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Traumatic Brain Injury Screening Tools in Primary Care

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TRAUMATIC BRAIN INJURY SCREENING TOOLS IN PRIMARY CARE

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Abstract

Traumatic brain injuries are a significant health concern, being responsible for over 52,000 deaths each year. Unfortunately, many traumatic brain injuries often go misdiagnosed or undiagnosed. Primary care providers are the principal and first source of medical contact for individuals, meaning that they are vital in the diagnosis of previous traumatic brain injuries in order to prevent future sequelae. There are currently several well-validated screening tools currently available for use by primary care providers. This study uses a self-reported survey to determine which of these tools are used by primary care nurse practitioners from a northern New England state and to compare the results to the suggestions made in current literature.

The tools chosen by different primary care providers vary greatly, as do the indications used for initiation of traumatic brain injury screening. There were a total of 17 participants in the study, all of whom were at least masters level prepared nurse practitioners. The average number of years spent in practice was 11.7, with an average of 10.4 of those years in primary care. The most commonly used screening tool was the Mini Mental Status Exam, followed by the Montreal Cognitive Assessment and the CDC Acute Concussion Evaluation tool. Screening tools developed specifically for TBI assessment, such as the Ohio State University TBI ID Method and the Brief Traumatic Brain Injury Questionnaire were found to be seldom used (17% of total participants). Many primary care providers do not feel confident in their ability to diagnose such injuries, often due to lack of expertise in the area, which was reflected in the self-reported survey. As new screening tools become available, it is imperative that they are tested for validity, and then utilized in practice. Due to the complexity of diagnosing traumatic brain injuries, the most simple and accurate screening tools are often the ones preferred by providers.

Moving forward, simple new screening tools need to be evaluated for effectiveness and ease of use. These tools should then be introduced to primary care practitioners, with suggestions as to how to best supplement them with other parts of an exam. Since TBIs are becoming an increasingly more common diagnosis in primary care, future advanced nursing evidence-based practice should focus on the recommended screening tools so as to better identify and guide treatment. Future research is needed to evaluate the extent to which part of an exam yield the most pertinent and accurate findings, as well as to compare the effectiveness of screening models utilized in civilian and military settings.

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Chapter 1- Introduction

The Centers for Disease Control and Prevention (CDC) currently defines a traumatic brain injury (TBI) as "a bump, blow or jolt to the head that disrupts the normal function of the brain"(CDC, 2014). Effects caused from a TBI can include minor symptoms such as headache and confusion, and range all the way up to lifelong impairments in cognitive functioning, behavior and mood, and physical functioning (O'Connor et al, 2014). The true incidence and prevalence of TBIs each year in the general population is unknown, as the CDC uses population-based data to estimate the number of TBIs each year. Unfortunately, these numbers do not include individuals who never seek medical care, those who do not have TBI noted in their medical record, or those treated at a federal, military or Veterans Affairs hospital (CDC, 2014). The CDC estimates that every year 17 million individuals sustain a TBI, and that 5.3 million people in the US are living with sequelae of chronic TBI (used to refer to TBIs with lasting symptoms).

Traumatic brain injuries pose a significant public health problem, as they are responsible for 52,000 deaths every year. In addition to being the main cause of death, they are a contributing factor to 30.5% of all injury-related deaths in the United States annually ("BlueBook_factsheet-a.pdf," n.d.). Of the estimated 17 million TBIs every year, 1.365 million cases are treated in the emergency department. Resulting from these visits are 275,000 hospitalizations, with an unknown number of individuals seen outside of the emergency department ("BlueBook_factsheet-a.pdf," n.d.). This leaves a huge gap between the number of TBIs treated in an emergency room and the amount of individuals who were seen elsewhere, or not at all. Better tracking of TBIs is needed, as they account

for an estimated $60 billion in direct and indirect medical costs (such as lost productivity).

Significance of Study Research

The purpose of this study was to look at the screening methods currently being used by primary care providers in a northern state in New England. A self-reported survey was used to evaluate indications for screening for TBIs, as well as which screening tool was used.

Theoretical Framework

The study design of this research is guided by the social cognitive theory. The social cognitive theory is used to explain how people acquire and maintain certain behavioral patterns, while also providing intervention strategies for behaviors. It suggests that there are three main factors influencing behavior- the environment, people and behavior("Social Cognitive Theory," n.d.). By deconstructing these factors, it becomes possible to determine how people acquire and maintain certain behavioral patterns. In the course of this study, this framework will show how different offices, different providers and past experience influence the use of individual screening tools for TBIs.

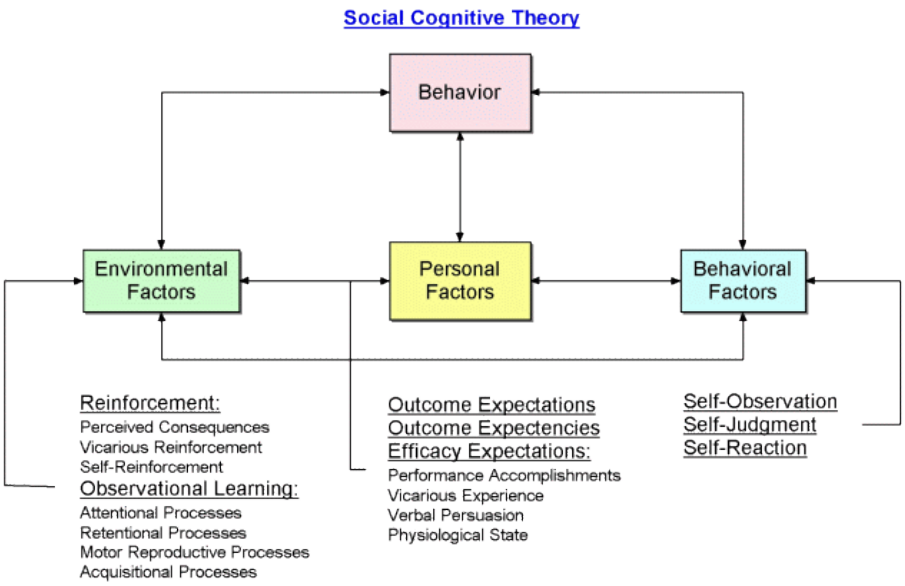

Figure 1: Social Cognitive Theory

("Phase 4—Educational & Ecological Assessment—Start Page," n.d.)

Implications for Nursing Practice

Often times primary care providers, by their definition, are the principal and first source of medical contact for patients. Patients suffering from TBIs and the resulting sequelae often do not seek emergency care following the injury. As such, the initial diagnosis is often assessed during a subsequent primary care visit. As advanced practice nurses begin to comprise an increasingly larger percentage of primary care providers, it is vital that they continue to expand their knowledge on common primary care conditions. Currently, there are 17 million people suffering TBIs each year. In addition, many veterans of Iraq and Afghanistan, who had high risks of sustaining a TBI, are being seen in civilian primary care offices. As with all aspects of providing quality medical care, evidence-based practice is key.

There are currently several other well-researched and validated screening tools used extensively in primary care for things such as depression and substance abuse. The purpose of this study is to contribute further insight and knowledge into TBI screening practices, specifically among advanced practice nurses in this case. As research continues to be gathered on TBIs, it can be implemented into the current evidence-based model followed by advanced practice nurses. While this study may not have an immediate impact on evidence-based practice, it will help contribute to the growing body of knowledge surrounding TBIs.

Research Questions

There were two questions addressed in this study. The first question was what outpatient symptoms are used as indications to initiate traumatic brain injury screening within primary care settings. The second question determined which specific screening tools and methods were used when screening was indicated.

Aims and Objectives

The objective of the study was to determine the current practice for screening individuals for recent or past traumatic brain injuries, with or without current manifestations of symptoms. There were three aims which include: 1) to appraise available literature for studies which identify the most reliable screening tests for TBI as evidenced by sensitivity and specificity calculations, 2) to survey primary care providers within a rural northern New England state and determine which screenings are performed for TBIs, what screening tool is used, and why the particular screening tools being used were chosen, and 3) to utilize the evidence from the literature review and practitioner

questionnaire to identify gaps between the recommended screening guidelines and current practices.

Significance

Identifying current screening patterns and tools for traumatic brain injuries can identify gaps between current evidence based guidelines for screenings, and actual implementation of these screenings. Doing so will assist practitioners in developing more comprehensive screening procedures, as well as providing education on the evidence behind these guidelines. In addition, the information gained from this study may help to guide future development of new screening guidelines, which will take into account the severity of the sustained brain injury.

Chapter 2- Literature Review

The search performed was used to identify published papers written within the past 10 years which reported on screening tools and interventions for the diagnosis of traumatic brain injuries. The databases used to find these studies included CINAHL and OVID Medline. The key search terms used, either exclusively or in various combinations, included 'traumatic brain injuries', 'screening tools', 'sensitivity', 'specificity', 'reliability' and 'diagnosis'. Initial review identified 5 articles relevant to the search criteria. Each article was read in its entirety, and any papers not relevant to primary or secondary screening techniques were excluded. Of the articles included, all 5 were quantitative, with the intention of determining validity and/or sensitivity and specificity of various screening tools.

Understanding the consequences of TBIs, the military has conducted numerous studies to try to refine a system that demonstrates both sensitivity and specificity in screening for symptoms of a TBI. The first TBI screening assessments for military members were instituted in 2006 by the Department of Defense to assist in diagnosing unwitnessed and/or undocumented TBIs. Currently, the Neurobehavioral Symptom Inventory is in use and has demonstrated internal validity (Vanderploeg et al, 2014), while the Deployment Health Assessment traumatic brain injury screening has also been employed, although without validation (Terrio et al, 2011). The military also conducts return-to-duty (RTD) assessments on soldiers following a TBI, which includes an extensive checklist ascertaining operational competence and performance, dizziness handicap, visual acuity, neuropsychological screenings, and visual search and sequencing among other things (Kelley et al, 2015). Among civilian screening tools, the Brain Injury

Screening Questionnaire has also been employed in a variety of practices, to screen for a lifetime history of self-reported TBI symptoms and to rule out alternative explanations for reported symptoms (O'Connor et al, 2014).

The Ohio State University Traumatic Brain Injury Identification Method has begun to gain popularity in many different practice settings as well. It is a screening procedure which entails a short 3-5 minute interview, which elicits an individual's lifetime history of TBI ("OSU TBI-ID for Clinical Professionals Ohio Valley Center for Brain Injury Prevention and Rehabilitation," n.d.). The tool is based off of the CDC case definitions and recommendations for TBI surveillance ("Screening for TBI: A SynapShot from OVC Ohio Valley Center for Brain Injury Prevention and Rehabilitation," n.d.). Several versions have been developed, which vary in length and can be customized for various research or screening applications. Reliability has been demonstrated by both inter-rater and test/re-test reliability. Additionally, predictive validity has been shown by the relationship between indices of lifetime history and measures of cognitive performance, affective status, interpersonal functioning, and aggression. (Corrigan & Bogner, 2009). Currently, the OSU TBI-ID has been recommended for use in multiple settings, including research studies on TBI, Parkinson's research, and thorough assessment of TBI before and after rehabilitation. It has also been utilized in several federally funded research projects, whose populations included military personnel, veterans, prisoners, and clients diagnosed with substance abuse and severe mental illness("Screening for TBI: A SynapShot from OVC Ohio Valley Center for Brain Injury Prevention and Rehabilitation," n.d.).

The Department of Veteran Affairs recently completed a 4 year prospective cohort study to provide estimates of temporal reliability and internal consistency on available traumatic brain injury screening tools. The screening tools which they studied include the veteran traumatic brain injury screening tool (VATBIST), the brief traumatic brain injury screen (BTBIS), and the warrior administered retrospective casualty assessment tool (WARCAT)(Donnelly et al., 2011). Each of these three screening tests have been used extensively in evaluating veterans of Operation Iraqi Freedom and Operation Enduring Freedom (OIF/OEF). The Department of Defense estimates that approximately 19.5% of veterans from these conflicts have sustained a TBI during deployment, which prompted the cohort study in order to identify a "routine, reliable and valid detection [tool] of TBI"(Donnelly et al., 2011).

The brief traumatic brain injury screen (BTBIS) was the first TBI screening tool used for OIF/OEF veterans, and was first implemented at Walter Reed Army Medical Center in 2006. It is a self-reported questionnaire specifically geared towards common risk factors for TBIs, to include deployment history, helmet characteristics, exposure to a possible TBI event, loss of consciousness, and post-concussive symptoms (Schwab et al., 2006). The screening tool findings were psychometrically studied with 596 recently returned veteran. The results of the preliminary study showed that those who screened positive for TBI on the BTBIS generally had consistent responses to information given in follow-up interviews, either immediately after the BTBIS or within 2 weeks. Additionally, the BTBIS showed low to moderate correlations with 2 other criterion TBI questionnaires, with TBI reported more frequently on the BTBIS than on more detailed

screening tools. Ultimately, the authors determined that the BTBIS showed promise, but a more complete analysis of its reliability and validity was needed(Schwab et al., 2006).

The Warrior Administered Retrospective Casualty Assessment Tool (WARCAT) was developed as a successor to the BTBIS and is based on its design. The WARCAT includes elements of the BTBIS such as TBI risk factors related to combat, loss of consciousness, and post-concussive symptoms, but broadened the screening to also include post-concussive symptoms present post-deployment as well(Terrio, Brenner, & Ivins, 2009). This new tool was implemented on 4000 returning veterans of OIF/OEF at Fort Carson, Colorado. Veterans who were administered the WARCAT had follow-up clinical diagnostic interviews, and approximately 23% were confirmed to have a deployment-related TBI. Of those with a confirmed TBI, one-third had reported experiencing 3 or more postconcussive symptoms, but less than 8% endorsed having these symptoms postdeployment. This research confirmed that postconcussive symptoms were much higher in veterans diagnosed with TBI than those without such injuries (Terrio et al., 2009).

Each of the two previous screening tools were used by the Department of Defense. The Department of Veteran Affairs, however, convened an interdisciplinary task force to develop a separate TBI screening tool and evaluation protocol in late 2006. The resulting screening protocol of this task force was the VA TBI screening tool (VATBIST)(Petzel, 2009). The VATBIST is composed of 4 questions, with positive responses to any of these 4 questions eliciting subquestions. As of January 2010, over 392,000 OIF/OEF veterans have been screened using this tool. As a whole, the VATBIST is sensitive to the presence of a TBI 94% of the time, and specific 59% of the

time. Further descriptive analysis has shown it to have high-internal consistency and moderate to high test-reliability(Donnelly et al., 2011). It has since been supplemented by the Rehabilitation Institute of Chicago (RIC) Military Traumatic Brain Injury Screening Instrument. The RIC screening instrument is the only known tool designed to screen for TBI in the military while also acknowledging the symptom overlap between TBI and post-traumatic stress disorder (Zollman et al, 2014).

The Montreal Cognitive Assessment (MoCA) was devised in 2005 for use in civilians and has been validated for use in detecting cognitive impairment and dementia. A three year study was conducted at the Neuro-Headache, TBI and Cognitive Research Center in Shreveport, Louisiana to test the reliability of the MoCA for TBI screening (Kumar, Jawahar, & Kumar, 2015). The participants were all selected from this outpatient center, 117 in all, and each had a confirmed history of TBI. The results of the MoCA were compared to those of the Weschler Memory Scale IV at 50^{th} percentile, to test for mild cognitive impairment. The MoCA showed a sensitivity of 87.9% and a specificity of 66.7% for cognitive impairment. While cognitive impairment alone is not enough to confirm the presence of a TBI, the authors of the study recommended that the MoCA may prove useful as both a spot screening tool, and as an effective tool to guide rehabilitation and treatment (Kumar et al., 2015).

The Mini Mental Status Exam (MMSE) has been in use since 1975 and is used for screening for cognitive impairment in a variety of conditions (Kosaka, 2006). While originally developed for screening for dementia, it is also used quite frequently for monitoring TBI symptoms due to the fact that it can be quickly implemented by a variety of healthcare providers. However, most of the studies that looked at its efficacy in

screening for TBIs have shown it to have many limitations. It has demonstrated accuracy in estimating gross cognitive capacity, but is limited by the fact that it does not take into account mental flexibility or working memory (Kosaka, 2006). Additionally, patients with comorbid psychiatric conditions have demonstrated adaptation through memorizing the aspects of the test due to repeated administration of the MMSE. There is low demonstrated sensitivity in screening for TBI due to the fact that the test was created to screen medial temporal and bitemporoparietal cognitive function (linked to dementia) versus the frontally-mediated cognitive function most often impacted by TBIs (Arciniegas et al., 2005).

Comparison/Contrast of Literature Findings

The application of screening tests for traumatic brain injuries appears to be heavily influenced by presenting symptoms. The most common indicators for screening include recent deployment to a warzone and the presence of current TBI symptoms (Kelly et al, 2015)(Vanderploeg et al, 2014)(Terrio et al, 2011). Screening tests are routinely performed on returning soldiers as recommended by the Department of Defense due to the high incidence of unwitnessed or undiagnosed events with a high likelihood of a TBI. One article suggested that all individuals, nonspecific to military members, be screened for a lifetime history of TBI as a public health responsibility, due to the discovery of recent literature which suggests that delayed or late effects of single and multiple TBI events may be asymptomatic (O'Connor et al, 2014). None of the included articles suggest any one specific screening diagnostic tool for evaluation. The most common type of screening tool used in these studies are self-reported questionnaires, and

each article reports that the screenings find a higher prevalence of TBI than existing estimates suggest.

The RIC Military TBI Screening Instrument was shown to have a sensitivity of 96%, specificity of 64%, negative predictive value of 95% and positive prediction value of 69% (Zollman et al, 2014). This study provides different results to that of the Post-Deployment Health Assessment TBI screening question (60% specificity and 96% sensitivity)(Torrio et al, 2011). However, this screening tool is composed of 4 questions, and when only affirmative answers to the first 2 were included in analysis, the sensitivity increased to 80% with a specificity of 93%, after confirmation by a clinician-diagnosed deployment-related TBI. The study used the basis of this information to conclude that documentation and referral for a TBI be included with affirmative answers to these first 2 questions, as it demonstrated higher sensitivity than a positive response to all 4 questions. Similarly, another study concluded that there was convergent validity between Military Functional Assessment Program scores and clinical assessment scores (Kelley et al, 2015).

The fact that these screenings are based on self-report means that they are subject to over-reporting or exaggeration, as was demonstrated with the Neurobehavioral Symptom Inventory (NSI) (Vanderploeg et al, 2014). In an attempt to decrease bias, the researchers in the article instituted a validity scale to determine invalid response styles, determined by distinguishing between performance reporting and symptom reporting. The introduction of a validity scale provided "considerable promise for validity assessment when the NSI is used as a population-screening tool"(Vanderploeg et al, 2014 p. 1). Additional support for population screening was provided in proving it to be cost

effective and efficient, finding 27%-54% of high-risk populations screening positive for a history of TBI when assessed using the Brain Injury Screening Questionnaire in a community setting (O'Connor et al, 2014). Both articles supporting the use of population-screening disclosed that initial positive screenings should be referred for a clinician assessment for confirmation of a TBI.

Conclusion

Although there are many types of TBI screening assessment tools being used in various sectors of the population, none of them have yet been proven to be as accurate a predictor for previous TBI as an assessment by a clinician. While the sensitivity and specificity of screenings such as the RIC Military TBI Screening Instrument and the Post-Deployment Health Assessment TBI screening have been determined, they have been determined to only be accurate enough to serve as augmentation for clinician assessments. The weakness of these screenings lie in the fact that they are self-reported and thus heavily influenced by bias. Evidence for necessary further research into the area is indicated by the lack of one universal screening tool, along with the inconclusive recommendations of the researchers.

Chapter 3- Methodology

This study examined the practice of primary care providers in screening for traumatic brain injuries in the general population. Data collection techniques, participants, and inclusion and exclusion criteria are defined. Along with this the survey design, description and analytic procedure are detailed.

Research Design

The research for this study was gathered by the principal investigator through utilizing a survey research design with convenience sampling. Electronic surveys were distributed to various nurse practitioners throughout the state using the available mailing list from the state Nurse Practitioner Association website, as well as the state Nurses Association Advanced Practice Psychiatric Nursing membership electronic list server. The main purpose of the survey was to determine the screening tool(s) used for suspected traumatic brain injuries among patients seen by that provider. Along with identifying screening tools used in primary care, there were questions which inquire about indications for screening during a patient encounter, the provider's comfort in diagnosing TBI, and any other screenings performed. Completion of the survey was completely voluntary.

Definitions

Traumatic Brain Injury (TBI): a mild, moderate, or severe acquired brain injury which occurs with sudden trauma, which may or may not be accompanied by loss of consciousness ("Traumatic Brain Injury Information Page: National Institute of Neurological Disorders and Stroke (NINDS)," n.d.)

Screening tool: a test used to identify and/or eliminate those affected by a disease or medical condition

Primary care: a practice setting in which the provider is the first contact and principal point of continuing care for patients

Participants

Study participants were comprised of nurse practitioners who voluntarily complete the survey questionnaire. To be eligible, these providers must be employed in an outpatient setting specializing in either family or internal medicine. The providers must have completed the educational requirements for their chosen occupation and be certified by their respective licensing board. Exclusion criteria includes student providers, providers who have not yet been licensed, or outpatient clinics which do not specialize in primary care, which includes urgent care.

Protection of Subjects

Passive informed consent was provided through completion of the survey. Completed surveys were not distributed and were kept confidential to the principal investigator and members of the thesis committee. No personal identifiers were included in the survey questionnaires and the questionnaires were destroyed once the information has been entered into a collection database. Prior authorization for conducting the study was received by the University of Vermont Institutional Review Board before proceeding with distribution of the surveys.

Study Procedure

Electronic surveys consisting of 9 questions were distributed among primary care offices within the state. Providers at each office received a written statement outlining the purpose of the research, along with a disclaimer that explains completion of the survey acted as passive informed consent. The surveys were distributed over a one

month time frame, with all completed surveys being collected at the end of that time. Once collected, the data was entered into a secured database to be analyzed. Survey results were categorized by time in practice and years spent practicing in primary care.

Data Analysis

Analysis was conducted once all eligible surveys were entered into the secured database. Descriptive statistics were utilized to establish distribution and variation of the collected information. Responses were analyzed to determine how the amount of time in practice, as well as familiarity with TBI patients, affected survey answers. Survey results were limited to closed-ended questions so that all results could be categorized appropriately.

Chapter 4- Results

Approximately 75 surveys were distributed to potential respondents using an electronic link. In total, 17 surveys were completed for a response rate of 23%. As was outlined in the research methods, all of the respondents are practicing within the same rural state in New England. The respondents were recruited from the state Nurse Practitioner Association and the state Nurses Association's Advanced Practice Psychiatric Nursing Interest Group membership electronic list servers. All of the primary care providers were at minimum Master's degree prepared nurse practitioners with specializations in Adult, Family, or Psychiatric-Mental Health.

The highest percentage of practitioners were between the ages of 55 to 64, as 35% of responders fell within this age bracket. The next most prevalent age group was 25 to 34 years old, as 24% of responders were between these ages. None of the providers were under the age of 24 or older than 64 years. The average number of years spent practicing was 11.7, with the most experienced nurse practitioner having 29 years of experience and the newest nurse practitioner having just 1.5 years of experience. However, the average number of years these practitioners have spent in primary care is 10.4.

																		Mean
Years in Practice	1.5	3	3	3	3	4	5	6	12	12	16	17	17	17	20	29	30	11.7
Years in Primary Care	1.5	3	3	3	3	4	5	3	10	12	16	10	17	17	17	21	5	10.4

Figure 2: Number of years in primary care and practice by responder

The frequency with which the respondents see individuals with suspected or known traumatic brain injuries varies greatly. The majority of providers, 53%, see traumatic brain injury patients infrequently, with only 18% seeing these individuals frequently. The remaining 29% of practitioners rarely see known or suspected traumatic brain injuries. This level of familiarity is reflected in the self-described skill level for assessing and diagnosing traumatic brain injuries. The highest reported skill level on a 1-10 scale, with 1 being not skilled and 10 being expert, was 7. Only two practitioners rated themselves at a 7, for a total of 12%. In contrast, 41% rated themselves as a 5, which is described as 'competent'. One responder rated themselves at a 1, 'not skilled', three at a 3 (18%), three at a 4 (18%), and one gave themselves a 6 (6%).

Answer Choices	**Percentage**	**Number of responses**
1 Not Skilled	5%	1
2	0%	0
3	18%	2
4	18%	3
5 Competent	41%	6
6	6%	1
7	12%	2
8	0.00%	0
9	0.00%	0
10 Expert	0.00%	0

Figure 3: Responses to self-described skill level in diagnosing suspected traumatic brain injury

Four choices were listed as screening methods for assessing potential traumatic brain injuries- clinician interview, clinician observation, neurological exam, and self-reported patient symptoms. The only method that received a 100% response rate was self-reported patient symptoms. Clinician interview was the next most utilized method, with 94% of practitioners choosing it as a screening option. Clinician observation and neurological examination were reported to be used by 83% of responders. While the use of screening tools was endorsed by nearly every nurse practitioner, the specific screening tool used varied greatly. The screening tool most commonly used was the Mini Mental Status Exam, which was utilized by 67% percent of practitioners. This was followed by the Montreal Cognitive Assessment, which received a 50% utilization rate, and the CDC Acute Concussion Evaluation, which received a 42% utilization rate. Interestingly, only 12 practitioners (71%) responded to this question suggesting that using screening tools are not necessarily included as part of the clinician interview or neurological exam.

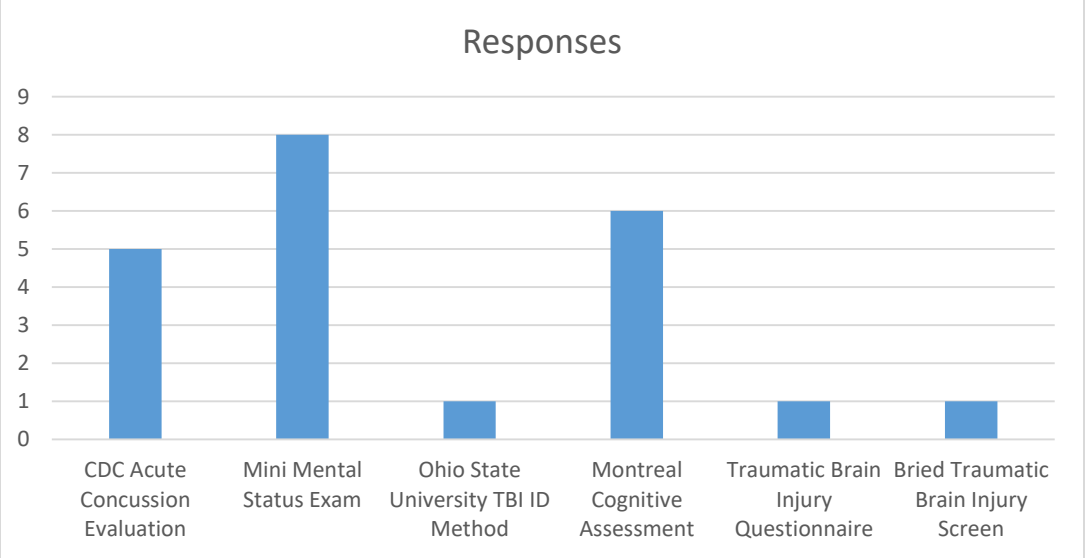

Figure 4: Screening tools utilized to diagnose traumatic brain injury

The choice of which tool was used was heavily influenced by the individual practitioner. Only one of the responders answered that their choice of screening tools were recommended by their practice. In fact, 50% chose the tool based on personal preference. Familiarity and ease of implementation also heavily impacted the choice, with 83% and 67% response rates respectively. Cost effectiveness had little influence, with only 17% of those responding stating that it factored into their decision of choosing screening tools.

The greatest variation in responses can be found in the objective and subjective symptoms used by the provider as possible indications for traumatic brain injury. There were 23 different symptoms listed by the survey, with only 4 of these receiving a 100% response rate. These four symptoms were headache, amnesia, cognitive changes, and loss of consciousness. The symptom receiving the lowest response rate was suicidal ideas with 18%. Other symptoms which received under a 50% response rate were paresthesia (35%) and hypervigilance (24%). The remainder of symptoms garnered between 59% and 94 % response rate.

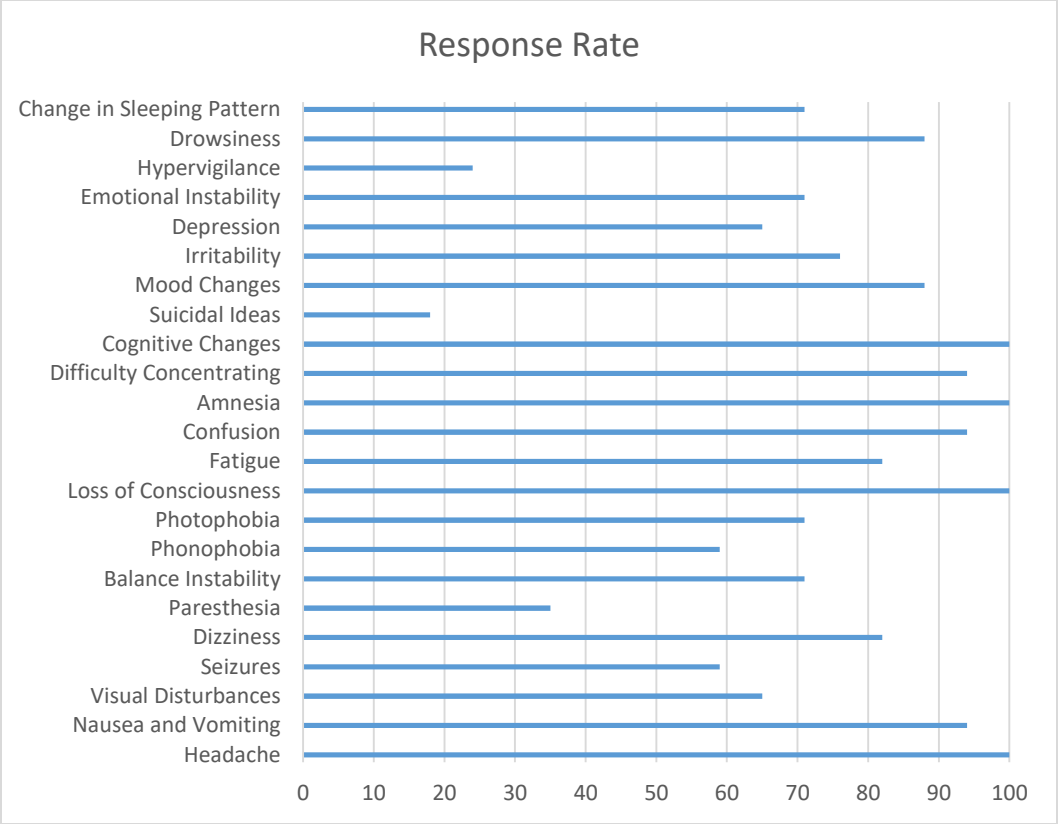

Figure 5: Symptoms used as indications for possible traumatic brain injury

Chapter 5- Discussion

The research questions posed by this study were: What outpatient symptoms are used as indications to initiate traumatic brain injury screening within primary care settings? Which specific screening tools and methods were used when screening was indicated?

Traumatic brain injury screening is heavily influenced by both the subjective and objective symptoms being experienced by the patient. It is known that TBIs can present in many different ways, and the responses by the providers show that they approach presenting symptoms differently. There were only four symptoms out of twenty-three which providers agreed should warrant an evaluation for a traumatic brain injury. One possible explanation for this is that the comfort level and expertise of the providers in assessing and diagnosing TBIs varied greatly. Due to the way the data was collected on the electronic database, the providers' answers are not associated with their years in practice or their self-described skill level in dealing with TBIs. As such, it cannot be determined whether more experienced providers clue in on fewer, more specific symptoms, or if they are more likely to screen based on more vague and generalized symptoms.

The response rates varied greatly between symptoms, but there did not seem to be any obvious correlations between high response rates and low response rates. For example, headache and cognitive changes both received 100% response rates yet they are very vague symptoms which can be correlated with many different diagnoses. In contrast, amnesia and loss of consciousness also received 100% response rates, yet they are much less commonly seen symptoms and are often associated with traumatic brain

injuries. Furthermore, hypervigilance received a 24% response rate yet is often associated with sequelae of TBI and/or post-traumatic stress disorder.

It appears that the responses might suggest that presenting symptoms are not viewed independently, but rather as how they are concomitantly present. This may account for why they are no obvious correlations in the data analysis. If a patient were to present with fatigue and difficulty concentrating, the provider may not evaluate them for a TBI as the symptoms are not highly indicative of this diagnosis. However, a patient who presents with fatigue, difficulty concentrating, headache, amnesia and a loss of consciousness will most likely be evaluated. Unfortunately, this can only be extrapolated on due to the limitations of the study design.

The screening tools used during the evaluation yielded some interesting results. Providers rely heavily on self-reported patient questionnaires and clinician interview for eliciting information suggestive of TBI. In addition to these subjective findings, the providers also utilized objective findings through observation and a neurological examination. These techniques often vary in their efficacy depending on the expertise of the provider and do not provide uniform or standardized findings. This is precisely why TBI screening tools were devised, but yet only 71% of providers answered that they utilize any kind of screening tool whatsoever in evaluating TBIs. This finding suggests that providers do not necessarily believe that validated screening tools are essential in the workup for TBI, either alone or in conjunction with a clinician interview and neurological exam. While the research discovered in the literature review does endorse that screening tools are not as accurate when not used in conjunction with a clinician interview, it also

reinforces that the use of such screening tools can increase the sensitivity of discovering past TBIs (Torrio et al., 2011).

Among practitioners who do utilize screening tools, the Mini Mental Status Exam (MMSE) was the most commonly used. This is perhaps due to the fact that many providers are very comfortable using this tool, as it is used in assessing many other neurological and cognitive conditions other than TBI. With familiarity (83%) and ease of implementation (67%) playing large roles in guiding the choice of screening tools, this would appear to make sense. Unfortunately, this tool has not been assessed as thoroughly for sensitivity and specificity for TBI detection as some of the other tools listed (Terrio et al., 2011)(O'Connor et al., 2014)(Donnelly et al., 2011).

The next most frequently used screening tool was the Montreal Cognitive Assessment (MoCA). Similar to the MMSE, the MoCA is frequently used for assessing and evaluating cognitive changes, rather than strictly screening for TBI. It has a demonstrated sensitivity of 87.9% and a sensitivity of 66.7% for screening for cognitive impairment. As 100% of providers answered that cognitive changes are an indication for TBI evaluation, this could help to explain why the MoCA is a popular choice. Furthermore, research in the literature review also recommend it as a spot screening tool, and an effective adjunct in helping to guide rehabilitation and treatment (Kumar et al., 2015).

Unfortunately, TBI-specific screening tools were not heavy utilized in our sample of providers. The CDC Acute Concussion Evaluation was used the most among these tools, but was still only applied by 29% of participants. The remaining tools only received 6% utilization rates, as a total of 1 provider for each tool uses them in their

practice. Despite the fact that these tools were created with the specific intent of increasing the sensitivity and specificity of TBI detection, the sample in this study did not find that to be the most important feature (Corrigan & Bogner, 2009)(Donnelly et al., 2011). Instead, familiarity and ease of implementation were found to have more bearing.

Familiarity and ease of use is likely due to subjective experience. In comparison to the other screening tools, the Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID) has been shown to be efficient in its implementation, consisting of a 3-5 minute interview. Like the CDC Acute Concussion Evaluation, it was developed based off of CDC case definitions and recommendations for TBI surveillance. One of the unique features of this screening tool is that it can be customized to vary in length depending on the comfort level and expertise of the practitioner administering it. In contrast to the MMSE, the OSU TBI-ID has demonstrated reliability and predictive validity in measuring lifetime history of TBI as determined by future presenting symptoms (Corrigan and Bogner, 2009).

The brief traumatic brain injury screen was one of the first TBI screening tools developed, although there is conflicting research on its effectiveness. It has been used historically in military settings, and has not had a complete analysis of its reliability or validity (Donnelly et al., 2011). These findings may provide some insight into why it is not more heavily used among our sample, which was entirely a civilian population. However, the brief traumatic brain injury screening tool (VATBIST), developed as its predecessor, has been used in both military and civilian practices, and has much more evidence to support its use. The VATBIST is also very quick and easy to implement with four initial questions. Additional questions are then asked if there are positive responses

to any of these four questions. This tool has been shown to be sensitive to TBI presence 94% of the time, and specific 59% of the time (Donnelly et al., 2011).

The Social Cognitive Theory offers a possible explanation for the choice of screening tool by provider, and differs from that offered by the providers themselves. The three main influencing factors in this theory are the environment, the people and behavior. The TBI specific screening tools are more likely to be used in military settings, as this is what they were initially developed for. These settings often have mandated TBI screening policies, ensuring that the tools and screening process are very common and familiar to both patient and provider (Petzel, 2009). In the civilian sector, this does not always hold true. The providers in the study are therefore influenced by their environment in that TBI screening is not a uniform practice, meaning that the particular TBI screening tools are not as familiar to them. The more general screening tools used in primary care such as the MMSE and MOCA were very familiar however, and as such the providers tended to default to them.

The second influencing factor is the people. The people in this study applies to both the patients and the providers. Again, TBI screening tools are heavily utilized in military settings due to the high percentage of individuals who may have suffered a TBI, either diagnosed or undiagnosed. Increased screening practices reflect this fact, and TBIs must therefore be considered by providers as a possible diagnosis for many presenting symptoms. Conversely, the providers in our sample see a different patient population. The patients are not at such an increased risk for TBIs, and the screening practices of the providers have adapted to this lower likelihood of suspicion. The self-reported comfort level and expertise of the providers reinforce this circumstance.

The third factor in play is behavioral patterns. Behavioral patterns are partly influenced by the observational learning of the providers. With TBI being a less likely diagnosis, providers will often screen for the more commonly seen diagnoses that present with the same types of symptoms. While this is not necessarily the incorrect approach, it can lead to a missed diagnosis resulting in further symptoms. As the more common diagnoses are excluded and symptoms are still present, TBI may be considered at that point. Lack of knowledge of specific TBI screening tools may influence the exam of a provider suspicious of TBI, which was reflected in the 71% utilization rate.

These three factors coincide with the main findings- that screening tool use is often predicated on familiarity and ease of use. Studies have shown that TBI specific screening tools are on par or superior in ease of use than the tools chosen by our providers, proving that the main hurdle may be familiarity due to lack of exposure. The lack of exposure may be attributed to the different screening practices resulting from a wholly different patient population that those which were utilized in the research for the TBI screening tools.

Implication for Advanced Practice, Education and Health Care Policy

This study showed that there does not appear to be a standard protocol for evaluation of TBIs among our sample population. Evaluation techniques varied by comfort level and familiarity with TBIs, and the screening tools used reflected this comfort level. While TBI specific screening tools have been developed to assist in detecting symptoms of past TBI, they are still not utilized by many providers. Screening tools are not as effective as the clinician interview and exam, but they still offer diagnostic value. The main deterrence of these tools seem to be lack of familiarity of

them by providers. Enhanced awareness and training in the proper application of TBI specific screening tools may help to develop a more standardized evaluation process, as well as increase proper diagnosis.

Advanced nursing practice follows the principles of evidence-based practice in order to ensure that patients receive the highest quality of care. The results of this study when compared to the data discussed in the literature review shows that providers may not be adhering to this principle as it pertains to TBI. Nursing education reflecting the need to continue to offer new practice guidelines resulting from discoveries such as this is important moving forward. Practitioners should be given the opportunity to update their current practices on things such as TBI screening through their required continuing education credits.

An increased understanding by practitioners of the impact of updating their practices may also assist in the implementation of said screening. While the participants in this study were all at least master's level prepared, the doctorate of nursing practice (DNP) is rapidly being adapted as the new entry level degree required for nurse practitioners (Auerbach et al., 2014). One of the differences between the master's level nurse practitioner degree and that of the doctoral level is the focus on evidence based practice and how to best utilize it. With new practitioners having more focus on this in their education, the aforementioned implementation should hopefully reflect this difference in preparation. This presents a strong argument for all nurse practitioners to attain the DNP.

Health care policy needs to also understand the importance of funding for continued research. The majority of funding for TBI research has come from the

Department of Defense, as the research was conducted specifically on military populations due to their high risk (Petzel, 2009). This has caused most TBI screening tools to be biased towards military members, making screening harder in civilian populations using the most studied TBI screening tools. Additional funding should be allocated to conduct research on the validity, reliability and predictability of TBI screening tools among civilian populations.

Limitations

Due to the small sample size of the study, additional research needs to be conducted to determine if screening practices vary among different providers. All of the providers in this study were nurse practitioners, so future research should also include physician assistants and physicians. Additionally, demographic data was not gathered, so it is not possible to compare how results varied among those practicing in rural areas versus those practicing in more urban areas.

The survey design was composed of closed-ended questions to allow it to be more conducive for data analysis. The structure of the survey was designed in order to more easily categorize the data at the expense of more personalized and expansive answers. This limited the usefulness of the data, as it did not allow for providers to give feedback on what their reasoning was behind using certain screening methods. Providers also were not given the opportunity to give feedback as to why certain symptoms were used as indicators for TBI screening.

Future research should focus on including providers who see both military and civilian patients. Including these different providers may give different results as to which factors influence the screening tools used. Such research will also help to either

confirm or deny the way in which the Social Cognitive Theory impacts the actions of providers. Larger sample sizes will allow for more generalizable data, increase external validity, and lend itself to better to statistical analysis, from which stronger conclusions can be made.

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Appendix

Survey distributed to providers:

What is your age?	
How many years have you been practicing?	
how many years have you spent practicing in primary care?	
How often do you see patients with known or suspected traumatic brain injuries?	Rarely ( ) Infrequently ( ) Frequently ( )
How would you describe your skill level with assessing for and diagnosing traumatic brain injuries?	Not skilled 1 2 3 4 Competent 5 6 7 8 9 Expert 10
What are the primary screening methods you use when assessing for potential traumatic brain injuries (check all that apply)?	Clinician interview ( ) Clinician observation ( ) Neurological exam ( ) Self-reported patient symptoms ( ) other: ( )
What Screening tools do you use to assist in diagnosing traumatic brain injuries (check all that apply)?	CDC Acute Concussion Evaluation ( ) Mini Mental Status Exam ( ) Ohio State University TBI ID method ( )

	MONTREAL COGNITIVE ASSESSMENT ( ) TRAUMATIC BRAIN INJURY QUESTIONNAIRE ( ) BRIEF TRAUMATIC BRAIN INJURY SCREEN ( ) OTHER: ( )
WHAT IS THE REASON(S) FOR USING YOUR CHOSEN SCREENING TOOL(S) (CHECK ALL THAT APPLY)?	PERSONAL PREFERENCE ( ) FAMILIARITY ( ) EASE OF IMPLEMENTATION ( ) COST EFFECTIVENESS ( ) TOOL RECOMMENDED BY PRACTICE ( ) OTHER: ( )
WHICH OF THESE SYMPTOMS DO YOU USE AS POSSIBLE INDICATIONS FOR TRAUMATIC BRAIN INJURY SCREENING (CHECK ALL THAT APPLY)?	CHANGE IN SLEEPING PATTERN ( ) DROWSINESS ( ) HYPERVIGILANCE ( ) EMOTIONAL INSTABILITY ( ) DEPRESSION ( ) IRRITABILITY ( ) MOOD CHANGES ( ) SUICIDAL IDEAS ( ) COGNITIVE CHANGES ( ) DIFFICULTY CONCENTRATING ( ) AMNESIA ( ) CONFUSION ( ) FATIGUE ( ) LOSS OF CONSCIOUSNESS ( ) PHOTOPHOBIA ( ) PHONOPHOBIA ( ) BALANCE INSTABILITY ( )

	PARESTHESIA ( ) DIZZINESS ( ) SEIZURES ( ) VISUAL DISTUBRANCES ( ) NAUSEA AND VOMITING ( ) HEADACHE ( ) OTHER: ( )