CHALLENGES TO SECONDARY BRAIN INJURY PREVENTION IN SEVERE TRAUMATIC BRAIN INJURY

by

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As members of the DNP Project Committee, we certify that we have read the practice inquiry prepared by Kristen Jo Keller entitled Challenges to Secondary Brain Injury Prevention in Severe Traumatic Brain Injury and recommend that it be accepted as fulfilling the practice inquiry requirement for the Degree of Doctor of Nursing Practice.

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Signed: Kristen Jo Keller, MSN, RN, ACNP-BC
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To my committee chair, Dr. Matthew Gallek - your expertise and leadership have been influential in my growth and success. And to my committee members, Drs. Leslie Ritter and Ted Rigney - I am indebted to you for your energy and direction.

Perhaps most importantly, this work is dedicated to those patients (and their friends and families) living with the sequelae of traumatic brain injury. I am hopeful that it is one step on the long, winding road to understanding an extremely complex set of processes and learning to mitigate the disability, both short and long term, which results from them.
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ABSTRACT

BACKGROUND/AIMS: Inconsistency in the use of secondary brain injury prevention guidelines among US trauma centers after severe traumatic brain injury is prevalent in many literature sources. However, this phenomenon has not been thoroughly studied. The purpose of this DNP project is to identify the key barriers and challenges in compliance to the evidence-based guidelines for secondary brain injury prevention. DESIGN: An exploratory, emergent design was used to collect descriptive qualitative data through the use of a survey. SETTING: Six Phoenix Metropolitan Level 1 trauma centers. PARTICIPANTS: All survey participants who consented to survey completion, which had greater than six months of experience and directly worked with patients suffering from a severe TBI in the clinical setting. MEASUREMENTS: Participant demographics (work experience, area of work, job title), current awareness and use of Brain Trauma Foundation guidelines, and time duration for evidence based order set implementation. Narrative responses were also used to identify barriers to current use of the BTF guidelines and factors that may promote their use in the future. RESULTS: A total of 43 participants consented to the survey study, with completion by 35 participants. RNs (n=27), Physicians (n=2), NPs or PAs (n=5), with an average work experience of 6 to 14 years (42.86%). A total of n=22 (62%) of participants were unaware of the current BTF guidelines for severe TBI and only 25% (n=9) aware that their facility has a protocol based on the BTF guidelines for severe TBI, while 51% (n=18) were unsure if their facility had a protocol. Barriers were identified in narrative form and were consistent with awareness/education, provider congruence, communication, and order set/protocol process improvement. CONCLUSION: The understanding of current patient management for severe TBI based on the BTF guidelines is
sporadic among the greater Phoenix area Level 1 trauma centers. Requiring proof of BTF
guidelines compliance by the ACS at time of Level 1 certification may increase the consistent
recommended use of the BTF guidelines for the care of severe TBIs.
CHAPTER 1: OVERVIEW

Introduction

Each year 1.7 million people suffer a traumatic brain injury (TBI) in the United States (Centers for Disease Control and Prevention [CDC], 2013a). These injuries are sustained by numerous mechanisms and are classified as either closed or penetrating injuries, with the most common being a closed injury pattern. TBI is defined as a blow, bump, or shake to the head that disturbs normal brain function; and the majority of brain injuries are classified as mild or concussive injuries (CDC, 2013a). However, TBI is the leading cause of death in adolescents and young adults and nearly half of patients hospitalized after a TBI remain disabled one year after the traumatic event (CDC, 2013a; Haddad & Arabi, 2012). Each year TBI accounts for an estimated 60,000 deaths and approximately 90,000 patients sustain permanent neurologic disability (Marik, Varon & Trask, 2002).

TBI creates a devastating personal and societal loss. There is currently an estimated 5.3 million Americans living with disabilities sustained after a TBI (Fakhry, Trask, Waller & Watts, 2004). These disabilities affect their personal independence as well as their ability to contribute to society. TBI affects all aspects of a person’s life. The injury and disability sustained continues on to produce a ripple effect throughout the lives of their loved ones and onward to society.

The financial cost from medical care and lost productivity is overwhelming. TBI is associated with a financial strain of approximately 40 to 100 billion dollars annually in the United States alone with the majority expenditure (90%) derived from severe hospitalized traumatic brain injuries (CDC, 2013a; Fakhry et al., 2004; Marik et al., 2002).
The personal, societal and financial impact of TBI warrants further investigation to expose the barriers associated with providing the most current evidence-based care to this critical patient population.

**Background and Significance**

**Primary vs. Secondary Injury**

According to Dawodu (2013), a severe TBI is defined as a Glasgow Coma Score (GCS) of eight or less within the first forty-eight hours after injury, representing severe impairment in verbal and/or motor function from neurologic insult. The potential effects of sustaining a TBI include impairments in cognitive functioning, motor coordination, and sensory perception, as well as emotional strife (CDC, 2013a). The degree to which these are impacted is dependent on the severity of injury. TBI occurs in two phases, known as the primary and secondary injuries. The primary injury occurs at the time of the impact or accident and may be caused by an array of mechanisms such as motor vehicle crashes, motorcycle crashes, falls, or assaults. There is no treatment for the primary injury except for preventative measures.

The next phase is known as the secondary brain injury, which occurs over a period of hours to days after the initial primary injury. Secondary brain injury is a sequence of events following the primary injury that results in additional ischemia and/or cerebral edema and occurs in up to ninety percent of TBI patients (McNett, Doheny, Sedlak & Ludwick, 2010). While there is little that can be done for the focal primary injury, certain supportive therapies have been shown to reduce further ischemia to an already compromised brain. Thus, reducing the effects of secondary brain injury.
**Pathophysiology Behind Secondary Brain Injury**

Secondary brain injury is a well documented and at times a catastrophic cascade of pathologic processes that exacerbate the initial injury. This process involves the release of a series of destructive substances (glutamate, cytokines, free radicals) that further proliferates cell membrane disruption and ion displacement causing added neuronal impairment (Marik et al., 2002). However, most secondary brain injury insults result from ischemia and can be produced by a number of mechanisms not only from intracranial processes but also extracranial factors. Intracranial alterations include cerebral edema, intracranial hypertension, infection, seizures, excitotoxicity and vasospasm (Haddad & Arabi, 2012). Systemic alterations in physiologic parameters should be closely monitored and hypotension, hypocapnia, hypoxemia, anemia, hyponatremia, fever and hypothermia should be avoided (Haddad & Arabi, 2012). The extracranial or systemic alterations are components that can be optimized and influenced by intensive care medicine. Without vigorous attention to hemodynamic and physiologic parameters, patients suffering from TBI are placed at high risk for secondary brain injury complications. These complications include, among others, an increase in hospital length of stay, cost, and, perhaps most importantly, functional status (Faul et al., 2007; Fakhry et al., 2004; Gerber et al., 2013).

Accordingly, the Brain Trauma Foundation (BTF) has gathered data and formulated a set of instructions for maintenance of these systemic and extracranial parameters to be optimized during medical treatment. Such guidelines have been available for nearly a decade, however research is showing their standardized use is limited (Faul et al., 2007; McNett et al., 2010; Schirmer-Mikalsen et al., 2013).
**Brain Trauma Foundation Guidelines**

Specific treatment guidelines have been established by the BTF and although they are well documented, they are not consistently applied at the bedside. After multiple failed attempts for improved outcomes with pharmaceutical management of TBI, a group of neurosurgeons and brain injury experts reviewed the established evidence to classify and rate the existing treatment modalities (Gerber, Chiu, Carney, Hartl & Ghajar, 2013) Their efforts led to the publication of the first edition of guidelines for severe TBI in 1996, with the most current edition announced in 2007. Management of the often-complicated sequelae of events takes a dynamic and thorough approach from the bedside nurse to trauma center protocols.

The TBI guidelines set forth by the BTF, advises physiologic parameters be maintained within normal limits for blood pressure, temperature control, oxygen saturation, intracranial pressure, cerebral perfusion pressure, and nutrition (Brain Trauma Foundation, 2007). Identification and response to fluctuations of these physiologic parameters by the bedside nurse is imperative to prevention of secondary brain injury. A recent survey of bedside nurses found that only twenty-seven percent of nurses were aware of these population specific guidelines (McNett et al., 2010). Standard protocols not consistently in place and the end-user, the bedside nurse, are unaware of current evidence-based management principals for optimal outcomes.

Not only have the BTF guidelines been associated with improved neurologic outcomes, there are also reported financial benefits. Faul, Wald, Rutland-Brown, Sullivent & Sattin (2007), found that consistent use of the BTF guidelines not only saves lives and produces better neurologic outcomes, but also reduces cost, which is most likely related to the reduction in the severity of long term disability as well as the incidence. Although the majority of the cost
savings are at the societal level, lifetime work loss ($3.8 billion), medical ($262 million) and rehabilitation ($43 million) costs were also reduced with regular use of the recommended guideline therapy (Faul et al., 2007).

Subsequent studies have reviewed their efficacy in not only producing better patient outcomes, but also in reducing the cost burden of these devastating injuries. Recently, the CDC (2013b) conducted a study reviewing the use of the BTF guidelines for secondary injury prevention in severe TBI and found that when adopted, the guidelines reduced mortality by up to fifty percent. The financial savings is estimated at $288 million dollars in medical care and rehab alone, with another $3.8 billion in total society and economic savings (CDC, 2013b).

These current evidence-based guidelines have been established for the care of the traumatically brain injured patients, but the regular use and effect they have on patient management is unclear (McNett et al., 2010). Recent studies suggest that even with widespread availability to these guidelines, their use has been poorly integrated in one-third of US trauma centers (Faul et al., 2007). These findings demonstrate the inconsistencies between evidence-based research and bedside patient management. The use of a secondary brain injury protocol in conjunction with staff education should not only increase integration of guidelines and reduce cost, but also improve clinical outcomes.

**Secondary Brain Injury Protocols**

The BTF guidelines contain fourteen targets that need consistent attention throughout the acute treatment period, making the management a multi-factorial collaboration within the entire care team (Appendix C; Brain Trauma Foundation, 2007). Faul et al. (2007), found that the use of the established BTF guidelines not only increased the percentage of good outcomes (decrease
mortality, medical and societal costs), but also decreased the percentage of poor outcomes (mortality and GOS), by 31 and 15 percent respectively.

A collection of protocols has been created through various institutions for the care and management of traumatically brain-injured individuals. Complex trauma patients may require many different consulting specialties for injury management. It is prudent that all members of the patient care team consider care for secondary brain injury prevention. The utilization of protocols may aid in achieving this standard of care. While there is documented success in patient outcomes, length of stay and a decrease cost with these protocols, adherence to these protocols remains poor (Faul et al., 2004; Arabi et al., 2010; Fakhry et al., 2004; Gerber et al., 2013; Shirmer-Mikalsen et al., 2013).

**Summary**

Secondary brain injury prevention after TBI involves a complex, dynamic, multi-system approach to care delivery by the entire care team. While established guidelines for care exist, consistent utilization of the guidelines set forth by the BTF remains elusive. The fourteen BTF guidelines are well documented as factors minimizing costs, improving outcomes and decreasing disability after TBI.

**Purpose of the DNP Project**

The purpose of this DNP project is to identify the key barriers and challenges in adhering to evidence-based care guidelines for secondary brain injury prevention. The goal of this project is to bridge the practice gap between evidence-based standards of care and bedside practice by better understanding how to incorporate clinically documented interventions to improve outcomes among traumatically brain-injured adults.
Study Aims

1. Through the use of a survey, identify and evaluate the current barriers to BTF guideline adherence as perceived by healthcare providers, bedside nurses, and systems administration.

2. Using a mixed methods approach, analyze quantitative and qualitative survey data through descriptive statistics and content analysis and organizing data themes to determine potential barriers to implementing BTF guidelines in caring for patients with a severe TBI.

3. Develop an action plan of recommendations to overcome the barriers identified.
CHAPTER 2: CONCEPTUAL FRAMEWORK

Outcomes of TBI are dependent on the influence of multiple circumstances from time of injury through the coordinated hospital care and recovery. The use of a Secondary Brain Injury Prevention Protocol may be the key to improving care for this complex patient population. Numerous studies have justified the use of practice protocols for reducing secondary brain injury in the care of the TBI patient, but remark that adherence and compliance remains a problem.

Literature Review

This DNP project will identify and evaluate the current barriers to guideline adherence as perceived by healthcare providers, bedside nurses, and systems administration. Currently, the BTF has organized a guideline document that addresses fourteen aspects of care believed to directly affect outcomes and secondary injury after a TBI is sustained (Brain Trauma Foundation, 2007). These practice guidelines use a variety of methods to influence bedside care, such as treatment protocols and individually ordered parameters to follow. Although not a standard of practice, treatment protocols have been employed through various institutions and showed substantial improvement in outcomes and cost savings (Arabi et al., 2010; Gerber et al., 2013; Schirmer-Mikalsen et al., 2013). However, during review deviations from these evidence-based standard-of-care protocols remained high (Faul et al., 2007; Shirmer-Mikalsen, Moen, Skandsen, Vik & Kepstad, 2012). The dynamic approach and monitoring required to manage severe TBI patients necessitates further inquiry.

Currently, there is no universally accepted best practice protocol for managing the patient with TBI, despite the strong evidence base of the BTF’s severe TBI guidelines. Not only have the individual aspects of these recommendations been thoroughly studied, the routine use of the
guidelines as a whole has been examined. Successful documentation and adherence to these guidelines has revealed a decrease in mortality of approximately fifty percent as well as a reduction in healthcare cost of nearly eight thousand dollars per person and four million dollars annually (CDC, 2013b; Fakhry et al, 2004; Faul et al., 2007; Gerber et al., 2013).

**Neurologic Outcome and Mortality**

Comparison of outcomes between the current non-standardized approach to care and outcomes from studies demonstrating strong adherence to the BTF guidelines supports their effectiveness (Gerber et al., 2013; Faul et al., 2007; English et al., 2013; Arabi et al., 2010). The use of the BTF guidelines is projected to save approximately 3,600 lives a year, which is an estimated decrease in mortality of 15% in those patients who were classified as having a severe TBI (Faul et al., 2007). While survival is an important outcome commonly measured, it is important to analyze the quality of outcomes after severe TBI. Not only was the mortality rate lessened with the utilization and adherence to the BTF guidelines, but also the volume of patients who recovered with good outcomes (GOS 4-5, moderate disability to good recovery) increased by 30% (Faul et al., 2007). These outcomes were evaluated by the Glasgow Outcome Score, which is a categorical assessment tool utilized for evaluation of recovery, as seen in Table 1 (Greenberg, 2010).

While decreasing mortality, the consistent use of the BTF guidelines for severe TBI did not appear to be associated with an increase in the number of patients surviving with severe disabilities as the use of these guidelines did not prolong the duration of mechanical ventilation or ICU length of stay (Arabi et al., 2010).
Table 1. Glasgow Outcome Score

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<tr>
<td>1</td>
<td>Death, usually occurring within the first 48 hours after injury</td>
</tr>
<tr>
<td>2</td>
<td>Persistent vegetative state, unconscious and speechless at 2-3 weeks</td>
</tr>
<tr>
<td>3</td>
<td>Severe disability, dependent for activities of daily living (ADLs)</td>
</tr>
<tr>
<td>4</td>
<td>Moderate disability, disabled but able to perform ADLs</td>
</tr>
<tr>
<td>5</td>
<td>Good recovery, regain function with minor deficits</td>
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Gerber et al (2013) found a significant reduction in two-week mortality between 2001-2009 when there was an increase in BTF guideline fidelity in New York State. These changes took place after a statewide initiative to increase compliance with the BTF guidelines. While the age-adjusted mortality rate decreased by an estimated 45% with improved compliance to the BTF guidelines, there were variations in adherence noted within hospital trauma systems throughout the state. Suggesting further evaluation of the initiative needed to support further improvements with compliance to the evidence-based management.

Financial Benefit

Along with the devastating personal and societal impairment, there is a remarkable financial encumbrance that follows severe TBI. A study piloted in the Journal of Trauma Injury, Infection, and Critical Care estimated the costs to be approximately $4,300 per day with a total ranging from $65,600 to $105,653 per patient using market values and numbers from 2002 (Faul et al., 2007). The incurred costs increased in proportion to the disability as categorized by their Glasgow Outcome Score. Cost analysis data from the adoption of the BTF guidelines revealed a annual costs savings of $8,000, per patient (after implementation costs) and a societal savings of nearly $165,000 per patient (Faul et al., 2007). Not only are these savings from the direct
medical care from severe TBI, but also the lifetime societal and economic costs from the consequences of disability.

**Protocol Management in Severe TBI**

Although there is not a universal protocol, various protocols have been developed and implemented for the treatment and management of severe TBI. Studies evaluating the use of these protocols have revealed an increase in compliance with the BTF guidelines; with a resultant increase in good neurologic outcomes and a decrease in mortality, length of stay and financial costs incurred (Fakhry et al., 2004; English, Turgeon, Owen, Doucette, Pagliarello & McIntyre, 2012; Arabi et al., 2010). Individualized studies have recommended the use of the BTF guidelines for the management of severe TBI in adults, but have shown poor compliance in implementation among trauma centers. Protocol management of severe TBI has shown to be beneficial in increasing BTF guidelines compliance, thus improving outcomes (Fakhry, Trask, Waller & Watts, 2004; English, Turgeon, Owen, Doucette, Pagliarello & McIntyre, 2012; Arabi et al., 2010).

While there is a strong association between the use of clinical practice protocols and more efficient, cost effective quality care, the development of a protocol is not straightforward. Alarcon et al (2012), reviewed the data and evaluated twelve clinical practice guidelines (CPGs) for severe TBI and found that only two thirds of the protocols were based on evidence, which left a recommendation for only three of the protocols reviewed for clinical practice.

However, protocol use was independently associated with a decrease in ICU and hospital mortality and was not attributed to an increase in length of stay, mechanical ventilation, or tracheostomies (Arabi et al., 2010). Gerber et al (2013) conducted a study from 2001 to 2009
assessing the 2-week mortality after severe TBI in New York State and found a decrease in mortality from 22% to 13% (p<0.0001), with the increase in BTF guideline adherence. The establishment of a TBI protocol revealed a decrease in the deviations from the physiologic parameters recommended by the BTF, but frequent deviations from the protocol remained in existence.

While there is a plethora of data supporting the management of the BTF guidelines and some new studies suggesting protocol use will increase adherence to these guidelines, there remains a clear gap between the documented evidence and clinical bedside practice. A recent article by Gerber et al. (2013), suggest further inquiry for identifying barriers and methods to increase the routine use of the BTF evidence-based guidelines. This DNP project will follow an invitation to assess and document the lack of evidence translation throughout the Phoenix area trauma systems.

**Conceptual Framework**

This DNP project is based on Neuman’s System Model. Neuman’s System Model was derived to organize the extensive amount of knowledge that is required for comprehensive care within dynamic human situations, and describes client environments as internal, external, and created (Neuman & Fawcett, 2011). The goal of the healthcare provider is to provide stability and wellness through a process known as reconstitution. Reconstitution occurs with a treatment or intervention that aids in the return of homeostasis or client system stability (Neuman, 2005). The current lack of knowledge and evidence translation to the bedside impedes the caregivers and providers from supporting a stable client system. Reconstitution cannot occur without identifying the barriers to intervention and treatment implementation. In the setting of severe
TBI, implementation of the BTF guidelines acts as the manipulation of interventions to return the patient to a state of stability for recovery and improved outcomes. Figure 1 demonstrates the client system structure, the environmental interactions, and where reconstitution must happen to contribute to patient wellbeing and system stability.

Figure 1. Neuman’s System Model

Core Client System

The core client system represents the inherent components that regulate physiologic function including genetics, strengths and weaknesses, along with genetic patterns (Meleis, 2007). The determination of the patient’s response to injury or insult is determined by their core structure and is individual to everyone (Neuman, 2005). This unique response pattern contributes to the dynamic approach and presentation for patients with severe TBI. This core client system is not a standardized mechanism and should be treated as individualized phenomena in response to injury.
**Internal Environment**

The internal environment occurs and is contained to the individual client system itself (Meleis, 2007). The internal factors of the core client system are the components of the internal environment and give a response dependent on their ability to adapt to injury, insult, and instability. In severe TBI, the internal environment is the determining factor for severity of illness and disruption of homeostasis from a given event.

**External Environment**

The external environment is comprised of elements imposed on the patient from the outside environment (Meleis, 2007). This environment has the most potential for change and control during reconstitution. Secondary brain injury prevention in accordance to the BTF guidelines is a heterogeneous method for manipulating the external environment to optimize outcomes.

**Created Environment**

The created environment is the client’s unconscious fluidity of energy shifting between the internal and external environment, which acts as a repository for the system’s integrity (Meleis, 2007). This environment is a dynamic and complex interaction between injury, core system response, and ability to adapt after a traumatic brain injury. The BTF guidelines are mechanisms and management techniques that are instituted on this environment to maintain homeostasis of function and promote optimal outcomes.

**Reconstitution**

The conceptual framework for this practice inquiry focuses on the reconstitution efforts to maintain homeostasis within the described environments. The current evidence suggests that
despite the availability of effective methods for treatment of secondary brain injury prevention, the healthcare community lacks implementation, or according to Neuman’s System Model, reconstitution.

Summary

Understanding and identifying the barriers preventing reconstitution of effective evidence-based treatment modalities in the management of severe TBI will help bridge the gap between the patient’s core structure and their environments post injury. When identified these undocumented barriers will be utilized for system development of an approach to provide evidence-based care. Thus, increasing the quality of care for secondary brain injury prevention and promoting optimal outcomes.
CHAPTER 3: METHODS

Study Aims

1. Through the use of a survey, identify and evaluate the current barriers to BTF guideline adherence as perceived by healthcare providers, bedside nurses, and systems administration.

2. Using a mixed methods approach, analyze quantitative and qualitative survey data through descriptive statistics and content analysis and organizing data themes to determine potential barriers to implementing BTF guidelines in caring for patients with a severe TBI.

3. Develop an action plan of recommendations to overcome the barriers identified.

Design

An exploratory, emergent design was used to collect data describing the barriers to utilizing the established BTF guidelines for severe TBI in current practice. This study involved the use of surveys that are comprised of specific and open-ended questions that maintain a consistent theme throughout the organizational tier (Physicians, Nurse Practitioners (NP), Physician Assistants (PA), Registered Nurses (RNs) and nursing administration involved in order set approval) to which they are distributed (Appendix D). The questions were derived from a literature review, the author’s experience, and committee collaboration. Contact was made via email with the trauma program manager of each Level 1 trauma facility as the liaison for survey distribution (Appendix E). Surveys were electronically offered through to each potential subject by the Trauma Program Manager at each site for dispersion to their nursing, administration, and trauma and neurosurgical teams.
The survey was hosted through the Survey Monkey website and all responses were collected and analyzed by the principal investigator from the host site. Survey responses were anonymous and could not be tracked back to the individual participant. Informed consent was obtained at the start of each survey with options to opt in or decline to participate. Questions were asked regarding years of healthcare experience, work environment, and use of current TBI protocol. A subsequent five questions were asked to assess knowledge, process, and utilization of TBI protocols, with the last two questions requiring a narrative response (Appendix D). Human subjects’ protection approval was obtained through IRB approval prior to survey distribution.

**Setting**

The setting of this study was six Level 1 trauma centers in the local Phoenix area. A Level 1 trauma center provides the highest level of surgical and trauma care from prevention through to rehabilitation and are have specialists available to treat all injury patterns (CDC, 2010). At the time of initial survey enrollment, the Phoenix had six Level 1 trauma centers. Phoenix has one pediatric Level 1 trauma facility that was excluded from the study due to the fact that the BTF guidelines are written for adults suffering from severe TBI. These six trauma centers are centrally located in Maricopa County and cover 60% of the state’s population ("State trauma advisory," 2011). Multiple sites were chosen to provide a naturalistic, more generalized field of response. The six Phoenix area Level 1 trauma hospitals all receive and care for adults suffering from severe TBI.
Sample

Purposive sampling was used to recruit RNs with greater than six months of trauma experience, trauma NPs, trauma PAs and neurosurgeons who actively treat and write orders for TBI patients, and trauma system administrative staff involved in policy formation. Participants with less than six months experience were excluded based on the amount of exposure and education they were likely to have given they amount of time in practice. Physicians and NPs/PAs who write orders for severe TBI patients were included as they are the dominant providers in initiating orders consistent with the BTF guidelines. Administrative staff involved in policy formation was asked to participate in the survey as they play a critical component in the details involved in order set and protocol development including time frame to dissemination and evaluation processes.

Data Analysis

Descriptive statistics were used to analyze demographic and healthcare-related variables. Content analysis was used to identify recurring themes and identify patterns in data collected regarding BTF guidelines use, facility order-set implementation process, perceived barriers to use, and suspected factors that would promote use of the BTF guidelines. The population from which these conclusions of themes was drawn is physicians, NPs/PAs, and RNs who are employed at Level 1 trauma centers and care for adult patients who are suffering from severe TBI.

Qualitative content analysis is the analysis of data through the identification of common patterns by breaking down data into smaller units of content. The context in which the data is analyzed is through the identification of recurring patterns in participant’s responses and
classifying the responses as smaller units (Polit & Beck, 2008). Tables were employed to illustrate the thought process and document the transition from raw data to overarching themes through the breakdown of the larger raw data narrative. This process of documentation allows for data transparency and credibility by including how the data was interpreted and themes established, which is often critiqued in qualitative studies (Noble & Smith, 2013; Polit & Beck, 2008).

The initial steps encompassed reviewing the data and formulating descriptive codes for each subset of responses to each question. Then these categories were summarized into the development of the overall themes. A theme can be defined as a significant identifying label that emerges from a data source by separating commonalities between the responses and can be depicted by charts or tables for development (Polit & Beck, 2008). Once the categories were formed based on the raw data responses the final themes were summarized. The final themes derived from the qualitative data underwent a check of confirmability with the author’s committee chair.

The survey design protected the participant’s anonymity through the utilization of the online survey tool, Survey Monkey. During design of the survey, the option for complete anonymity of responses was enabled; blocking all sources of respondents’ identity including IP address from which the survey was completed. The principal investigator was the only person with access to the survey tool login for protection and security of data collected.
CHAPTER 4: RESULTS

Description of Survey Participants

From May 7th, 2014 to July 11th, 2014, participants were invited to participate in the Challenges to Secondary Brain Injury Prevention in Severe Traumatic Brain Injury survey. A total of forty-three participants responded. A total of 35 participants identified their current position, with 27 participants (77%) identified as RNs, 2 Physicians (5.71 %), 5 NPs or PAs (14.29 %), and 1 Health Unit Coordinator (2.86%), see Table 2. The average years of work experience was between six and fourteen years, at 42.86% of participants (Table 3). Hospital setting was described as mainly Community by 85.71% (n=30) of participants, Private by 8/57% (n=3), and Academic 5.71% (n=2). When asked about work environment the majority of responses were of from the Intensive Care Unit 65.71% (n=23), then the Emergency Room at 37.14% (n=13) followed by narrative written responses stating ‘trauma/trauma unit’ at 11.43% (n=4). There were no participants who responded with a work environment of administrative office.

Table 2. Characteristics of Participants

<table>
<thead>
<tr>
<th>Participants</th>
<th>Total Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered Nurses</td>
<td>27</td>
<td>77.00%</td>
</tr>
<tr>
<td>Physicians</td>
<td>2</td>
<td>5.71%</td>
</tr>
<tr>
<td>NP/PA’s</td>
<td>5</td>
<td>14.29%</td>
</tr>
<tr>
<td>Health Unit Coordinator</td>
<td>1</td>
<td>2.86%</td>
</tr>
</tbody>
</table>

Table 3. Years of Experience

<table>
<thead>
<tr>
<th>Less than 6 months</th>
<th>6 months to 5 years</th>
<th>6 to 14 years</th>
<th>15 to 25 years</th>
<th>26+ years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/5.71%</td>
<td>6/17.14%</td>
<td>15/42.86%</td>
<td>6/17.14%</td>
<td>6/17.14%</td>
</tr>
</tbody>
</table>
Familiarity with BTF Guidelines

When asked about awareness of the BTF guidelines for TBI, 22 (62.86 %) participants responded that they were 'unaware' of the current guidelines. The remaining 13 (37.14%) participants answered 'yes', they were aware of the BTF guidelines. Given the option for free text, they responded they had heard about the guidelines from various influences such as research trials, experience in field, and through donor network.

Participants were asked if they agreed with the BTF guidelines for the management of TBI. A total of 26 participants answered the question with 24 (92.31%) answering 'yes', and 2 (7.69%) answering 'no'. The participants answering 'no' stated they were unfamiliar with the guidelines.

Table 4. Awareness of BTF Guidelines

<table>
<thead>
<tr>
<th>Unaware of Guidelines</th>
<th>Aware of Guidelines</th>
<th>Agree with Guidelines</th>
<th>Do Not Agree with Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>22/62.86%</td>
<td>13/37.14%</td>
<td>24/92.31%</td>
<td>2/7.69%*</td>
</tr>
</tbody>
</table>

* The participants answering ‘no’ stated they were unfamiliar with the guidelines

Current Practice

Survey participants were then asked if they would use a standardized order set based on the BTF guidelines for severe TBI. There were 33 (97.06%) participants responding 'yes' they would use an evidence-based order set for TBI based on the BTF guidelines. There was one (2.94%) participants responding 'no', they would not because they have a neuro-intensivist that manages their TBI care. Next, the participants were asked if they currently use an order set specific to TBI patients. Of the participants surveyed, 14 (40 %) responded 'no' to currently using an order set specific to TBI patients. There were 19 participants (54.29%) who replied
'yes', but they were unsure if it is based on the BTF guidelines and 2 (5.71%) participants replied they used an order set for TBI patients based on the BTF guidelines.

Table 5. BTF Guidelines Use in Future/Current Practice

<table>
<thead>
<tr>
<th>Would use a standardized order set based on BTF Guidelines</th>
<th>Would not use a standardized order set on BTF Guidelines</th>
<th>Currently not using an order set specific to TBI patients</th>
<th>Currently using an order set specific to TBI patients but unsure if it is based on BTF Guidelines</th>
<th>Currently using an order set specific to TBI patients based on BTF Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>33/97.06%</td>
<td>1/2.94%</td>
<td>14/40%</td>
<td>19/54.29%</td>
<td>2/5.71%</td>
</tr>
</tbody>
</table>

Protocols are facility-approved documents with guidance on how patients with certain conditions should be treated, while evidence-based order sets are standing orders that can be continuously implemented and give parameters for care (Chan, Chan, Cafazzo, Rossos & Tripp…Easty, 2012). Most protocols are general guidelines, and do not offer the step-by-step instructions for direct patient care that are provided in evidence-based order sets. Studies have shown that the utilization of order sets or protocols increase compliance in evidence based guideline utilization and may contribute to improved quality measures such as length of stay, improved outcomes, as well as identify undesirable events (Chan et al., 2012; English et al., 2013; Alarcon et al., 2013). Participants were asked about the facility process, current protocols, and the use of evidence-based order-sets in other areas of care.

The average perceived process time from order set submission to implementation was greater than six months. However, 60% of participants responded that they were 'unsure' how long the process actually takes to approve evidence-based order sets. Six participants responded
that their facilities process time was 6 months (8.57%), 1-3 months (5.71%), and less than one month (2.86%) respectively.

Table 6. Time Duration for Evidence Based Order Sets Approval

<table>
<thead>
<tr>
<th>Time Duration</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months or greater</td>
<td>8/22.86%</td>
</tr>
<tr>
<td>1-3 months</td>
<td>3/8.57%</td>
</tr>
<tr>
<td>Less than 1 month</td>
<td>2/5.71%</td>
</tr>
<tr>
<td>Unsure</td>
<td>21/60%</td>
</tr>
</tbody>
</table>

While some facilities may not use evidence-based order sets, there are facilities were protocols are being utilized. Of the 35 participants, 9 (25.71%) replied 'yes' their facility has a protocol for TBI management that is based on the BTF guidelines, while 8 (22.86%) and 18 (51.43%) responded that their facility 'did not' have a protocol or were 'unsure' respectively.

Table 7. Protocol Use Based on BTF Guidelines

<table>
<thead>
<tr>
<th>Protocol Use</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility has a protocol</td>
<td>9/25.71%</td>
</tr>
<tr>
<td>Facility does not have a protocol</td>
<td>8/22.86%</td>
</tr>
<tr>
<td>Unsure if their facility has a protocol based on BTF guidelines</td>
<td>18/51.43%</td>
</tr>
</tbody>
</table>

When asked if the facility at which survey participants worked encouraged the use of order set-derived care for evidence-based guidelines in other areas of patient care 4 (11.43%) replied always, 21 (60%) replied mostly, 6 (17.14%) replied sometimes, 4 (11.43%) replied unsure with no responses for never.

Table 8. Workplace Support for Evidence Based Protocols/Order Sets

<table>
<thead>
<tr>
<th>Support</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>4/11.43%</td>
</tr>
<tr>
<td>Mostly</td>
<td>21/60%</td>
</tr>
<tr>
<td>Sometimes</td>
<td>6/17.14%</td>
</tr>
<tr>
<td>Unsure</td>
<td>4/11.43%</td>
</tr>
<tr>
<td>Never</td>
<td>0/0%</td>
</tr>
</tbody>
</table>
Barriers to Implementation

As part of the qualitative portion of the survey, participants were asked to identify possible barriers to implementation of a standard order set based on the BTF guidelines for the care of TBI patients. Four themes emerged from the data: provider congruency, implementation process, resistance to change, and education/awareness. Appendix A contains the raw data responses with their corresponding categorical assignment. Provider congruency, implementation process, and education/awareness were the predominating themes identified as potential barriers to BTF guideline implementation.

These responses demonstrate the viewpoints of current practitioners (Physicians, NPs/PAs, and bedside nurses) in the clinical setting. Their day-to-day experience with patients and facility processes to incorporate evidence-based research to the bedside leaves them being a crucial element to organizational awareness and structure for understanding the barriers to which imperative components of current research are being barricaded from the bedside.

Promote Use of BTF Guidelines

Participants were also queried on factors that would promote further use of the BTF guidelines within their facility. A total of twenty open-ended responses were received. This study derived four general themes from the raw data responses that include: education/awareness, provider congruency, communication, protocol/order process improvements. Appendix B contains the raw data responses and their corresponding categorical placement. The majority of the responses are associated with education/awareness, and then communication followed by the process for protocol/order set development, and provider congruency.
Missing Data

As a convenience sample survey, only volunteered information was used in the final survey results. Two participants identified themselves with having less than six months of work experience, and based on inclusion criteria, their responses were excluded from the final results. One participant identified himself or herself as being a health unit coordinator, which did not meet clinical inclusion criteria, and their response was also excluded from the final results. There were no participants identifying themselves as administrative members. Each survey question was skipped by a various number of participants.
CHAPTER 5: DISCUSSION

When surveyed, a total of forty-three health care workers and providers who deliver care to the TBI population at Level-1 Trauma centers in the metropolitan Phoenix area consented to give their feedback on the current use, understanding, barriers, and potential factors to promote use of the BTF guidelines.

Demographics of Survey Respondents

A total of 35 participants responded to the multiple-choice portion of the survey. The participants were from varied positions of healthcare providers, but the majority of the responses were from bedside nurses. The job position of the respondent likely influenced the data secondary to education level and influence within patient care orders, with the majority of the responses from bedside nurses. However, the sample of participants may reflect the general composition of the healthcare workforce, as there are more nursing providers than physicians and NPs/PAs combined. This is significant as nurses may already be abiding by individually written BTF guidelines but be unaware of the current components within the document, therefore persuading the responses to show noncompliance versus unfamiliarity. The average years of experience within the sample population was 6 to 14 years, at 42.86% of participants. The frequency distribution of responses is normal, as in the majority of participants fall within the middle range of years of experience, as seen in Figure 2.
Familiarity of the BTF Guidelines

One way to identify if the research recommendations are reaching the clinical environment is to evaluate their familiarity among providers. According to this study, there were 22 participants (62.86%) that stated they were ‘unaware’ of the current BTF guidelines for severe TBI, with the remaining 13 (37.14%) stating ‘yes’ that they were aware of them. Similar to these findings are consistent with the lack of implementation within US trauma centers as described by Faul and colleagues (2007), the participants position held may contribute to the lack of awareness.

Familiarity with the BTF guidelines may differ between the participants based on position within the healthcare workforce. Physicians and NP/PA’s may have a greater understanding and/or exposure to the evidence-based guidelines due to their required advanced education. The large majority of participants identify themselves as RNs (77%), whose practice and education may vary greatly from that of physician and advanced practice providers (NP or PAs). This study investigated the awareness of the BTF guidelines and the findings are...
consistent with that of McNett et al (2010), who found that only one quarter of bedside nurses surveyed were aware of the BTF guidelines for secondary injury in severe TBI.

When asked if participants agreed with the BTF guidelines for the management of TBI, 92.31% stated ‘yes’, while 7.69% stated ‘no’. Those that stated no commented that they could not agree with the guidelines because they were unaware of them. It would be expected that more responses would be ‘no,’ given that 62% of respondents stated they were unaware of the guidelines. From the data, it appears that some participants, agreed with using BTF guidelines for the management of severe TBI when they were unaware of what the guideline were. It is not possible to determine which participants answered yes to agreeing with the guidelines while being unaware of their existence due to the anonymity of the survey. However, it remains clear that a gap exists between documented research and clinical awareness of the BTF guidelines.

Research recommendations and evidence-based guidelines for care are crucial components for the bedside nurse to understand, as the nurse is the final intermediary between ordered interventions and the patient. According to Neuman’s System model, the point of reconstitution (or return to wellness) cannot occur without the bedside nurses’ general awareness of the BTF guidelines. When caring for the individual patient, nurses need to be aware of the factors and interventions that promote homeostasis and optimal outcomes to be able to make clinical judgments and involve the appropriate people, thus supporting reconstitution. Their understanding of these interventions and variables will affect their judgment and intensive care management by supporting the appropriate interventions to reduce the risk of secondary brain injury.
Current Practice

This study demonstrates that the current use, as well as knowledge, of the BTF guidelines use is limited. While 5.71% of participants responded they were using an order set based on the BTF guidelines, 54.29% of participants responded that their facility uses an order set to care for TBI patients but they were unsure if it was based on the BTF guidelines. However, 40% of participants responded that their current practice did not include any order set specific to TBI patients. These results are congruent with the Faul et al (2007) findings that estimates only one third of US trauma centers adequately adopt these guidelines into practice.

Despite the above-mentioned statistics, the overwhelming majority (97.06%) of survey participant were in favor of using a standardized order set based on the BTF guidelines for future practice. One participant (2.94%) stated they would not use a standardized order set due to the fact that an additional service line (neuro-intensivist) monitors the care of these patients.

The data remained congruent when asked about protocols for TBI management. Slightly less than half of the participants responded that their facility had a protocol, although 25% were unsure about its congruency with the BTF guidelines, and the other 51.43% were unsure if their facility had a protocol for TBI management. While the information on protocols and order sets are not used in the same way, both are resources to guide evidence-based management within the clinical setting.

A substantial gap remains between evidence-based recommendations and application in clinical practice, and not just those for severe TBI management (Glasgow et al., 2005). Other studies have shown that the use of evidence-based order sets increases compliance and improved clinical outcomes for patients with sepsis and elevated venous thromboembolism risk.
Winterbottom et al., 2011; Zeidan, et al., 2013). These findings may represent that a key barrier to consistent guideline use is at the system level.

Workplace culture and facility processes vary from institution to institution. While 60% of participants were unsure of the time duration for evidence-based order set approval within their facility, 31.4% stated their facility took either 6 months or greater than 6 months. While the turnaround time for order-set/protocol approval remains extended, 60% of survey participants stated that their facility ‘mostly’ supported the use of evidence-based order sets and protocols. Facilities commitment to adhere to the BTF guidelines should include a system audit evaluating the translational research process.

Methods to assess the diffusion of TBI order sets should include the need for the innovation, facility dedication, and the amount of change required. The evidence-based order sets should be perceived as a need within the facility and be supported by dedicated leadership to commission the change (Bradley et al., 2004). The amount of change required within the facility determines the speed and effort at which the adoption will take place, thus affecting the success of the intervention (Bero et al., 1998; Fiefer et al., 2006). This process will vary from facility to facility contingent on their current practices, but plays a key role in the reconstitution of the client system as described in Neuman’s System model. Without this facility process in place, the therapeutic evidence-based interventions cannot consistently reach the bedside. An evidence-based order set and/or protocol will assist in reconstitution by regulating the core client system’s physiologic responses in balance with the internal and external stimulus evoked from the injury pattern.
Barriers to Implementation

The barriers associated with the translation of the BTF guidelines for severe TBI are multifactorial. This study demonstrates the lack of awareness and use of the BTF guidelines at the clinical level, which is in congruence with previous studies showing that the BTF guidelines are not reaching the bedside (McNett et al, 2010; Faul et al., 2007). However, based on this study there seem to be additional components affecting this evidence translation. These factors include resistance to change, provider congruency, the process to implement evidence-based data into a facility, and overall education/awareness of the guidelines.

Resistance to Change

One of the most common occurrences in coordination of new system processes is the resistance to change (Grady, 2010). Consistent use and promotion of evidence-based interventions by providers should displace the resistance among nursing staff after appropriate education and discussion. Organizational readiness assessments may aide in understanding components of individual facilities workflow and potential areas for opposition.

Increased education and thus awareness of the BTF guidelines for severe TBI and their benefit, will initiate acceptance among healthcare providers, reducing aversion to the change process necessary for implementation. Successful dissemination of evidence-based recommendations requires acceptance of the interventions by users as desirable and advantageous (Grady, 2010). The resistance to change barriers identified cannot be managed solely, but rather as part of the entire implementation process for dissemination of evidence-based recommendations.
Implementation Process

The implementation process of an evidence-based protocol or order set varies between individual facilities. The feedback provided during the qualitative portion of the survey identified the protocol/order set approval process and physician investment as barriers associated with the implementation process of the BTF guidelines within their facility. While the order set/protocol implementation process varies from facility to facility, 60% of respondents were unable to identify their facilities processing time and 22.8% stated this process took longer than six months to complete. Findings in this study are consistent with previous reports of a prolonged period from evidence development to impact on patient care, in spite of research recommendations (Glasgow et al., 2005). The transition time between submittal of evidence-based protocol/order sets likely contributes to the minimal use of standardized guidelines use among Phoenix area Trauma centers.

Translational research is a process used to apply scientific findings in clinical practice (Grady, 2010; Planas, 2008). A translational research template is an adaptable tool to assist in the establishment of an efficient evidence-based intervention application. The components of a translational research template include: identifying a problem, authenticate evidence, order set/protocol development, implementation, and evaluation. The intention of this process is to systemize the change or intervention so it becomes an established practice within the facility.

Provider Congruency

This study found numerous responses stating physician preference was a barrier to initiating the BTF guidelines. Unfortunately, the lack of physician response to the survey inhibits a true understanding of this perceived barrier. However, this should be examined in
greater detail. The consistency in care provided by following these guidelines would improve patient care and potentially decrease cost. When asked if participants would use an order set based on BTF guidelines, 97% of respondents replied ‘yes.’ However, 22.8% of participants also answered that their facility did not have a current protocol based on the BTF guidelines and 51% replied that they were unaware if their facility had a protocol based on the BTF guidelines. While participants responded that they are willing to use a protocol or evidence-based order set, many are still not within their facility.

Physician and NP/PA investment is imperative to the creation and success of evidence-based order sets. Meleskie and Eby (2009) found that implementation rates were highest when order set usage was regarded as voluntary, as opposed to being required, and providers could augment the order sets at time of use to enhance individualized patient focused care. Thus, reducing conflict about composition and style, while generating the premise that the order sets were convenient and efficient.

With physician/NP/PA order entry on many electronic health records today, TBI order sets are easily uploaded once approved by the governing committees. Trauma centers would benefit from establishing order-sets that include the BTF guidelines and are agreed upon by the Trauma and Neurosurgery teams for easy retrieval and use for patients suffering from severe TBI.

**Education/Awareness**

While team member communication, facility implementation processes, and physician preferences have been identified as inherent barriers to the use of the BTF guidelines, an overwhelming majority of data was collected in supporting awareness/education as a major
barrier to implementation. Of the total participants, 22 (62.86%) replied ‘no’ to being aware of the current BTF guidelines for severe TBI. These findings are consistent with the McNett et al (2010) publication that surveyed bedside nurses' understanding and awareness of the BTF guidelines for severe TBI. The end-user of patient care is the bedside nurse, and with limited or no knowledge of these guidelines, is unable to advocate for the continued or initiated use of the BTF recommendations.

This study as well as the McNett et al (2010) findings both show the vast need for increased education/awareness of evidence-based management in the form of standardized content to assist research penetration to the bedside. The use of a process that includes both education and system change will enhance clinical research adaptation. Translational research requires involvement of someone who is knowledgeable in both science and clinical practice (Wong, 2014). The utilization of a DNP prepared leader within acute care hospital systems provides understanding of both the scientific research process and clinical application. Therefore, the DNP acts as a conduit for establishing reconstitution as the research recommendations reach the clinical bedside, through the translational research process.

**Summary**

The factors contributing to the challenges in providing consistent secondary brain injury prevention in severe TBI are dynamic in nature. It is seen that the challenges to implementing the BTF guidelines at the patient care level are not only factors of education/awareness but also of physician congruency, communication, and facility protocol processes. Currently, there is no set requirement held to facilities with Level 1 trauma designation for their participation in
protocol or order set development utilizing the BTF guidelines for the care of patients suffering from severe TBI.

**Factors to Promote Further Use of the BTF Guidelines**

When surveyed the participants were able to give open-ended feedback on their suggestions for further use and promotion of the BTF guidelines within their facility. The results were consistent with the perceived barriers. The factors identified included increased education/awareness, provider congruency, communication, and protocol/order set process improvement.

**Education/Awareness**

In this study the majority of the responses were related to increasing education and awareness of the guidelines, identifying this as a main theme. It was suggested that education be given on any current protocols that may already be in place at their facility. The main emphasis of responses was geared to the promotion of nursing education. These suggestions for further promotion of the BTF guidelines are congruent with the perceived barrier previously identified within the study survey.

Nursing education and ICU management curriculum should include these recommendations for care. Evidence-based standards are having an increasing impact on nursing practice, with the expectation that nurses are informed on current recommendations in their area of clinical field (McNett et al., 2010). Collaboration between the DNP leader and Trauma/Neurosurgery ICU nursing educators should be utilized to assist in the diffusion of knowledge, simultaneously and throughout the translational research process.
Provider Congruency

Numerous responses stated there is a potential to increase the utilization of the BTF guidelines if providers had regular meetings and formal discussion on the management and practice of this patient population. Rayan et al. (2012) found that patients with head injuries were at the highest risk of receiving substandard care of all severely injured trauma patients. While the BTF guidelines have been well studied, there remains a lack of level-1 evidence among the recommendations, which may play a role in the inconsistent use among providers (Rayan et al., 2012). The lack of level-1 evidence may be primarily due to the ethical implications involved in conducting studies of that rigor. However, the uses of protocols for patients with severe TBI developed from the BTF guidelines were found to have a significant decrease in mortality. One study documented a 27.8% decrease in the control group and an 18.8% decrease in the group where TBI protocols were consistently implemented (Arabi et al., 2010).

The formulation of a DNP led practice improvement team that includes interdisciplinary colleagues who are invested in the care of severe TBI is essential to the integrity of the research translation. Involving key clinical decision makers, end-users and review board specialists will promote investment in not only the order set format and usability, but the implementation process itself.

Communication

Participants also stated that there needed to be additional communication, not only about the BTF guidelines themselves but the supporting evidence that has been documented since their publication. One participant stated “communication of the evidence and the end users finding
value in their use.” Communication will increase overall awareness and support from the bedside nurse in advocating for their implementation, placing pressure on providers and systems to evaluate their process and direction of care.

The feedback loop within the translational research process is a method of analyzing internal and external validity (Grady, 2010). This type of communication allows for discussions regarding strategies to identify efficient practice modifications among complex care systems. Not only does this type of communication create an investment among its stakeholders, but develops a forum for discussion of the evidence and its usefulness within the system.

**Order Set/Protocol Process Improvement**

This study also identified the need for process improvement with evidence-based order set and protocol approval process. Rayan et al. (2012) suggests that protocol-driven care may be a component to increasing compliance of recommended trauma care in Intensive Care units. Education on the protocols and order sets along with the resources to be able to implement and disseminate the knowledge was stated as a way to further promote the use of the BTF guidelines.

Evidence-based order sets for TBI based off of the BTF guidelines aid as a tool for the reconstitution component seen in Neuman’s System model. The development of the order set through the five steps of translational research is an essential element that can be utilized by providers and bedside nurses to achieve optimal homeostasis within all identified client systems. The order set will provide consistent connection between well-documented research recommendations and clinical patient care. The use of a DNP-led translational research initiative in Intensive Care units to promote awareness and knowledge of the BTF guidelines as
well as lead a committee to indoctrinate an evidence-based order set will likely increase the translation of this evidence to the bedside.

**Summary**

The factors identified as potential methods to increasing the utilization of the BTF guidelines were consistent with the barriers identified. They included increasing awareness/education, provider congruency, communication, and order set/protocol process improvement. These factors interact with each other and should be approached in conjunction with each other to enhance the development of BTF guidelines integration into direct patient care.

**Conclusion**

Severe TBI is a devastating societal, financial and personal impairment. In 2007, the BTF compiled an evidence-based blueprint for the management of these injuries. Post publication these management guidelines have been studied by numerous entities testing their efficiency, cost-effectiveness, and neurologic outcomes. While promising results were produced, these guidelines remained distant from the bedside in many US Trauma centers.

The current knowledge of patient management based on the BTF guidelines and their use in practice is greatly unknown within the greater Phoenix area Trauma centers. This factor alone is related to the lack of understanding seen with providers, mainly bedside nurses in the existence of the severe TBI guidelines produced by the BTF.

The main themes of the open-ended responses were inherent to education and awareness for both barriers and promotion of the current evidence available. There were additional factors identified that may also influence translation of evidence to the bedside and ultimately the
patient. Provider congruency, communication, and facility order/protocol implementation are additional challenges in research translation. A better understanding of the barriers to implementation and factors that will facilitate further use of these guidelines is imperative to the translation of these evidence-based guidelines.

**Recommendations**

An action plan of recommendations specific to the findings of this study include:

1. The results of this study will be disseminated to the six level 1 trauma centers in the Phoenix metropolitan area.
2. Resurvey the trauma program managers for interest in evaluation of their individual center for BTF guidelines compliance.
3. Perform a DNP-led translational research process at one facility with re-evaluation of its success.
4. Resurvey the Phoenix metropolitan areas Level 1 trauma centers with results of successful integration of BTF guidelines within one organization to determine any additional interest.

**Discussion of recommendations**

The recommendations of this study are made to enhance patients’ neurologic outcomes and decrease healthcare costs as seen in previous studies by improving adherence to the BTF guidelines. Neuman’s System model is the conceptual framework supporting this study. Prior to this study there was a consistent and well-documented gap in reconstitution (therapeutic interventions to regain homeostasis) between current research recommendations and the care delivered to patients suffering from severe TBI (Faul et al., 2007; Gerber et al., 2013; Rayan et
al., 2012). Internal and external factors influence optimal recovery after suffering a severe TBI. The BTF has organized a document of guidelines that discusses factors to manipulate the physiologic internal and external components to decrease potential risk of secondary brain injury and improve outcomes. However, these recommendations are scarcely reaching the bedside in a consistent manner. Efforts to enhance reconstitution through evidence-based order sets will increase consistent use and compliance among healthcare providers. Thus, achieving reconstitution and improved neurologic outcomes.

To augment the above action plan to disseminate the study results and resurvey the six level 1 trauma centers in the Phoenix area for interest in a translational research process to improve their center’s compliance with the BTF guidelines, additional general recommendations have been made by the author. It is recommended that the ACS require documentation showing proof of protocol or evidence-based order sets during facilities Level-1 audit review. Compliance with this standard, if required by the ACS, will ensure facilities with Level 1 designation have the proper system development to manage this complex patient population. This requirement would in turn force facilities to re-examine their protocol process to establish evidence-based care documents and would simultaneously subject nursing staff to education regarding the protocol/orders as they are initiated.

Neurotrauma is a devastating public health problem and should be at the forefront of every Level 1 trauma centers’ attention. Mandating proof of documentation by the major trauma accrediting bodies may increase compliance with the use of the BTF guidelines for severe traumatic brain injury. This study is a first attempt to understand the barriers associated with inconsistent BTF guidelines use within Level-1 Trauma centers for management of severe TBI.
It is also recommended that a larger national study be conducted focusing on the barriers to assume a more global understanding of the problem.

**Limitations**

This study has some limitations that must be recognized. This study’s sample population is skewed as the majority of participants identified themselves as RNs that take care of patients suffering from a severe traumatic brain injury. However, the workforce has predominately more nurses than providers, which may suggest an expected response rate given the labor pool composition. This survey tool used may be used in additional studies among different samples to assess for dependability and transferability of results obtained from the current study. The study is at risk for sample bias as it is unable to determine the representation from the six different Level 1 trauma centers surveyed to enable anonymity, thus, making it difficult to infer transferability/generalizability of the findings through multiple other facilities.
APPENDIX A

BARRIERS TO IMPLEMENTATION, RAW DATA
### Appendix A. Barriers to Implementation, Raw Data

<table>
<thead>
<tr>
<th>Response #</th>
<th>Resistance to Change</th>
<th>Implementation Process</th>
<th>Provider Congruency</th>
<th>Education/Awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nurses don't like change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>none-we just need one</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>A lot of times, many patients do not fall within the typical guidelines</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Take too long</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Our charting system and physician buy-in</td>
<td>Our charting system and physician buy-in</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lack of consistency from MDs creates lack of interest and buy in from nurses</td>
<td>Lack of consistency from MDs creates lack of interest and buy in from nurses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>nursing/physician</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>Physician personal preference</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>The neurosurgeons: their practice varies by 2 standard deviations</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Resistance to change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>I think getting the protocol instituted and a comfort level with it among the surgeons will be the biggest barrier. Once the</td>
<td>I think getting the protocol instituted and a comfort level with it among the surgeons will be the biggest barrier.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>practitioners and surgeons become more aware of the protocol, I think the use of it will become more typical</td>
<td>Once the practitioners and surgeons become more aware of the protocol, I think the use of it will become more typical</td>
<td></td>
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<tr>
<td>---</td>
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<td></td>
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<tr>
<td><strong>13</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>14</strong></td>
<td></td>
<td></td>
<td>Lack of awareness, change is bad philosophy</td>
<td></td>
</tr>
<tr>
<td><strong>15</strong></td>
<td></td>
<td></td>
<td>I think education is the largest barrier. Teaching about the importance would be the largest advantage</td>
<td></td>
</tr>
<tr>
<td><strong>16</strong></td>
<td>MD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>17</strong></td>
<td></td>
<td>Neurosurgeons are resistant to order sets, believe their midlevel providers will make sure that all issues are addressed.</td>
<td>Neurosurgeons are resistant to order sets, believe their midlevel providers will make sure that all issues are addressed.</td>
<td></td>
</tr>
<tr>
<td><strong>18</strong></td>
<td></td>
<td>lack of education, different doctors have different preferences</td>
<td>lack of education, different doctors have different preferences</td>
<td></td>
</tr>
<tr>
<td><strong>19</strong></td>
<td></td>
<td>The implementation to practice is a possible barrier, getting the committee in order to initiate the project and gather the data to prove the</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Responses were *unsure, ** none really, *** n/a
-Data in this table was taken directly from the survey and is stated verbatim from the participating respondents.
APPENDIX B

FACTORS TO PROMOTE FURTHER USE OF THE BTF GUIDELINES,
RAW DATA RESPONSES
### Appendix B. Factors to Promote Further use of the BTF Guidelines, Raw Data Responses.

<table>
<thead>
<tr>
<th>Response #</th>
<th>Education/Awareness</th>
<th>Provider Congruency</th>
<th>Communication</th>
<th>Protocol/Order Set Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>If it is evidence based and if it worked</td>
<td>If it is evidence based and if it worked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>A standard order set in place</td>
</tr>
<tr>
<td>3</td>
<td>Solid evidence that it works</td>
<td>Solid evidence that it works</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Neurosurgeon input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Regular meetings or any communication with neuro docs and midlevel providers from both the neuro and trauma teams.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Nursing education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>Communicating of the evidence and the end users finding value in their use</td>
<td></td>
</tr>
<tr>
<td>9 *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Education on the guidelines themselves as well as use of the protocol (implementing it into a power plan within the EMR)</td>
<td></td>
<td>Education on the guidelines themselves as well as use of the protocol (implementing it into a power plan within the EMR)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>Just writing one</td>
</tr>
<tr>
<td>13</td>
<td>Education, Education, Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>More</td>
<td>More</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>education/awareness</td>
<td>education/awareness</td>
<td></td>
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<td>---------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Further education and showing of data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Getting MD's (neurosurgeons to agree on the order set)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>By-In from midlevel providers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Further education for the nurses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>The resources and dissemination of information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Education</td>
<td>The resources and dissemination of information</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response was * unsure
Data in this table was taken directly from the survey and is stated verbatim from the participating respondents.
APPENDIX C

BRAIN TRAUMA FOUNDATION GUIDELINES
Appendix C. Brain Trauma Foundation Guidelines

- Blood Pressure and Oxygenation

**Level 1**- insufficient data to support
**Level 2**- blood pressure should be monitored and hypotension avoided (SBP<90)
**Level 3**- oxygenation should be monitored and hypoxia avoided (PaO2<60)

In helicopter transport study, patients with a documented sat <60% had a 50% mortality rate and those who survived were severely disabled.

- Hyperosmolar Therapy

**Level 1**- insufficient data to support
**Level 2**- Mannitol is effective for raised intracranial pressure at doses of 0.25-1gm/kg-body weight. Arterial hypotension should be avoided.
**Level 3**- Restrict mannitol use prior to ICP monitoring to patients with signs of transtentorial herniation or progressive neurological deterioration not attributable to extracranial causes.

- Prophylactic hypothermia

**Level 1**- insufficient data to support
**Level 2**- insufficient data to support
**Level 3**- prophylactic hypothermia is not significantly associated with decrease in mortality when compared to normothermic controls. However, prelim findings suggest a greater decrease in mortality when target temperatures are maintained for more than 48 hours. However, prophylactic hypothermia is associated with higher Glasgow outcome scores (GOS) than normothermic controls.

6 moderate quality RCTs failed to demonstrate that hypothermia had a reduction of all cause mortality, but those treated were more likely to have a higher GOS (4 to 5).

- Infection Prophylaxis

**Level 1**- insufficient data to support
**Level 2**- peri-procedural antibiotics for intubation should be administered to reduce the risk of pneumonia; however, it does not change length of stay or mortality. Early tracheostomy should be done to reduce mechanical ventilation days: however, it does not change mortality or the rate of nosocomial pneumonia.

**Level 3**- EVD exchange or prophylactic antibiotic use is not recommended to reduce infection. Early extubation in qualified patients can be done without increased risk of pneumonia.

- DVT Prophylaxis

**Level 1**- insufficient data to support
**Level 2**- insufficient data to support
**Level 3**- Graduated compression stockings or intermittent compression stockings
should be used unless lower extremities injuries prevent their use. They should be continued until the patient is ambulatory. There is insufficient evidence to support the dose, timing, or agent for pharmacologic prophylaxis.

- Indications for Intracranial Pressure Monitoring

  **Level 1** - insufficient data to support
  **Level 2** - ICP should be monitored in all salvageable patients with a GCS of 3-8 after resuscitation and an abnormal CT scan (hematomas, swelling, contusions, herniation, compressed basal cisterns).
  **Level 3** - ICP monitoring is warranted in severe TBI and a normal CT scan if two of the following are present: age >40, unilateral or bilateral motor posturing, systolic blood pressure <90mmHg.

- Intracranial Pressure Threshold

  **Level 1** - insufficient data to support
  **Level 2** - treatment should be initiated with ICP >20mmHg
  **Level 3** - combination of values from CT, clinical exam, and ICP should determine the need for treatment.

- Cerebral Perfusion Threshold

  **Level 1** - insufficient data to support
  **Level 2** - Aggressive attempts to raise CPP >70 with fluids and pressors should be avoided due to the risk of ARDS.
  **Level 3** - CPP<5mmHg should be avoided. Target CPP values lie within the 50-70 range and patients with intact pressure autoregulation tolerate higher CPP values. Ancillary monitoring of cerebral parameters that include blood flow, oxygenation, or metabolism facilitates CPP management.

- Brain Oxygen Monitoring and Thresholds

  **Level 1** - insufficient data to support
  **Level 2** - insufficient data to support
  **Level 3** - jugular venous saturation (<50%) or brain tissue oxygen tension (<15mmHg) are treatable thresholds. Jugular venous saturation or brain tissue oxygen monitoring measure cerebral oxygenation.

- Anesthetics, Analgesics and Sedatives

  **Level 1** - insufficient data to support
  **Level 2** - prophylactic administration of barbiturates to induce burst suppression EEG is not recommended. However, high dose administration of barbiturates is recommended to control elevated ICP refractory to standard care medical/surgical treatment. Hemodynamic stability is essential before and during barbiturate therapy. Propofol is recommended for ICP control, but shows no improvement in mortality or 6 month outcome. High dose propofol can produce significant morbidity.
Level 3- no data.

• Nutrition

Level 1- insufficient data to support
Level 2- Patients should be fed to support full caloric replacement by day 7 post injury. To achieve full caloric replacement by day 7, nutritional replacement is usually begun no later than 72 hours post injury.
Level 3- no data

• Anti-seizure Prophylaxis

Level 1- insufficient data to support
Level 2- prophylactic use of Dilantin or valproate is not recommended for preventing late posttraumatic seizures. Anticonvulsants are indicated to decrease the incidence of posttraumatic seizure within 7 days of injury. However, early PTS is not associated with worse outcomes.
Level 3- no data

• Hyperventilation

Level 1- insufficient data to support
Level 2- prophylactic hyperventilation (PaCO2 of 25 or less) is not recommended
Level 3- hyperventilation is recommended as a temporizing measure for the reduction of elevated ICP. Hyperventilation should be avoided during the first 24-hour post injury when cerebral blood flow is often critically reduced. If hyperventilation is used brain oxygen monitoring (by jugular venous saturation or brain tissue) is recommended to measure oxygen delivery.

• Steroids

Level 1- The use of steroids is not recommended for improving outcome or reducing ICP. In patients with moderate to severe TBI the use of methylprednisolone is associated with increased mortality and is contraindicated.
APPENDIX D

CHALLENGES TO SECONDARY BRAIN INJURY PREVENTION IN SEVERE TBI SURVEY
Appendix D. Challenges to Secondary Brain Injury Prevention in Severe TBI Survey

Demographic Questions

1. What is your current position?
   a. RN
   b. MD
   c. NP/PA
   d. Administrative

2. How many years of experience?
   a. <6 months
   b. 6 months to 5 years
   c. 6-14 years
   d. 15-25 years
   e. 26+ years

3. Which environment best describes the area in which you work? (Check all that apply)
   a. Emergency Room
   b. Intensive Care Unit
   c. Administrative
   d. Other (comment box)

4. What type of hospital most accurately describes your work setting?
   a. Academic
   b. Community
   c. Private
   d. Other (comment box)

5. Does your facility currently have a protocol for TBI management based on the Brain Trauma Foundation (BTF) guidelines?
   a. Yes
   b. No
   c. Unsure

Survey Questions

1. Are you aware of the BTF guidelines for TBI?
   a. Yes
      i. If yes, how did you learn about them?
         1. School
         2. Online
         3. Journal articles
         4. Conferences
   
   b. No

2. Do you currently use an order set to care for traumatically brain-injured patients?
a. Yes
   i. If Yes, is it based on the BTF guidelines?
      1. Yes
      2. No
      3. Unsure
b. No
c. Unsure

3. Do you agree with the BTF guidelines for the management of TBI?
   a. Yes
   b. No
      i. If no, why not? (comment box)

4. Does the facility at which you work at encourage the use of order set-derived care for standard evidence-based guidelines in other areas?
   a. Always
   b. Mostly
   c. Sometimes
   d. Never
   e. Unsure

5. In your facility, how long does the process take to approve evidence-based order sets? From submittal to implementation.
   a. <1 month
   b. 1-3 months
   c. 6 months
   d. >6 months
   e. Unsure

6. Would you use a standardized order set based on the BTF guidelines for your TBI patients?
   a. Yes
   b. No
      i. If No, why? (Comment Box)

7. Can you identify possible barriers to implementation of a standard order set based on the BTF guidelines for care of your TBI patients?
   a. Comment box

8. What do you feel would promote further use of the BTF guidelines in your facility?
   a. Comment box
APPENDIX E

EMAIL RECRUITMENT/CONSENT
Appendix E. Email Recruitment/Consent

Every year 1.7 million people suffer a traumatic brain injury; Secondary brain injury occurs hours to days after the initial injury and takes place in up to 90% of severe TBIs. Attached you will find a link to a survey that focuses on the challenges to secondary brain injury prevention following TBI.

I am a University of Arizona graduate student and this survey is part of my final research project. This voluntary survey will take less than 5 minutes to complete and provide valuable information for our TBI patients. Please take a moment and share your expertise.

An Institutional Review Board responsible for human subjects research at The University of Arizona reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

Informed Consent for Participation in Online Survey

You are invited to participate in a research study of secondary brain injury prevention in severe traumatic brain injury. We hope to learn the challenges and barriers to secondary brain injury prevention in current practice. You were selected as a potential participant in the study because you either directly care for patients with severe TBI or are involved in the administrative process for policy formation.

Project Title: Challenges to Secondary Brain Injury Prevention in Severe Traumatic Brain Injury  
Principle Investigator: Kristen Keller, MSN, RN, ACNP-BC, CCRN  
Institution: The University of Arizona

Your participation in this study is completely voluntary. This online survey will take approximately 5 minutes of your time. All responses are entirely anonymous and will be de-identified through Survey Monkey at the time of submittal. Your decision not to participate will not have any negative effect on your current position. And if at any time during the survey you may discontinue participation without loss or penalty.

Study findings will be available following project completion and graduation in the year of 2014.

If you chose to participate please follow the link below to begin the survey.

If you have any questions please do not hesitate to contact me at kjchern@email.arizona.edu or by phone 602-361-8990. Thank you.
REFERENCES


http://www.neumansystemsmode.org/NSMdocs/NSM%20overview%20as%20PDF.pdf


Wong, T. (2014). How to bridge the 'valley of death' between a research discovery and clinical application? *Translational Medicine, 43*(8).