Guided revisions of formalized stroke response protocols, in combination with education and training for healthcare professionals, can lead to improvements in stroke diagnosis, communication, and a reduction in stroke mimic cases, ultimately reducing the time taken to initiate treatment (Manners et al., 2019). These approaches include continuous education, comprehensive training, and efficient protocols, all aimed at empowering nurses to recognize and respond to stroke cases swiftly.

These implications discussed above are critical in improving outcomes for those who suffer from in-hospital strokes. Studies mentioned previously highlight the critical need for quick identification and effective nursing education. Gumbinger et al.'s study (2014) demonstrates that the timely administration of thrombolytic therapy is strongly time-dependent, with the most

favorable outcomes occurring when treatment is initiated within the first 1.5 hours of symptom onset. This emphasizes the urgency for nurses to recognize stroke symptoms swiftly and to initiate the need for treatment. Additionally, Almallouhi et al.'s study (2019) shows how significant the impact of timing is on thrombectomy procedures and patient outcomes. The quicker the patients can get to reperfusion therapies, the better the results. These findings collectively emphasize that prompt recognition and immediate intervention are crucial in improving patient outcomes, providing strong evidence on why nursing education is needed.

Conclusion

Stroke is a significant global health concern that requires quick recognition and evaluation to mitigate its debilitating effects and improve patient outcomes. Nursing education plays a significant role in facilitating early stroke recognition, enhancing timely action, and delivering quality stroke care to patients. The reviewed literature shows the importance of nursing knowledge, education, and protocols in improving stroke identification and care in hospital settings.

The studies demonstrate that nursing staff's stroke knowledge is instrumental in prompt stroke recognition. Traditional markers such as clinical experience and educational background were not correlated with stroke knowledge. Instead, self-efficacy in identifying stroke symptoms and recognizing the importance of timely identification were key factors associated with stronger stroke knowledge (Adelman et al., 2014). Beyond education, instilling confidence and a sense of urgency among nurses can significantly contribute to improved stroke recognition.

Time is of the essence when it comes to strokes. Delays in recognizing strokes in surgical patients were identified, and procedural factors such as anesthesia and intubation play a role in

these delays (Cummings et al., 2022). Improving nurse-to-patient ratios and maintaining vigilant monitoring for neurological changes can ensure prompt stroke recognition (Kamal et al., 2020).

Furthermore, educational programs and quality improvement initiatives have shown promising results. Simplifying stroke protocols, offering ongoing education, and implementing interdisciplinary communication to enhance stroke recognition and care quality (Drogemueller et al., 2020). Utilizing simulation programs for training can boost nurses' confidence in managing acute stroke cases (Newey et al., 2017). Multi-faceted stroke programs, combining several educational methods, have effectively improved adherence to guidelines and stroke knowledge (Reynolds et al., 2016).

The implications for nursing practice are evident. To enhance patient outcomes, healthcare institutions must prioritize ongoing education for nurses and equip them with the latest evidence. Specialized training, interdisciplinary collaboration, and efficient protocols are crucial in empowering nurses to recognize and respond to stroke cases quickly. These changes can provide more timely recognition of in-hospital strokes and get patients to reperfusion therapy quicker, which has been shown to lead to improved patient outcomes and decreased rates of mortality (Almallouhi et al., 2019; Gumbinger et al., 2014).

While this review has demonstrated the positive impact of educational programs, future research should look into the long-term efficacy of these interventions. Comparative studies analyzing different educational methods' effects on nursing knowledge and stroke recognition skills will be beneficial. Also emphasized in this review is the importance of stroke recognition, but there remains a need to investigate the enduring impact on patient outcomes. Future studies should focus on the long-term consequences of timely recognition, including patient recovery and quality of life. As mentioned previously, optimal nurse-to-patient ratios in different hospital

units are essential to enhance stroke recognition (Kamal et al., 2020). Future research can provide evidence-based recommendations for the ideal nurse staffing levels required to facilitate early detection and intervention. Additionally, in this current era of technology, the potential use of telemedicine to support nurses in stroke recognition is favorable for exploration. Future research can investigate the integration of smartphone apps and remote consultations in aiding early stroke detection and assessment. By addressing these future research areas, we can continue toward advancing stroke care, alleviating the burden of stroke-related disabilities, and elevating the standard of care.

In conclusion, this literature review emphasizes the urgency of prompt stroke identification and immediate intervention to improve patient outcomes. Nursing education, ongoing training, and streamlined protocols are vital components in enhancing stroke recognition and care in hospital settings. By focusing on these aspects, healthcare institutions can contribute to the early identification and effective management of strokes, ultimately leading to better patient outcomes and a reduction in the debilitating effects of this important health concern.

References

Adelman, E. E., Meurer, W. J., Nance, D. K., Kocan, M. J., Maddox, K. E., Morgenstern, L. B., & Skolarus, L. E. (2014). Stroke awareness among inpatient nursing staff at an academic medical center. *Stroke*, *45*(1), 271–273. https://doi.org/10.1161/STROKEAHA.113.002905

Almallouhi, E., Kasab, S.A., Harvey, J.B., Reardon, C., Alawieh, A., Girotra, T., Aysse, P., Turner IV, R.D., & Holmstedt, C.A. (2019). Impact of treatment time on the long-term outcome of stroke patients treated with mechanical thrombectomy. *Journal of Stroke and Cerebrovascular Diseases*, *28*(1), 185-190. https://doi.org/10.1016/j.jstrokecerebrovasdis.2018.09.033

American Heart Association. (2019). *Rapid Arterial Occlusion Evaluation Scale.* Mission: Lifeline Stroke. https://www.heart.org/-/media/files/affiliates/mwa/nebraska-ml-stroke/hospital-toolkit/race.pdf

Benjamin, E. J., Virani, S. S., Callaway, C. W., Chamberlain, A. M., Chang, A. R., Cheng, S., Chiuve, S. E., Cushman, M., Delling, F. N., Deo, R., de Ferranti, S. D., Ferguson, J. F., Fornage, M., Gillespie, C., Isasi, C. R., Jimenez, M. C., Jordan, L. C., Judd, S. E., ... Muntner, P. (2019). Heart disease and stroke statistics—2019 update: A report from the American Heart Association. *Circulation*, *139*(10), e56-e528. https://doi.org/10.1161/CIR.0000000000000659

Case, C. A. (2017). Promoting evidence-based practice at a primary stroke center: A nurse education strategy. *Dimensions of Critical Care Nursing*, *36*(4), 244-252. https://doi.org/10.1097/DCC.0000000000000251

Cummings, Kasner, S. E., Mullen, M., Olsen, A., McGarvey, M., Weimer, J., Jackson, B., Desai, N., Acker, M., & Messé, S. R. (2022). Delays in the identification and assessment of in-hospital stroke patients. *Journal of Stroke and Cerebrovascular Diseases*, *31*(4), 106327–106327. https://doi.org/10.1016/j.jstrokecerebrovasdis.2022.106327

Drogemueller, C. J., Kashyap, B., Huna Wagner, R. L., Shebeshi, H., Clayton, M. W., Fennig, M. W., & Hussein, H. M. (2020). A successful quality improvement project for detection and management of acute stroke in hospitalized patients. *Journal of Neuroscience Nursing*, *52*(4), 186-191. https://doi.org/10.1097/JNN.0000000000000517

Feigin, V. L., Abajobir, A. A., Abate, K. H., Abd-Allah, F., Abdulle, A. M., Abera, S. F., Abyu, G. Y., Ahmed, M. B., Aichour, A. N., Aichour, I., Aichour, M. T. E., Akinyemi, R. O., Al Lami, F. H., Alabed, S., Al-Raddadi, R., Alvis-Guzman, N., Amare, A. T., Amoako, Y. A., ... Murray, C. J. L. (2017). Global, regional, and national burden of neurological disorders during 1990-2015: A systematic analysis for the Global Burden of Disease Study 2015. *Lancet Neurology*, *16*(11), 877-897. https://doi.org/10.1016/S1474-4422(17)30299-5

Grech, P. & Grech, R. (2021). The role of health promotion theories in stroke awareness and education. *Applied Nursing Research*, *58*, 151415. https://doi.org/10.1016/j.apnr.2021.151415

Gumbinger, Reuter, B., Stock, C., Sauer, T., Wiethölter, H., Bruder, I., Rode, S., Kern, R., Ringleb, P., Hennerici, M. G., & Hacke, W. (2014). Time to treatment with recombinant

tissue plasminogen activator and outcome of stroke in clinical practice: retrospective analysis of hospital quality assurance data with comparison with results from randomised clinical trials. *British Medical Journal, 348*. https://doi.org/10.1136/bmj.g3429

Jaunch, E. C., Saver, J. L., Adams, H. P., Jr., Bruno, A., Connors, J. J., Demaerschalk, B. M., Khatri, P., McMullan, P. W., Jr., Qureshi, A. I., Rosenfield, K., Scott, P. A., Summers, D. R., Wang, D. Z., Wintermark, M., Yonas, H. (2013). Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *44*(3), 870-947. https://doi.org/10.1161/STR.0b013e318284056a

Kamal, H., Ahmed, M.K., Zha, A., Navdeep, S., Shirani, P., Sawyer, R.N., & Mowla, A. (2020). Strokes occurring in the hospital: Symptom recognition and eligibility for treatment in the intensive care units versus hospital wards. *Brain Circulation*, *6*(3), 196–199. https://doi.org/10.4103/bc.bc_24_20

Manners, J., Khandker, N., Barron, A., Aziz, Y., Desai, S.M., Morrow, B., Delfyett, W.T., Martin-Gill, C., Shutter, L., Jovin, T.G., & Jadhav, A.P. (2019). An interdisciplinary approach to inhospital stroke improves stroke detection and treatment time. *Journal of Neurointerventional Surgery*, *11*, 1080-1084. https://doi.org/10.1136/neurintsurg-2019-014890

Meyer, B.C., Hemmen, T.M., Jackson, C.M., & Lyden, P.D. (2002). Modified National Institutes of Health Stroke Scale for use in stroke clinical trials. *Stroke*, *33*, 1261-1266. https://doi.org/10.1161/01.STR.0000015625.87603.A7

Newey, C. R., Bell, R., Burks, M., & Nattanmai, P. (2017). A new strategy in neurocritical care nurse continuing stroke education: A hybrid simulation pilot study. *Electronic Physician, 9*(5), 4255-4260. https://doi.org/10.19082/4255

Powers, W.J., Rabinstein, A.A., Ackerson, T., Adevoe, O.M., Bambakidis, N.C., & Becker, K. (2018). 2018 Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Journal of Vascular Surgery*, *67*(6), 1934–1934. https://doi.org/10.1016/j.jvs.2018.04.007

Reynolds, S. S., Murray, L. L., McLennon, S. M., & Bakas, T. (2016). Implementation of a stroke competency program to improve nurses' knowledge of and adherence to stroke guidelines. *Journal of Neuroscience Nursing, 48*(6), 328-335. https://doi.org/10.1097/JNN.0000000000000237

The Joint Commission. (n.d.). *Modified Rankin Score*. The Joint Commission Manual. https://manual.jointcommission.org/releases/TJC2018A/DataElem0569.html

Warren, T., Moore, L. C., Roberts, S., & Darby, L. (2021). Impact of a modified early warning score on nurses' recognition and response to clinical deterioration. *Journal of Nursing Management*, *29*(5), 1141–1148. https://doi.org/10.1111/jonm.13252

Appendix A: Review of Evidence

Study Author/year/title	Objectives/Aim/Purpose	Research design/Sample/Setting	Interventions (competencies & methods)	Instrument & Data collection methods	Study findings/results	Strengths	Limitations	Implications and recommendations
Author: Adelman, E.E., Meurer, W.J., Nance, D.K., Kocan, M.J., Maddox, K.E., Morgenstern, L.B., Skolarus, L.E. **Title:** Stroke awareness among inpatient nursing	**Objectives:** assess the level of knowledge of stroke signs/symptoms among nursing staff and identify factors that predict adequate stroke knowledge **Aim:** understand stroke knowledge among nurses and improve stroke education **Purpose:** enhance timely	**Research Design:** cross-sectional survey **Sample:** nursing staff working in inpatient and emergency department settings (n=875) **Setting:** large academic medical center	**Intervention:** not applicable	**Instruments:** 1-10 point Likert Scale survey **Data Collection Methods:** Data was collected through online surveys as part of a mandatory annual education module.	**Study Findings:** The study found that the majority of nursing staff in the academic medical center had adequate knowledge of stroke signs and symptoms. However, self-efficacy and outcomes expectations were significant predictors of	This study had a high response rate (83.8%) and a large sample size (n=875). An important and clinically relevant issue was addressed with established survey instruments. Various factors	This study was conducted at a single academic medical center, which may limit the generalizability of the findings to other healthcare settings. The cross-sectional design captures data at a single point in time,	The study suggests that educational efforts for nursing staff should go beyond providing knowledge of stroke signs and symptoms. In addition, self-efficacy should be emphasized in recognizing stroke symptoms

staff at an academic medical center **Year:** 2013	recognition and response to stroke symptoms to help improve outcomes for patients				better stroke knowledge, while other factors like clinical experience and nursing unit did not appear to influence stroke knowledge. **Results:** Eighty-seven percent of respondents correctly reported 2 or more stroke signs while 31% identified 3 warning signs. Numbness or weakness was the most frequently reported symptom. Greater self-efficacy in	were comprehensively explored, providing a more holistic understanding of the issue.	making it difficult to establish causality or track changes in knowledge/attitudes over time. The study does not include detailed information about the content of the survey used.	and the importance of rapid identification.

					identifying stroke symptoms and a higher outcome expectations rating were associated with stroke knowledge.			
Author: Almallouhi, E., Kasab S.A., Harvey, J.B., Reardon, C., Alawieh, A., Girotra, T., Aysse, P., Turner IV, R.D., Holmstedt, C.A. **Title:** **Year:**	**Objectives:** To assess the long-term functional outcome of stroke patients treated with thrombectomy during work hours versus after-hours **Aim:** provide insight into the potential impact of timing on patient recovery and to identify strategies for improving the functional outcomes of stroke patients	**Research Design:** retrospective observational **Sample:** stroke patients who received mechanical thrombectomy (n=196) **Setting:** comprehensive stroke center between December 2014 and December 2016	**Intervention:** mechanical thrombectomy procedure	**Instruments:** modified Rankin scale scores, admission National Institute of Health Stroke Scale (NIHSS) scores **Data Collection Methods:** Data collection was primarily through retrospective review of medical	**Study Findings:** The results indicated that the timing of mechanical thrombectomy for stroke patients significantly affected their long-term functional outcomes. Patients treated during off-hours were less likely to achieve favorable functional outcomes,	This study utilized propensity scores and inverse probability of treatment weights to address potential confounding factors, improving the rigor of the analysis and minimizing biases associated with the timing of	The study was conducted at a single comprehensive stroke center in the Southeastern United States, which means findings may not be representative of stroke centers in other regions or settings, limiting the generalizability of the results. The study	The study highlights the importance of timing for stroke patients and how hospitals should focus on strategies to reduce delays in initiating stroke treatment. Hospitals should consider staffing strategies to ensure that

	Purpose: investigate whether the timing of thrombectomy for stroke patients affects long-term functional outcomes			records, collection of modified Rankin scale scores, and patient interviews.	and this was partly attributed to prolonged door-to-groin times during off-hours. **Results:** Patients who underwent mechanical thrombectomy during off-hours had worse functional outcomes compared to those treated during regular work hours. The probability of achieving a favorable functional outcome (Rankin <2) at discharge was 12.6% lower for off-hours	thrombectomy treatment. While retrospective, the study design allowed for the examination of real-word data for a clinically relevant issue, enhancing the external validity of the findings. This study included a relatively large sample size for a single-center study.	acknowledges the presence of potential selection bias, and while propensity scores and IPTW were used to address this issue, it is challenging to fully eliminate all sources of bias in retrospective studies. The study did not specify the use of particular instruments or standardized assessment tools for collecting data, which could introduce	the necessary medical personnel are available during off-hours to perform procedures promptly. Ongoing training and education for healthcare professionals should be provided to ensure they are equipped to deliver timely care regardless of the time of day.

					patients. At 90 days post-discharge, patients treated off-hours had an estimated 18.7% lower probability of achieving a favorable functional outcome. Off-hours patients experienced longer door-to-groin time compared to on-hours patients.		variability in data collection methods.	
Author: Case, C.A. **Title:** Promoting evidence-based practice at a primary stroke center: A nurse	**Objectives:** design/implement a nursing education strategy demonstrating to bedside nurses how current evidence-based guidelines are used when creating standardized	**Research Design:** Quality Improvement educational implementation **Sample:** bedside registered nurse staff	**Intervention:** included four steps: 1. Creating of a poster using quotes from the current AHA/ASA Guidelines for the	**Instruments:** preintervention and postintervention surveys created specifically for this quality improvement project	**Study Findings:** Registered nurses reported a significant increase in perceived confidence in ability to explain how standardized stroke order	The application of the L-EBP model to evaluate this intervention suggests that enriching the evidence-	There was a small sample size which may limit the conclusions that can be drawn from this data. The measurement tool was not tested	It is important to constantly adapt to improve evidence-driven patient care. By providing education of evidence-

education strategy **Year:** 2017	stroke order sets at a primary stroke center **Aim:** to support an evidence-based practice culture within the health care facility **Purpose:** increase nurses' confidence in the use of standardized order sets at the point of care	from four units (n=89) **Setting:** 286-bed community hospital certified by the Joint Commission as a primary stroke center	Early Management of Patients with Acute Ischemic Stroke, standardized orders, and bedside interventions. 2. compilation of a supplemental binder containing the complete AHA/ASA Guidelines for the Early Management of Patients with Acute Ischemic Stroke with highlighted quotes	**Data Collection Methods:** The preintervention survey included an attitude assessment measuring the likelihood of RNs. To perform an ordered nursing intervention when they were confident that the order was evidence based compared with when they were unsure that the order was evidence based. The postinterven	sets reflect current evidence after the intervention. **Results:** There was a reported higher self-perceived likelihood of performing an ordered nursing intervention when there was also confidence that it was evidenced based (n = 88, $p < .001$).	based culture of the health care facility is a theoretical benefit that could potentially be measured. There were multiple steps included in this intervention based on AHA/ASA guidelines provided to improve nursing education. Also, this study brought to attention that increasing the confidence	for validity or reliability. There was no direct measurement for knowledge of the concept. Individual ratings of confidence were not matched for the pre- and postintervention mean scores.	based practice guidelines to registered nurses, confidence may increase for them to utilize these evidence-based guidelines.

			from the poster and numbered tabs to correspond matching standard orders and interventions 3. 90-second verbal poster presentation to RNs during preshift huddle 4. availability of the poster and binder in the staff breakroom for 1 week after presentation	tion survey asked about the educational intervention and their confidence in their ability to explain how the standard order set for stroke patients reflects current evidence.		of nurses can lead to an increase in evidence-based practice.		

Author: Cummings, S., Kasner, S.E., Mullen, M., Olsen, A., McGarvey, M., Weimer, J., Jackson B., Desai, N., Acker, M., Messé, S.R. **Title:** Delays in the identification and assessment of in-hospital stroke patients **Year:** 2022	**Objectives:** identify factors associated with delays from last known normal to symptom identification in patients with in-hospital stroke (IHS); assess the use of stroke interventions **Aim:** characterize the timing and factors associated with delays in identifying in-hospital stroke, the use of stroke interventions, and the incidence of large vessel occlusion (LVO) on vascular imaging **Purpose:** better understand and	**Research Design:** observational retrospective cohort study **Sample:** patients who experienced IHS (n=97) **Setting:** tertiary care comprehensive stroke center	**Intervention:** not applicable	**Instruments:** none specified **Data Collection Methods:** Researches reviewed the medical records of patients who experienced HIS and used hospital databases to see who qualified. Data on vascular imaging was also collected, along with information on any medical procedures done.	**Study Findings:** There were significant delays in the identification of in-hospital stroke patients. Delays also occurred from symptom identification to alerting the stroke team. Delays were associated with being on a surgical service, being in an ICU, being intubated, and a higher NIHSS score. **Results:** The median time from the last known normal to symptom	The study included comprehensive data collection from multiple sources, including medical records, databases, and patient assessments. The study used multivariable analysis to identify independent factors associated with delays, which helps clarify the relationships between variables	The study was conducted at a single tertiary care comprehensive stroke center, so generalizability is limited. The study's sample size might be relatively small for detecting potentially important associations. A comparison group of out-of-hospital stroke patients for context was not included, which could provide valuable insights into	Hospitals should focus on implementing and reinforcing in-house stroke alert protocols to expedite stroke assessment and treatment. Anesthesia protocols for patients undergoing procedures should include measures for rapid offset, enabling timely neurological assessments post-procedure. Hospitals should

	address the delays in diagnosing and treating IHS; reduce morbidity and mortality associated with IHS through the development of improved protocols and practices for stroke detection and treatment				identification was 5.1 hours. The median time from symptom identification to stroke team alert was 2.1 hours. Only 21% of ischemic stroke patients received acute stroke interventions, with 4% receiving tPA and 18% undergoing thrombectomy.	and outcomes.	the differences of care and outcomes.	continue educational efforts to increase awareness among healthcare professionals regarding the importance of early stroke detection and the initiation of stroke alerts.
Author: Drogemueller, C.J., Kashyao, B., Huna Wagner, R. L., Shebeshi, H., Clayton,	**Objectives:** to prioritize staff education, simplify the IHS process, empower staff to activate IHS code, ensure adequate support and	**Research Design:** Quality Improvement **Sample:** multidisciplinary teams within the hospital; 217	**Intervention:** implantation of a new IHS protocol that consisted of alerting a	**Instruments:** Face, Arms, Speech, and Time (FAST) assessment; progress note template	**Study Findings:** The new protocol led to an increase in stroke cases identified and treated with	This study took place over a time frame over two years. It also contained means of education,	Findings may be influenced by staffing and financial resources within the setting; lack of data for those who	Prioritize education and empowerment of nursing staff, set a time goal target, redesigning

M. W., Fennig, M. W., & Hussein, H. M. **Title:** A Successful Quality Improvement Project for Detection and Management of Acute Stroke in Hospitalized Patients **Year:** 2020	teamwork, identify well-defined quality metrics, provide feedback communication **Aim:** To improve the identification of and quality of care for inpatient strokes **Purpose:** increase stroke cases identified, rapid evaluation, and high utilization of acute stroke therapies	patients were included in the analysis **Setting:** urban comprehensive stroke center	specialized stroke team and clear the computed tomography (CT) scanner; also included staff education, case review, and discussion of opportunities for process improvement	with code details **Data Collection Methods:** collection of postimplementation event data on IHS cases (ex. Patient demographics, time of day, hospital unit, outcome); descriptive statistics used for demographic and clinical characteristics; progress notes with code details were created for event documentation by the	improved time to CT. **Results:** It was found that stroke mimics were attributed to evolution of a previously diagnosed stroke, brain tumor, delirium, encephalopathy, seizures, respiratory failure, and psychogenic disorder. The mean time to CT was 18.7 minutes in 2017 and 17.0 minutes in 2018. 38% achieved the target of fifteen minutes or less and 68% in twenty	implementation, organization, and quality reviews. The main focus for success was to prioritize education and empowerment of nursing staff.	had stroke symptoms and a stroke code was not called; lack of data in which MRI rather than CT was used for initial imaging; missing patient identification limited full view of stroke code events	response team members, establish real-time feedback; explore circumstances of the stroke code to better identify hospitalized patients at higher risk

				responding nurse	minutes or less.			
Author: Gumbinger, C., Reuter, B., Stock, C., Sauer, T., Wiethõlter, H., Bruder, I., Rode, S., Kern, R., Ringleb, P., Hennerici, M.G., Hacke, W. **Title:** Time to treatment with recombinant tissue plasminogen activator and outcome of stroke in clinical practice: retrospecti	**Objectives:** to study the time-dependent effectiveness of thrombolytic therapy for acute ischemic stroke **Aim:** assess the impact of time elapsed between stroke onset and thrombolytic therapy on patient outcomes, particularly focusing on functional outcomes and mortality **Purpose:** provide insight into the real-world effectiveness and safety of thrombolytic therapy in the treatment of	**Research Design:** retrospective cohort study **Sample:** patients with acute ischemic stroke (n=84,439) **Setting:** 148 hospitals within the state of Baden-Wuerttemberg, Germany	**Intervention:** administration of recombinant tissue-type plasminogen activator (rtPA) for patients with acute ischemic stroke	**Instruments:** Modified Ranking scale, NIHSS, hospital records **Data Collection Methods:** not specified	**Study Findings:** Treatment with rtPA was associated with an overall favorable outcome. The chance of a lower modified Ranking score at discharge was significantly increased with rtPA treatment, and the effect was larger with short time to treatment. **Results:** The mean rate of thrombolytic therapy for all patients with	The study included a substantial sample of 84,439 patients. Data was collected over a five-year period, allowing for the examination of trends and changes over time. The study included a diverse patient population in terms of age, comorbidities, and other baseline characteristic. The	Data accuracy relies on information input at various hospitals, and while efforts were made to ensure correctness through logic checks and data quality assessments, the extensive coverage prevented complete data verification. The study could not adjust for potential influential factors not collected in the state-	This study emphasizes the importance of initiating thrombolytic therapy within the first 4.5 hours after the onset of a stroke. The study emphasizes the importance of speeding up the process for thrombolytic therapy in hospitals. The study reaffirms that the effectiveness of thrombolytic therapy for acute ischemic

ve analysis of hospital quality assurance data with comparison with results from randomized clinical trials **Year:** 2014	stroke, which emphasis on early treatment and potential benefits and risks associated with the treatment				acute ischemic stroke was 12%, with a constant increase over time. The mean time to treatment for patients receiving rtPA was 140 minutes. The odds ratio decreased from 2.5 for treatment within 90 minutes to 1.3 for treatment within 3.0-4.5 hours. The adjusted in-house mortality for the group treated after 4.5 hours was significantly higher.	study assessed the impact of time to treatment on patient outcomes, emphasizing the importance of early intervention in acute ischemic stroke.	wide database. The group of patients treated beyond the 4.5-hour time window was relatively small and not standardized.	stroke is time dependent.

Author: Kamal, H., Ahmed, M. K., Zha, A., Lail, N. S., Shirani, P., Sawyer, R. N., & Mowla, A. **Title:** Strokes occurring in the hospital: Symptom recognition and eligibility for treatment in the Intensive Care Units Versus Hospital wards **Year:** 2020	**Objectives:** compare the meantime from last known neurologically intact to symptom detection and eligibility for acute treatment of patients based on their physical location in hospital **Aim:** provide data about the care delivery and outcome of this patient population **Purpose:** to put emphasis on timely and early detection of in-hospital AIS	**Research Design:** Cross-sectional study **Sample:** all patient diagnosed with in-hospital AIS over a 10-year period **Setting:** large high-volume comprehensive stroke center	**Intervention:** not applicable	**Instruments:** Get With the Guidelines-Stroke Database; IBM SPSS Statistics **Data Collection Methods:** variables included demographics, comorbidities, clinical presentations, the NIHSS, bed location/level of care, duration from last known neurologically intact to symptom recognition, duration from symptom	**Study Findings:** ICU/ED patients had a significantly shorter time to stroke symptom detection form last known neurologically intact when compared to floor patients; they also had a trend toward a higher likelihood of being eligible for acute treatment **Results:** 7.5% of patients received brain imaging within 25 minutes of symptom recognition;	Demonstrated how a better nurse-to-patient ratio and more knowledge about stroke symptoms among nursing staff may lead to quicker recognition of the neurological deficits among inpatient strokes	May not be generalizable to the quality of care in other centers; confounding effect of comorbidities which may have led to poor outcomes; outcomes cannot be reliably interpreted as solely being dependent on delayed treatments due to decisions for not pursuing aggressive treatment may be due to overall poor medical status and contraindications	Increase efforts toward higher quality neuro-specific nursing education for nurses on regular floors; encourage a low threshold for initiating stroke alerts; streamline inpatient stroke alert algorithms

				recognition to brain imaging, location of infarction and vascular distribution on brain imaging, and treatment undertaken; statistical analyses were carrying out using the IBM SPSS Statistics software	79% underwent brain imaging within 6 hours of symptom recognition, and of these 26% received intravenous thrombolysis within the first 4.5 hours of symptom onset and 17% underwent endovascular treatment.			
Author: Manners, J., Khandker, N., Barron, A., Aziz, Y., Desai, S.M., Morrow, B., Delfyett, W.T., Martin-	**Objectives:** to identify factors contributing to high morbidity and mortality in in-hospital stroke (IHS) cases **Aim:** To improve the diagnosis and time to	**Research Design:** retrospective and prospective cohort analysis **Sample:** two main cohorts: pre-implementation group (n=136) and	**Intervention:** implementation of a revised stroke code protocol designed to improve the recognition, diagnosis, and	**Instruments:** none specified **Data Collection Methods:** The study primarily relies on the collection and analysis of clinical	**Study Findings:** After the implementation of the revised stroke code protocol, there was a significant reduction in the rate of stroke	The study leveraged an existing stroke code protocol and made guided revisions to it, reflecting conditions where	This study was conducted at a single comprehensive stroke center which may limit the generalizability of the findings. A larger	The study suggests that healthcare institutions should consider revising and implementing stroke code protocols for IHS

Gill, C., Shutter, L., Jovin, T.G., Jadhav, A.P. **Title:** An interdisciplinary approach to an in-hospital stroke improves stroke detection and treatment time **Year:** 2019	thrombolysis and thrombectomy in IHS cases **Purpose:** to analyze IHS activations, guide revisions to the stroke code protocol, and assess the impact of these changes on patient outcomes	post-implementation group (n=69) **Setting:** comprehensive stroke center	treatment of HIS; involved stroke education for providers, improved communication, parallel processing, expectations for therapeutic decision-making, and feedback	data from patient medical records and the implementation of changes in the stroke code protocol as an intervention.	mimics. Several time metrics showed improvements in the post-implementation groups. **Results:** The rate of stroke mimics decreased from 52.% to 33.3%. Mean time to imaging after the protocol changes was 7.6 minutes shorter. Mean time to acute reperfusion therapy decreased from 45.7 minutes to 19.8 minutes.	hospitals often need to adapt existing protocols to improve patient care. Containing both retrospective and prospective data allowed for a comparison of outcomes before and after the protocol implementation. The study used rolling feedback to provide information and reinforcement elements	sample size could allow for a more in-depth analysis. The use of rolling feedback may induce potential bias in the post-implementation data. The study did not include a control group that did not undergo the protocol revisions. The study did not thoroughly assess missed cases of IHS.	cases. Hospitals should prioritize stroke education for a wide range of healthcare providers and establish feedback mechanisms for stroke code activations. They should also place a strong emphasis on reducing time metrics.

						of the protocol.		
Author: Newey, C. R., Bell, R., Burks, M., & Nattanmai, P. **Title:** A new strategy in neurocritical care nurse continuing stroke education: A hybrid simulation pilot study **Year:** 2017	**Objectives:** Using high-fidelity simulation to learn advanced skills for caring for patients with acute neurological deterioration through repetition and teamwork **Aim:** Increase the confidence of nurses in the care of patients with acute stroke through education and training **Purpose:** Improve nurses' understanding of patients with acute stroke and neurological deterioration	**Research Design:** Pilot Study **Sample:** neuroscience nurses (n = 37) **Setting:** University of Missouri Health System, Columbia, MO	**Intervention:** hybrid simulation using a combination of lecture and simulation manikin	**Instruments:** five-point Likert questionnaire **Data Collection Methods:** A confidential, voluntary survey was administered pre- and post-simulation asking nurses about their comfort level regarding patients with stroke; demographic data was collected including age, gender, nursing experience,	**Study Findings:** There was a reported significant improvement in understanding and managing patients with acute stroke and neurological deterioration after participating in this hybrid simulation. **Results:** For all six questions included in the survey, the majority of nurses agreed with the responses pre- (68.7-85.7%) and post- (81.1-	Through a hybrid simulation, the limited capabilities of simulations is overcome through incorporating an actor/actress and PowerPoint information including videos and images. High-fidelity manikins were used to make the simulation as realistic as	There is limited time that is necessary to create simulation scenarios and resources needed to host a simulation. Manikins have limited capabilities of simulating neurological emergencies. A small sample size may make it difficult to generalize the findings of this study.	Hybrid simulations, combined with manikin and lecture, can be used as a training tool in preparing nurses to deal with neurological emergencies.

				critical care nursing experience, and prior experience with simulation manikin	91.9%) simulation.	possible. The use of repetition and teamwork was implemented to increase nurses' confidence and understanding.		
Author: Reynolds, S. S., Murray, L. L., McLennon, S. M., & Bakas, T. **Title:** Implementation of a Stroke Competency Program to Improve Nurses'	**Objectives:** use multifaceted strategies to promote implementation of evidence-based practice **Aim:** determine if a tailored, multifaceted stroke competency program would improve nurses' knowledge of and adherence to	**Research Design:** pretest/posttest design study **Sample:** experienced nurses (n = 88) **Setting:** neurocritical care unit	**Intervention:** New printed educational materials were created and developed from guideline recommendations. There was also an educational outreach process that	**Instruments:** Meaningful Use requirements from the Centers of Medicare and Medicaid Services; A one-way analysis of variance (ANOVA)	**Study Findings:** There was a noted improvement in nursing adherence to stroke guidelines. **Results:** Before the program, adherence to documenting NIHSSS/neurological	Reliable and valid instruments were used to measure the success of the study. The use of multiple strategies rather than traditional didactic education was shown	Overlapping initiatives may have contributed to increased adherence to stroke activities. Documentation audits measuring adherence to these stroke activities occur throughout the whole	Extend findings to identify which bundle of strategies are most effective for implementing evidence into nursing practice.

Knowledge of and Adherence to Stroke Guidelines **Year:** 2016	evidence-based practices in the care of patients with stroke **Purpose:** Improve patient care by better education for nurses		consisted of one-on-one educational session by members of the implementation team with the nurses.	**Data Collection Methods:** Adherence was measured using documentation audits; all patients who experienced stroke were included in these audits. The stroke knowledge assessment consisted of multiple-choice questions that were put into three subscales (frequency of neurological assessments, patient and family education, dysphagia);	assessments were 88.6%; this improved to 90.5% after the program. Dysphagia documentation improved from 71% to 75%. When nurses were asked to identify potentially barriers to consistently providing stroke care according to guidelines, before the program, 84% of respondents reported a lack of knowledge of the required activities as a barrier; this percentage decreased to	to have positive results.	hospital and not solely on the neurocritical care unit. Other quality improvement initiatives that were coinciding may have contributed to improved documentation adherence rates.	

				there were also questions about barriers to implementing stroke guidelines. The nurses participated in this survey before the start of the program, immediately after the program, and three weeks after the program	65% during the follow-up assessment. Complexity/difficulty in understanding the requirements was reported by 49% during the preprogram assessment, and then decreased to 34% post program.			

Appendix B: **Modified Rankin Score**

0	The patient has no residual symptoms.
1	The patient has no significant disability; able to carry out all pre-stroke activities.
2	The patient has slight disability; unable to carry out all pre-stroke activities but able to look after self without daily help.
3	The patient has moderate disability; requiring some external help but able to walk without the assistance of another individual.
4	The patient has moderately severe disability; unable to walk or attend to bodily functions without assistance of another individual.
5	The patient has severe disability; bedridden, incontinent, requires continuous care.
6	The patient has expired (during the hospital stay or after discharge from the hospital).
7	Unable to contact patient/caregiver.
8	Modified Rankin Score not performed, OR unable to determine (UTD) from the medical record documentation.

Appendix C: Rapid Arterial Occlusion Evaluation (RACE) Scale

ITEM	INSTRUCTION		RACE Score
FACIAL PALSY	Ask the patient to show their teeth	**ABSENT** (symmetrical movement) **MILD** (slightly asymmetrical) **MODERATE TO SEVERE** (completely asymmetrical)	0 1 2
ARM MOTOR FUNCTION	Extending the arm of the patient 90 degrees (if sitting) of 45 degrees (if supine)	**NORMAL TO MILD** (limb upheld more than 10 seconds) **MODERATE** (limb upheld less than 10 seconds) **SEVERE** (patient unable to raise arm against gravity)	0 1 2
LEG MOTOR FUNCTION	Extending the leg of the patient 30 degrees (if supine)	**NORMAL TO MILD** (limb upheld more than 5 seconds) **MODERATE** (limb upheld less than 5 seconds) **SEVERE** (patient unable to raise leg against gravity)	0 1 2
HEAD AND GAZE DEVIATION	Observe eyes and cephalic deviation to one side	**ABSENT** (eye movements to both sides were possible and no cephalic deviation was observed) **PRESENT** (eyes and cephalic deviation to one side was observed)	0 1
APHASIA If right hemiparesis	Ask the patient two verbal orders: *- "close your eyes"* *- "make a fist"*	**NORMAL** (performs both tasks correctly) **MODERATE** (performs one task correctly) **SEVERE** (performs neither task)	0 1 2
AGNOSIA If left hemiparesis	Asking: *- "Who's arm is this?" while showing him/her the paretic arm (asomatognosia)* *- "Can you move your arm?" (anosognosia)*	**NORMAL** (no asomatognosia nor anosognosia) **MODERATE** (asomatognosia or anosognosia) **SEVERE** (both asomatognosia and anosognosia)	0 1 2
		RACE SCALE TOTAL: Any score above a "0" is a "Stroke Alert"	

** Chart adapted from Perez de la Ossa N, Carrera D, Gorchs M, et al. Design and validation of a prehospital stroke scale to predict large arterial occlusion: the rapid arterial occlusion evaluation scale. Stroke; a journal of cerebral circulation. Jan 2014;45(1):87-91.*

Appendix D: Modified NIHSS

Item Number	Item Name	Scoring Guide	Patient Score
1B	LOC Questions	0=answers both correctly 1=answers one correctly 2=answers neither correctly	_____
1C	LOC Commands	0=performs both tasks correctly 1=performs one task correctly 2=performs neither task	_____
2.	Gaze	0=normal 1=partial gaze palsey 2=total gaze palsey	_____
3.	Visual Fields	0=no visual loss 1=partial hemianopsia 2=complete hemianopsia 3=bilateral hemianopsia	_____
5a.	Left Arm Motor	0=no drift 1=drift before 10 seconds 2=falls before 10 seconds 3=no effort against gravity 4=no movement	_____
5b.	Right Arm Motor	0=no drift 1=drift before 10 seconds 2=falls before 10 seconds 3=no effort against gravity 4=no movement	_____
6a.	Left Leg Motor	0=no drift 1=drift before 5 seconds 2=falls before 5 seconds 3=no effort against gravity 4=no movement	_____
6b.	Right Leg Motor	0=no drift 1=drift before 5 seconds 2=falls before 5 seconds 3=no effort against gravity 4=no movement	_____
8.	Sensory	0=normal 1=abnormal	_____
9.	Language	0=normal 1=mild aphasia 2=severe aphasia 3=mute or global aphasia	_____
11.	Neglect	0=normal 1=mild 2=severe	_____
		Score (out of 31):	_____

* Scoring from Original Scale