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BE-FAST Assessments in Emergency Departments to Increase Recognition of Posterior Circulation Strokes

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Abstract

Posterior circulation strokes are often missed in emergency departments due to atypical symptom presentation that leads to poor prognosis and increased medical costs related to treatment. The purpose of this project is to increase identification of posterior circulation strokes by providing an educational tool and introducing a revised stroke assessment tool that includes symptoms caused by posterior circulation strokes. Success of project implementation was measured by improved test scores of post education and post intervention questionnaires, increased use of the BE-FAST assessment tool, increased completed MRIs, and an increase in the number of confirmed posterior circulation strokes. This multi-part quality improvement project occurred in a level IV emergency department and focused on enhancing registered nurses' awareness of atypical symptom presentation due to neurological etiologies. Approximately 36% (n = 18) registered nurses participated in this project and 33% (n = 6) of those nurses completed both questionnaires. The second part of this project encompassed retrospective and prospective chart review looking at chief complaints, whether an MRI was completed, final diagnosis, and if there was a correlation between utilization of BE-FAST assessments and posterior circulation stroke diagnosis. There were 130 charts that met criteria for review. Chi square test of independence showed no statistical significance of BE-FAST assessment with posterior stroke ($p > 0.05$): however, there was a statistical significance between MRIs completed and a diagnosis of a posterior stroke ($p < 0.05$). Further studies with a longer implementation time, improved disbursal method, and easier shortcut to recalling smart phrase is recommended to further evaluate the efficacy of implementing a BE-FAST assessment for patients presenting with neurological symptoms in healthcare settings.

Key words**:** Posterior circulation stroke, posterior strokes, BE-FAST, strokes, neurological symptoms, MRI, emergency department

Contents

Introduction

Strokes are a leading cause of death and long-term disability in the United States (Centers for Disease Control and Prevention [CDC], 2022). According to the CDC, approximately one in six cardiovascular disease related deaths are due to a stroke. There are approximately 795,000 people who suffer from strokes annually, every 40 seconds somebody in the US suffers from a stroke, and every three and a half minutes someone dies. Between 2017 and 2018 stroke costs related to health care services, medications, and missed days of work were almost $53 billion (CDC, 2022). These costs are projected to increase to approximately $184 billion by 2030 (Tan et al., 2019). Those who receive delayed care are more likely to experience disability related to their stroke (CDC, 2022). It is estimated that 87% of strokes are ischemic (CDC, 2022). Compared to anterior circulation and hemorrhagic strokes, posterior circulation strokes (PCS) are more likely to cause disability and death (Schneck, 2018). PCS can be more difficult to diagnose due to "atypical" stroke presentation with signs such as changes in balance, coordination, and vision (Pickham et al., 2018). Posterior circulation strokes are about three times more likely than anterior strokes to be missed in the emergency department (Arch et al., 2016) and "twenty percent of ischemic events involve posterior circulation" (Caplan, 2019, para. 1). Gaps in the knowledge remain in areas of assessment strategies for PCS in both pre-hospital and in-hospital settings because most of the literature in these areas concentrate on anterior circulation. The addition of balance and visual disturbances to these assessments may decrease disability and death for these patients.

Evidence-Based Literature Review

An extensive search was done to see what current and relevant research has been published on posterior stroke assessments, risk factors, treatments, and outcomes. Literature

review was completed using articles collected from CINAHL, PubMed, Cochrane, Google Scholar, Ebsco, and UpToDate. Articles were filtered using key words such as posterior stroke, posterior circulation ischemia, posterior circulation stroke, anterior stroke, BE-FAST, "balance, eyes, face, arms, speech, time", FAST, emergency department, emergency room, identification, recognition, dizziness, vertigo, gait ataxia, strokes, and ischemic strokes. Peer reviewed journals were selected, and a concerted effort was made to only include studies done in the United States within 10 years, but exceptions were made when deemed appropriate.

Arch et al. (2016) conducted a retrospective analysis at two different hospitals. They used electronic health records of past patients that were discharged from the hospital with a diagnosis of an ischemic stroke. They found that about 20% of patients missed the time window for thrombolytic therapy due to misdiagnosis and atypical symptom presentation associated with posterior circulation strokes. This study found that patients who presented with headaches, nausea, vomiting, dizziness, seizures, syncope, difficulty walking, and falls were more likely to be misdiagnosed and have a missed posterior circulation stroke than patients who presented with common neurological symptoms such as dysmetria, focal weakness, and numbness. Arch et al. (2016) also found that in certified stroke hospitals, nurses and doctors in the ED were not initiating stroke workups in part because the patient's presentation did not trigger consideration of a stroke as a differential diagnosis.

Another key study (Blasberg et al., 2017) focused on whether or not transient vertigo was caused by an etiology of ischemic strokes, since vertigo/dizziness was one of the most common symptoms that patients report when admitted to the ED (Blasberg et al., 2017; Chen et al., 2016) and is present in posterior circulation strokes without focal signs (Blasberg et al., 2017). In addition to other atypical neurological symptoms, nausea and vomiting may indicate potential for

future posterior circulation strokes. Underlying causes of dizziness, nausea, and vomiting tend to be benign in origin which would not warrant any further diagnostic testing and/or blood work (Blasberg et al., 2017; Chen et al., 2016). Patients also seek medical attention in places other than the emergency department, such as urgent care and primary care offices. Seeking medical care at these types of medical facilities may end up delaying treatment of the patient due to insufficient resources in a primary care office (e.g., MRI and CT scan).

Patients who present with symptoms that have resolved in a short period of time are usually diagnosed with a transient ischemic attack (TIA). Because TIAs are considered a predisposing factor that may lead to an anterior stroke, patients who presented with a TIA received a full neurological work-up since their symptoms triggered the stroke-specific protocol. Many patients who sought treatment for TIAs and/or anterior strokes did so because they recognized the common acronym for stroke recognition: FAST, which stands for facial droop, arm weakness, speech difficulty, and time (Kennedy et al., 2003).

A 2020 meta-analysis of 24 observational studies with 10,446 patients evaluated stroke recognition by first-aid providers in a pre-hospital setting (Meyran et al., 2020). Scales were differentiated based on assessment measures. Meyran and his co-authors noted four relevant studies on the FAST assessment and only one relevant study on BE-FAST. These studies were all focused on the pre-hospital setting (Meyran et al., 2020). Evidence suggests that there is an overall shortage of studies testing validated screening tools in an inpatient setting (El Ammar et al., 2020; Meyran et al., 2020; Pickham et al., 2019).

Similar to what Meyran et al. (2020) found in their meta-analysis, the majority of the literature does not differentiate between anterior and posterior strokes. There was also limited research on stroke assessment tools that include changes in balance and visual disturbances

(Aroor et al., 2016; Meyran et al., 2020). Therefore, more research is needed on the effectiveness of stroke assessment tools' ability to recognize posterior strokes with the addition of changes in balance and visual disturbances, particularly in an inpatient setting.

Purpose and Aims

The purpose of this project was to increase identification of posterior circulation strokes using an MRI as a definitive diagnosis. The aims of the project were to 1) implement education on utilization of BE-FAST assessment to ED nurses triaging patients, 2) assess knowledge of the stroke presentation with use of pre-education and post-intervention testing, 3) incorporate a BE-FAST smart phrase into patient's electronic health record (EHR), and 4) evaluate effectiveness of the posterior stroke education with Retrospective and Prospective Chart Reviews, specifically looking at completed MRIs results for patients presenting with stroke-like symptoms.

Theoretical Framework

This project was based on the Donabedian Theory of Quality Framework, which focuses on the assessment of the quality of care utilizing three main categories: structure, process, and outcomes (Ayanian & Markel, 2016). For this project, the structure included education about symptom presentation in posterior circulation and the methods ED nurses used to triage and chart patients that presented with stroke-like symptoms. Attention was focused on the use of the BE-FAST assessment tool. The BE-FAST smart phrase charting instrument for patients presenting with neurological symptoms was monitored for use. Last, the expected outcome was an increase of diagnosed posterior circulation strokes determined by MRI results.

Methods

Project Design

This quality improvement project was conducted via a two-person team that utilized both quantitative and qualitative measures to evaluate the effectiveness of implementing an improved stroke assessment tool (BE-FAST), adapted from the American Heart Association, after providing education of posterior circulation strokes. The educational component was created by project leads utilizing information extracted from the CDC, American Heart Association, and other articles referenced in the literature review. This project was submitted to Seattle University's Institutional Review Board (IRB) and Common Spirit's Evidence Based Practice (EBP) board determined to be a quality improvement project exempt from further review.

This project was implemented in multiple phases. Phase one involved presentation of an educational PowerPoint with information on the importance of early stroke recognition, how posterior circulation strokes present atypically, implementation of a BE-FAST assessment, and inclusion of a smart phrase charting tool (see Appendix A). After the presentation, emergency department nurses were provided with a Qualtrics post-education questionnaire (Stroke Questionnaire I) that included qualitative and quantitative questions to assess potential barriers to project implementation and understanding of educational materials (see Appendix B).

Phase Two started after completion of the education and Stroke Questionnaire I. This phase encompassed a Retrospective Chart Review and utilization of the BE-FAST smart phrase charting tool, which was created by one of the project leads (see Appendix C). Retrospective Chart Review dated back to one month before smart phrase implementation. Chart review was completed to determine the type of assessment utilized for patients who presented with atypical neurological symptoms. There was a review for whether an MRI was completed in addition to if

there was a diagnosis of a posterior circulation stroke. Ideally, nurses would utilize the BE-FAST smart phrase charting tool for patients that was presented to the emergency department (ED) for stroke-like symptoms including facial droop, arm weakness, ataxia, vertigo, etc. A "code neuro" would then be called overhead at provider's discretion to ensure imaging and proper treatments were initiated for thrombolysis-eligible patients within the specific timeframe. A "code neuro" is a health system specific alert that is paged overhead at the hospital. Initiating a code neuro expedites the process of obtaining a CT scan, as treatment for an ischemic stroke is time sensitive (American Heart Association, 2021).

Prospective Chart Review was conducted for data analysis to determine the number of diagnosed posterior strokes over approximately a two-month period. Patient charts included for review were limited to patients presenting to the emergency department for chief complaints relating to stroke-like symptoms, focusing specifically on the use of the newly implemented BE-FAST charting tool and subsequent MRI.

The final phase of the project consisted of a post-implementation questionnaire (Stroke Questionnaire II). The rationale of post-education and post-intervention testing was to ensure long-term retention of the educational material rather than a short-term improvement which would be expected with a pre- and post- education test administered within a short timeframe.

Setting

The clinical setting is a level IV, 25 bed emergency department serving King County, South King County, and Pierce County, WA. This emergency department serves approximately 120 patients daily, ranging in age from newborn to geriatric patients. The target population of this project included ED nurses at this acute care setting and patients who present to this ED with

anterior and posterior stroke symptoms. Posterior circulation stroke education and smart phrase implementation took place exclusively in the emergency department.

Participants

Nurses Recruitment

Approximately 50 registered nurses working in the ED were asked to participate in the questionnaires via virtual Zoom staff meeting and were sent a follow up email with a link to the questionnaire and a second link via work-designated Facebook page two months later.

Patient Recruitment

Inclusion criteria for chart review consisted of patients who presented to the ED with neurological deficits that encompassed both typical and atypical stroke symptoms. Typical stroke symptoms included facial droop, slurred speech, and unilateral extremity weakness. Atypical symptoms were identified as sudden dizziness, gait disturbances, visual disturbances, and nausea. Patients who presented to the ED for non-neurological medical emergencies, such as abdominal pain, chest pain, or extremity lacerations were excluded from this project.

Ethical Considerations for Human Subjects

Nurses

While a secure system was used to collect data, the risk of data breach could not be completely eliminated. Qualtrics Online Survey platform is a secure, password-protected software that will collect and store all questionnaire data. Creating a Qualtrics account requires an academic institution affiliated email. The account associated with this project was affiliated with one of the project lead's academic emails; they were the only person who had access to the questionnaire results. Analyzed and anonymized data downloaded from Qualtrics were then

stored in a password-protected Microsoft Excel file on the project lead's password-protected computer. The nurses did not need to create a Qualtrics account to access the questionnaires.

To maximize privacy of nurses and their identities, no personal information, demographic information, or IP addresses were collected. All data were anonymized and aggregated via the Qualtrics reporting function. The first page of the questionnaire was an information page that provided the following: 1) the nurse's role in the project should they choose to participate, 2) that this project has the support of the stroke coordinator and ED manager, and 3) contact information for both project leads in the case there were any questions or concerns. Nurses had the ability to choose if they wanted to participate in the questionnaire or not; meaning before beginning the questionnaire, the nurse had to choose if they would like to participate by selecting "begin the knowledge test" or "I do not wish to participate". If they click "begin the knowledge test" they would be directed to the first page of the questionnaire. To allow matching between the first and second questionnaire while maintaining anonymity of participants, a question was included in both questionnaires that required the participant to create and remember a unique personal identifier only they would know.

Patients

This study was approved by the Seattle University IRB and Common Spirit's Evidence Based Practice Committee who determined there were minimal to no risks to patient outcomes. Patient data collected from chart reviews included date of service, age, gender, primary language, chief complaint, CT and MRI imaging results and interpretation. No direct patient identifiers were collected. Information collected via chart review was stored on a password-protected computer and a dual-password protected Microsoft Excel document. To ensure

maximum protection of indirect identifiers, the only person who had access to this information was the project lead who completed this aspect of the data collection.

Stakeholders

Stakeholders included the stroke coordinator, the ED manager, and the ED educator. The common goal of these stakeholders was to increase nurses' recognition of posterior circulation strokes so that ED physicians were alerted in a timely manner and could initiate the stroke protocol.

Intervention

Both project leads attended two staff meetings to present project background, justification, and implementation process to ED nurses. Two meetings, which are normally in person and were held via Zoom due to the Covid-19 pandemic, were conducted so that both day shift and night shift staff members could attend. The first meeting had 44 participants and the second meeting had 36 participants. Meeting participants included ED nurses, ED technicians, the stroke coordinator, ED manager, ED educator, and both project leads. Participants were in their homes, at work, or in other locations. Approximately 50 of these 80 participants were ED nurses. The presentation in each meeting was around 15 minutes and included a PowerPoint presentation focusing on the pathophysiology of posterior circulation strokes and their atypical symptom presentation. The PowerPoint was composed of evidence-based research that supported the new assessment tool, introduced the BE-FAST charting assessment tool and correct methods of utilization, and the need to pay special attention to patients that presented with sudden neurological changes in comparison to chronic neurological symptoms.

The BE-FAST assessment charting tool included the following symptoms: sudden balance or gait issues, sudden blurry vision, double vision, or loss of vision in one eye, sudden

facial droop, sudden arm weakness, and sudden slurred speech. A smart phrase charting tool provides a standard blank note template that would be created by the primary nurse. This specific smart phrase charting tool was made to assess neurological signs that a patient may be experiencing, such as dizziness, gait disturbance, visual changes, etc., as well as the time when symptoms first started. Furthermore, a BE-FAST reference sheet was created by the stroke coordinator and placed in various sections of the department, on doors, and next to the computers to help with recollection of atypical neurological symptoms and to increase retention of knowledge.

Many of the nurses who attended the presentation identified patients that may have had atypical stroke symptoms and verbalized that posterior stroke presentation was an important topic to be discussed. Following the presentation, the stroke coordinator presented the educational PowerPoint and the smart phrase charting tool to the ED medical director and co-director to report a change of practice.

One week later, the presentation and a link to Stroke Questionnaire I were distributed via email to the ED nurses by the ED educator to ensure contact information of the nurses was kept confidential from the project leads.

Data Collection Procedures

Questionnaires

The data for retention and improvement of knowledge of the ED nurses was collected through questionnaire responses gathered via Qualtrics. This data was then reviewed and analyzed by one of the project leads.

Chart Reviews

Retrospective and Prospective Chart Reviews were completed by the other project lead. Access to electronic health records was granted via Medical Staff Services after the project lead was onboarded as a student with Common Spirit. Patient health records were accessible via EPIC database to employees who have been granted access. Prospective Chart Review was completed on a weekly basis and consisted of analyzing reports for patients admitted in the ED including patients who had a chief complaint of facial droop, dysphagia, dizziness, nausea, headache, visual changes, eye problems, or stroke-like symptoms. Demographic identifiers collected via both chart reviews included age, gender, and primary language. Retrospective Chart Review focused on symptoms that patients presented with, imaging completed, and final diagnosis. Results of CT were included in chart reviews to determine the need for further diagnostic imaging and the frequency of missed posterior circulation strokes. Retrospective Chart Review also included review of MRIs to determine how often MRIs were used diagnostically in posterior circulation strokes. Prospective Chart Review focused on two criteria: 1) use of the BE-FAST smart phrase charting tool by the ED nurses to report patients who present with posterior stroke symptoms, and 2) the MRI results for those patients. The BE-FAST smart phrase charting tool was accessible to all ED nurses and implemented to improve recognition of a potential posterior stroke which could then be documented in the patient's electronic health record.

Measures

Questionnaires

The post-education questionnaire (Stroke Questionnaire I) consisted of an information sheet followed by a short-answer question. There was one short-answer qualitative question to assess participant perception of potential barriers to project implementation. Two quantitative

questions assessed for understanding of the educational component and included two select-all-that-apply questions and one multiple choice question regarding information directly from the presentation. Stroke Questionnaire I also included one case study with two application-style multiple choice questions for a total of seven questions. The length of time required to take Stroke Questionnaire I from beginning to completion was approximately 10 to 15 minutes.

The post-implementation, post-education questionnaire (Stroke Questionnaire II) was distributed two months after distribution of the first questionnaire. This questionnaire had the same components as the other questionnaire with exception for the qualitative question. While the first questionnaire assessed what barriers participants believed could impact project implementation, the second asked for what barriers they had experienced in the implementation phase.

Chart Reviews

Retrospective Chart Review dated back one month before beginning this project. Chart reviews were continued through the end of project implementation, which was completed in the first week of April. The primary focus of Retrospective Chart Review was on presenting symptoms, imaging completed, and final diagnosis for patients presenting with neurological complaints. Results of CT were included in chart reviews to determine the need for further diagnostic imaging and the frequency of missed posterior circulation strokes. Prospective Chart Review began after BE-FAST smart phrase charting tool was made available for use in the EPIC charting system.

Data Analysis

Questionnaires

All data collected from both stroke questionnaires were transferred to Microsoft Excel. Due to a small sample size, descriptive statistics were used to analyze quantitative data from Stroke Questionnaire I and II. Data were analyzed to compare individual participant scores between first and second questionnaire question-by-question. Both questionnaires were also statistically analyzed to determine overall mean, median, mode, range, minimum score, maximum score, and standard deviation of scores for comparison. A tool that was created for scoring quantitative responses for both questionnaires can be found in Appendix D.

Responses from the two open-ended qualitative questions assessing for potential and perceived barriers to implementation were analyzed for emerging themes using the method of summative content analysis. Responses were categorized into themes based on content and meaning and were summarized in table format. These tables were used by project leads to help determine and plan for potential barriers and to inform project limitations and recommendations. All participants who responded to qualitative questions were included in qualitative data analysis.

Chart Reviews

Data for chart reviews were collected using the chart audit tool and are displayed in Table 1 and Table 2. The chart audit tool includes date of admission to the ED, gender of the patient, age of the patient, chief complaint, a BE-FAST assessment (exclusively for Prospective Chart Review), a CT scan, an MRI scan, and the patient's final diagnosis. Data collected through chart audits were analyzed using chi square testing of independence to determine relationship between use of BE-FAST and diagnosis of posterior circulation strokes.

Table 1

Chart Audit Tool Used for Retrospective Chart Review

Date Of Service	Age	Gender	Primary Language	Chief Complaint	CT Scan	Results	MRI Scan	Results	Final Dx
2/15/22	68	F	English	Dizziness	Yes	No acute findings	Yes	Left cerebellar infarct	CVA

Table 2

Chart Audit Tool Used for Prospective Chart Review

Date Of Service	Age	Gender	Primary Language	Chief Complaint	BE-FAST?	CT Scan	Results	MRI Scan	Results	Final Dx
3/21/22	45	F	English	Dizziness	Yes	Yes	No acute findings	Yes	Left cerebellar infarct	CVA

Results

Qualitative Findings

Questionnaires

The stroke questionnaires each had one qualitative question. Stroke Questionnaire I asked the participants to enter free text to describe potential barriers they foresaw using the BE-FAST smart phrase. Stroke Questionnaire II asked what barriers they experienced with implementation of the BE-FAST smart phrase. Qualitative results for question 3 from each questionnaire were analyzed for key takeaways and emerging themes. Major themes that emerged during analysis of

Stroke Questionnaire were “not perceiving potential barriers” and “difficulty motivating staff to change”. Three participants left this question blank.

Two major themes that emerged during analysis of Stroke Questionnaire II were “not perceiving experienced” and “difficulty accessing smart phrase”. One participant put the response “didn’t have a neuro patient”, which was categorized as “other”. The other two participants left this question blank. Table 3 shows the frequencies and percentages of common themes found during content analysis of question 3 for Stroke Questionnaires I and II.

Table 3

Qualitative Data of Barriers Collected from Stroke Questionnaires I and II

Stroke Questionnaire I		
Theme	*n*	%
Not Perceiving Experienced Barriers	8	50
Motivating Staff to Change	5	31
Question Response Left Blank	3	19
Other	0	0
Stroke Questionnaire II		
Theme	*n*	%
Not Perceiving Experienced Barriers	3	38
Difficulty Accessing Smart Phrase	2	25
Question Response Left Blank	2	25
Other	1	13

Note. $n = 18$ for all respondents on both questionnaires, $n = 16$ for Stroke Questionnaire 1 and $n = 8$ for Stroke Questionnaire 2. All percentages were rounded up to the nearest whole number.

Chart Reviews

Both Retrospective Chart Review and Prospective Chart Review were completed using EPIC electronic health record database. Data were extracted from the charts of patients who presented with chief complaints of dizziness, stroke-like symptoms, numbness, nausea, headaches, and blurry vision.

Retrospective Chart Review was completed one month prior to the project implementation and identified 38 patients (n = 38) that presented to the emergency department with neurological symptoms (headache, dizziness, stroke-like symptoms, extremity weakness, and numbness). Of those 38 patients whose charts were reviewed, 5% (n = 2) were diagnosed with an ischemic stroke, with one (n = 1) of those patients having a confirmed diagnosis of a stroke that occurred in the posterior circulation. Approximately 58% (n = 22) of the patients were females and 42% (n = 16) were males (see Table 4). The primary language of those patients was English with some patients speaking Somali, Spanish, Vietnamese, or Dari. Primary chief complaints included dizziness (53%; n = 20), headache (26%; n = 10), and stroke-like symptoms (8%; n = 3). Patients who presented with the primary complaints mentioned previously were often diagnosed with dizziness (13%; n = 5), vertigo (11%; n = 4), or a transient ischemic attack (8%; n = 3). Retrospective Chart Review identified many other causes to a patient's neurological complaint (see Table 5).

Table 4

Demographic Data Collected from Retrospective Chart Review

	Number	%
Gender		
Female	22	58
Male	16	42
Language		
English	34	89
Somali	1	3
Spanish	1	3
Vietnamese	1	3
Dari	1	3
Age		
17-29	7	18
30-39	8	21
40-49	3	8
50-59	7	18
60-69	3	8
70-79	5	13
80-89	5	13

Table 5

Diagnostic Process from Retrospective Chart Review

	Number	%
Presenting Symptoms		
Dizziness	20	53
Headache	10	26
Stroke-Like Symptoms	3	8
Numbness	2	5
Emesis	2*	5
Extremity Weakness	1	2.6
Fall	1	2.6
Nausea	1	2.6
Diagnostic Imaging		
CT Scan	20	53
MRI	7	18
No Imaging	11	29
Final Diagnoses		
Dizziness	5**	13
Vertigo	4**	11
Transient Ischemic Attack	3	8
Acute Ischemic Stroke	3**	8
Non-intractable Headache	3**	8
Covid-19	2	5
Syncope	2	5
Anemia	1	3
Atrial Fibrillation	1	3
Bell's Palsy	1	3
Chest Wall Pain	1	3
Cirrhosis	1	3
Concussion	1	3

Malaise	1	3
Hypertensive Encephalopathy	1	3
Non-Traumatic Intracerebral Hemorrhage of Cerebellum	1	3
Lightheadedness	1	3
Medication Side Effect	1	3
Meniere's Disease	1	3
Migraine Without Aura	1	3
Near-Syncope	1	3
Seizure	1	3
Numbness	1	3
Palpitations	1	3
Sinusitis	1	3
Hypo-Osmolar Hyponatremia	1	3
Weakness	1	3

*Patients presented with multiple complaints that met criteria for retrospective chart review.
**Patients were diagnosed with multiple final diagnoses.

Prospective Chart Review identified 130 patients (*N* = 130*)* that met criteria for review (see Table 6 and 7). Of the 130 patients, 60% (*n* = 78) were female and 40% (*n* = 52) were male. Most patients spoke English while some patients spoke other languages such as Korean, Vietnamese, Somali, and Tagalog. The ages of patients ranged from 19 years to 98 years. There were multiple neurological symptoms that patients reported; the most frequently reported chief complaints reviewed included dizziness (48%; *n* = 62), stroke-like symptoms (17%; *n* = 22), and headache (12%; *n* = 18). The patients who reported dizziness consisted of 58% (*n* = 36) females and 49% (*n* = 26) males. Two of the 26 males (49%) who reported dizziness were diagnosed with a posterior circulation stroke, ages were 57 and 58 years. There were 22 patients (*n* = 22) who were triaged with "stroke-like symptoms", 50% female (*n* = 11) and 50% male (*n* = 11); of

those 22 patients, four patients (36%; *n* = 4) were diagnosed with a posterior circulation stroke. Their ages ranged from 66 to 70 years. Amongst those patients that presented with a headache, 61% were females (*n* = 11) and 39% were males (*n* = 7), where only one female (5%; *n* = 1) aged 40 was diagnosed with a posterior circulation stroke.

There were seven confirmed posterior circulation strokes accounting for 5% of the patients that sought help for a neurological complaint in the ED. MRIs were completed for 86% of those patients. BE-FAST smart phrase assessment and charting tool was used in three of the charts reviewed that had an MRI confirmed posterior circulation stroke (see Table 7). Data was analyzed with chi square testing comparing BE-FAST assessment/smart phrase and diagnosis of posterior circulation strokes, which resulted in chi square value of 1.48 with a p-value of 0.22.

Table 6

Demographic Data collected from Prospective Chart Review

	Number	%
Gender		
Female	78	60
Male	52	40
Language		
English	122	94
Korean	2	1
Vietnamese	2	1
Somali	1	0.8
Tagalog	1	0.8
Age		
19-29	9	7
30-39	15	12
40-49	17	13
50-59	21	16
60-69	25	19
70-79	24	18
80-89	15	12
90+	4	3

Table 7

Diagnostic Process from Prospective Chart Review

	Number	%
Presenting Symptoms		
Dizziness	62*	48
Stroke-Like Symptoms	22	17
Headache	18*	12
Numbness	9*	6
Nausea	7	5
Extremity Weakness	4*	3
Altered Mental Status	3*	2
Aphasia	3*	2
Facial Droop	3	2
Fall	1	0.77
Gait Disturbance	1	0.77
Blurry Vision	1*	0.77
Weakness	1	0.77
Other	1	0.77
Diagnostic Imaging		
CT Scan	69	53
MRI	37	28
No Imaging	24	18
Final Diagnoses		
Dizziness	18**	14
Acute Intractable Headache	17**	13
Vertigo	10	8
Transient Ischemic Attack	6	5
Cerebrovascular Accident	6*	5
Acute Kidney Injury	6**	5
Paresthesias	6	5

Acute Ischemic Stroke	5	4
Dehydration	5**	4
Near Syncope	4	3
Limb Weakness	3**	2
Lightheadedness	3	2
Nausea	3**	2
Generalized Weakness	3*	2
End Stage Renal Disease (ESRD)	3**	2
Atrial Fibrillation with Rapid Ventricular Response	2*	2
Recurrent Headaches	2	2
Hepatic Encephalopathy	2	2
Orthostatic Hypotension	2	2
Peripheral vertigo	2	2
Hypoxia	2	2
Acute Cystitis	1	0.8
Ataxia	1*	0.8
Basilar Artery Occlusion	1	0.8
Bell's Palsy	1	0.8
Benign Paroxysmal Positional Vertigo (BPPV)	1	0.8
Bradycardia	1	0.8
Cerebellar Infarct	1	0.8
Concussion	1	0.8
Diverticulitis	1	0.8
Dysmetria	1	0.8
Flu-Like Symptoms	1	0.8
Hyperglycemia	1*	0.8
Hypoglycemia	1	0.8
Imbalance	1	0.8

Lacunar Infarct	1	0.8
Medication Reaction	1	0.8
Migrainous Vertigo	1	0.8
Multiple Sclerosis Exacerbation	1	0.8
Perforation of tympanic membrane	1	0.8
Peripheral vasoconstriction	1	0.8
Pseudoseizure	1	0.8
Pyelonephritis	1	0.8
Respiratory Arrest	1	0.8
Sepsis	1	0.8
Suspected Stroke	1	0.8
Symptomatic Anemia	1	0.8
Syncope	1	0.8
Transient Memory Loss	1	0.8
Transient Speech Disturbance	1	0.8
Trigeminal Neuralgia	1	0.8
Upper Respiratory Tract Infection	1	0.8
Urinary Tract Infection	1	0.8
Vestibular Neuritis	1	0.8

*Patients presented with multiple symptoms that met criteria for prospective chart review.
**Patients had multiple final diagnoses.
†5 patients were not included as they were active patients during time of prospective chart review and final diagnosis was not collected.

Quantitative Findings

Questionnaires

The questionnaires were disseminated two months apart. The responses to stroke questionnaires were analyzed and stratified. Of the 50 ED nurses who were present in the staff meetings, a total of 18 (n = 18, 36%) responded to one or both questionnaires. Sixteen people (n = 16) responded to the first questionnaire, six (n = 6, 32%) responded to the second. This means 37.5% of nurses who participated in the first questionnaire also participated in the second. Twelve percent of the nurses who completed both questionnaires attended at least one of the presentations. A table that shows each participant and which questionnaire(s) they responded to can be found in Appendix E.

Table 8 shows statistics for the first stroke questionnaire including mean and median scores, range, minimum and maximum scores, and standard deviation of scores. There were 16 respondents (n = 16) for the first questionnaire, and 8 (n = 8) respondents for the second. The mean score decreased by 20% between the first and second questionnaires and the range for the first questionnaire was 20 points less than the second. The minimum score on the first questionnaire was 20 points more than the second. Both questionnaires had a maximum score of 100%. The standard deviation of the first questionnaire was a smaller value than the second.

Table 8

Scores for Stroke Questionnaires I and II

	n	Mean	Median	Range	Min	Max	Standard Deviation
Stroke Questionnaire I	16	82.5	80	60	40	100	17.1
Stroke Questionnaire II	8	62.5	60	80	20	100	29.0

Figure 1 compares individual participant scores from Stroke Questionnaire I to those of Stroke Questionnaire II. Participants included in the comparison were those who completed both questionnaires. Participants 7, 9, and 10 scored better on the first questionnaire than they did on the second; participant 7 scored 80% on the first questionnaire and 20% on the second, participant 9 scored 80% on the first and 60% on the second, and participant 10 scored 100% on the first and 80% on the second. Participants 8 and 13 had an improvement in score on the second questionnaire; participant 8 increased from 40% to 60% while participant 13 went from 80% to 100%. Participant 12 retained a score of 100% on both questionnaires. In summary, most participants scored lower on the second questionnaire. Two participants improved on the second questionnaire while one participant had the highest score on both questionnaires.

Figure 1

Comparison of Participant Scores Between Stroke Questionnaires I and II

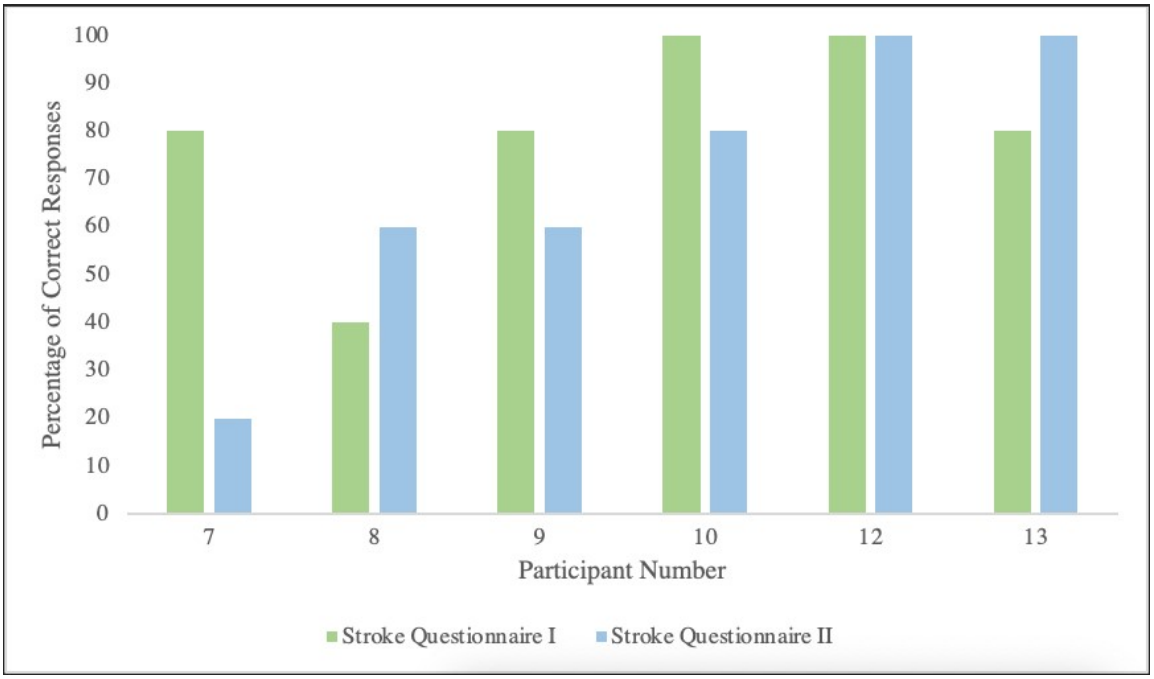
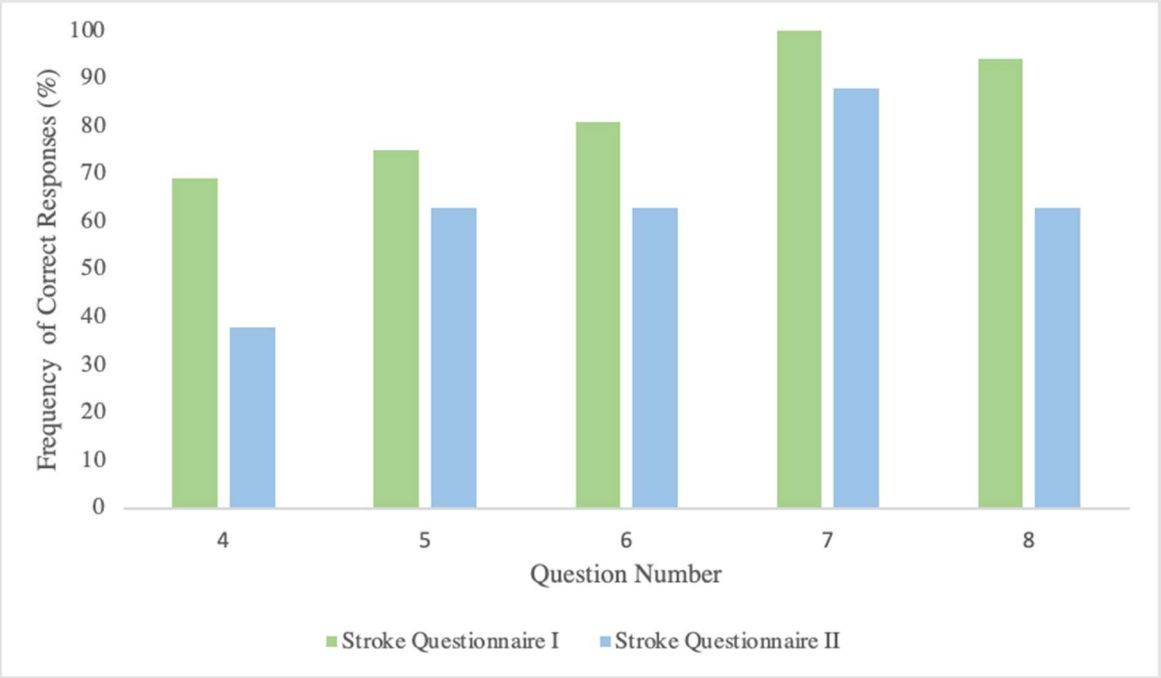


Figure 2 shows a comparison of correct responses by question between Stroke Questionnaire I and II. Please note that there were 16 participants (n = 16) who responded to the first questionnaire and eight who responded to the second (n = 8). The correct answers were chosen more frequently for each question on the first questionnaire than the second. The most frequently correct question on both questionnaires was question 7. The frequencies of correct choices for questions 5, 6, and 8 were the same for Stroke Questionnaire II (63%).

Figure 2

Comparison of Frequency of Correct Responses by Question Between Stroke Questionnaires I and II



Discussion

This quality improvement project sought to increase recognition and prognosis of PCS patients through improving nursing knowledge of 1) PCS presentation, and 2) interventions to perform when a posterior stroke is suspected. The findings for this project were drawn from the analysis of two online Qualtrics questionnaires (Stroke Questionnaire I and Stroke Questionnaire

II) as well as a Prospective and a Retrospective Chart Analysis. Quantitative analysis for the Stroke Questionnaires was done through descriptive analysis particularly looking at measures of frequency, mean, median, range, minimum, maximum, and standard deviation of scores. Content analysis was performed for emerging themes in the open-ended question in the questionnaires to determine potential and perceived barriers with project implementation.

There were ultimately four aims of this project. The first aim was to implement education on utilization of BE-FAST assessment by ED nurses triaging patients. This aim was completed as the first portion of project implementation. On two separate days, both project leads attended staff meetings and presented a 15-minute PowerPoint presentation developed using evidence-based research. The presentation focused on pathophysiology of posterior circulation strokes, atypical symptom presentation, and the BE-FAST assessment tool. Following the presentation, the stroke coordinator presented the PowerPoint educational tool to the ED medical director and co-director to report a change of practice. The PowerPoint educational tool was also sent in combination with Stroke Questionnaire I to the ED nurses via email by the ED educator. Based on feedback received from ED nurses, educator, manager, and stroke coordinator, it was determined there was a need in this ED for education on posterior circulation stroke clinical presentation, protocols for charting symptom presentation, and steps to take once a posterior circulation stroke is suspected.

The second aim was to assess knowledge of stroke presentation with use of Stroke Questionnaires I and II. The questionnaires were sent two months apart. Six people ($n = 6$) of the 16 ($n = 16$) who responded to the first questionnaire responded to the second. This means 37.5% of nurses who participated in the first questionnaire also participated in the second and 12% of nurses who attended one of the presentations completed both questionnaires. Six people ($n = 6$).

answered both questionnaires. Two people (n = 2) showed an improvement in score, one person (n = 1) retained the same score, and three people (n = 3) had a decrease in scores on the second questionnaire. The frequency of correct answers was higher for every question on the first questionnaire than they were on the second. In addition, the mean score for the first questionnaire was 82.5% and the second was 62.5%. The overall mean score decrease suggests that there was not retained understanding of the concepts learned from the educational PowerPoint. The change in scores from the first to second questionnaires was disheartening but not altogether surprising given educational research on the normal curve of knowledge deterioration over time (Bell et al., 2008).

Bell et al. (2008), a randomized control experiment, consisted of 87 internal and family medicine residents that had educational follow up measured at randomly assigned intervals. These educational follow ups ranged from anywhere between zero to 55 days after completion of an online tutorial. It was determined that there was increased knowledge amongst participants immediately after they completed the modules; however, new knowledge diminished rather quickly (Bell et al., 2008). Recommendations included to allow regular access to this knowledge in practice to allow for cumulative learning and knowledge integration. Other studies that support their findings were also listed.

Question 7 was an application style case study developed with information from the educational PowerPoint to assess 1) nurses' ability to recognize this patient is experiencing a posterior circulation stroke, and 2) what should be done subsequently. This question arguably required the most in-depth understanding of posterior circulation strokes of all questions because the answers were not directly in the PowerPoint. Participants got this question correct most frequently on both questionnaires, which could indicate collective understanding of posterior

circulation strokes amongst ED nurses not reflected in mean scores. Understanding may not have been retained and it cannot be determined whether there was an initial improvement of understanding due to lack of baseline questionnaire.

The third aim was to incorporate the BE-FAST smart phrase charting tool into the patient's electronic health record. This aim was successfully completed as part of the second phase of this project. One of the project leads worked with the hospital's stroke coordinator to submit the components of the smart phrase to the technicians of the EPIC electronic health record database. Once the smart phrase charting tool was approved, it was made accessible to all ED nurses. The educational PowerPoint explained and modeled how to successfully utilize the smart phrase.

The fourth and final aim was to evaluate the effectiveness of stroke education through comparison of completed MRIs before and after project implementation. The project lead who performed Retrospective and Prospective Chart Reviews looked for a comparison of completed MRIs for patients who presented with stroke symptoms. The Retrospective Chart Review (N = 38) prior to project implementation found three percent of the patients (n = 1) were confirmed to have a posterior circulation stroke by completion of an MRI. Comparing these results with Prospective Chart Review (N = 130), a total of 37 MRIs were completed to determine a posterior circulation stroke, an increase of about 10 percentage points. Completion of this aim was successful as shown by statistically significant results after completing chi-square testing. A chi-square test of independence showed that there was a significant association between MRIs and diagnosis of posterior circulation strokes with a chi square value of 14.6 and a p-value < 0.05.

Chart reviews and data collection indicated that dizziness was a common chief complaint; but this symptom rarely had a neurological etiology, which could be the reasoning for an absence

of change when comparing diagnosis of posterior circulation stroke with Retrospective and Prospective Chart Reviews. Some of the causes of dizziness included vertigo, hypertension, acute kidney injury, and alcohol intoxication, to name a few. The increase of MRIs completed in the Prospective Chart Review did not reflect an increase in the percentage of posterior circulation strokes that were diagnosed.

Data were collected over a two-month time span, which may have limited the variety of symptoms of patients who were admitted to the ED. Additionally, when completing the Retrospective Chart Review, the EPIC medical chart database restricted access to patient's records to 32 days prior to the date of chart review. Therefore, Retrospective Chart Review was limited based on the date the charts were reviewed.

Limitations

A few limitations were observed over the course of project implementation. While the first questionnaire received 16 responses ($n = 16$) from the approximate 50 nurses ($N = 50$) that attended the staff meeting, the second questionnaire received eight ($n = 8$) responses. In addition, overall scores for the second questionnaire were lower than that of the first. There are likely a few reasons for these observations, the first being the length of time between dissemination and closure of the first questionnaire was significantly longer than that of the second. In addition, the questionnaire was distributed about a week after the staff meetings and with the educational PowerPoint, which was a significantly smaller time frame and thus required less knowledge retention compared to the second questionnaire. The PowerPoint had many of the answers embedded within, allowing for higher scores should the nurses have chosen to utilize this tool while completing the first stroke questionnaire. The second questionnaire was distributed two months later, was not preceded by a lecture, and was not sent with the educational PowerPoint. It

should be noted that at the time of project implementation, the ED had a high census of high acuity patients thus putting them in surge capacity. This means that the nurses were caring for full patient caseloads, sometimes more than based on staffing for the day. This likely made it difficult for them to complete any additional tasks outside of patient care. Additionally, with the Covid-19 pandemic, there was an increase of staff burnout which resulted in lack of motivation for process change and/or desire to read emails that did not pertain to personal issues.

Another problem that could have been prevented is that while there were 16 respondents (n = 16) to the first questionnaire, and eight respondents (n = 8) to the second, only six people (n = 6) had responded to both questionnaires. There are a few potential reasons for this in addition to the reasoning named above. The first is that participants had forgotten their unique personal identifier. This could have been prevented by offering one prompt for suggestion of unique identifiers instead of multiple examples. Another factor at play is how the questionnaires were distributed. While the first questionnaire was primarily dispersed via email, a work-designated Facebook page was the primary method of disbursal for the second questionnaire. It was verbally relayed to one of the project leads that the nurses rarely checked their emails; and when they did they skimmed their inboxes which would likely result in missing the questionnaire link, educational PowerPoint, and BE-FAST smart phrase information.

Project Strengths

Project strengths include improved education about strokes, both posterior and anterior circulation, improved recognition of various patient symptom presentations that may occur throughout a patient's stay, and importance of BE-FAST assessment vs. FAST assessment. After the educational PowerPoint was presented, nurses were witnessed to use BE-FAST assessment tools more frequently and had a better understanding of why there was a need to improve the

primary stroke assessment tool. Additionally, nurses communicated they felt more comfortable advocating for diagnostic imaging and further testing for patients that presented with sudden neurological changes of unknown etiologies.

Recommendations

One recommendation for future studies would be to extend the chart review for a six-month time frame to fully encompass the variety of patients being seen in the ED. Emergency department nurses recalled multiple neurological patients after project implementation was completed; the data of these recent patients could not be included due to the short time frame of project implementation. To include more patients for future projects, extending symptoms to include falls, musculoskeletal injuries, and altered mental status may diagnose more posterior strokes due to the nature of atypical symptom presentation and secondary injuries caused from a neurological ischemic event.

Another recommendation would be to distribute the questionnaires the same way both times. The method that resulted in the most responses in a short period of time was the work-designated Facebook page compared to email. In order to recruit more nurses, one of the project leads could come to the staff break room with a computer and snacks to incentivize and help the nurses with the questionnaire and smart phrase charting tool. If the project lead showed up on the same shifts and days of the week for both questionnaires, this would increase the chance of reaching the same nurses for the second questionnaire as the first and thus increase chances of getting the same participants to respond to both questionnaires. Including a baseline pre-education questionnaire could help establish increased initial knowledge; however, it may also result in lower participation rates as this would require more time out of an ED nurses' already busy schedule.

The amount of time between questionnaire distribution and closure should be the same for both questionnaires. The educational PowerPoint should also be distributed with both questionnaires because distributing the PowerPoint presentation with the first questionnaire may have contributed to the higher average scores. Sending the presentation with both questionnaires allows for consistency between tools nurses could utilize while taking their test and would thus eliminate a potential compounding variable. In addition, one suggestion drawn from Bell et al. (2008) was to do a second educational activity on posterior circulation strokes and the BE-FAST assessment tool.

To allow for better accessibility of the BE-FAST smart phrase charting tool, the project lead could post the name of the smart phrase shortcut on the computers that are used by ED nurses. Computers are in patient rooms, nursing stations, and in triage. Placing a reminder note on computers could increase use of BE-FAST smart phrase charting tool. Another way to increase utilization would be for a project lead to go around the unit and model use of smart phrase charting tool for nurses.

The last recommendation would be to prolong the amount of time allotted for project implementation. The length of the project timeline made it difficult to collect enough data to show statistical significance. If more time was allotted, project leads would have had the ability to alter any deficits observed, which could have led to improved project outcomes.

Conclusions and Implications for Practice

In summary, there is still much to learn to improve patient prognosis when they present with neurological deficits in an emergency room setting, urgent care, or primary care setting. During project implementation, numerous registered nurses at this emergency department verbally confirmed to one of the project leads that they had an increased awareness of atypical

neurological symptoms associated with posterior circulation strokes. This was supported by the high frequency of correct responses on question 7, which was designed to assess for understanding of posterior circulation stroke symptoms. Distribution of a baseline knowledge test to the ED nurses would better allow for comparison between initial posterior stroke knowledge and what was learned from the educational component of this project.

The project was designed with the idea of implementing change through educating the ED nurses; however, they are not the only participants in the hospital system required to make a systemic change. There was no education done directly to ED physicians. Improved nursing knowledge may not result in better outcomes, because there is an entire hospital system to be considered. The ED physician has the final word on which diagnostic tests to use, thus, increased completed MRIs may not be the best measure to indicate success of the BE-FAST assessment in this department.

Conclusions drawn from this project support the findings from the literature review that there is a need to evaluate stroke assessment tools that include atypical presentation in healthcare settings (Aroor et al., 2016; Meyran et al., 2020). Further studies are needed to determine if completing a BE-FAST assessment for any neurological patient will increase recognition of posterior circulation strokes by diagnosis using MRI imaging. Advocating for the use of the BE-FAST assessment when patients present with neurological complaints may continue to improve recognitions of posterior strokes. Implementation of this improved stroke assessment tool will help healthcare providers expand the lists of differentials and complete appropriate diagnostic imaging as needed.

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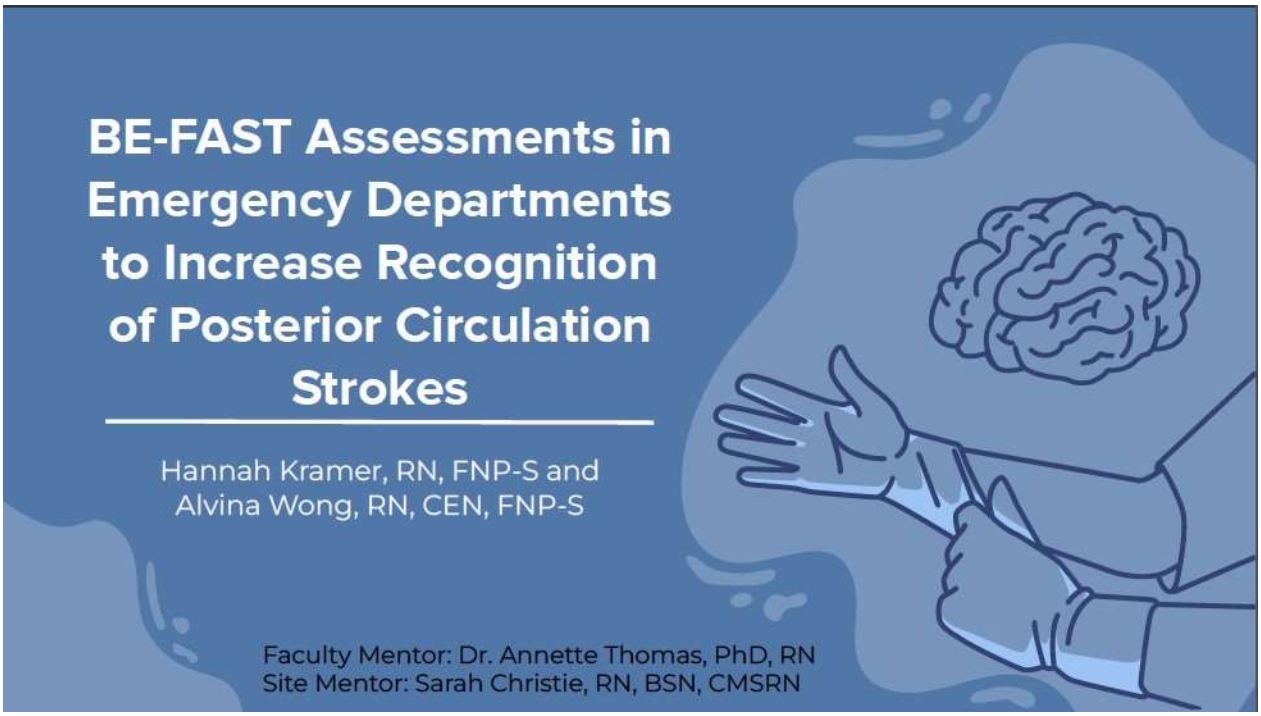
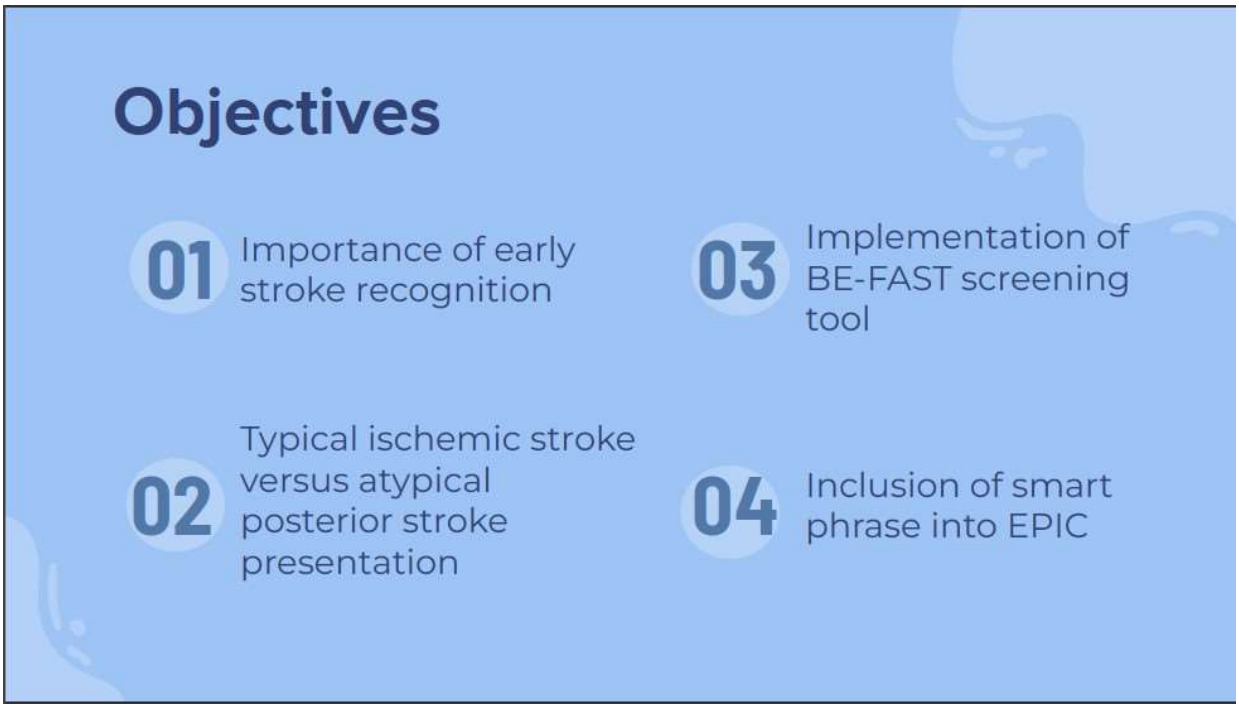
Appendix A. Educational Power Point Presentation for the Nursing Staff

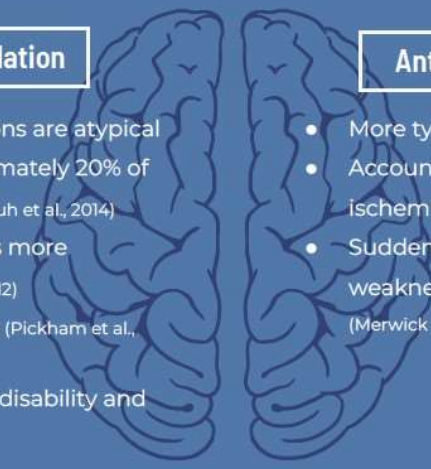




Stroke Overview

- Strokes are a leading cause of death and disability in the US (Centers for Disease Control and Prevention [CDC], 2020).
- A stroke happens every 40 seconds; a stroke-related death every 4 minutes (CDC, 2020).
- Delayed care increases the chance of disability and death (CDC, 2020).

Posterior versus Anterior Circulation Stroke



Posterior Circulation

- Clinical manifestations are atypical
- Account for approximately 20% of ischemic strokes (Nouh et al., 2014)
- Neurological deficits more common (Tao et al., 2012)
- Difficult to diagnose (Pickham et al., 2018)
- More likely to cause disability and death (Shneck, 2018)

Anterior Circulation

- More typical presentation
- Account for approximately 80% of ischemic strokes (Nouh et al., 2014)
- Sudden facial droop, arm weakness, and slurred speech (Merwick & Werring, 2014)

Typical Ischemic Stroke Presentations

(Most telling sign = acute onset of symptoms [96%])

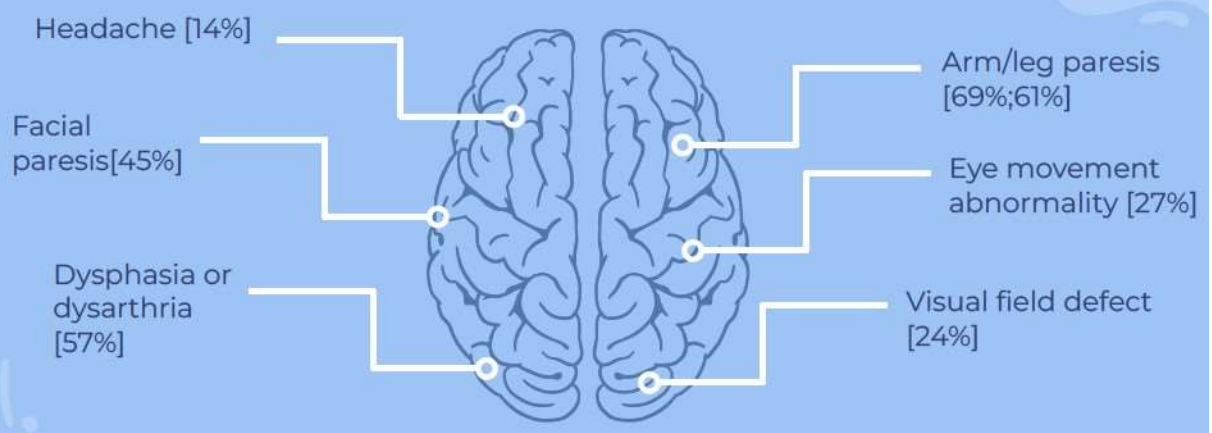


***Image does not depict where symptoms occur in the brain.**

(Yew & Cheng, 2015)

Posterior Stroke Atypical Presentations

- **Dizziness** is the most prevalent symptom at 47% vs. 13% in typical stroke presentations.
- **Limb weakness** and **difficulty speaking** are prevalent (38-41%), but seen less than in typical stroke presentations (54-63%).
- Prevalence of **nystagmus** is 24%, similar to the prevalence of **abnormal eye movement** in ischemic strokes (27%).

Symptom or sign	*Prevalence (%)*
Symptoms	
Dizziness	47
Unilateral limb weakness	41
Dysarthria	31
Headache	28
Nausea or vomiting	27
Signs	
Unilateral limb weakness	38
Gait ataxia	31
Unilateral limb ataxia	30
Dysarthria	28
Nystagmus	24

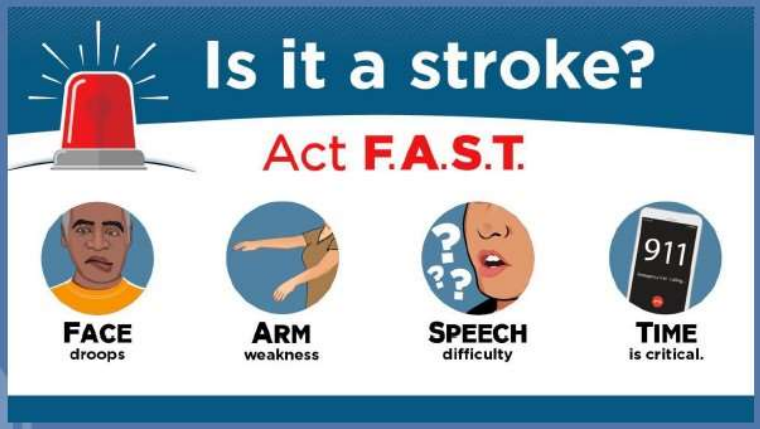
(Yew & Cheng, 2015)

Posterior and Anterior Circulation Stroke Recognition

Aspects	Anterior circulation (carotid territory)	Posterior circulation (vertebrobasilar territory)
Clinical recognition tools		
Prehospital triage tools and scores, such as FAST*	High sensitivity: >90%	Moderate sensitivity: ~60%
Imaging		
Computed tomography	Moderate sensitivity	Poor sensitivity
Magnetic resonance imaging	Very good to excellent sensitivity (>95%)	Very good sensitivity (>80%)

- Clinical recognition tools and diagnostic imaging are more sensitive for anterior circulation strokes.
- Adjustment to screening tools to include signs/symptoms of posterior circulation strokes could result in faster recognition of all ischemic strokes.
- MRI has better sensitivity than CT for both anterior and posterior circulation strokes.

(Merwick & Werring, 2014)



- FAST is what is currently being used in the emergency department.
  - Often used by emergency medical services (EMS).
- Does not take into account changes in balance and vision, making a missed posterior circulation stroke more likely.

So, what's next?

Implementing BE-FAST assessments when caring for patients with stroke-like symptoms.

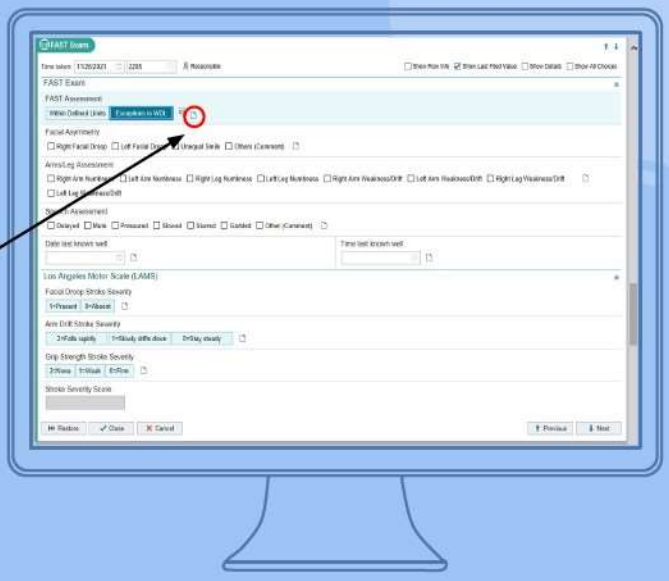
What to do when patients present with any stroke-like symptoms?

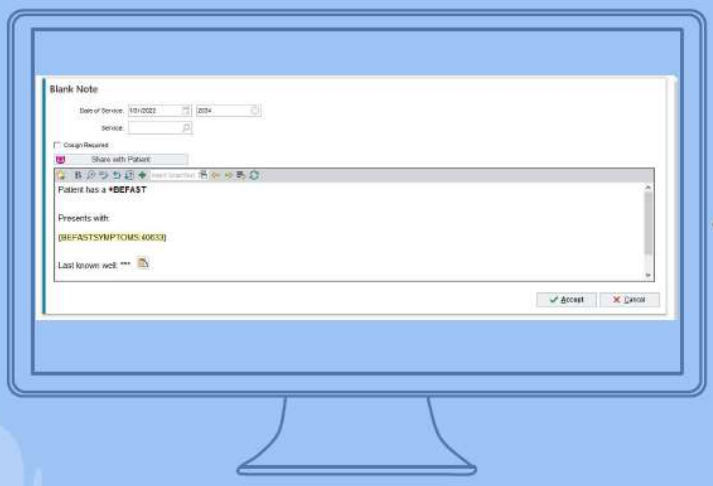
- Utilize BE-FAST assessment ensuring to incorporate changes in balance and vision.
- Contact provider if high suspicion for stroke.
  - Code neuro may be called at this time...**remember time is brain!**
- Chart a BE-FAST assessment in electronic health record (EHR).
- Once patient is roomed and imaging is complete, conduct a swallow screen prior to any PO intake to avoid silent aspiration.

(Martino, et al., 2005)

Charting BE-FAST Assessment

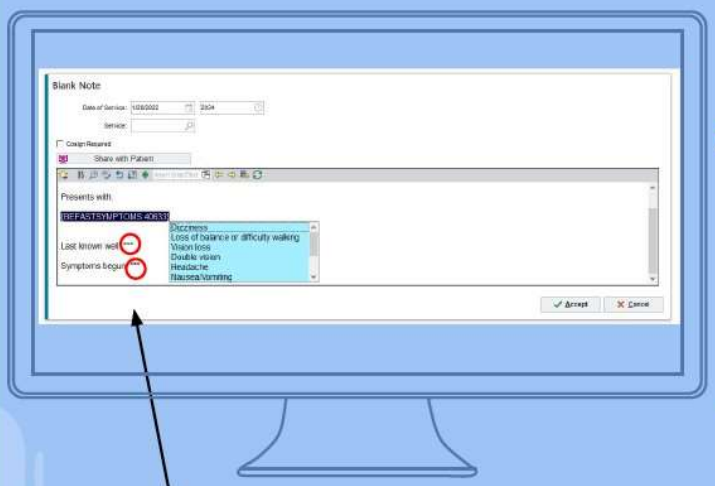
- Specify which BE-FAST symptoms patient presents with in the **triage documentation** under "**FAST exam.**"
  - Symptoms may include:
    - **B**alance
      - Gait disturbances, dizziness, etc.
    - **E**yes
      - Visual changes, double vision, or loss of vision, nystagmus, etc.
    - **F**acial droop
    - **A**rm weakness/numbness
    - **S**lurred speech
    - **T**ime





BE-FAST Smart Phrase

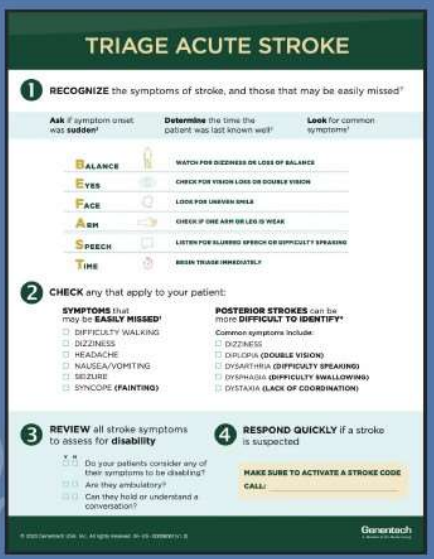
- Typing "**.FHSBEFAST**" in blank notes will auto-populate a smart phrase to be completed.



How to chart in the BE-FAST smart phrase...

TIP: *"F2" moves you to the next section to complete.*

1. Press "**F2**" to access drop down menu.
   a. Select ALL symptoms the patient presents with, then press enter.
2. Complete asterisks appropriately.



Recap

1. If patient presents with any neurological symptoms, assess using BE-FAST assessment.
2. Consult provider if high suspicion for stroke.
3. Chart BE-FAST assessment in FAST Exam in ED triage documentation **or** in a blank note using BE-FAST smartphrase.
4. After completion of CT/MRI **perform swallow screen** and document.

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Questions?

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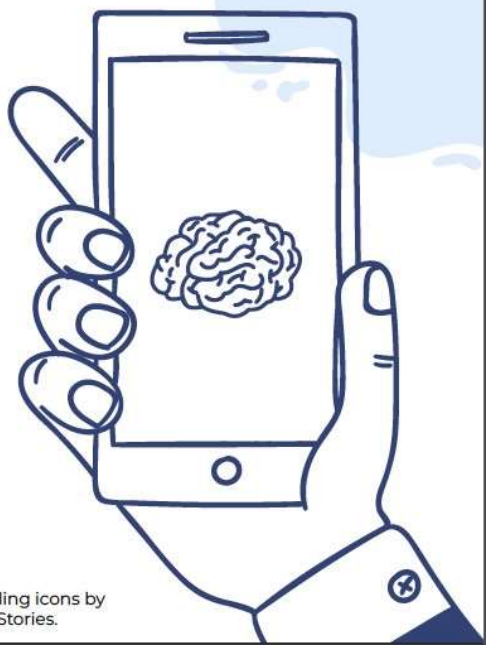


Appendix B. Stroke Questionnaire

SEATTLE UNIVERSITY

English

ONLINE SURVEY INFORMATION PAGE
Post-Education Knowledge Test

This is a student project that is being implemented in your emergency department to satisfy DNP graduation requirements. This project is being headed by co-partners Hannah Kramer and Alvina Wong with the support of stroke program coordinator Sarah Christie and emergency department manager Chantel Arnone. The clinical question we are asking is: Will implementation of a standardized BE-FAST stroke assessment tool increase recognition of posterior circulation strokes in an emergency department setting? You can help us answer this question and contribute to our knowledge by reading through the PowerPoint provided and subsequently participating in this knowledge test. You are being asked to participate because as a nurse in the emergency department you have a unique perspective of how your emergency department functions and firsthand experience working with assessment and charting for stroke patients. By participating you will help us understand 1) if our educational tool was successful in helping retain or increase your knowledge of posterior circulation strokes and the BE-FAST assessment tool, and 2) potential barriers you see to implementation of the BE-FAST assessment tool and charting of BE-FAST in electronic health records.

If you have any questions about this project, please contact either Hannah Kramer at (510) 468-8587, kramerhannah@seattleu.edu or Alvina Wong at (661) 373-3454, wongalvina@seattleu.edu. By clicking the button to begin the test below, you acknowledge that you are aware that you may choose to terminate your participation at any time for any reason, you are at least 18 years old, and you are a nurse in the emergency department at St. Francis hospital.

Begin the knowledge test

I do not wish to participate

→

SEATTLE UNIVERSITY

English

Please create a unique personal identifier that only you will know.

Some examples include: make and model of first car you owned, first pet's name, house number, favorite teacher, etc.

Remember this identifier, as you will need again it for your second survey

What potential barriers, if any, do you see for implementation of a BE-FAST smart phrase?

→

SEATTLE UNIVERSITY

English

Which of the following would indicate a positive BE-FAST assessment (select all that apply)

- Double vision
- Slurring of words
- Heat or cold intolerance
- Unilateral limb weakness
- Dizziness
- Lethargy

What percentage of ischemic strokes occur in the posterior circulation?

- 10%
- 20%
- 30%
- 40%

If you suspect a patient is experiencing a posterior circulation stroke, which of the following should be done? (select all that apply)

- Do BE-FAST assessment on patient
- Chart BE-FAST assessment in patient's EHR
- Immediately send patient for MRI
- Contact provider with suspicions of code neuro

SEATTLE UNIVERSITY

English

A 68-year-old female walks into triage while leaning on partner with an unsteady gait. Her partner explains that patient is normally ambulatory, but this morning she was unable to get out of bed without assistance. Patient was complaining of sudden dizziness associated with severe nausea. Symptom presentation was about 1.5 hours prior to ER arrival.

Vital signs are as follows:

Temp: 37 °C
BP: 175/102
HR: 99
O2%: 90 RR: 25

What would you expect to happen next?

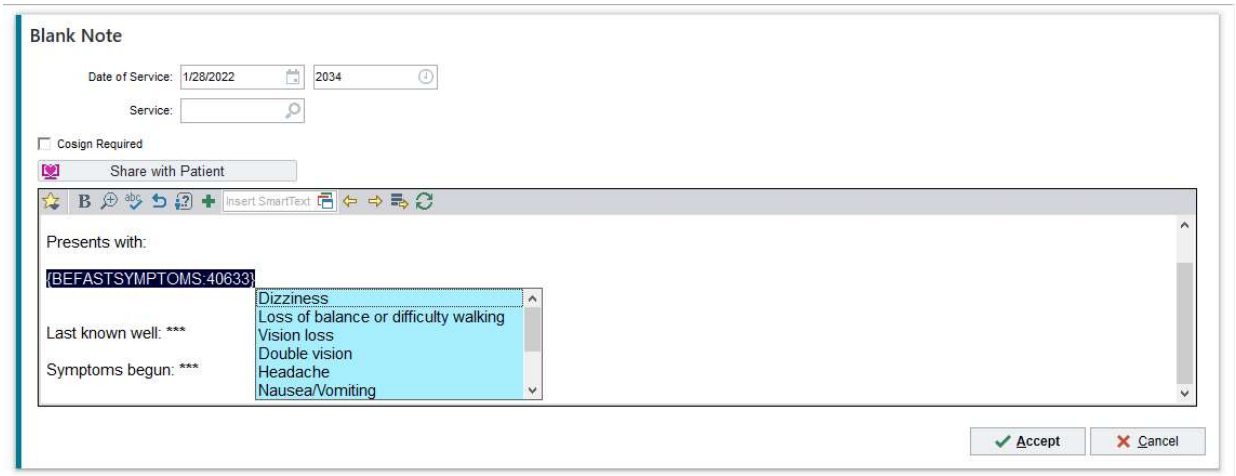
- CT scan of brain is ordered
- MRI of brain is ordered
- Patient is sent home, there is not enough room and this disease process doesn't warrant an ED stay
- IV fluids

Looking at the case study above, this patient is likely suffering from:

- Vertigo
- Alcohol intoxication
- Posterior circulation stroke
- Anterior circulation stroke
- Subdural hematoma

→

Appendix C. BE-FAST Smart Phrase Charting Tool



Appendix D. Coding Tool for Stroke Questionnaires

Coding for Stroke Questionnaires

Question 4. Which of the following would indicate a positive BE-FAST assessment? (select all that apply)

1. Double vision *
2. Slurring of words *
3. Heat or cold intolerance
4. Unilateral limb weakness *
5. Dizziness *
6. Lethargy

**For one full point participants must select ONLY the following options: 1, 2, 4, 5*
Excluding one or choosing an extra option resulted in zero points for this question

---

Question 5. What percentage of ischemic strokes occur in the posterior circulation?

1. 10%
2. 20% *
3. 30%
4. 40%

**For one full point participants must select ONLY the following option: 2*

Question 6. If you suspect a patient is experiencing a posterior circulation stroke, which of the following should be done? (select all that apply)

1. Do BE-FAST assessment on patient *
2. Chart BE-FAST assessment in patient's EHR *
3. Immediately sent patient for MRI
4. Contact provider with suspicions of code neuro *

**For one full point participants must select ONLY the following options: 1, 2, 4*
Excluding one or choosing an extra option resulted in zero points for this question

---

Question 7. A 68-year-old female walks into triage while leaning on partner with an unsteady gait. Her partner explains that patient is normally ambulatory, but this morning she was unable to get out of bed without assistance. Patient was complaining of sudden dizziness associated with severe nausea. Symptom presentation was about 1.5 hours prior to ER arrival.

Vital signs are as follows:
Temp: 37 °C
BP: 175/102
HR: 99
O2%: 90 RR: 25

What would you expect to happen next?

1. CT scan of brain is ordered *
2. MRI of brain is ordered
3. Patient is sent home, there is not enough room and this disease process doesn't warrant an ED stay
4. IV fluids

**For one full point participants must select ONLY the following option: 1*

Question 8. Looking at the case study above, this patient is likely suffering from:

1. Alcohol intoxication
2. Posterior circulation stroke *
3. Anterior circulation stroke
4. Subdural hematoma

**For one full point participants must select ONLY the following option: 2*

Question 4- Question 8 are each worth one point for a possible total score of five points

Possible test scores (%) based on number of points correct:
1/5- 20%,
2/5- 40%,
3/5- 60%,
4/5- 80%,
5/5- 100%

Questions and coding for Questionnaire 1 and Questionnaire 2 are the same

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Appendix E. Participation Completion of Stroke Questionnaires

Participant ID	Finished First Questionnaire	Finished Second Questionnaire	Finished Both Questionnaires
1	Yes	No	No
2	Yes	No	No
3	Yes	No	No
4	Yes	No	No
5	Yes	No	No
6	Yes	No	No
7	Yes	Yes	Yes
8	Yes	Yes	Yes
9	Yes	Yes	Yes
10	Yes	Yes	Yes
11	Yes	No	No
12	Yes	Yes	Yes
13	Yes	Yes	Yes
14	Yes	No	No
15	Yes	No	No
16	Yes	No	No
17	No	Yes	No
18	No	Yes	No