INTENSIVE CARE UNIT NURSE JUDGMENTS
ABOUT SECONDARY BRAIN INJURY

A dissertation submitted to the
Kent State University College of Nursing
in partial fulfillment of the requirements
for the degree of Doctor of Philosophy

by
Molly M. McNett

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Dissertation written by

Molly M. McNett

B.S.N., Marquette University, 1998

M.S.N., Kent State University, 2005

Ph.D., Kent State University, 2008

Approved by

______________________________      Margaret Doheny, PhD, RN, CNS, ONC, CNE
Co-Chair, Doctoral Dissertation Committee

______________________________      Carol Sedlak, PhD, RN, CNS, ONC, CNE
Co-Chair, Doctoral Dissertation Committee

Members, Doctoral Dissertation Committee

______________________________       Ruth Ludwick, PhD, RN.C, CNS

______________________________       Phillip Rumrill, PhD

______________________________       Mary Agnes Kendra, PhD, RN

Accepted by

______________________________         Karen Budd, RN, MSN, PhD
Director, Joint Ph.D. in Nursing Program

______________________________         Laura Cox Dzurec, RN, MSN, PhD
Dean, College of Nursing
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ABSTRACT

McNett, Molly M., PhD, RN    May, 2008    NURSING

INTENSIVE CARE UNIT NURSE JUDGMENTS ABOUT SECONDARY BRAIN INJURY

Directors of Dissertation: Margaret Doheny, PhD, RN, CNS, ONC, CNE
Carol Sedlak, PhD, RN, CNS, ONC, CNE

Traumatic brain injury (TBI) affects over 1.4 million Americans every year. Interdisciplinary care focuses on treating the primary brain injury and limiting further brain damage from secondary brain injury. Intensive care unit (ICU) nurses have an integral role in preventing secondary brain injury; however, little is known about how ICU nurses make judgments when managing secondary brain injury. The purpose of this study was to examine how physiological, situational, and nurse variables influenced ICU nurse judgments about patient risk of secondary brain injury and determining appropriate levels of intervention.

This study was guided by social judgment theory and incorporated a multiple segment factorial survey design. Vignettes reflecting the complexity of real life patient scenarios were randomly generated using different values of each independent variable. Anonymous vignette surveys were administered to ICU registered nurses from two Level I trauma centers. Multiple regression was used to examine which variables influenced judgments about secondary brain injury.
Sixty seven nurses completed study surveys. Judgments about risk for secondary brain injury were influenced by oxygen saturation (O2sat), intracranial pressure (ICP), cerebral perfusion pressure (CPP), mechanism of injury, primary diagnosis, and nursing shift. Judgments about level of intervention were influenced by O2sat, CPP, and nursing shift. The initial judgments made by nurses were the most significant variable predicting follow up judgments.

Findings from this study provide information about factors influencing nurse judgments when managing secondary brain injury. This information will serve as the basis for future educational initiatives for nurses, which may improve management of secondary brain injury and improve patient outcomes.
CHAPTER I

INTRODUCTION

The purpose of this study was to examine how physiological, situational (contextual), and nurse variables influence intensive care unit (ICU) nurses’ judgments about secondary brain injury when caring for critically ill traumatic brain injury (TBI) patients. Traumatic brain injury is a complex phenomenon that affects over 1.4 million Americans every year (Centers for Disease Control [CDC], 2004). Traumatic injuries to the brain following motor vehicle accidents, falls, and assaults account for over 37.8 billion healthcare dollars annually (CDC, 1999). Interdisciplinary care for the TBI patient centers on treating the primary brain injury and limiting the occurrence of further damage to surrounding brain tissue from secondary brain injury. Secondary brain injuries occur in 60%-90% of TBI patients (Jeremitsky, Omert, Dunham, Protech, & Rodriguez, 2003; Jones et al., 1994) and have detrimental effects on short and long term patient outcomes (Andrews et al., 2002; Sarrafzadeh et al., 2001). Secondary brain injuries occur as a result of brain tissue ischemia, cerebral edema, and cellular changes at the site of the primary brain injury. The physiologic abnormalities associated with secondary brain injuries include hypotension, hypoxia, hyperthermia, increased intracranial pressure (ICP), and decreased cerebral perfusion pressure (CPP) (Davis, 2000; Doberstein, Hovda, & Becker, 1993).

ICU nurses are pivotal in preventing secondary brain injuries that occur in the hours and weeks following the primary brain injury (Chamberlain, 1998; Hickey, 2003;
March et al., 2004; Nolan, 2005). ICU nurses are responsible for monitoring and managing the physiological parameters of blood pressure (BP), oxygen saturation levels (O2sat), temperature, ICP, and CPP. Several studies provide evidence of the relationship between ICU nursing interventions and fluctuations in these physiological parameters (Crosby & Parsons, 1992; Kerr et al., 1997; March, Mitchell, Grady, & Winn, 1990; Rising, 1993; Rudy, Turner, Baun, Stone & Brucia, 1991). Routine interventions such as repositioning and suctioning can cause increases in ICP and BP, and may lower O2sat and CPP levels (Brucia & Rudy, 1996; Rudy et al., 1991; Williams & Coyne, 1993).

Nurses and other health care professionals vary, however, in their practice when caring for TBI patients. The Brain Trauma Foundation (BTF), in conjunction with the American Association of Neurological Surgeons (AANS), conducted a systematic review of the research literature and established guidelines for the management of TBI patients who have sustained severe head injuries (BTF & AANS, 2000, 2003). These guidelines include recommended ranges for certain physiological values, such as BP, O2sat, ICP, and CPP in order to prevent secondary brain injury. Use of these standardized guidelines results in favorable patient outcomes including lower mortality rates (Elf, Nilsson & Enblad, 2002; Robertson et al., 1999). Despite evidence of the effectiveness of these guidelines, only 16% of trauma centers in the United States had implemented and were in full compliance with the guidelines in 2002 (BTF, 2002). The BTF recommends that additional education is needed for all members of the healthcare team involved with care of the TBI patient (BTF, 2002).

While educational programs for ICU nurses who care for TBI patients are imperative, there are no data documenting what ICU nurses know about secondary brain
injury and the factors that influence how these nurses determine appropriate interventions when caring for the critically ill TBI patient. Key responsibilities of ICU nurses are to continuously monitor and interpret several different physiological values simultaneously and deliver appropriate interventions (Benner, Hooper-Kyriakidis & Stannard, 1999; Hickey, 2003). ICU nurses are the health care professionals best positioned to first detect physiological abnormalities leading to secondary brain injury and institute first line measures. Given the variation in nurses’ practice, baseline information about judgments made by these nurses when managing multiple physiological parameters in the care of TBI patient is needed. Information gained from this study will aid in the development of educational interventions to improve nurses’ care of TBI patients, which in turn, could lead to the reduction of secondary brain injuries.

Purpose

The purpose of this study was to investigate how physiological, situational, and nurse variables influenced ICU nurse judgments about secondary brain injury in the critically ill TBI patient. The study incorporated a quantitative research design using factorial survey methodology to investigate factors that influence judgments made by ICU nurses when managing physiological parameters that lead to secondary brain injuries.

For this study, judgments are defined as “an interpretation or conclusion about a patient’s needs…or health problems” (Tanner, 2006, p. 204). In the nursing research literature, the phrase “decision-making” is often used interchangeably with the phrases of “clinical judgment,” “problem solving,” and “critical thinking” to describe the actions taken by the nurse to embark upon a course of action (Tanner, 2006). However,
Thompson and Dowding (2002) provide a clear differentiation between judgments and decisions: judgments are the assessment of the situation or conclusion about what should be done, while decisions are the actions that take place as a result of the judgment.

Research on ICU nurse decision-making and judgments indicate that ICU nurses make numerous, rapid decisions during the course of a typical shift (Bucknall, 2000). Hypothetico-deductive and intuitive reasoning methods are commonly used by these nurses, particularly when detecting early and subtle changes in a patient’s condition (Corcoran-Perry, Narayan & Cochrane, 1999; Lauri et al., 1998; Minick, 1995; Peden-McAlpine & Clark, 2002; Pyles & Stern, 1983). This ability to recognize and interpret physiological and situational cues exhibited by the patient is especially important when caring for TBI patients, as many subtle changes can indicate an acute deterioration in the patient’s condition (Hickey, 2003; March et al., 2004).

This study specifically examines the influence of physiological and situational (i.e. contextual) variables on judgments made by ICU nurses when caring for critically ill TBI patients. The physiological and situational variables included in this study, along with their definitions and rationale for inclusion, are listed in Tables 1 and 2. Physiological variables include BP, O2sat, temperature, ICP, and CPP. Situational variables are patient primary diagnosis, secondary diagnosis, age, gender, mechanism of injury, nursing shift, and type/time of nursing assessment. Because characteristics of the nurse, such as age (Bakalis, Bowman & Porock, 2003), level of experience (Bakalis et al., 2003; Baumann & Bourbonnais, 1982; Bucknall, 2000; Currey, Browne, & Botti, 2006; Tierney, 1992), and educational preparation (Baumann & Bourbonnais, 1982; Bakalis et al., 2003) have been shown to influence the judgments and decision making capabilities
of ICU nurses, this study will also examine how individual nurse variables (Table 3) influence judgments made when managing secondary brain injury.

Table 1

*Independent Vignette Variables: Physiological Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Conceptual Definition</th>
<th>Operational Definition</th>
<th>Rationale</th>
<th>Levels</th>
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<tbody>
<tr>
<td>Blood Pressure</td>
<td>The pressure of blood within the arteries after the heart contracts (Heoff &amp; Shiel, 2003).</td>
<td>Systolic Blood Pressure (SBP)</td>
<td>Hypotension occurs in 35% of TBI patients and increases mortality 50-150% (Chesnut et al., 1993a).</td>
<td>1=SBP 90-100 2=SBP 80-89 3=SBP 70-79 4=SBP&lt;70</td>
</tr>
<tr>
<td>O2Sat</td>
<td>The amount of oxygen bound to hemoglobin in the blood, expressed as a percentage of the maximum binding capacity (Heoff &amp; Shiel, 2003).</td>
<td>O2sat &lt;80-95%</td>
<td>Episodes of desaturation in TBI patients increase mortality rates and patient outcomes (Chesnut et al., 1993a).</td>
<td>1=O2sat90-95% 2=O2sat85-89% 3=O2sat80-84% 4=O2sat&lt;80%</td>
</tr>
<tr>
<td>Temp</td>
<td>The specific degree of hotness or coldness of the body, measured with a thermometer (Heoff &amp; Shiel, 2003)</td>
<td>T 38.0-39.6 degrees Celsius</td>
<td>Fever occurs in 50-70% of TBI patients and has adverse effects on outcome (Diringer, Reaven, Funk &amp; Uman, 2004; Geffroy et al., 2004; Jiang, Gao, Li, Yu &amp; Zhu, 2002).</td>
<td>1=T 38-38.5 2=T 38.6-39 3=T 39.1-39.5 4=T&gt;39.6</td>
</tr>
<tr>
<td>ICP</td>
<td>The pressure exerted by the cerebral spinal fluid on the brain (Hickey, 2003).</td>
<td>ICP 15-30mmHg</td>
<td>Increased ICP occurs in approximately 50% of TBI patients and has adverse effects on outcome (Bekar et al., 1998; Graham, Lawrence, Adams, Doyle &amp; McLellan, 1987; Juul, Morris, Marshall &amp; Marshall, 2000; Miller et al., 1977; Uzzell, Obrist, Dolinkas &amp; Langfitt, 1986).</td>
<td>1=ICP 15-20 2=ICP 21-25 3=ICP 26-30 4=ICP &gt;30</td>
</tr>
<tr>
<td>CPP</td>
<td>The blood pressure gradient across the brain, measured as the difference between mean arterial pressure and ICP (Hickey, 2003)</td>
<td>CPP&lt;50-65mmHg</td>
<td>Decreased CPP is associated with poor patient outcome and mortality (Changaris et al., 1987; Kirkness, Burr, Cain, Newell &amp; Mitchell, 2005).</td>
<td>1=CPP 60-65 2=CPP 55-59 3=CPP 50-54 4=CPP&lt;50</td>
</tr>
</tbody>
</table>
Table 2

*Independent Vignette Variables: Situational Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Conceptual Definition</th>
<th>Operational Definition</th>
<th>Rationale</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Diagnosis</td>
<td>The primary injury to to the brain</td>
<td>Epidural hematoma (EDH), subdural hematoma (SDH), intracerebral hemorrhage (ICH), diffuse axonal Injury (DAI)</td>
<td>EDH occurs in 2-6% of TBI patients, SDH occurs 30% TBI, ICH is present in 4-15% of TBI, and DAI accounts for 50% of TBI (Hickey, 2003; March et al., 2004; McNair, 1999).</td>
<td>1=EDH 2=SDH 3=ICH 4=DAI</td>
</tr>
<tr>
<td>Secondary Diagnosis</td>
<td>Injuries sustained in addition to the primary injury, or pre-existing co-morbidities.</td>
<td>Extracranial injuries, hypertension (HTN), diabetes, null</td>
<td>Extracranial (EC) injuries occur in 95% of TBI (Gennarelli, Champion Copes &amp; Sacco, 1994). Hypertension and diabetes occur in 28-73% of TBI, and increase mortality (Coronado, Thomas, Sattin, &amp; Johnson, 2005; Mosenthal, et al., 2004; Pasquale, Cipolle, Masiado &amp; Wasser, 2005; Scheetz, 2005)</td>
<td>1=EC 2=HTN 3=Diabetes 4=Null</td>
</tr>
<tr>
<td>Patient Age</td>
<td>The number of years the patient has been alive.</td>
<td>Age increments of 25, 35, 45, 55, 65, 75, 85</td>
<td>Most TBI patients are between 15-34 years; age is a strong predictor of outcome in TBI patients (Langlois, Rutland-Brown &amp; Thomas, 2006; Choi, Narayan, Anderson &amp; Ward, 1988; Choi, Ward &amp; Becker, 1983; Lokkeberg &amp; Grimes, 1984; Narayan et al., 1981).</td>
<td>1=25 2=35 3=45 4=55 5=65 6=75 7=85</td>
</tr>
<tr>
<td>Patient Gender</td>
<td>The sex of the patient.</td>
<td>Male (M), Female (F)</td>
<td>Males are 1.5 times more likely to sustain a TBI (Langlois et al., 2006).</td>
<td>1=M 2=F</td>
</tr>
<tr>
<td>Mechanism of Injury</td>
<td>The cause of the primary brain injury.</td>
<td>Fall, MVA, Struck by object, Assault</td>
<td>Falls, MVAs, being struck, and assaults are leading causes of TBI. MVAs responsible for highest number of hospitalized TBI (Langlois et al., 2006).</td>
<td>1=Fall 2=MVA 3=Struck 4=Assault</td>
</tr>
</tbody>
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Table 2, cont.

*Independent Variables: Situational Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Conceptual Definition</th>
<th>Operational Definition</th>
<th>Rationale</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing Shift</td>
<td>The 8 or 12 hour period of time nurses are assigned to work in their respective units.</td>
<td>Days, Evenings, Nights</td>
<td>The types of decisions made by nurses varies by nursing shift (Bucknall, 2000).</td>
<td>1=Days</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>2=Evenings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3=Nights</td>
</tr>
<tr>
<td>Type/ Time of Assessment*</td>
<td>The physical assessment nurses must perform at certain time intervals during a typical shift.</td>
<td>Follow up assessment (done 15 minutes later); Routine shift reassessment (done 4 hours after start of shift).</td>
<td>Re-assessment of changes in patient status must occur at least every 15 minutes. Routine reassessment of stable ICU patients occurs at least every 4 hours (Benner et al., 1999; Hickey, 2003.).</td>
<td>1=Follow up assessment 15 minutes later</td>
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<td>2=Routine shift reassessment 4 hours later</td>
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*Will only be used in follow up vignettes*
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<th>Variable</th>
<th>Conceptual Definition</th>
<th>Operational Definition</th>
<th>Rationale</th>
</tr>
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<tbody>
<tr>
<td><strong>Age</strong></td>
<td>The chronological number of years the nurse has been alive.</td>
<td>20-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, &gt;60 yrs</td>
<td>Age influences nurse judgments (Tanner, 2006).</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>The anatomical sex of the nurse.</td>
<td>Male, Female</td>
<td>Provides data about sample.</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td>The racial, national, or cultural group within which the nurse identifies or affiliates himself/herself.</td>
<td>Caucasian, African American, Asian, Hispanic, Other</td>
<td>Provides data about sample.</td>
</tr>
<tr>
<td><strong>Years as RN</strong></td>
<td>The number of years the nurse has possessed an active and valid license from a state board of nursing to practice as a registered nurse.</td>
<td>0-5 yrs, 6-10 yrs, 11-15 yrs, 16-20 yrs, greater than 21 yrs</td>
<td>Experience influences ICU nurse judgments (Bakalis, Bowman, &amp; Porock, 2003; Currey, Browne &amp; Botti, 2006).</td>
</tr>
<tr>
<td><strong>Years in current ICU</strong></td>
<td>The number of years the nurse has been listed as a registered nurse employee in the ICU in which they are presently employed.</td>
<td>0-5 yrs, 6-10 yrs, 11-15 yrs, 16-20 yrs, greater than 21 yrs</td>
<td>Experience influences ICU nurse judgments (Bakalis, Bowman, &amp; Porock, 2003; Currey, Browne &amp; Botti, 2006).</td>
</tr>
<tr>
<td><strong>Years with TBI Patients</strong></td>
<td>The number of years the nurse has been responsible for caring for TBI patients.</td>
<td>0-5 yrs, 6-10 yrs, 11-15 yrs, 16-20 yrs, Greater than 21 yrs</td>
<td>Experience influences ICU nurse judgments (Bakalis, Bowman, &amp; Porock, 2003; Currey, Browne &amp; Botti, 2006).</td>
</tr>
<tr>
<td><strong>Highest Degree</strong></td>
<td>The terminal degree the nurse possesses from an accredited college or school of nursing.</td>
<td>Associates degree, Nursing diploma, BSN, MSN, PhD</td>
<td>Education affects ICU judgments (Bakalis et al., 2003).</td>
</tr>
<tr>
<td><strong>Shift</strong></td>
<td>The time of day the nurse most often works within the current ICU.</td>
<td>Days, evenings, nights, day/evening, day/night</td>
<td>Shift influences judgments (Bucknall, 2003).</td>
</tr>
</tbody>
</table>
Research Questions and Hypotheses

The purpose of this study was to investigate how physiological, situational, and nurse variables influenced ICU nurse judgments about secondary brain injury when caring for the critically ill TBI patient. Specifically, the following research questions and hypotheses were addressed:

1) How do physiological and situational variables influence ICU nurse judgments about secondary brain injury when caring for the critically ill TBI patient?

**Hypothesis 1A (H1A):** More severe physiological variables (i.e. level 3 or 4 values, or values farthest from normal ranges), and situational variables of primary diagnosis, (intracerebral hemorrhage (ICH) or diffuse axonal injury (DAI)), secondary diagnosis (extracranial injuries, hypertension, diabetes mellitus (DM)), and increasing patient age will increase nurse judgments about patient risk for secondary brain injury.

Rationale for physiological variables in H1A: A key responsibility of ICU nurses is to manage fluctuations of physiological values in critically ill patients (Benner et al., 1999). Therefore these nurses possess knowledge and experience pertaining to the correlation between severe fluctuations in physiological parameters and poor patient outcomes, including brain damage. However, because ICU nurses are not routinely educated about the influence of minor fluctuations (i.e. level 1 or level 2 values—see Table 1) of physiological parameters on secondary brain injury in TBI patients, it is expected that these nurses will not associate minor physiological fluctuations with risk of secondary brain injury.
Rationale for situational variables in H1A: ICU nurses responsible for care of the critically ill TBI patient have cared for patients with a number of different types of primary and secondary diagnosis that accompany TBI and therefore have witnessed the association between certain diagnoses and poor patient outcomes including additional brain injury. Similarly, these nurses have experienced the increased incidence of poor outcomes associated with the older TBI patient (Langlois et al., 2006), and therefore may associate increased age with risk for additional injury.

Hypothesis 1B (H1B): More severe physiological variables (level 3 or 4 values, or values farthest from normal ranges), and the situational variable of shift (day shift) will decrease nurse judgments to manage a situation solely with nursing interventions.

Hypothesis 1C (H1C): More severe physiological variables (level 3 or 4 values, or values farthest from normal ranges), and the situational variable of shift (day shift) will increase nurse judgments to manage a situation by consulting another member of the healthcare team.

Rationale for physiological variables in H1B & H1C: A key skill of ICU nurses is to simultaneously monitor, evaluate, and provide instantaneous interventions to stabilize physiological parameters in patients and avert a crisis situation (Benner et al., 1999). Thus, ICU nurses are experienced and comfortable managing minor fluctuations (i.e. level 1 or level 2 values-see Table 1) in physiological parameters, and would be likely to use nursing interventions initially to manage the situation. As fluctuations in physiological parameters become more severe
(i.e. move to level 3 or level 4 values that are farther outside normal ranges), the ICU nurse will recognize that the situation is becoming more unstable and transforming into a crisis situation. At this point, nurses would be more likely to determine that management solely with nursing interventions is inappropriate, and consultation with other members of the healthcare team is necessary to manage the situation.

Rationale for situational variables in H1B & H1C: The resources and personnel available for ICU nurses vary by nursing shift, which influences the types of decisions and judgments that these nurses are required to make (Bucknall, 2000). ICU nurses working the day shift are more likely to uphold or maintain decisions that have already been made by other members of the healthcare team (Bucknall, 2000). In addition, there are often several members of the healthcare team readily available during the day shift. Thus, nurses working the day shift would be less likely to manage a situation solely with nursing interventions, and more likely to consult other healthcare team members when making a judgment about the patient situation presented in the vignettes. In contrast, ICU nurses working evening or night shifts are more involved with re-evaluating existing decisions and making new decisions independently based on changes in patient status (Bucknall, 2000). Further, there is less support staff and healthcare team members present during these shifts. Thus, nurses working evening or night shifts would be more likely to manage the patient situations in the vignette solely with nursing interventions, and less likely to consult another member of the healthcare team to manage a situation.
2) How do nurse variables influence ICU nurse judgments about secondary brain injury when caring for the critically ill TBI patient?

**Hypothesis 2A (H2A):** Nurses with higher levels of experience (i.e. total years in ICU, years in current ICU, and years with TBI patient) will have increased judgments scores about patient risk for secondary brain injury.

Rationale for H2A: ICU nurses who have significant experience working either in critical care, their current intensive care units, and/or in caring for TBI patients have been responsible for managing the neurological and physiological status of patients who have sustained head injuries. These nurses have witnessed or been involved with fluctuations in physiological parameters that have resulted in poor patient outcomes. Because a key method used by ICU nurses when making judgments and decisions is reflection on their past experiences (Ashcraft, 2001; Currey et al., 2006; Peden-McAlpine & Clark, 2002; Pyles & Stern, 1983), these nurses are likely to reflect on these experiences when evaluating the vignettes and determine when a patient is at increased risk for poor outcomes, including additional brain injury.

**Hypothesis 2B (H2B):** Nurses with higher experience levels (i.e. total years in ICU, years in current ICU, years with TBI patient) and who work night shift will have increased judgments scores to manage a situation solely with nursing interventions.

**Hypothesis 2C (H2C):** Nurses with higher experience levels (i.e. total years in ICU, years in current ICU, years with TBI patient) and who work day shift will
have increased judgments to manage a situation by consulting another member of the healthcare team.

Rationale for H2B and H2C: Research on nurse judgments and decision-making suggests that the number of years a nurse works in the ICU and/or the same unit influences how the individual evaluates a patient situation (Bakalis et al., 2003; Baumann & Bourbonnais, 1982; Bucknall, 2000; Currey et al., 2006). Benner et al. (1999) support this assertion and argue that attainment of “clinical wisdom” among ICU nurses is achieved in part through intuitive methods that are accumulated through repeated and cumulative experience caring for particular patient populations. Thus, ICU nurses who have several years of experience caring for either critically ill patients and/or TBI patients may possess a greater sense of knowledge and autonomy when making judgments about appropriate levels of interventions (i.e. management solely with nursing interventions vs. consulting) for patients. Nursing shift is also likely to influence judgments about appropriate level of intervention due to the fact that the types of decisions and judgments required by ICU nurses vary by nursing shift (Bucknall, 2000).

The definitions and rationale for the physiological and situational variables in this study are listed in Tables 1 and 2. Data for this study were collected through administration of an anonymous survey administered to a convenience sample of ICU registered nurses from two Level I Trauma Centers in Northeast Ohio. The survey was composed of three sections. Section A gathered data on the last TBI patient each nurse cared for in their ICU. This aided in establishing content validity of the study vignettes, a process that is described in detail in Chapter 3. Section B of the study survey was
composed of a series of randomly generated unique two segment vignettes that each nurse was asked to read and indicate judgments they would be most likely to make about the situation presented in the vignette. An example template of the two segment vignette is provided below:

**Template of Initial Vignette (Segment 1):**

You are performing your initial assessment when caring for a ______ (age) _______ (gender) patient in your SICU on the _____ (shift). The patient has sustained a _______ (primary diagnosis) from _______ (mechanism of injury) and also has _______ (secondary diagnosis). In performing your assessment, you record the following values:

- _______ (BP)
- _______ (O2 sat)
- _______ (Temperature)
- _______ (ICP)
- _______ (CPP)

**Template of Follow up Vignette (Segment 2):**

You are now performing your _____________ (type of assessment) on this same patient. You now record the following values:

- _______ (BP)
- _______ (O2 sat)
- _______ (Temperature)
- _______ (ICP)
- _______ (CPP)

Consistent with the factorial survey approach, different values of physiological and situational variables in Tables 1 and 2 were randomly inserted into the vignette template. ICU nurses were asked to evaluate information presented in each vignette and indicate their judgments about (1) patient risk for secondary brain injury, (2) likelihood of managing the situation in the vignette solely with nursing interventions, and (3) likelihood they would consult other members of the healthcare team to assist in managing the situation. These three judgments are the dependent variables of the study and are displayed in Table 4. The methodology of the factorial survey design is described in
further detail in Chapter 3. The final section of the study survey (Section C) was a series of demographic questions to gather data about individual nurse characteristics (Table 3) that may influence judgments.

Table 4

**Dependent Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Conceptual Definition</th>
<th>Operational Definition</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk for secondary brain injury</td>
<td>The likelihood that additional damage to brain tissue will occur.</td>
<td>The level of risk (or likelihood) of a patient experiencing additional brain damage on a 10-point likert scale ranging from 0 -10.</td>
<td>Untreated fluctuations in physiological parameters will result in additional damage to brain tissue (McNair, 1999).</td>
</tr>
<tr>
<td>Management solely with nursing interventions</td>
<td>The patient situation can be managed solely with nursing interventions</td>
<td>The degree to which (or likelihood) that only nursing interventions would be performed, rated on a 10 Point likert scale ranging From 0-10.</td>
<td>Nursing interventions alone can influence physiological parameters associated with secondary brain injury (Crosby &amp; Parsons, 1992; Kerr et al., 1997; March et al., 1990; Rising, 1993; Rudy et al., 1991).</td>
</tr>
<tr>
<td>Consultation with other members of healthcare team</td>
<td>The patient situation is best managed by communicating, or consulting with other members of the healthcare team.</td>
<td>The degree to which (or likelihood) that other members of the healthcare team would be consulted to assist in managing the patient situation, rated on a 10 point likert scale</td>
<td>Severe fluctuations in fluctuations in parameters require interventions outside the scope of practice for registered nurses (BTF&amp;AANS, 2000, 2003)</td>
</tr>
</tbody>
</table>

**Theoretical Framework**

This study is guided by social judgment theory, which was first proposed by Brunswik (1952) and later described and applied to the study of human judgment by Hammond, Stewart, Brehmer and Steinmann (1975). Social Judgment Theory is grounded in the assumption that all judgments occur as a result of the interactions between two distinct sub-systems: the environment or ecology of the situation, and the
individual who is making the judgment (Cooksey, 1996). The principle of parallel
corcepts, which guides this theory, asserts that these two subsystems can and should be
described using the same constructs (Cooksey, 1996). These constructs are the ecology or
the situation that is present in the environment, the cues that are present as a result of the
situation, and the judgment that is made by the individual.

Within social judgment theory, the ecology, or the situation that exists within the
environment, elicits a particular set of cues. The cues then serve as a lens through which
the individual views the current situation. The individual observes these cues and assigns
weights to each cue, which determines how heavily each cue influences the judgment
made by the individual. Through this assessment, the individual arrives at a judgment
about the situation (Cooksey, 1996). This lens model of social judgment theory is
presented in Figure 1. The left side of the model represents the ecological subsystem,
while the right side of the model represents the subsystem of the individual. The
constructs of the model, along with the variables that will be used in this study to
measure each construct are also depicted in Figure 1. Each construct of the model is
discussed in greater detail in the following sections.
EcoLOGY
Independent Situational Variables

- Primary diagnosis
- Secondary diagnosis
- Age
- Gender
- Mechanism of injury
- Nursing shift
- Type/time of assessment

CUES
Independent Physiological Variables

- BP
- O2sat
- Temperature
- ICP
- CPP

Judgments
Dependent Variables

Judgment 1: Patient is at risk for additional brain injury
Judgment 2: Situation will be managed solely with nursing interventions
Judgment 3: Situation will be managed by consulting another member of healthcare team

Ecology

The ecology component of the lens model of social judgment theory represents specific ecological circumstances that are present within the environment (Cooksey, 1996). In healthcare research using social judgment theory, patient status frequently represents the ecological component of the lens model (Brown, Brown, Edwards & Nutz, 1992; Brown, Brown, Sanders, Castelaz & Papasouliotis, 1997; Holmes et al., 1989; Thompson, Foster, Cole, & Dowding, 2005). Characteristics of the patient and of the care
environment comprise the ecological aspect of the model in this study. These variables are classified as independent situational variables in this study and are listed in Figure 1. These variables, either in isolation or combination with one another, emit the cues that are then interpreted by the individual.

Cues

According to social judgment theory, the components of any ecology emit cues that are then interpreted by the individual (Cooksey, 1996). Because patient status is the key component of the ecology under investigation in the current study, the cues that are emitted from this ecology are the signs and symptoms that the patient is displaying. These physiological variables are the cues or lens through which the ICU nurse views the ecology of the situation and subsequently makes judgments about his/her course of action. The cues that are used in the current study are labeled as independent physiological variables (Figure 1) and include blood pressure (BP), oxygen saturation (O2sat), temperature, ICP, and CPP. These variables are the physiological responses that lead to secondary brain injury, and occur frequently in TBI patients (Doberstein, Hovda & Becker, 1993).

Judgments

The right side of the lens model presented in Figure 1 represents the subsystem of the individual (Cooksey, 1996). Within this subsystem, the individual who is making the judgment observes and interprets the cues that are presented. During this process, the individual may perceive certain cues as being more influential on the judgment that is under consideration. The different weights that are assigned by the individual to these presenting cues impacts how the ecology is viewed, or how the individual perceives what
is occurring. This is then the basis for the resulting judgment that is made by the individual (Cooksey, 1996). In the current study, there were three key judgments that ICU nurses were asked to make when presented with vignettes about TBI patients experiencing secondary injury: a) judge the likelihood of risk for secondary brain injury; b) likelihood of managing the patient solely with nursing interventions; and c) likelihood of consulting other members of the healthcare team to assist in managing the patient situation. These three judgments are displayed in Figure 1, and were the dependent variables of the study. The individual characteristics of the nurse (i.e. age, gender, ethnicity, years as a registered nurse (RN), total years worked in the ICU, number of years in their current ICU, number of years caring for TBI patients, highest educational nursing degree, and primary shift assignment) were variables that could influence the subsystem of the individual and thus are depicted on the right side of the lens model in Figure 1.

Significance of Study

This study was significant for its contribution to nursing knowledge and education, and for its methodological approach in investigating nurse judgments. ICU nurses are responsible for the continuous monitoring and interpretation of physiological values that can result in development of secondary brain injuries. However, no research studies have investigated what nurses know about secondary brain injury, or what factors influence nurses’ judgments about the likelihood of risk for experiencing secondary brain injury. Further, no studies provide evidence of how ICU nurses determine if a patient’s current status can be managed solely by nursing interventions or if consultation with other healthcare team members is necessary. Errors in judgment in either direction can
have deleterious impact not only on the patient, but on the health care organization because of excessive use of costly resources. An investigation into factors that influence these judgments will contribute to knowledge of current nursing judgment with critically ill TBI patients.

This study was also significant for its contribution to nursing education. Currently ICU nurses caring for TBI patients are not required or routinely provided with education about the importance of preventing secondary brain injuries. Nor is there baseline information on how nurses interpret physiological parameters and anticipate outcomes. Further, there is no evidence that ICU nurses are knowledgeable about or incorporate the Guidelines for Management of Severe TBI (BTF, 1996; BTF & AANS, 2000, 2003) into their practice. To begin to develop a systematic means for ensuring that all nurses are educated about preventing secondary brain injury, it is necessary to first establish baseline information about how nurses currently manage critically ill TBI patients. Findings from this study can be used to identify factors that influence judgments made by ICU nurses when monitoring and interpreting physiological variables that lead to secondary brain injury. Information about these factors can be used to further educate experienced ICU nurses and in teaching new nurses how to interpret and act in response to subtle physiological changes exhibited by the critically ill TBI patient.

Finally, this study was significant for its methodological approach. Few studies in nursing research have used a factorial survey design to examine judgments, and no studies have used a multiple segment factorial design to investigate nurse judgments. The factorial survey approach facilitates the creation of vignettes that reflect the complex situations that occur in actual clinical contexts (Ludwick & Zeller, 2001). By randomly
generating these vignettes using a number of different independent variables, it is possible to individually examine factors that are often highly intercorrelated. The use of multiple segment factorial survey allows for investigation as to how changes in a patient situation influence subsequent judgments. The factorial survey approach combines the benefits of randomization in a quantitative design with the advantages of social survey methodology (Ludwick et al., 2004). Combining vignettes with social judgment theory is a valid educational approach in moving toward more consistent judgments in nursing practice (Thompson & Dowding, 2002).

In summary, this study sought to examine ICU nurses’ judgments about secondary brain injury in critically ill TBI patients. Specifically, this study investigated how physiological, situational, and nurse variables influenced judgments that ICU nurses make about risk of secondary brain injury and subsequent level of intervention. Information from this study will be used to provide evidence of the role of the ICU nurse in preventing secondary brain injury. Findings from this study serve as a basis for a) designing future targeted educational initiatives for nurses about secondary brain injury in the TBI patient, and b) determining the effectiveness of these educational programs in reducing prevalence of secondary brain injury in critically ill TBI patient.
CHAPTER II
REVIEW OF LITERATURE

In this chapter, a review of the research literature specific to the study variables is presented. This review includes the following components: (1) a general overview of the physiological mechanisms of TBI and secondary brain injury; (2) a review of research on the physiological variables used in this study and nursing interventions that influence these variables; (3) the significance of the situational variables included in this study; (4) a review of the research findings on nurse characteristics and ICU nurse judgments.

Physiological Mechanisms of TBI and Secondary Brain Injury

Traumatic brain injuries are defined as a blow or penetrating injury to the head that disrupt normal brain function (CDC, 2007). TBIs are the result of falls (28%), motor vehicle accidents (MVAs) (20%), being struck by or against a moving or stationary object (19%), and assaults (11%) (Langlois et al., 2006). Damage to brain tissue in TBI is due to primary and secondary brain injuries. Primary brain injuries occur at the time of impact and are classified as focal (i.e. cerebral contusions, lacerations, and hemorrhages) or diffuse (i.e. concussions and diffuse axonal injuries) (Hickey, 2003). Secondary brain injuries occur as a result of the pathophysiological processes that happen in response to the primary injury. These secondary injuries usually develop in the hours and days after the primary injury (Chamberlain, 1998).

Primary injury to the brain damages brain tissue and disrupts the processes that normally ensure adequate cerebral oxygenation and nutrition (McNair, 1999). This
Disruption results in fluctuations of physiological parameters, which, if left untreated, cause additional damage to brain tissue, or secondary brain injury. These specific pathophysiological disruptions include cellular changes, brain tissue ischemia, and cerebral edema (Davis, 2000; McNair, 1999).

**Cellular Changes**

In response to the primary injury, brain cells are damaged, resulting in decreased intracellular pH, acidosis, and failure of the sodium-potassium pump (Davis, 2000; McNair, 1999). These changes facilitate water and sodium movement into the cell, resulting in cellular edema. A disruption in cellular calcium regulation also occurs, which upsets cellular metabolism, and causes production of free radicals, inflicting further damage to the cell membrane. These cellular changes can lead to hemodynamic changes, cerebral edema, and increased ICP (McNair, 1999).

**Brain Tissue Ischemia**

The primary injury to the brain causes microscopic damage to brain tissue (McNair, 1999). This damage upsets the mechanisms that normally regulate cerebral perfusion: autoregulation and the blood brain barrier. A disruption of autoregulatory mechanisms causes cerebral blood flow to become dependent on systemic blood pressure and extremely sensitive to changes in systemic oxygen and carbon dioxide levels. Disruption of the blood brain barrier results in excess water entering brain cells, causing edema (McNair, 1999). Both of these processes, if left untreated, can result in significant ischemia and further damage to brain tissue.
Cerebral Edema

Cerebral edema is common after TBI, and can be localized at the site of the primary brain injury or diffuse in nature (Davis, 2000; McNair, 1999). The cellular and ischemic changes described above can further exacerbate cerebral edema. As brain tissue begins to swell, mass effect occurs, resulting in compression and damage to other areas of the brain that might not have been damaged from the primary injury (McNair, 1999). An increase in ICP usually results and if left untreated, causes fluctuations in other physiological parameters, such as blood pressure and cerebral perfusion pressure. If these physiological parameters are not controlled, cerebral edema and additional brain damage continues to occur.

The above cascade of events cause initial fluctuations in physiological parameters, such as blood pressure, ICP, and CPP. If these fluctuations are not controlled, brain tissue is not adequately perfused and additional brain damage occurs. Because the brain is extremely susceptible to these fluctuations and is at increased risk of ischemia, ensuring adequate oxygenation is crucial. Lastly, increases in body temperature increase cerebral metabolic rate, which further exacerbates the above pathophysiological processes. Thus, it is imperative that ICU nurses meticulously manage BP, O2sat, temperature, ICP, and CPP levels in the critically ill TBI patient to minimize the occurrence of the above processes and prevent secondary brain damage.

Physiological Variables

Fluctuations in physiological values that occur in the processes described above lead to secondary brain injury. A key responsibility of ICU nurses is to monitor these physiological values and perform interventions to keep values within recommended
ranges (American Heart Association (AHA), 2005; Bader & Palmer, 2000; Chamberlain, 1998). The specific physiological variables included in this study are: BP, O2sat, temperature, ICP, and CPP. Research findings about the incidence and influence of each of these variables on outcome in the TBI patient are presented in this section. A summary of the research findings investigating how nursing interventions influence these physiological variables concludes this section.

Blood Pressure

Blood pressure is defined as the pressure of blood within the arteries (Heoff & Shiel, 2003). Hypotension (defined as systolic blood pressure less than 90 mmHg) (BTF & AANS, 2000) occurs in approximately 35% of TBI patients and increases mortality rates 50%-150% (Chesnut et al., 1993a). Episodes of hypotension in the TBI patient result in decreased CPP, which is calculated by subtracting ICP from mean arterial pressure (MAP) (Doberstein et al., 1993). Hypotension can be especially harmful in the TBI patient due to impaired cerebral autoregulation (Davis, 2000).

Hypotension in TBI patients is associated with higher mortality rates and even brain death (Chesnut et al., 1993a; Chesnut et al., 1993b; Sanchez-Olmedo et al., 2004). Early hypotension during the immediate post injury and resuscitation phase occurred in 34.6% of patients in the national traumatic coma data bank (n=717) and caused the mortality rate to double to 55% (Chesnut et al., 1993b). Late hypotension occurred in 32% of patients once they were admitted to the ICU. Of this number, 24% experienced only a single episode of hypotension, which resulted in 66% either dying or remaining in a persistent vegetative state, compared to 17% who had this outcome but never suffered a hypotensive episode (Chesnut, et al., 1993b). Similar smaller studies support the
association between hypotension and increased mortality among TBI patients (Fearnside, Cook, McDougall & McNeil, 1993; Hill, Abraham & West, 1993; Marmarou et al., 1991; Reed & Welsh, 2002), providing additional evidence that hypotension is a potentially avoidable physiological variation that can improve outcomes in critically ill TBI patients.

**Oxygen Saturation**

Oxygen saturation (O2sat) is defined as the amount of oxygen bound to hemoglobin in the blood, and is expressed as a percentage of the maximum binding capacity (Heoff & Shiel, 2003). Hypoxia (defined as O2sat below 90%) has been shown to be as detrimental as hypotension in TBI patients (Bardt et al., 1998; Chesnut, et al., 1993b; Robertson, 1993). An analysis of data on 717 patients from the national traumatic coma databank indicates that hypoxia (paO2<60mmHg) was independently associated with significant increases in morbidity and mortality when it occurred as a secondary injury in TBI patients (Chesnut et al., 1993b). Similarly, episodes of desaturation, as measured by jugular venous oxygen levels (Sjvo2 levels <50% for 10 minutes and confirmed with blood SaO2 levels), were associated with increased mortality and a higher incidence of poor outcome (Robertson, 1993). The mortality rate among TBI patients with several episodes of desaturation was 71%, and 88% of these patients with multiple desaturations had poor outcomes (severe disability, persistent vegetative state, or death) (Robertson, 1993). Even single episodes of desaturation resulted in a 46% mortality rate and 77% of those patients had poor outcome, as compared to patients with no desaturation episodes whose mortality rate was 18% and incidence of poor outcome was 54% (Robertson, 1993). Thus, even a single incident of desaturation has important implications for patient outcome.
A separate study by Bardt et al. (1998) investigated the effects of cerebral hypoxia on patient outcome by obtaining measurements of brain tissue oxygenation. Over half of the patients (56%) who experienced at least 300 minutes of cerebral hypoxia died, and 22% had an unfavorable outcome (defined as persistent vegetative state or severe disability) (Bardt et al., 1998). Further, cerebral hypoxia was associated with increased ICP, decreased CPP, and hypocarbia in this study sample of TBI patients.

**Temperature**

Temperature is defined as the degree of hotness or coldness of the body, expressed in degrees (Heoff & Shiel, 2003). Hyperthermia (defined as body temperature greater than 38.5 degrees Celsius) is detrimental to TBI patients (Deitrich, 1992; Diringer et al., 2004). Fever in this patient population occurs due to infection or damage to the hypothalamus (March et al., 2004; Thompson, Pinto-Martin & Bullock, 2003). Increases in body temperature result in increased metabolic rate; for every 1 degree Celsius rise in body temperature, there is a 5%-10% increase in metabolic rate, resulting in increased cerebral blood flow, carbon dioxide production, oxygen consumption, and ICP (Hickey, 2003; March et al., 2004). Febrile episodes (defined as temperature greater than 38.5 degrees Celsius) occur in 50%-70% of head-injured patients and have adverse effects on mortality, disability, and ICU and hospital length of stay (Diringer et al., 2004; Geffroy et al., 2004; Jiang et al., 2002).

Diringer et al. (2004) examined data that had been prospectively collected on a sample of 4295 patients admitted to a neurological/neurosurgical intensive care unit (NICU). They examined if increases in body temperature remained an important predictor of length of stay, mortality, and discharge disposition after controlling for
patient age, injury severity, and other complications. Increased body temperature, defined as low (37.5-38.4), moderate (38.5-39.0), and high (>39.0), was recorded and entered into a computer database every 1-2 hours. Hierarchal multiple regression analysis revealed that increased body temperature was associated with a dose dependent increase in ICU and hospital length of stay, increased mortality, and poor discharge disposition. An increase in body temperature was associated with an additional 3.2 days spent in the ICU and 4.3 days spent in the hospital. While the number of complications was shown to be the best predictor of ICU length of stay, increased body temperature was shown to be the second best predictor of length of stay. Although the study sample included critically ill patients with a variety of neurological and neurosurgical diagnoses (i.e. aneurysm repair, brain tumor, intracerebral hemorrhage, ischemic stroke, seizures, traumatic brain injury), those patients with intracerebral hemorrhage, ischemic stroke, and traumatic brain injury had the highest percentage of increases in body temperature. Thus, it is evident that increased body temperature is prevalent in critically ill TBI patients and has detrimental effects on patient outcome.

Intracranial Pressure

Intracranial pressure is defined as the pressure the cerebral spinal fluid exerts on the brain, measured in mmHg (Hickey, 2003). Elevated ICP (defined as ICP>20mmHg) in the acute stages of injury in the TBI patient have been linked to increased mortality rates (Graham et al., 1987; Juul et al., 2000; Marmarou et al., 1991; Miller et al., 1977), Glasgow Outcome Scale (GOS) scores (Juul et al., 2000), and patient performance on neuropsychological tests (Uzzell et al., 1986). Increased ICP (ICP >20mmHg) occurs in almost half of patients who sustain severe head injuries (Bekar, et al., 1998; Graham et
al., 1987; Miller et al., 1977), regardless of the type of primary injury. Severe ICP has been shown to be the primary cause of death in half of patients who die as a result of the head injury, and has been associated with increased morbidity rates (Graham et al., 1987; Miller et al., 1977). ICP levels greater than 20mmHg were shown to be the strongest predictor of neurological deterioration in a sample of 427 TBI patients (Juul et al., 2000). The mortality rate among these patients with an elevated ICP and subsequent neurological deterioration was 93%, compared to a 46% mortality rate among patients who did not have elevated ICP. Further, only 7% of the patients with elevated ICP had favorable outcomes (as measured by GOS) (Juul et al., 2000).

In a separate study by Marmarou et al. (1991), combining the incidence of elevated ICP values with admission variables was shown to be highly predictive of patient mortality. The incidence of elevated ICP levels (ICP >20 mmHg) significantly (p<0.0001) predicted outcome when added to a logistic regression model that included patient age, admission motor score, and pupillary reaction.

Finally, it has been suggested by Uzzell et al. (1986) that elevated ICP levels can influence patient performance on neurological tests up to one year post-injury. TBI patients who had sustained elevated ICP levels in the acute stages of injury had greater memory deficits one year after injury when compared to TBI patients who had not experienced periods of elevated ICP (Uzzell et al., 1986). Thus, elevated ICP levels have the potential to influence patient outcome up to one year post-injury.

_Cerebral Perfusion Pressure_

Cerebral perfusion pressure (CPP), which is calculated by subtracting ICP from the MAP, is a physiological value that reflects the pressure gradient responsible for
cerebral blood flow (BTF & AANS, 2003; Hickey, 2003). Initial guidelines from the BTF and AANS (2000) recommended CPP levels to be maintained above 70mmHg. However, these guidelines were later revised (BTF & AANS, 2003) based on evidence that maintenance of CPP levels above 60mmHg did not affect patient mortality rates or disability outcomes, and that CPP greater than 70mmHg had been associated with increased incidence of acute respiratory distress syndrome (ARDS) (BFT & AANS, 2003; Juul et al., 2000). Thus, the current guidelines based on the best research evidence are to maintain CPP levels above 60mmHg.

Maintaining CPP within recommended guidelines can be difficult after TBI. Cerebral vascular resistance and cerebral autoregulation are often impaired as a result of the primary brain injury. Low CPP values cause cerebral ischemia and additional brain damage, and have been linked to increased mortality rates and disability outcomes (Juul et al., 2000; Kirkness et al., 2005; Marmarou, Saad, Aygok & Rigsbee, 2005; Marshall, Gautille & Klauber, 1991; Rosner, Rosner & Johnson, 1995).

A recent prospective study by Kirkness et al. (2005) investigating the relationship between CPP levels and outcome among 157 critically ill TBI patients provides data on the cumulative percent of time that TBI patients experience certain CPP values within and below the range recommended by the BTF & AANS (2003). Within the study sample, CPP levels less than the recommended 60mmHg occurred 15% of the time, while values 61-70mmHg were recorded 47% of the time. Multivariate analysis illustrated that less cumulative time with CPP values 55-70mmHg was associated with higher mortality outcomes at discharge and six months post-injury, and with improved disability outcomes at discharge. Thus, while maintenance of CPP within recommended ranges can be
difficult, it is an important variable that influences patient mortality and disability months after the initial injury.

*Nursing Interventions and Physiological Variables*

Interventions done by ICU nurses caring for TBI patients can increase or decrease risk of secondary brain injury by causing fluctuations in physiological parameters. Several research studies provide evidence of how routine nursing interventions adversely affect physiological variables that can lead to secondary brain damage. Endotracheal suctioning and patient repositioning in particular have been shown to increase BP, O2sat, ICP, CPP, and heart rate (HR) in critically ill TBI patients (Crosby & Parsons, 1992; Hugo, 1987; Kerr et al., 1997; March et al., 1990; Mitchell & Mauss, 1978; Mitchell, Ozuna & Lipe, 1981; Parsons & Shogan, 1984; Rising, 1993; Rudy et al., 1991; Snyder, 1983). Early nursing research studies using observational designs provided preliminary evidence that ICP levels increased when patients were repositioned (Hugo, 1987; Mitchell & Mauss, 1978; Snyder, 1983) and when respiratory care was provided (Boortz-Marx, 1985; Hugo, 1987; Snyder, 1983). Smaller increases in ICP occurred with neurological assessments (Snyder, 1983) and when patients received the bedpan (Mitchell & Mauss, 1978). While these early studies are limited by small sample sizes (n=4, n=9) and difficulty with inferring causation (because multiple nursing activities were sometimes done all at once), they do provide initial reports of how nursing activities adversely influence physiological parameters in critically ill TBI patients, and of the cumulative effect that nursing interventions can have on physiological values, particularly ICP levels (Hugo, 1987; Mitchell et al., 1981).
Only two early nursing research studies incorporated quasi-experimental designs using slightly larger sample sizes (n=20) (Bruya, 1981; Mitchell et al., 1981). Bruya (1981) investigated if planned rest periods between routine nursing activities influenced ICP levels in 20 critically ill head injured adults. The study sample was comprised of two groups: Group A received the usual sequence of morning nursing activities (i.e. vital signs, respiratory care, bath), while group B received a 10 minute rest period before morning activities. No significant differences were found in ICP levels between the two groups; however, this study did provide initial evidence that the highest ICP levels were recorded when patients received respiratory care and repositioning.

Similarly, Mitchell et al. (1981) incorporated a quasi-experimental design to examine the effect of various nursing activities on ICP levels in 20 adult patients admitted to a neurology-neurosurgery ICU by measuring ventricular fluid drainage (VFD). Patients who had ventriculostomy drains as routine neurological care comprised the study sample, and thus the sample included patients with mass lesions (i.e. tumors and intracerebral hematomas), hydrocephalus, and subarachnoid hemorrhage. There were no TBI patients included in the sample, as ventriculostomy drains were not routinely placed on these patients as part of standard care. The variation in ventricular fluid drainage (VFD) in response to eight selected nursing activities was measured on each patient.

Nursing activities were performed in the same sequence on 19 of the patients and included arm extension, hip flexion, and turning to four different positions: supine to left, left to supine, supine to right, and right to supine. VFD was recorded every 15 seconds for a five minute period before and after the nursing activity. There was an increase in the
mean VFD readings on all patients after at least one of the turns. Arm extension and hip flexion resulted in a slight mean increase in VFD for the group (increase of 1 cm H2O). The cumulative effect of the series of nursing activities on VFD was also significant: the baseline VFD that was recorded prior to each nursing activity was shown to be higher than the baseline VFD that occurred with the previous nursing activity that was performed. Study findings provide additional evidence of how routine nursing interventions can adversely affect ICP, and place patients at increased risk of secondary brain injury.

Subsequent nursing research studies using slightly larger sample sizes and more complex research designs support findings from the above studies. Endotracheal suctioning in particular was extensively examined by several researchers for its effect on physiological values, such as BP, O2sat, ICP, CPP, MAP, and HR in critically ill TBI patients (Brucia & Rudy, 1996; Crosby & Parsons, 1992; Kerr et al., 1997; Parsons & Shogan, 1984; Rudy et al., 1991). Quasi-experimental, 2 group designs and slightly larger sample sizes (range n=20 to n=66) were used in all of these subsequent studies. Cumulative findings from these studies yielded the following information: serial (i.e. more than 2 consecutive) passes with an endotracheal suction catheter exhibits a cumulative negative effect on ICP, MAP, and CPP (Parsons & Shogan, 1984; Rudy et al., 1991); the negative cardiovascular response that occurs with endotracheal suctioning (i.e. MAP, CPP, HR, and ICP) takes at least 2 minutes to resolve (Crosby & Parsons, 1992); short duration hyperventilation prior to suctioning prevents severe ICP increases (Kerr et al., 1997); and the tracheal stimulation that occurs from endotracheal suctioning significantly increases ICP, MAP, and CPP, while the negative pressure brought on by
endotracheal suctioning increases ICP and HR (Brucia & Rudy, 1996). Findings from these studies were used to educate ICU nurses about the most effective way to deliver an essential nursing intervention while minimizing severe fluctuations in physiological values that put patients at increased risk for secondary brain injury (Geraci & Geraci, 1996; Kerr, Rudy, Brucia & Stone, 1993).

Other nursing interventions, such as patient positioning, have been investigated for their influence on ICP levels among patients admitted to neurological intensive care units. Williams and Coyne (1993) examined the effect of four non-neutral neck positions on ICP levels in a convenience sample of 10 head-injured patients. ICP levels were recorded at one minute intervals while all patients experienced a sequence of neck positioning (head to right, head to left, neck flexion, neck extension). Each neck positioning episode was separated by a five minute rest period with the head in a neutral position. ICP levels were found to be highest when the neck was rotated to the either side or in the flexion position.

Nursing research studies cited above provide data on how routine nursing activities can cause fluctuations in physiological parameters that place a critically ill TBI at increased risk of secondary brain injury. While information from these studies has been used to educate ICU nurses about methods to use for limiting this risk (i.e. clustering nursing activities, only performing necessary activities if the patient already has increased ICP, only suctioning when necessary) (Kerr et al., 1993; Geraci & Geraci, 1996), there is no research evidence documenting nursing interventions that specifically decrease a patient’s risk for secondary brain injury, and little evidence exists about the interventions that nurses do in response to fluctuations in physiological parameters when caring for
critically ill TBI patients. Only one study (Kenner, 2002) provides preliminary information on interventions of ICU nurses in response to abnormal fluctuations in physiological parameters when caring for the critically ill TBI patient.

Kenner (2002) conducted an observational study of 17 critically ill TBI patients to determine if the type of CPP display that was used in the ICU influenced the amount of time that physiological parameters of patients were outside specified thresholds, and to investigate the nursing care activities that were done when these values were outside the thresholds. This study was a masters thesis conducted as part of a larger study investigating use of active CPP displays for improving outcomes in TBI patients (Kirkness, Burr, Cain, Newell & Mitchell, 2006). While the larger study by Kirkness et al. (2006) concluded that use of active CPP displays resulted in a better odds of survival and discharge disposition, it did not provide information about how these active CPP displays influenced nursing interventions. Instead, the smaller study by Kenner (2002) was designed to investigate these nursing interventions.

In Kenner’s (2002) study, a non-participant observer recorded nursing care activities in three different intensive care units (trauma ICU (TICU), Neurological ICU (NICU), and Burn ICU (BICU)) in a level-one trauma center. Each unit used one of three types of CPP displays for a set period of time in the study (active CPP display, non-active CPP display, and a space lab display). Nursing care activities were recorded on a checklist when a physiological parameter was outside of the threshold. The checklist of nursing activities was composed of 125 variables and included recording of vital signs, performing physical assessments, delivering respiratory care, conversing with the patient, repositioning the patient, and adjusting and delivering medications. Results from the
study indicate that patients who were monitored with active CPP displays had a significantly less mean percent of time with CPP values below 60 mmHg or 70 mmHg when compared to patients monitored by non-active CPP displays or space lab displays. There was no difference in the amount of time that patients experienced physiological values outside set thresholds for the remaining physiological variables when using the three different monitoring systems. Also, there was no difference in the nursing care activities that were delivered when patients were monitored with the three different systems.

This study by Kenner (2002) provided data on the amount of time that certain physiological parameters (CPP, MAP, O2sat, ICP) varied from set thresholds with three different monitoring devices, and about the nursing interventions performed in response to these fluctuations. The mean percent of time that each physiological value was outside of set thresholds was based on total amount of time that observations occurred. Values of CPP<70mmHg occurred 3.6% of the time with active CPP displays, and 35.1% and 36.9% of time with non-active CPP and space lab displays, respectively. MAP values less than 90mmHg occurred 30.3%-54.4% of the time, ICP values greater than 20mmHg occurred 15.5%-44.7% of the time, and O2sat levels <90% occurred 1.9%-5.8% of the time. Of the 17 observations, only one nursing activity was reported to occur in direct response to a drop in a patient’s CPP level. In this instance, the patient’s CPP dropped below 59mmHg and the nurse increased the neoepinephrine to increase the MAP of the patient. A strict decision rule was made prior to the study that the non-participant observer would not interact with nursing staff or ask why a nursing intervention was being delivered. If a nurse offered his/her rationale for an intervention, then it was
recorded on the data collection sheet by the non-participant observer. Because of this limitation, the study was not able to contribute any additional information about nursing interventions that were performed directly in response to alterations in physiological variables. Thus, this study provided data about the frequency of fluctuations in physiological parameters in TBI patients, but did not contribute significant information about interventions that ICU nurses perform when these physiological fluctuations occur.

**Summary of Research on Physiological Variables**

The preceding review of the research that pertains to the physiological variables in this study illustrates that variations in physiological parameters that cause secondary brain injury do occur and have detrimental effects on patient outcomes. ICU nurses are the primary members of the healthcare team that detect these early changes which are indicative of secondary brain injury, yet no studies have investigated how nurses determine which physiological variations place the patient at increased risk for secondary brain injury, nor have any studies documented how nurses make judgments about appropriate interventions based on these physiological variables. Nursing research provides evidence that routine nursing interventions can adversely affect physiological variables, causing increased secondary brain injury, yet little information exists on the interventions done by nurses that exert a positive influence on these physiological parameters and how nurses respond to fluctuations in physiological variables. This information could contribute to educational programs for nurses about how to prevent secondary brain injury, which can improve patient outcomes.
Situational Variables

Situational variables in this study are those independent variables that create the context of the situation presented in the vignette. The situational variables that are used in this study include patient primary diagnosis, secondary diagnosis, age, gender, mechanism of injury, nursing shift, and type/time of nursing assessment. An overview of the research findings on these variables as they are relevant to this study are reviewed in this section.

Primary Diagnosis

There are a number of different primary diagnoses associated with TBI, and these reflect the initial damage that is done to the brain from the primary injury. Diagnoses that reflect focal brain injuries and frequently require critical care monitoring include epidural hematomas (EDH), subdural hematomas (SDH), and intracerebral hemorrhages (ICH). The most common type of diffuse brain injury necessitating critical care monitoring is a diffuse axonal injury (DAI) (Hickey, 2003).

EDH occurs as a result of blood accumulation between the skull and the dura and is present in 2%-6% of TBI (McNair, 1999). Ninety percent of adults who sustain EDH sustain a skull fracture in the temporal region (March et al., 2004). Signs and symptoms of EDH can be subtle, such as confusion and decreasing level of consciousness. These types of hematomas are usually arterial in nature, and thus patient deterioration can occur rapidly and require immediate intervention to prevent further brain damage (McNair, 1999).

Subdural hematomas (SDH) occur in approximately 30% of TBI patients, are usually recognized within the first 48-72 hours of TBI, and occur as a result of blood
accumulation between the dura and the brain (Hickey, 2003; March et al., 2004, McNair, 1999). Symptoms of patient deterioration due to the SDH can again be subtle, such as confusion and drowsiness, but may require rapid intervention (McNair, 1999). Early recognition and surgical intervention for SDH has been shown to improve patient outcomes (Hickey, 2003).

Intracerebral hemorrhages (ICH) are diagnosed when there is evidence of bleeding within the cerebral parenchyma. This type of injury occurs in 4%-15% of TBI patients (Hickey, 2003), and is responsible for 15% of TBI related deaths (March et al., 2004). Cerebral vessels are ruptured in response to bruising or contusions to the brain tissue from the primary injury. This type of injury usually occurs in the frontal or temporal lobes. Sign and symptoms typically include headache, decreasing level of consciousness, contralateral hemiplegia, and dilation of the ipsilateral pupil (Hickey, 2003).

Diffuse axonal injuries (DAI) are the result of damage that is done to the nerve fibers in the brain tissue upon sustaining an acceleration-deceleration injury to the brain. Approximately 50% of TBI are due to DAI, and DAI is responsible for 35% of all TBI related deaths (Hickey, 2003). DAI usually results in immediate unconsciousness, followed by a prolonged period of confusion and amnesia. These types of injuries are typically associated with a prolonged recovery period (Hickey, 2003).

Secondary Diagnosis

Secondary diagnoses examined in the present study include extracranial injuries sustained at the time of the primary brain injury, diabetes mellitus (DM), and hypertension. Extracranial injuries occur in up to 95% of head-injured trauma patients
The presence of extracranial injuries occurring in addition to TBI has not been shown to increase mortality rates, disability outcomes, or the incidence of secondary injuries (Gennarelli et al., 1994; Sarrafzadeh et al., 2001). However, the mere presence of TBI, whether or not extracranial injuries are present, has been shown to significantly affect these outcome measures when compared to trauma control groups that sustained only extracranial injuries (Gennarelli et al., 1994; Sarrafzadeh et al., 2001).

Other pre-injury comorbidities, predominately hypertension and DM, occur in 73% of TBI patients over the age of 65 and up to 28% of those under age 65 (Coronado et al., 2005; Mosenthal, et al., 2004; Pasquale et al., 2005). The presence of these comorbidities, particularly when associated with increased patient age, has been shown to influence mortality rates in trauma patients (EAST, 2001; Pasquale et al., 2005; Scheetz, 2005).

**Patient Age**

Over 1.4 million Americans sustain a TBI annually in the United States. Of this number, approximately 447,000 are between the ages of 15-34; 364,000 are under the age of 14; and 105,000 are over age 75 (Langlois et al., 2006). Patient age has shown to be a powerful predictor of patient outcome in critically ill TBI patients (Choi et al., 1983; Choi et al., 1988; Lokkeberg & Grimes, 1984; Nararyan et al, 1981). Age, when combined with admission Glasgow coma scale (GCS) score and pupillary or oculocephalic response has been shown to be 80-84% accurate in predicting patient outcome (Choi et al., 1983; Narayan et al., 1981) into one of two categories, either good or poor outcome. Similarly, age when combined with best motor score and pupillary reaction, was shown to be the best predictor of outcome using stepwise logistic regression.
with mortality as the main outcome measure (Mamelak, Pitts, & Damron, 1996). Further, increasing age has been shown to exert a detrimental effect on more recent mortality rates among individuals who sustain TBI. Patients over age 75 who sustain TBIs account for the highest numbers of TBI related hospitalizations (44,000) and deaths annually (8,095 deaths per year) (Langlois et al., 2006). Thus patient age is a variable that influences the occurrence of physiological variables leading to secondary brain injury. Because ICU nurses may have knowledge of or experience with poor outcomes associated with the older TBI patient, this variable may influence nurse judgments as well.

**Patient Gender**

It is reported that males are one and a half times more likely than females to sustain a TBI resulting in an emergency department visit, a hospitalization, or death (Langlois et al., 2006). From 1995-2001 in the United States it is estimated that approximately 835,000 males every year sustained a TBI, compared to 561,000 females. The majority of males who sustain TBI requiring hospitalizations are between the ages of 25-34 (n=22,000), while only 8,000 females in the same age range require hospitalizations for TBI. The highest number of women who sustain TBIs are over the age of 75 (Langlois et al., 2006). Because such a significant number of young males sustain TBI, ICU nurses are more likely to have significant experience caring for male TBI patients. Since these nurses rely on intuition and past experiences to make judgments, patient gender could be a variable that influences ICU nurses’ current judgments about secondary brain injury.
Mechanism of Injury

TBI occur most often as a result of falls (28%), MVAs (20%), being struck by or against an object (19%), and assaults (11%). Falls were the leading cause of TBI between 1995-2001, and fall rates were highest among children ages 0-4 and adults over the age of 75 (Langlois et al., 2006). MVAs are responsible for the highest number of TBI requiring hospitalizations (59,000/year) and resulting in deaths (16,800 deaths/year) (Langlois et al., 2006). Based on this information, ICU nurses are likely to care for a number of TBI patients who have sustained MVAs. Again, because nurses rely on past experiences when making decisions about interventions, this variable could influence nurses’ judgments.

Nursing Shift

ICU nurses make frequent, rapid judgments and decisions when caring for critically ill patients (Bucknall, 2000). These decisions are made using hypothetico-deductive and intuitive reasoning methods, and frequently involve detecting early and subtle changes in a patient’s condition (Corcoran-Perry et al., 1999; Lauri et al., 1998; Minick, 1995; Pyles & Stern, 1983; Peden-McAlpine & Clark, 2002). An observational study of the decisions made by 18 ICU nurses was conducted and provides evidence that the types of decisions made by these nurses varies by nursing shift (Bucknall, 2000). Decisions made by these nurses can be categorized as intervention decisions, communication decisions, and evaluation decisions.

Intervention decisions were those that involved performing an act to modify or prevent a patient situation; communication decisions involved any nursing actions that required deliberate and direct communication with healthcare team members, patients, or visitors; and evaluation decisions were those decisions about patient care that were made
based on a review of collected data about the patient (Bucknall, 2000). The decisions made within each of these categories were further defined as being “old” or “new” decisions. Old decisions were those that were made based on a previously established decision, while new decisions were those that occurred for the first time and were initiated by the nurse. Bucknall (2000) concluded that the types of decisions that were made by the ICU nurses varied by nursing shift. Day shift nurses made the greatest number of old intervention decisions; evening shift nurses frequently made new communication and evaluation decisions, and night shift nurses were most likely to make old evaluation decisions. This information, coupled with the fact that nurses have different resources and perhaps different patient priorities during the various nursing shifts, may influence the judgments and subsequent decisions made by ICU nurses when managing secondary injury in TBI patients.

*Type/Time of Assessment*

ICU nurses are responsible for continuous assessment and management of changes in patient status. Benner et al. (1999) describe simultaneous responsibilities of diagnosing and managing fluctuations in physiological parameters as part of standard nursing practice when caring for critically ill patients. This constant collection and interpretation of patient data requires frequent physical assessments by the ICU nurse. Clinical practice recommendations and standards identify that ICU nurses must perform an initial physical assessment upon assuming care of a patient, which is typically done at the beginning of the nursing shift (American Association of Critical Care Nurses (AACN), 2007a; Ohio Board of Nursing, 2004). Changes in patient status that occur in isolation or in response to nursing interventions require re-assessment by the ICU nurse.
(Ohio Board of Nursing, 2004). This reassessment should occur in at least 15 minute increments, if not more frequently (Hickey, 2003). Stable patients who require critical care monitoring are typically assessed at least every 4 hours by the ICU nurse to aid in detecting subtle changes in a patient’s condition (Benner et al., 1999; Hickey, 2003). These repeated assessments contribute to the ability of the ICU nurse to “know the patient”. This concept of intuition or knowing the patient has been identified as a crucial aspect of nursing judgments and decision making, and is further discussed in the later sections of this chapter.

Summary of Research on Situational Variables

The above review of the research that pertains to situational variables in this study provides information about how these variables might influence ICU nurse judgments. Patient variables, such as primary and secondary diagnosis, age, gender, and mechanism of injury all influence the ecology of the situation that reflects what is happening with the patient. ICU nurses might have more experience caring for certain types of critically ill TBI patients, which could influence their judgments about interventions. The final situational variables of nursing shift and type/time of assessment contribute to the context in which the situation takes place, which may further influence judgments made by these nurses.

Nurse Variables and Judgments

For this study, judgments are defined as “an interpretation or conclusion about a patient’s needs…or health problems” (Tanner, 2006, p. 204). In the nursing research literature, the phrase “decision-making” is often used interchangeably with the phrases of “clinical judgment”, “problem solving”, and “critical thinking” to describe the actions
taken by the nurse to embark upon a course of action (Benner et al., 1999; Tanner, 2006). Research in this area reveals significant variation exists in terms of types of decisions, reasoning processes, and factors that influence decisions among nurses.

A review of the literature on nurses’ clinical judgment concludes that decisions made by nurses are influenced by individual characteristics of the nurse, the phenomenon of “knowing the patient”, and the context of the situation (Tanner, 2006). Further, many reasoning processes are used among nurses to reach a decision, and a reflection on previous judgments or decisions influences development of knowledge and future reasoning of the individual nurse. While these cumulative research findings included research on judgments made by all types of nurses (not just ICU nurses), the conclusions drawn by Tanner (2006) are in fact supported when examining the research specifically about ICU nurse judgments and decision-making. Further, extensive work done by Benner et al., (1999) about ICU nurses’ knowledge and interventions lend additional support to Tanner’s conclusions when applied to only ICU nurse judgments. Therefore, Tanner’s (2006) conclusions will be used as a guide to present research findings about ICU nurse decision making and judgments. This section will summarize the influence of nurse characteristics on ICU nurse judgments, the concept of knowing the patient, the context and reasoning processes that influence ICU nurses, and how reflecting on previous decisions influences ICU nurse judgments and decisions.

*Individual Nurse Characteristics*

Individual nurse characteristics, particularly years of experience, are shown in several studies to influence decisions made by ICU nurses (Bakalis et al., 2003; Baumann & Bourbonnais, 1982; Bucknall, 2000; Currey et al., 2006). In a sample of Greek and
English nurses working in coronary care units, Bakalis, et al. (2003), reported that the number of years that the nurse had worked in the unit was positively correlated with their scores on decision-making using Q-sort methodology (r=0.33, p<0.01).

Baumann and Bourbonnais (1982) assessed decisions made by ICU nurses using a qualitative approach with semi-structured interviews and a patient scenario as a case study. After discussing their decisions, nurses were then asked to identify factors they felt most influenced the decisions that were made. Thirty four percent of the nurses cited knowledge and experience as equally contributing to decisions that they made in the case study (Baumann & Bourbonnais, 1982). Thus, studies using both qualitative and quantitative methods have reported that years of experience can influence the decisions made by ICU nurses. In contrast, two other authors concluded that experience did not influence decisions made by ICU nurses (Henry, 1991; Lauri et al., 1998). Other nurse factors, such as age (Bakalis et al., 2003), and educational preparation (Bakalis et al., 2003; Baumann & Bourbonnais, 1982) were also shown to influence the decisions made by ICU nurses.

Knowing the Patient

The phenomenon of “knowing the patient” has been shown to influence ICU nurse decisions (Benner et al., 1999; Chase, 1995; Pyles & Stern, 1983). An ethnographic study of the social context of the critical care environment revealed that ICU nurses frequently commented on this phenomenon of knowing the patient when communicating with physicians regarding patient needs (Chase, 1995). In fact, knowing the patient has been cited as a key difference between nursing and medical assessments (Crow, Chase & Lamond, 1995; Taylor, 2006). An analysis of cognitive processes involved in nursing
assessments indicates that both nurses and medical staff use similar processes when assessing the patient (Crow et al., 1995). However, the purpose of the medical assessment is to reach a diagnosis of the patient problem, while the purpose of the nursing assessment is to collect enough data to adequately grasp the entirety of the patient’s condition and the situation surrounding this condition, and hence really “know the patient” (Crow et al., 1995; Peden-McAlpine & Clark, 2002). It is this concept of knowing the patient that may contribute to the ability of ICU nurses to detect subtle changes in a patient condition (Minick, 1995; Peden-McAlpine & Clark, 2002; Pyles & Stern, 1983), and may influence the reasoning processes used by ICU nurses when making patient care decisions.

**Context and Reasoning Processes**

ICU nurses do not consistently incorporate one type of reasoning process when making a decision. The context of the critical care setting is a key factor that influences the ability of ICU nurses to engage in formal reasoning processes (Tierney, 1992). The acuity of patients and the technologically advanced nature of the ICU environment require nurses to make frequent, rapid decisions (Bucknall, 2000). During an observational study of 18 nurses practicing in an ICU environment, Bucknall (2000) reported several types of decisions that were made by the nurses. These included both old and new decisions that could be categorized as intervention decisions, communication decisions, and evaluation decisions. Given the sheer volume of different types of decisions that had to be made by the ICU nurse, it was concluded that an individual nurse made a decision every 30 seconds when caring for a patient. An earlier study by Baumann and Bourbonnais (1982) indicated that the demands of the ICU environment
influenced nurse decisions. Semi-structured interviews were conducted with 50 ICU nurses to explore the nature of rapid decisions that must be made in the critical care setting by nursing staff. ICU nurses were not only adept in making appropriate decisions in a crisis situation, but a significant number of these nursing decisions were made for patients prior to contacting a physician (Baumann & Bourbonnais, 1982).

Findings from these studies suggest that often there is insufficient time for ICU nurses to engage in formal reasoning processes. A study investigating decisions made by 483 nurses from 5 different types of patient care units (long term care, short term care, critical care, health care, and psychiatric units) illustrated that ICU nurses consistently rely on a number of different methods when making decisions, which is in stark contrast to the methods used by nurses from other units (Lauri et al., 1998). Factor analysis was used in this study to identify 5 different types of decision making models used by nurses. These included a rule oriented model, nursing process oriented model, nurse oriented model, patient oriented model, and an intuitive model. ICU nurses reported infrequent use of the rule model (which includes strictly following pre-established orders or protocols), and very frequent use of all of the remaining types of models to guide their decisions. No other group of nurses cited frequent use of so many different models, and no other group reported frequent use of an intuitive model to guide their decisions.

Other research reports lend support to the above findings that ICU nurses incorporate different reasoning processes (Corcoran-Perry et al., 1999; Redden & Wotton, 2001). One report (Corcoran-Perry et al., 1999) cites that a group of 16 nurses from coronary care units used up to 25 different lines of reasoning when presented with hypothetical situations and asked to verbalize their thoughts using the “think aloud”
method to arrive at a decision. In fact, more experienced nurses in this group used less linear or hypothetico-deductive methods of reasoning to make a decision. This method of reasoning involves collecting and processing data systematically in order to formulate hypotheses about the situation. The nurse using this method then creates and implements a plan of care for the patient, and evaluates its effectiveness (Field, 1987). This method closely coincides with the traditional nursing process model of assessing, planning, implementing, and evaluating as a primary approach to patient care. While this approach is certainly used in the critical care setting, it is evident that ICU nurses with additional years of experience rely less on this traditional approach to making decisions (Tierney, 1992).

*Reflecting on Previous Decisions*

The nurse’s ability to reflect upon previous decisions has been cited as a method used to further refine critical thinking skills and reasoning processes of the individual (Tanner, 2006). In reviewing studies on the decisions of ICU nurses, it is evident that this process occurs (Ashcraft, 2001; Currey et al., 2006; Peden-McAlpine & Clark, 2002; Pyles & Stern, 1983). The classic study by Pyles & Stern (1983) reports on the ability of the critical care nurse to combine past experiences with basic knowledge. This, coupled with identifying individual sensory input and cues from the patient result in what is described as nursing gestalt (Pyles & Stern, 1983).

Incorporating past experiences when making decisions aids in the ability of the ICU nurse to recognize subtle changes in a patient’s condition (Peden-McAlpine & Clark, 2002). In a qualitative study investigating factors that influenced early recognition of changes in patient status among expert ICU nurses, Peden-McAlpine and Clark (2002)
described the nurse’s ability to reflect upon past experiences with the same patient or with a similar patient in order to detect and act upon changes in patient status that might have otherwise gone unnoticed. It is these past experiences that refine the reasoning skills of the ICU nurse and influence the individual’s expertise (Ashcraft, 2001).

Judgments of Neuroscience Nurses

Few studies have investigated the decisions or judgments made by ICU nurses caring for TBI patients. A qualitative study by Villaneuva (1999) examined the experiences of critical care nurses caring for unresponsive patients. Sixteen ICU nurses participated in semi-structured individual interviews. The core category that emerged from all interviews was “giving the patient a chance”. Subthemes relating to this core category included learning about the patient, maintaining and monitoring, talking to the patient, working with the family, struggling with dilemmas, and personalizing the experience. Making clinical judgments was a crucial task in the maintaining and monitoring phase. According to the nurses interviewed, expected outcomes in this stage were to make correct judgments about the patient’s condition and to maintain or improve the neurological and physiological status of the patient. Nurses’ experiences in this phase were influenced by patient variables, such as the etiology of the coma, Glasgow coma scale scores, and acuity level of the patient. The primary characteristic of the nurse that influenced this stage was the experience level of the nurse.

Research done by Thompson, Kirkness, Mitchel & Webb (2007) centers on how neuroscience nurses define fever in TBI patients and determine appropriate interventions. A survey of 328 neuroscience nurses indicates that nationally, nurses vary in how they define fever and determine appropriate interventions (Thompson, Kirkness, Mitchell &
Webb, 2007). Results of these surveys indicate that there are no commonly accepted temperature standards or protocols in place that guide nurses in fever management when caring for TBI patients. Interventions performed by these nurses to manage fever included administration of anti-pyretic medication, use of ice packs, water cooling blankets, and tepid bathing (Thompson et al., 2007). Decisions about which method was used for fever management were influenced by nurse, patient, and organizational barriers (Thompson, Kirkness & Mitchell, 2007).

Another qualitative study by Thompson (2007) investigated the clinical decision-making of neuroscience nurses when managing fever in patients. Semi-structured interviews were conducted with seventeen nurses working in five different units at two hospitals. Three units were intensive care units, and one was specifically designated as a neuro ICU. Four key themes emerged from the interviews and were used as a guide to define and describe how nurses managed fever. These included patient, nurse, intervention, and practice environment. Overall, nurses working on dedicated neuroscience units considered a greater array of factors (i.e. patient vulnerability, assessment findings) when managing fever in their patients, when compared to nurses from other units. Further, nurse practices when managing fever were often based on personal experiences and trial and error approaches, rather than on evidence-based practice.

Lastly, Fonteyn and Fisher (1994) used the “think aloud” method in conjunction with participant observation and semi-structured interviews to examine the reasoning processes of critical care nurses. The sample consisted of three ICU nurses who had been designated as “experts” within their units; a cardiovascular nurse, a neuroscience nurse,
and an expert in both cardiovascular and neuroscience critical care. Nurses were instructed to speak into voice-activated tape recorders and verbalize their thought processes as they cared for their patients. The investigators also recorded the nurses’ actions using observational methods. Each nurse then participated in a private interview after they were observed.

In the interview, each nurse was asked to identify priorities of care or expected outcomes for their patients. The neuroscience nurse identified the following priorities when caring for a post-operative craniotomy patient: (1) the patient will become responsive, and (2) the patient will remain hemodynamically stable (Fonteyn & Fisher, 1994). Data from the observational period on this nurse supported these claims. Specific indicators provided evidence of these priorities. These indicators, listed by the frequency with which they were performed included assessments of the level of consciousness/neurological status, blood pressure, breath sounds, temperature, amount of respiratory secretions, central venous pressure, heart rate and rhythm, pulse pressure, and arterial blood gases.

The neuroscience ICU nurse provided evidence of the high level of autonomy of expert nurses. This nurse exhibited confidence in changing and adjusting ongoing therapy and delivering nursing interventions to ensure that priorities were met. The nurse reported adjusting vasoactive medications within physician’s orders, but also adjusting these medications outside prescribed parameters when necessary to stabilize the patient. These changes outside prescribed parameters were then reported to physicians later in the shift. Nursing interventions to decrease ICP were also performed prior to contacting a physician. These interventions included: titrating medications, hyperventilating the
patient, and elevating the head of the bed. While this study provided preliminary evidence of decisions and nursing interventions done by one neuroscience ICU nurse caring for post-operative craniotomy patients, the information from the study is not generalizable to the practice of all neuroscience ICU nurses. Further, the study findings did not provide insight into how neuroscience ICU nurses make judgments about risk of additional brain injury or required level of intervention when caring for TBI patients.

Summary of Review of Literature

The studies discussed in this chapter provide evidence of the incidence of physiological and situational variables that occur among critically ill TBI patients and how variations in these variables influence risk for secondary brain injury and patient outcome. Nursing research illustrates that interventions done by ICU nurses can negatively influence physiological parameters in TBI patients, but there is little evidence of ICU nurse interventions that positively affect physiological parameters. Further, few studies have investigated how ICU nurses respond to alterations in physiological parameters when caring for TBI patients. While research on ICU nurse decision-making and judgments provide information on the influence of nurse characteristics and the processes used when making judgments, this information has not been applied to the care of the critically ill TBI patient, which is often extremely complex. There are no studies examining the multitude of factors (physiological, situational, or nurse specific) that can influence the judgments made by ICU nurses when caring for these patients.
The present study fills this gap and provides information about how ICU nurses caring for TBI patients assess these factors and determine patient risk of injury and appropriate level of intervention.
CHAPTER III

METHODS

A factorial survey design was used to examine judgments made by ICU nurses about secondary brain injury in the critically ill TBI patient. Registered nurses working in three different intensive care units from two Level I Trauma centers in the Midwest United States were surveyed regarding their practices when caring for the TBI patient. The study was guided by the Lens model of social judgment theory (Cooksey, 1996), which is discussed in detail in Chapter 1. ICU nurses participating in this study were presented with seven vignettes to review and asked to report the likelihood of making three separate judgments about the situation depicted in each vignette. In this chapter, a detailed description of the research design is presented. An overview of factorial survey methodology is first presented, followed by a discussion on human subjects protection as it pertains to this study. The study sample, setting, instruments, and methods for participant selection are then identified. Finally, the methods for data collection and analysis are described.

Overview of Factorial Survey Methodology

The factorial survey approach uses vignettes in conjunction with sample survey methodology. This type of study design combines the strength of random assignment with the generalizability of the sample survey, and has been used extensively in the social sciences to investigate the decisions and judgments among a number of different samples (Rossi & Nock, 1982). Independent variables that normally would be difficult to control
or unethical to manipulate can be thoroughly examined simultaneously using factorial survey methodology (Ludwick & Zeller, 2001).

As many as 10-15 independent variables and up to three dependent variables may be included in each vignette, creating situations that better represent the complexities encountered in real-life scenarios (Ludwick et al., 2004; Ludwick & Zeller, 2001). Each independent variable included in the study had different levels, or ranges of values (see Tables 1 and 2). A random table of numbers was used to mathematically formulate different two segment vignettes using the various levels of each of these independent variables. As a result, each study participant received a different set of two segment vignettes to judge, which allowed factors that impacted participant’s judgments at time 1 (i.e. judgments about initial vignettes) and time 2 (i.e. judgments about follow up or second vignettes) to be causally tested using regression techniques. These factors were the independent variables of the study and are listed in Tables 1 and 2. The independent variables included in each vignette were categorized as physiological variables (i.e. BP, O2sat, temperature, ICP, and CPP), or situational variables (i.e. patient primary diagnosis, secondary diagnosis, age, gender, mechanism of injury, nursing shift, and type/time of nursing assessment).

Various values or levels of each independent variable were randomly inserted into vignettes, creating a realistic patient situation. Study participants were instructed to read each vignette and answer specific questions about the situation presented. These questions were structured to gather data about the knowledge, judgments, or attitudes of the participant and served as dependent variables of the study (Ludwick & Zeller, 2001). Table 4 lists and describes the dependent variables examined in this study. These
dependent variables included the likelihood that (1) the patient is at risk for secondary brain injury, (2) the situation could be managed solely with nursing interventions, and (3) consultation with other members of the healthcare team was needed to manage the situation. Further discussion on the creation of vignettes and methods for data analysis using factorial survey methodology is presented in later sections of this chapter.

Protection of Human Subjects

Support for this research was obtained from nursing administration at both study sites. Approval for this study has been granted from the Institutional Review Boards (IRBs) at MetroHealth Medical Center, Summa Akron City Hospital, and Kent State University (Appendices A,B,C). There were no interventions for this study and risks to the participants were minimal.

Participants meeting inclusion criteria were given a study packet containing an introductory letter and the study survey. The primary risk to participants in this study was breach of confidentiality and privacy. In order to minimize this risk, specific precautions were taken. First, all study materials were anonymously completed by participants. Participants were instructed to not place their names anywhere on completed surveys or vignettes. Second, a waiver for written informed consent was requested and granted from each IRB. Because signed consent forms would have been the only document linking a participant to the study records, this would have actually increased the risk of breach of confidentiality and privacy. By instituting these two measures, there was no information identifying which ICU nurses chose to participate in the study and/or how an individual ICU nurse responded to a set of vignettes, which minimized the risk of breach of confidentiality or privacy. Instituting these measures also encouraged ICU nurses to
provide honest answers on the study survey and minimized any concern that co-workers and/or supervisors (i.e. their nurse manager or director) may discover who participated and how they responded to vignettes.

All study participants were informed of the overall purpose of the study, the risks/benefits of participating, and their rights as research participants through an introductory letter contained in each study packet (Appendix D and E). Participants were instructed in the letter to only complete and return the enclosed survey if they were willing to participate in the study. They were instructed that completion and return of the survey indicated their consent to participate in the study. Therefore, return of a completed survey by each participant provided evidence of their willingness to participate in the study and implied consent.

Information from completed surveys was entered into a database created by the primary investigator (PI). This database was stored on a jumpdrive which was kept in a locked file cabinet in the locked office of the PI. No other information was stored on this jumpdrive, and there was no information linking data to individual participants.

There were no direct benefits for nurses who agreed to participate in this study. Information gained from this study will be used to create and implement future educational programs for ICU nurses about managing secondary brain injury in critically ill TBI patients. These future programs have the potential to minimize secondary injury through nursing interventions and thus improve outcomes for TBI patients. It was therefore believed that the benefits associated with information from this study outweighed the minimal risks posed to nurses who agreed to participate in this study.
Sample

The study sample was comprised of 67 ICU registered nurses from two different level I trauma centers in the Midwest United States who were directly responsible for the care of critically ill TBI patients. Inclusion criteria was as follows: (1) must hold active and valid Ohio registered nurse license, (2) employed full time, part time, or per diem as a clinical bedside nurse in an ICU that admits critically ill TBI patients, (3) have at least 3 months of experience caring for critically ill TBI patients; (4) employed in the current ICU for at least 3 months. Exclusion criteria are nurses who have not had experience caring for critically ill TBI patients and who are currently in nursing orientation within the ICU, and those nurses who are not directly responsible and involved with the continuous bedside monitoring and delivery of care to the critically ill TBI patients in the ICU.

The study sample was drawn from three ICUs in two different level I trauma centers in the Midwest United States: MetroHealth Medical Center (MHMC), and Summa Akron City Hospital (SACH). A description of the setting of both medical centers and their respective nursing units is provided in the following section of this chapter. Intensive care unit nurses from two surgical ICUs (SICUs) at MHMC, and from one SICU at SACH were approached about participating in the study. Within the potential sample from both study sites, approximately 80% of RNs were female, and the majority of RNs were Caucasian, with smaller percentages of African American, Hispanic, Asian, and Middle Eastern ethnic backgrounds represented. The age range of RNs in these units was 22-60 years of age. SICU A at MHMC employed 41 registered nurses (RNs), while SICU B had 34 RNs. The SICU at SACH (which will be labeled
SICU C for this study) was composed of 77 RNs. Thus, it was estimated that a total of 152 RNs would be eligible for participation in this study.

Because the unit of analysis with factorial survey methods is the vignette, rather than the participant, adequate power to detect relationships among variables may be obtained either by increasing sample size or by increasing the number of vignettes that each participant is asked to evaluate. For this study, it was determined that a sample of 30 nurses from each study site (i.e. 30 nurses from MHMC, and 30 nurses from SACH; total sample size of 60) would be sufficient to detect relationships among variables if each respondent was asked to evaluate 5 vignettes (with each vignette having 2 segments). Because the unit of analysis with factorial survey is the vignette, administration of at least 5 vignette sets to a minimum of 60 nurses would result in 300 observations. This number is sufficient to detect a medium small effect size of 0.20 with a power of 0.80. Therefore, the number of nurses available at each study site was adequate to meet the needs of this study.

Setting

The study took place at two level I trauma centers in the Midwest United States: MetroHealth Medical Center (MHMC), and Summa Akron City Hospital (SACH). Each study site will be described separately below.

MetroHealth Medical Center

MetroHealth Medical Center is a 731-bed county teaching hospital located in Cleveland, Ohio, and is the only hospital in the state that is designated as a Level I trauma center for adult, pediatric, and burn patients by the American College of Surgeons (ACS). MHMC was the first county hospital in the country to be designated a Magnet
Hospital by the American Nurses Credentialing Center, which certifies excellence in nursing care and patient outcomes. The trauma service at MHMC admits over 3000 patients per year, which places it in the top 10% of the nation in trauma volume. Trauma patients that sustain critical injuries necessitating ICU monitoring are admitted to one of two SICUs: 5A (which will be labeled SICU A for this study) or 5C (which will be labeled SICU B).

SICU A is a 15-bed unit and SICU B is a 10 bed unit. Both units are composed of single occupancy rooms, and admit patients requiring intensive care monitoring who have either sustained traumatic injuries or have undergone surgical procedures. Both units are composed of an all RN staff responsible for the continuous monitoring and care of critically ill patients. Nurse/patient ratios are typically 1:1 or 1:2. RNs are hired on a full-time, part-time, or per diem basis, and are designated to work a particular shift (i.e. day/night rotating, day/evening rotating, evenings, or nights). All nurses work 4, 8, or 12 hour shifts.

Each unit is supervised by its own nurse manager. Additionally, a charge nurse is assigned every shift on each unit to oversee unit needs on a shift-by-shift basis. A certified critical care clinical nurse specialist is assigned to both units and is responsible for education, quality, and policy practices that affect nursing staff and delivery of patient care. The nursing director of medical/surgical/trauma critical care is responsible for both units from an administrative standpoint, and reports directly to the vice president of nursing for MetroHealth Medical Center.
**Summa Akron City Hospital**

Summa Akron City Hospital is located in Akron, Ohio, and is part of the Summa Health System. The Summa Health System is one of the largest organized healthcare delivery systems in the nation and includes a network of hospitals, community health centers, a health plan, a physician-hospital organization, and a private foundation. Akron City Hospital is a teaching hospital that is part of the Summa network and is the first hospital in Akron, Ohio to be designated as a Level I trauma center by the ACS. The trauma service admits approximately 1,000 patients every year, and those patients who sustain critical injuries necessitating ICU monitoring are admitted to the SICU, which is called T2.

T2, which will be labeled SICU C for the study, is composed of 26 single occupancy rooms. This unit is composed of an all RN staff, and the typical nurse: patient ratio is 1:1 or 1:2. Similar to the MHMC units described above, SICU C admits patients who have sustained traumatic injuries and/or have undergone surgical procedures and require critical care monitoring. RNs on this unit are hired on a full time, part time, or per diem basis, are assigned a primary shift (i.e. days, evenings, nights, day/evening, or day/night), and work 4, 8, or 12 hour shifts.

The nursing oversight and supervision of SICU C is similar to that of SICU A and SICU B. The immediate supervisor over SICU C is the unit manager; however, a charge nurse is assigned every shift to oversee the unit clinical activities for that shift. There is a critical care clinical nurse specialist who is involved with staff education, quality initiatives, and practice policies. The unit manager reports to the director of critical care nursing services, who then reports to the chief nursing officer of the hospital.
Both sites are similar in that they are designated as acute care, level I trauma centers by the ACS and admit similar types of patients to their SICUs. The nursing staff and organization are similar among all units. MHMC is a larger facility and admits a higher volume of trauma patients when compared to SACH; however, both hospitals are large urban teaching hospitals. Finally, MHMC has been designated a Magnet facility which indicates excellence in nursing care. While SACH has not yet been awarded this designation, the nursing staff ratios and staff composition remain similar between both facilities.

Instruments

Data for the study was collected using a study survey composed of three sections: Section A, B, and C (Appendix F). Each study survey had an identification number that indicated from which ICU the study was completed. Participants were asked to complete the study survey only once.

Section A: Last Case Data

The first section of the study survey (Section A) asked each participant a series of questions about the last TBI patient they cared for in their ICU. This information was used to establish the validity of the vignettes and is described in the later sections of this chapter.

Section B: Vignettes

The second section of the survey (Section B) was composed of a series of vignettes. A vignette is a short story or fictional case study that depicts a concept or a situation (Ludwick & Zeller, 2001). Vignettes are used to investigate the knowledge and judgments that individuals have about certain aspects or variables that are presented in
the situation or short story. These vignettes are particularly useful when manipulation of the study variables would be unethical or difficult to control (Ludwick & Zeller, 2001). The vignette reflects the complex patient situations that frequently occur in the ICU setting when nurses are caring for TBI patients. An example of the vignette template and a sample vignette is provided below:

**Vignette Template:**
You are performing your initial assessment at the beginning of your shift when caring for a _______(age) _________(gender) patient in your SICU on the ______(shift). The patient has sustained a ______ (primary diagnosis) from _________(mechanism of injury) and also has _________(secondary diagnosis). In performing your assessment, you record the following values:

_______(SBP)
_______(O2 sat)
_______(Temperature)
_______(ICP)
_______(CPP)

**Sample Vignette:**
You are performing your initial assessment at the beginning of your shift when caring for a 45 year old male patient in your SICU on the evening shift. The patient has sustained an epidural hematoma from fall, and also has hypertension. In performing your initial assessment, you record the following values:

SBP 80-89 mmHg
O2 sat 86-90%
Temperature >39.6 degrees
ICP 26-30 mmHg
CPP 45-49 mmHg

The different independent variables of the study were randomly generated into the vignette, which allowed for a causal examination into the impact of these factors that are closely related in clinical situations (multicollinear). Each independent variable had different levels of possible values (Table 1 and 2). The level that was included in each vignette was randomly generated. The various levels of each independent variable each had an equal chance of being randomly entered into each vignette that was created. This
The technique of automatic sampling with replacement (i.e. simple random sampling) assumes that every observation and every combination of observations is equally likely. As a result, a $4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 7 \times 2 \times 4 \times 3$ factorial design is used for the initial vignette segment.

There were two segments for each vignette. This technique of multiple segment factorial vignette design (MSFV) allows the researcher to examine the causal effects of changes over time on the judgments of individuals (Ganong & Coleman, 2006). The first segment, or initial vignette pictured above was randomly created using the independent physiological and situational variables of the study. The second segment, or follow-up vignette contained a different set of randomly generated physiological variables. The situational variables in this follow up vignette remained essentially unchanged. The only situational variable that was included in the follow up vignette was the type/time of assessment. Inclusion of this situational variable reflected the time that has passed since the first assessment in the initial vignette. Because this additional situational variable was included, a $4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 7 \times 2 \times 4 \times 3 \times 2$ factorial design was used for each follow up vignette. An example template and sample of the follow up segment of the vignette is pictured below:

**Template of Follow up Vignette:**
You are now performing your _________(type of assessment) on this same patient. You now record the following values:

- _________ (BP)
- _________ (O2 sat)
- _________ (Temperature)
- _________ (ICP)
- _________ (CPP)
After reading each segment of the vignettes, participants were be asked to answer three questions about the judgments that they would be most likely to make if presented with the situations depicted in the vignette. These questions served as the dependent variables of the study and are listed below:

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   
   (not very likely)                              (very likely)
   0 1 2 3 4 5 6 7 8 9 10

2. What is the likelihood that you would manage this situation *solely* with nursing interventions:
   
   (not very likely)                              (very likely)
   0 1 2 3 4 5 6 7 8 9 10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   
   (not very likely)                              (very likely)
   0 1 2 3 4 5 6 7 8 9 10

   Who would you consult? (check all that apply)
   
   ___ I would not consult anyone at this time
   ___ A respiratory therapist
   ___ A more senior nurse
   ___ A physician

The use of these randomly generated vignettes with the factorial survey approach allows the researcher to independently vary each of the independent variables under investigation. In real-life contexts, many of these independent variables are so strongly
correlated that credible analyses are often difficult. The factorial survey approach assists the researcher in disentangling these collinear effects that exist in real-life situations. Thus as the correlations of these independent variables approach zero, the multiple regression slopes performed will not be affected by the interpretational problems that arise when independent variables are collinear.

All participants were given a total of seven vignettes to evaluate. The first two vignettes only contained the first segment and were labeled “give away” vignettes. These first two short vignettes were not randomly generated or entered into the final regression analysis. Rather, they aided in reducing the response bias that can occur if a respondent tends to always judge a vignette high or low (Rossi & Nock, 1982). The first vignette was created using the highest level of each variable and this same vignette was administered to all participants. Similarly, the second vignette was created using the lowest level of each variable and was also administered to all participants. Administration of these 2 “give away” vignettes familiarized participants with the structure of the vignette and subsequent questions, and also identified how high or low a participant tended to score vignettes when compared to all other participants (Rossi & Nock, 1982). The remaining 5 vignettes each had 2 segments and were randomly generated using the procedures outlined above and administered to participants.

Section C: Demographic Data

The final section of the study survey (Section C) consisted of a series of demographic questions. These questions were structured to gather information about individual nurse variables, such as age, gender, educational background, and years of experience.
Validity

A key advantage of factorial survey methods is the high degree of internal validity (Ludwick & Zeller, 2001). The combination of experimental design with survey methodology enhance internal validity by (1) allowing the values of each independent variable to vary randomly, (2) eliminating the multi-collinear nature of the variables, and (3) enhancing the possible variance of the independent variables (which can often be limited by when collected clinically) (Ludwick & Zeller, 2001).

While use of vignettes can be criticized for not accurately portraying clinical situations, employing certain measures with the factorial survey design aids in establishing content validity of the vignettes. First, independent variables that are randomly entered into each vignette were selected based on a thorough review of the research literature. Numerous studies examining different aspects of care of the critically injured TBI patient provide evidence of the frequency and incidence of each independent variable, as well as the effects of these variables on patient outcome (Andrews et al., 2002; Bekar et al., 1998; Changaris et al., 1987; Chesnut et al., 1993; Diringer et al., 2004; Doberstein et al., 1993; Geffroy et al., 2004; Graham et al., 1987; Jeremitsky et al., 2003; Jiang et al., 2002; Juul et al., 2000; Kirkness et al., 2005; Marmarou et al., 1991; Miller et al., 1977; Robertson, 1993; Sanchez-Olmedo et al., 2005; Sarrafzadeh et al., 2001). Table 1 and table 2 provide a summary of this evidence for each independent variable. This evidence is discussed extensively in Chapter 2. Cumulative findings from these studies indicate that the independent variables used in this study do in fact occur in the critically ill TBI patient and thus require management by ICU nurses and other
members of the healthcare team. This provides support for contextual aspects of the vignette, thus strengthening its validity.

A second measure to establish content validity of the vignettes was incorporation of the recent case method. The recent case method is a technique used with the factorial survey approach to ensure that the situations presented in each vignette represents real life experiences or situations (Ludwick, O’Toole, O’Toole & Webster, 1999; Ludwick et al., 2004). Using this technique, participants are asked to provide information about the most recent real life situation involving the situation under investigation. Section A of the study survey (Appendix F) consisted of a set of questions asking each participant to provide information on the most recent case in which they cared for a critically ill TBI patient in their SICU. Data from these questions was used to validate the content of randomly generated vignettes. Stability between variables reported in recent cases and vignette variables establishes content validity.

Procedures

The following section outlines procedures of this study. Methods for participant selection, data collection techniques, and compensation of participants are discussed.

Participant Selection

RNas in each of the SICUs were approached by the PI about participating in the study during scheduled nursing staff meetings and during the routine nursing unit report sessions. At each staff meeting and unit report session, the PI was present and verbally explained the eligibility requirements of the RNs who are present. All RNs meeting inclusion criteria were asked if they were interested in participating in the study.
Data Collection Techniques

RNs in each unit were approached about participating in the study during scheduled nursing staff meetings and during routine unit nursing report sessions over the course of four weeks. The presence of the PI at these staff meetings and unit report sessions was verified in advance with the nurse managers of each unit. When the PI arrived on the nursing unit, she notified that nurse manager. The unit manager directed the PI to the appropriate room for the staff meeting or report session. However, the unit manager was asked to leave the room during the administration, completion, and collection of all study surveys.

At each staff meeting and/or unit report session, the PI introduced herself and administered study packets to all RNs meeting inclusion criteria. Study packets included an introductory letter that provided a brief description of the study, the risks/benefits of participating, and the instructions to follow if an RN was interested in participating (Appendix D), and the study survey (Appendix F). The PI verbally explained the inclusion criteria for the study. RNs who met inclusion criteria were instructed in the introductory letter to only complete the survey if they were willing to participate in the study. Upon completion of the survey, participants were instructed to return the completed study materials directly to the PI. Participants could either hand completed study materials directly to the PI at the end of the staff meeting or unit report session, or they could send completed surveys by U.S. mail to the PI. The PI provided pre-addressed, stamped envelopes to those individuals who wished to mail their completed study materials.
In order to assure that all RN staff members in the three SICUs were notified and invited to participate in the study (i.e. some nurses may have not been present during the above unit meetings and report times), the PI placed a letter describing the study (Appendix E) and a study survey (Appendix F) into the unit mailboxes of all RN staff. RNs were instructed in the letter to disregard the study materials if they had already completed and returned the surveys. If the RN had not completed and returned the surveys and was willing to participate in the study, he/she was instructed in the letter to complete the survey and return it to the PI via U.S. mail using an envelope enclosed in the study packet.

Compensation

It was estimated that it would take each nurse an average of 5-10 minutes to read and complete the study survey. The nurse managers at the study sites had been informed of the study and were willing to allow RNs time to complete the surveys while at work. A raffle for a $25 gift card was offered at each study site for nurses interested in participating in the study. If nurses wanted to be entered into the raffle, they were instructed in the study letter to call/email the PI with their first name and a contact phone number or email. This information was kept separate from the study records and was only used when drawing the winner of the raffle. The winner of each raffle was then notified using the contact information provided. The winner was not announced to the other study participants. After the winner was notified, the name/contact information of all nurses was destroyed. These measures helped to ensure the anonymity and privacy of participants while still offering a measure to compensate them for their time.
Data Analysis

Consistent with factorial survey methodology, multivariate regression analyses were conducted to investigate the relationships among study variables. Specifically, the following research questions and hypotheses were addressed:

1) How do physiological and situational variables influence ICU nurse judgments about secondary brain injury when caring for the critically ill TBI patient?

Hypothesis 1A: More severe physiological variables (i.e. level 3 or 4 values, or values farthest from normal ranges), and situational variables of primary diagnosis, (intracerebral hemorrhage (ICH) or diffuse axonal injury (DAI)), secondary diagnosis (extracranial injuries, hypertension, diabetes mellitus (DM)), and increasing patient age will increase nurse judgments about patient risk for secondary brain injury.

Hypothesis 1B: More severe physiological variables (level 3 or 4 values, or values farthest from normal ranges), and the situational variable of shift (day shift) will decrease nurse judgments to manage a situation solely with nursing interventions.

Hypothesis 1C: More severe physiological variables (level 3 or 4 values, or values farthest from normal ranges), and the situational variable of shift (day shift) will increase nurse judgments to manage a situation by consulting another member of the healthcare team.

2) How do nurse variables influence ICU nurse judgments about secondary brain injury when caring for the critically ill TBI patient?
Hypothesis 2A: Nurses with higher levels of experience (i.e. total years in ICU, years in current ICU, and years with TBI patient) will have increased judgments about patient risk for secondary brain injury.

Hypothesis 2B: Nurses with higher experience levels (i.e. total years in ICU, years in current ICU, years with TBI patient) and who work night shift will have increased judgments to manage a situation solely with nursing interventions.

Hypothesis 2C: Nurses with higher experience levels (i.e. total years in ICU, years in current ICU, years with TBI patient) and who work day shift will have increased judgments to manage a situation by consulting another member of the healthcare team.

The vignette variables were used as central analysis for model building to determine which variables best predicted ICU nurse judgments about (1) risk for secondary brain injury, (2) managing the situation solely with nursing interventions, and (3) managing the situation by consulting with other members of the healthcare team. Demographic data of the participants was then used to predict outcomes. The unit of analysis for regression is the vignette and the projected number of vignettes for analysis in this study was 300. The order of construction and arrangement of vignettes is random within and across individual respondents; thus, pooling of respondents’ vignettes for statistical analysis is appropriate (Rossi & Nock, 1982). Ordinary least squares regression (OLS) were performed to determine the best linear unbiased estimate of effects. The regression equation provided the effect sizes, statistical significances, and variances explained that were needed to investigate the effect of the randomly generated
independent variables about secondary brain injury on the dependent variables of the types of judgments that are made by the ICU nurses (Ludwick & Zeller, 2001).

The Statistical Package for the Social Sciences (SPSS) was used to assist with analysis. Partial regression coefficients were used for each level of independent variable. Each slope assessed the degree to which the mean judgment for each level of the independent variable differed from the mean of each level that has been omitted (Ludwick & Zeller, 2001). The influence of each independent variable and the overall power of the regression model were evaluated by the multiple correlation squared ($R^2$). Given the orthogonal generation of vignettes, the partial regression coefficients controlling for the other independent variables were approximately equal to the regression coefficients if the other independent variables had not been controlled. In addition, the multiple correlation squared across independent variable sets will be approximately equal to the sum of the correlations for each single independent variable set (Ludwick et al., 2004). The model for each dependent variable predicted by the independent variables can be demonstrated by the following equation:

$$Y' = a + b_1x_1 + b_2x_2 + \ldots b_kx_k$$

Where $a$ is the intercept for the regression equation; $b_1$ is the slope predicting $Y$ from $X_1$; $b_2$ is the slope predicting $Y$ from $X_2$; $b_k$ is the slope predicting $Y$ from $X_k$.

The proposed model accommodated nominal, ordinal, and scale variables (Ludwick et al., 2004). When nominal variables are used, all $k-1$ levels of each independent variable were recoded into $k-1$ dummy variables. All sets of dummy variables were used as predictors in a multiple regression equation predicting the outcome variable. The regression slope produced when using all sets of dummy variables
simultaneously were approximately the same as the regression slopes produced when multiple regression analyses are conducted for each set of dummy variables representing each independent variable separately.
CHAPTER IV

RESULTS

The purpose of this study was to examine how patient physiological variables (i.e. blood pressure (BP), oxygen saturation (O2sat), temperature, intracranial pressure (ICP), cerebral perfusion pressure (CPP)), situational variables (i.e. primary and secondary diagnoses, age, gender, mechanism of injury, shift, type/time assessment), and nurse variables (i.e. number of years as registered nurse (RN), years in intensive care unit (ICU), years in current ICU, years with traumatic brain injury (TBI) patients, education, shift) influenced ICU nurse judgments about secondary brain injury when caring for the critically ill TBI patient. The specific judgments that ICU nurses were asked to provide data on included (a) patient risk for secondary brain injury, (b) likelihood of managing the situation solely with nursing interventions, and (c) likelihood of consulting another member of the healthcare team to assist in managing the situation.

The study incorporated a quantitative research design using factorial survey methodology to investigate factors influencing judgments of ICU nurses managing physiological parameters that lead to secondary brain injuries. Data were collected from an anonymous survey distributed to ICU nurses working in three ICUs from two Level I trauma centers in the Midwest United States. Consistent with the factorial survey approach, each study survey contained a series of randomly generated vignettes that nurses were asked to read and indicate judgments they would be most likely to make if presented with the situation in the vignette. Surveys contained questions about the last
TBI patient the nurse cared for in the ICU, and a series of demographic questions to gather data on nurse characteristics. The Statistical Package for the Social Sciences (SPSS), Version 15.0 was used for all data analyses.

This chapter includes results of the data analyses. The chapter is organized in the following manner: description of study sample, overview of data analysis techniques, data cleaning, quality check of vignettes, hypothesis testing, and supplemental methodological analyses.

Study Sample

Participants were registered nurses working in three different ICUs from two level I trauma centers in the Midwest United States. SICU A and SICU B represented the two surgical intensive care units at MetroHealth Medical Center, while SICU C was the surgical intensive care unit at Summa Akron City Hospital. A total of 152 nurses were invited to participate, and 67 returned completed surveys for a total response rate of 44% (Table 5). The principal investigator (PI) attended routine change of shift report sessions and prescheduled staff meetings in each of the ICUs during all nursing shifts (i.e. days, evenings, nights) for a period of 4 weeks to approach nurses in person about participating in the study. To ensure all nurses were approached about participating, additional study surveys were placed in all RN unit mailboxes. A power analysis done prior to data collection indicated that a total sample size of $n=60$ would be adequate to detect a medium small effect size of 0.20 with a power of 0.80. Thus, the resulting sample of $n=67$ provided 335 vignettes for analyses, and was sufficient to conduct the necessary
analyses for this study. Table 5 displays the number of completed surveys and response rate from each study site.

Table 5

<table>
<thead>
<tr>
<th>ICU</th>
<th># Surveys Returned per ICU</th>
<th>Response Rate per ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>SICU A (MetroHealth) (# Nurses=41)</td>
<td>15</td>
<td>36.5%</td>
</tr>
<tr>
<td>SICU B (MetroHealth) (# Nurses=34)</td>
<td>20</td>
<td>58.8%</td>
</tr>
<tr>
<td>SICU C (Summa) (# Nurses=77)</td>
<td>32</td>
<td>41.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67</strong></td>
<td><strong>44% (Total response rate)</strong></td>
</tr>
</tbody>
</table>

Study surveys contained a series of demographic questions to gather data on nurse characteristics. This information was used to describe the study sample and to determine to what degree nurse characteristics influenced judgments about risk for secondary brain injury. Table 6 provides a summary of the demographic characteristics of the sample. The majority of nurses (64.2%) were between the ages of 26-40 years of age, with the highest percentage of nurses between the ages of 31-35 years (26.9%). Seventy six percent of the sample were female, and 92.5% were Caucasian. Most nurses had worked as RNs for less than 10 years (61.2%). Approximately 70% of nurses had less than 10 years of ICU experience. While the remaining 30% of nurses had more than 10 years critical care experience, many of these nurses had recently started working in their current ICU caring for critically ill TBI patients, as evidenced by the high percentage of nurses (74.7%), who
responded they had only worked in their current ICU for less than 10 years. The majority of nurses (74.6%) had less than 10 years experience caring for TBI patients in general (i.e. in any care setting). Over half of the nurses (58.2%) had a bachelors degree in nursing (BSN), while 22.4% had associates degrees, and 19.4% had nursing diplomas. No nurses had a masters degree (MSN) or PhD in nursing. Approximately one-third of the nurses worked night shift (32.8%). When comparing these demographics to a national sample of ICU nurses (AACN, 2007b), the nurses in this study were younger and had less experience than the average ICU nurse. The remaining demographic characteristics of this study sample (i.e. gender, ethnicity, education) were comparable to those of a national sample of ICU nurses.
Table 6

*Demographic Summary*

<table>
<thead>
<tr>
<th>Nurse Characteristic</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-25 years</td>
<td>6</td>
<td>9%</td>
</tr>
<tr>
<td>26-30 years</td>
<td>15</td>
<td>22.4%</td>
</tr>
<tr>
<td>31-35 years</td>
<td>18</td>
<td>26.9%</td>
</tr>
<tr>
<td>36-40 years</td>
<td>10</td>
<td>14.9%</td>
</tr>
<tr>
<td>Greater than 40 years</td>
<td>18</td>
<td>27.0%</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>61</td>
<td>92.5%</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>7.5%</td>
</tr>
<tr>
<td><strong>Years as RN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10 years</td>
<td>41</td>
<td>61.2%</td>
</tr>
<tr>
<td>11 years or greater</td>
<td>26</td>
<td>38.7%</td>
</tr>
<tr>
<td><strong>Years in ICU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10 years</td>
<td>47</td>
<td>70.1%</td>
</tr>
<tr>
<td>11 years or greater</td>
<td>20</td>
<td>29.9%</td>
</tr>
<tr>
<td><strong>Years in Current ICU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10 years</td>
<td>50</td>
<td>74.7%</td>
</tr>
<tr>
<td>11 years or greater</td>
<td>17</td>
<td>25.3%</td>
</tr>
<tr>
<td>Nurse Characteristic</td>
<td>N</td>
<td>Percent</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Years with TBI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10 years</td>
<td>50</td>
<td>74.6%</td>
</tr>
<tr>
<td>11 years or greater</td>
<td>17</td>
<td>25.4%</td>
</tr>
<tr>
<td><strong>Highest Nursing Degree</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associates Degree</td>
<td>15</td>
<td>22.4%</td>
</tr>
<tr>
<td>Nursing Diploma</td>
<td>13</td>
<td>19.4%</td>
</tr>
<tr>
<td>BSN</td>
<td>39</td>
<td>58.2%</td>
</tr>
<tr>
<td><strong>Primary Nursing Shift</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days</td>
<td>17</td>
<td>25.4%</td>
</tr>
<tr>
<td>Day/Night</td>
<td>20</td>
<td>29.9%</td>
</tr>
<tr>
<td>Day/Evening</td>
<td>7</td>
<td>10.4%</td>
</tr>
<tr>
<td>Evening</td>
<td>1</td>
<td>1.5%</td>
</tr>
<tr>
<td>Nights</td>
<td>22</td>
<td>32.8%</td>
</tr>
<tr>
<td><strong>Knowledge of TBI EBP Guidelines</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>48</td>
<td>72.7%</td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
<td>27.3%</td>
</tr>
<tr>
<td><strong>Belong to Nursing Organization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>44</td>
<td>66.7%</td>
</tr>
<tr>
<td>Yes</td>
<td>22</td>
<td>33.3%</td>
</tr>
<tr>
<td><strong>Have Specialty Certification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>60</td>
<td>90.9%</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>9.1%</td>
</tr>
</tbody>
</table>
When nurses were asked to indicate their knowledge of evidence-based guidelines for TBI patients, 27% (n=18) indicated they possessed knowledge of existing guidelines. However, when asked to write in the name of the guidelines, no nurses referred to guidelines supplied by the Brain Trauma Foundation (BTF) and American Association of Neurological Surgeons (AANS) (2000, 2003), which are the current standard of care for TBI patients. Only one-third of nurses belonged to a nursing specialty organization; within this group, most reported membership in the American Association of Critical Care Nurses (AACN), and one nurse was a member of the American Association of Neuroscience Nurses (AANN). Fewer than 10% of nurses held additional nursing certifications within their specialty areas.

Last Case Data: Most Recent TBI Patient

All nurses were asked to provide information on the last TBI patient they cared for in their ICU to validate the content of vignettes. A series of open ended and forced choice questions comprised the first section of the study survey. Nurses were asked to describe characteristics of their last TBI patient and the physiological parameters they were responsible for managing while caring for this patient. This information was used to validate the situational and physiological variables used in the study vignettes. If information provided by nurses in this part of the survey was congruent with variables included in vignettes, content validity was established (Ludwick et al., 1999; Ludwick et al., 2004).

A summary of information provided by nurses about their last TBI patient is provided in Table 7. All nurses had cared for a TBI patient recently, with most (65.7%)
being within the last week. All nurses reported being responsible for managing BP, O2sat, and temperatures within these patients, and approximately half reported being responsible for ICP and CPP management. This is consistent with typical care delivered to critically ill TBI patients, as ICP/CPP monitoring is not always indicated for all patients. The majority of TBI patients had sustained a head injury from either a motor vehicle accident (MVA) (46.3%) or fall (34.3%), both of which are leading causes of TBI in adults (CDC, 2007). Most patients were males (85.1%), between the 18-65 years of age (85.1%), and most (61.2%) had sustained extracranial injuries. Other co-morbidities, such as hypertension and diabetes, were present to a lesser degree (34.3%, and 14.9%, respectively). This data verifies that ICU nurses are routinely responsible for managing the physiological parameters associated with secondary brain injury, and that content of the vignettes accurately reflects real-life patient scenarios, thus content validity was established.
Table 7

*Last Case Data*

<table>
<thead>
<tr>
<th>Characteristic of Last Case</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Last TBI Patient</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within last week</td>
<td>44</td>
<td>65.7%</td>
</tr>
<tr>
<td>Within last month</td>
<td>23</td>
<td>32.3%</td>
</tr>
<tr>
<td><strong>Parameters Managed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td>67</td>
<td>100%</td>
</tr>
<tr>
<td>O2sat</td>
<td>67</td>
<td>100%</td>
</tr>
<tr>
<td>Temperature</td>
<td>67</td>
<td>100%</td>
</tr>
<tr>
<td>ICP</td>
<td>35</td>
<td>52.2%</td>
</tr>
<tr>
<td>CPP</td>
<td>34</td>
<td>50.7%</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>16.4%</td>
</tr>
<tr>
<td><strong>Patient Mechanism of Injury</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVA</td>
<td>31</td>
<td>46.3%</td>
</tr>
<tr>
<td>Fall</td>
<td>23</td>
<td>34.3%</td>
</tr>
<tr>
<td>Assault</td>
<td>7</td>
<td>10.4%</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>9%</td>
</tr>
<tr>
<td><strong>Patient Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>57</td>
<td>85.1%</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>14.9%</td>
</tr>
</tbody>
</table>
Table 7, cont.

<table>
<thead>
<tr>
<th>Characteristic of Last Case</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-35 years</td>
<td>20</td>
<td>29.9%</td>
</tr>
<tr>
<td>36-65 years</td>
<td>37</td>
<td>55.2%</td>
</tr>
<tr>
<td>66-85 years</td>
<td>7</td>
<td>10.4%</td>
</tr>
<tr>
<td>Over 85 years</td>
<td>3</td>
<td>4.5%</td>
</tr>
<tr>
<td>Patient Secondary Diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extracranial Injuries</td>
<td>41</td>
<td>61.2%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>23</td>
<td>34.3%</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>10</td>
<td>14.9%</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>10.4%</td>
</tr>
</tbody>
</table>

Overview of Data Analysis Techniques

Data were analyzed using methods consistent with factorial survey methodology (Ludwick & Zeller, 2001). A series of vignettes reflecting real life clinical contexts were randomly generated using different values, or levels, of each physiological and situational variable. Each nurse respondent was asked to read two standardized (i.e. “give away”) vignettes to familiarize them with the structure of the vignettes, and to provide information on how high or low respondents tended to score vignettes. Each nurse respondent then received five randomly generated 2-part vignettes and was asked to indicate judgments they would make if faced with the situation in the vignette.
Consistent with factorial survey methodology, multiple regression analyses were conducted to investigate the relationships among study variables (Ludwick & Zeller, 2001). A multiple regression model was created for each dependent variable (judgments) to test the independent variables (i.e. vignette variables and nurse variables). The first set of regressions tested the effects of vignette variables (i.e. physiological and situational variables) on each dependent variable. The second set of regressions analyzed the effects of nurse variables on the same three dependent variables. Each analysis provided information on the amount of variance explained, effect sizes, and significance of variables predicting each of the three dependent variables.

Independent variables that were categorical and non-continuous were dummy coded to investigate the effect that each category of the nominal variable had on the dependent variable. In each regression model, one level of each independent variable was used as a base level for comparison and analysis. For physiological variables, level 1 values (i.e. normal values) were used as base levels. For situational variables that had a null category (i.e. patient secondary diagnosis), the null was used as the base level. For situational variables with no null category, the level that had the lowest mean was used as the base level in regression analyses. Table 8 displays the base level for each independent variable.
Table 8

*Base Categories of Independent Variables for Each Dependent Variable*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Base Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
<td>Level 1  (SBP 90-100mmHg)</td>
</tr>
<tr>
<td>O2sat</td>
<td>Level 1  (O2sat 90-95%)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Level 1  (T 38-38.5 degrees C)</td>
</tr>
<tr>
<td>ICP</td>
<td>Level 1  (ICP 15-20 mmHg)</td>
</tr>
<tr>
<td>CPP</td>
<td>Level 1  (CPP 60-65 mmHg)</td>
</tr>
<tr>
<td>Primary Diagnosis</td>
<td>Level 2  (SDH)</td>
</tr>
<tr>
<td>Secondary Diagnosis</td>
<td>Level 4  (Null)</td>
</tr>
<tr>
<td>Patient Age</td>
<td>Level 7  (Age=85)</td>
</tr>
<tr>
<td>Patient Gender</td>
<td>Level 1  (Male)</td>
</tr>
<tr>
<td>Mechanism of Injury</td>
<td>Level 1  (Fall)</td>
</tr>
<tr>
<td>Nursing Shift</td>
<td>Level 2  (Evenings)</td>
</tr>
</tbody>
</table>

To investigate how characteristics of nurse respondents influenced judgments above and beyond vignette variables (i.e. beyond physiological and situational variables),
two-step multiple regression analyses were done. In these analyses, independent variables for each judgment were entered in blocks. In the first block, all physiological and situational variables from vignettes were entered. In the second block, nurse variables were added. This was done to investigate the incremental $R^2$ change and whether the addition of nurse variables increased the variance explained when added to vignette variables.

Once multiple regression analyses was done, one way analysis of variance (ANOVA) was used with each significant independent variable to identify how different levels of each variable influenced mean judgment scores of nurse respondents. Finally, post hoc tests with Least Significant Difference (LSD) were used to identify significant differences among various pairs of means.

Data Cleaning

All methods for data cleaning and analyses were performed using SPSS, version 15.0. Data from study surveys were coded and entered into an SPSS database by the PI. Data were manually rechecked by the PI after each group of surveys (i.e. surveys from each of the different ICUs) were entered, and then again after all surveys had been entered. Frequency distributions and logic checks were performed using SPSS to determine outliers and missing values.

Quality Check of Vignette Data

To ensure the quality of the vignettes prior to hypothesis testing, several analyses were performed. First, nurse responses to the two standardized (i.e. “give away”) vignettes were analyzed. Second, correlational analyses were performed to determine
relationships among the independent variables used in the vignettes and among the three
dependent variables. The results of these analyses will be discussed separately.

_Apalysis of Standardized “Give Away” Vignettes_

The main section of the study surveys consisted of a series of vignettes that nurses
were asked to read and indicate judgments they would be most likely to make using a
likert rating scale. All nurses first received the same two standardized or “give away”
vignettes, followed by 5 randomly generated vignettes that were unique for each survey.
Consistent with factorial survey methodology, the first two standardized “give away”
vignettes were used to provide information on how high or low nurses tended to score
vignettes, and to familiarize nurses with the vignette structure. The first vignette
represented the “worst case scenario” and was composed of all Level 4 values (i.e. values
farthest from normal ranges) for each physiological variable. The second vignette
depicted a “best case scenario” and therefore contained Level 1 values (i.e. values closest
to normal ranges) for each physiological variable. Nurses were asked to rate the
likelihood of making the three separate judgments about secondary brain injury (risk for
secondary brain injury, using nursing interventions, consulting) using a likert rating scale.
The mean judgment scores for each give away vignette are depicted in Table 9.

It was expected that nurses would read the worst case vignette and judge the
patient to be at high risk for secondary brain injury (high judgment score), be unlikely to
manage with only nursing interventions (low judgment score), and be very likely to
consult another member of the healthcare team (high judgment score). This pattern is
apparent in Table 9. Conversely, it was expected that nurses would read the best case
vignette and determine low risk for secondary brain injury (low judgment score), high likelihood of managing only with nursing interventions (high judgment score), and low likelihood of consulting other members of the healthcare team (low judgment score). This pattern is again present in Table 9, which indicates that nurses were able to quickly familiarize themselves with the vignette structure and accurately make judgments based on the information presented, thus strengthening the validity of the vignettes.

Table 9

*Mean Judgment Scores for Give Away Vignettes*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Worst Case Vignette</th>
<th>Best Case Vignette</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk for Secondary Brain Injury</td>
<td>Mean=9.58</td>
<td>Mean=3.37</td>
</tr>
<tr>
<td></td>
<td>S.D.=1.032</td>
<td>S.D.=2.262</td>
</tr>
<tr>
<td>Nursing Interventions</td>
<td>Mean=1.33</td>
<td>Mean=7.12</td>
</tr>
<tr>
<td></td>
<td>S.D.=2.351</td>
<td>S.D.=2.837</td>
</tr>
<tr>
<td>Consulting</td>
<td>Mean=9.59</td>
<td>Mean=3.20</td>
</tr>
<tr>
<td></td>
<td>S.D.=1.276</td>
<td>S.D.=3.095</td>
</tr>
</tbody>
</table>

*Correlational Analyses*

Correlations Among Independent (Vignette) Variables

A total of 335 vignettes were used for data analysis. Because the vignette is the unit of analysis in factorial survey, it is important to ensure the orthogonality and independence of independent variables used in the randomly generated vignettes. A correlation matrix using all physiological and situational variables was therefore created to determine if variables were orthogonal and independent (Table 10). For the vignette variables (physiological and situational variables), no strong and significant correlations
were found, defined as correlations greater than \( r = .8 \), with a significance level at \( p = .000 \) or \( p = .05 \). This provides evidence of the independence and orthogonality of the vignette variables. When examining correlations between the different groups of variables (physiological and situational), again no strong and significant correlations were found, indicating each group of variables were independent of one another. Because the order of vignettes was random within and across the study sample, and because no strong and significant correlations were found among vignette variables or across the different groups of variables, the independent variables were considered to be independent.

Table 10

*Correlation Matrix for Independent Variables*

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BP</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. O2sat</td>
<td>.031</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Temp</td>
<td>.066</td>
<td>.019</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ICP</td>
<td>.284**</td>
<td>.035</td>
<td>.058</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. CPP</td>
<td>.564**</td>
<td>.081</td>
<td>.071</td>
<td>.426**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Primary Diagnosis</td>
<td>-.042</td>
<td>-.005</td>
<td>-.042</td>
<td>.039</td>
<td>-.026</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Secondary Diagnosis</td>
<td>.133*</td>
<td>.035</td>
<td>-.062</td>
<td>.011</td>
<td>.150*</td>
<td>.012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Mechanism Injury</td>
<td>-.004</td>
<td>.024</td>
<td>.187*</td>
<td>-.017</td>
<td>-.014</td>
<td>-.023</td>
<td>-.064</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Shift</td>
<td>.056</td>
<td>-.021</td>
<td>-.007</td>
<td>.094</td>
<td>.035</td>
<td>.040</td>
<td>-.028</td>
<td>.028</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10. Assessment</td>
<td>-.009</td>
<td>-.032</td>
<td>-.070</td>
<td>-.070</td>
<td>-.072</td>
<td>.053</td>
<td>-.008</td>
<td>-.064</td>
<td>.069</td>
<td>1</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2 tailed)
Correlations Among Dependent Variables

Separate analyses were performed to determine correlations among dependent variables (Table 11). Moderate correlations were found among the dependent variables of risk of secondary brain injury and manage by consulting ($r=0.767$, $p=.001$). Conversely, there was a modest negative correlation between the dependent variables of risk of secondary brain injury and managing with nursing interventions ($r=-0.775$, $p=.001$). This can be explained by the fact that if a nurse judges a patient to be at high risk of secondary brain injury, the nurse would be more likely to consult another member of the healthcare team to assist with the situation, and less likely to manage that situation solely with nursing interventions.

Table 11
Correlation Matrix for Dependent Variables

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Secondary Brain Injury</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing Interventions</td>
<td>-.775**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Consulting</td>
<td>.767**</td>
<td>-.758**</td>
<td>1</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2 tailed)

While modest correlations exist among the dependent variables of this study and make clinical sense, they are still considered to be three separate judgments. A nurse may judge a patient to be at increased risk for secondary brain injury, but may still determine that nursing interventions are appropriate. Conversely, a patient may be considered at
lower risk for secondary brain injury and a nurse may determine that consultation with
another member of the healthcare team is necessary to assist with the immediate
management of the situation. Thus, although the modest correlations among dependent
variables indicate that nurses may be likely to use nursing interventions or consult
depending on patient risk for secondary brain injury, this may not always be the case.

Hypothesis Testing

The purpose of this study was to investigate how physiological, situational, and
nurse variables influenced ICU nurse judgments about secondary brain injury when
caring for the critically ill TBI patient. Specifically, the following research questions and
hypotheses were addressed:

1) How do physiological and situational variables influence ICU nurse judgments about
secondary brain injury when caring for the critically ill TBI patient?

   **Hypothesis 1A**: More severe physiological variables (i.e. level 3 or 4 values, or
values farthest from normal ranges), and situational variables of primary
diagnosis, (intracerebral hemorrhage (ICH) or diffuse axonal injury (DAI)),
secondary diagnosis (extracranial injuries, hypertension, diabetes mellitus (DM)),
and increasing patient age will increase nurse judgments about patient risk for
secondary brain injury.

   **Hypothesis 1B**: More severe physiological variables (level 3 or 4 values, or values
farthest from normal ranges), and the situational variable of shift (day shift) will
decrease nurse judgments to manage a situation solely with nursing interventions.
Hypothesis 1C: More severe physiological variables (level 3 or 4 values, or values farthest from normal ranges), and the situational variable of shift (day shift) will increase nurse judgments to manage a situation by consulting another member of the healthcare team.

2) How do nurse variables influence ICU nurse judgments about secondary brain injury when caring for the critically ill TBI patient?

Hypothesis 2A: Nurses with higher levels of experience (i.e. total years in ICU, years in current ICU, and years with TBI patient) will have increased judgments about patient risk for secondary brain injury.

Hypothesis 2B: Nurses with higher experience levels (i.e. total years in ICU, years in current ICU, years with TBI patient) and who work night shift will have increased judgments to manage a situation solely with nursing interventions.

Hypothesis 2C: Nurses with higher experience levels (i.e. total years in ICU, years in current ICU, years with TBI patient) and who work day shift will have increased judgments to manage a situation by consulting another member of the healthcare team.

Hypothesis (H) 1A-1C: Vignette Variables and Judgments

Regression Model 1A: Vignette Variables and Risk for Secondary Brain Injury (H 1A)

As stated in hypothesis 1A, it was expected that severe physiological variables (i.e. level 3 or 4 values, or values farthest from normal ranges), patient primary diagnosis of ICH or DAI, secondary diagnosis of extracranial injuries, hypertension, or DM, and increasing patient age would cause nurses to judge a patient to be at increased risk of
secondary brain injury. Regression model 1A presents the results of the multiple regression analyses performed using all physiological and situational variables with the dependent variable of patient risk for secondary brain injury. The overall significance of this model will first be presented, followed by an explanation of the physiological variables in the model as they relate to hypothesis 1A. Finally, the situational variables of regression model 1A will be described in relation to hypothesis 1A.

**Significance of regression model 1A.** The multiple regression conducted on model 1 revealed that this model was significant in predicting nurse judgments about risk for secondary brain injury. Specifically, physiological and situational variables had a .613 correlation with likelihood of secondary brain injury, and accounted for over 30% of the variance ($R=.613; R^2=.376; R^2_{adj}=.308; F(33, 301)=5.500, p=.000$). As shown in the “Coefficients” output (Table 12), each of the 33 regression slopes was calculated, and of these twelve were significant.
### Table 12

*Regression Coefficients Predicting Risk of Secondary Brain Injury*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>$\beta$</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>4.035</td>
<td>.523</td>
<td>7.714</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>BP2 (SBP 80-89)</td>
<td>.061</td>
<td>.272</td>
<td>.014</td>
<td>.224</td>
<td>.823</td>
</tr>
<tr>
<td>BP3 (SBP 70-79)</td>
<td>.439</td>
<td>.328</td>
<td>.085</td>
<td>1.339</td>
<td>.182</td>
</tr>
<tr>
<td>BP4 (SBP &lt;70)</td>
<td>.536</td>
<td>.299</td>
<td>.112</td>
<td>1.794</td>
<td>.074</td>
</tr>
<tr>
<td>O2sat2 (85-89%)</td>
<td>1.024</td>
<td>.251</td>
<td>.244</td>
<td>4.087</td>
<td>.000</td>
</tr>
<tr>
<td>O2sat3 (80-84%)</td>
<td>1.302</td>
<td>.250</td>
<td>.305</td>
<td>5.212</td>
<td>.000</td>
</tr>
<tr>
<td>O2sat4 (&lt;80%)</td>
<td>1.233</td>
<td>.265</td>
<td>.271</td>
<td>4.662</td>
<td>.000</td>
</tr>
<tr>
<td>Temp2 (38.6-39)</td>
<td>.098</td>
<td>.248</td>
<td>.024</td>
<td>.398</td>
<td>.691</td>
</tr>
<tr>
<td>Temp3 (39.1-39.5)</td>
<td>-.192</td>
<td>.263</td>
<td>-.043</td>
<td>-.727</td>
<td>.467</td>
</tr>
<tr>
<td>Temp4 (&gt;39)</td>
<td>.113</td>
<td>.270</td>
<td>.025</td>
<td>.416</td>
<td>.677</td>
</tr>
<tr>
<td>ICP2 (ICP 21-25)</td>
<td>.182</td>
<td>.225</td>
<td>.045</td>
<td>.809</td>
<td>.419</td>
</tr>
<tr>
<td>ICP3 (ICP 26-30)</td>
<td>.582</td>
<td>.290</td>
<td>.122</td>
<td>2.006</td>
<td>.046</td>
</tr>
<tr>
<td>ICP4 (ICP &gt;30)</td>
<td>.952</td>
<td>.282</td>
<td>.197</td>
<td>3.381</td>
<td>.001</td>
</tr>
<tr>
<td>CPP2 (CPP 55-59)</td>
<td>.907</td>
<td>.395</td>
<td>.144</td>
<td>2.295</td>
<td>.022</td>
</tr>
<tr>
<td>CPP3 (CPP 50-54)</td>
<td>1.284</td>
<td>.398</td>
<td>.226</td>
<td>3.223</td>
<td>.001</td>
</tr>
<tr>
<td>CPP4 (CPP &lt;50)</td>
<td>1.843</td>
<td>.372</td>
<td>.461</td>
<td>4.956</td>
<td>.000</td>
</tr>
<tr>
<td>EDH (Diagnosis1)</td>
<td>.366</td>
<td>.242</td>
<td>.085</td>
<td>1.513</td>
<td>.131</td>
</tr>
</tbody>
</table>
Table 12, cont.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICH (Diagnosis3)</td>
<td>.482</td>
<td>.242</td>
<td>.112</td>
<td>1.993</td>
<td>.047</td>
</tr>
<tr>
<td>DAI (Diagnosis4)</td>
<td>.511</td>
<td>.254</td>
<td>.112</td>
<td>2.011</td>
<td>.045</td>
</tr>
<tr>
<td>Extracranial Injury (Sec.Dx1)</td>
<td>.338</td>
<td>.253</td>
<td>.081</td>
<td>1.337</td>
<td>.182</td>
</tr>
<tr>
<td>Hypertension (Sec.Dx2)</td>
<td>.173</td>
<td>.249</td>
<td>.041</td>
<td>.693</td>
<td>.489</td>
</tr>
<tr>
<td>DM (Sec. Dx3)</td>
<td>-.042</td>
<td>.266</td>
<td>-.009</td>
<td>-.158</td>
<td>.875</td>
</tr>
<tr>
<td>Patient Age1 (25)</td>
<td>.146</td>
<td>.331</td>
<td>.027</td>
<td>.441</td>
<td>.660</td>
</tr>
<tr>
<td>Patient Age2 (35)</td>
<td>.273</td>
<td>.340</td>
<td>.051</td>
<td>.805</td>
<td>.422</td>
</tr>
<tr>
<td>Patient Age3 (45)</td>
<td>-.181</td>
<td>.333</td>
<td>-.034</td>
<td>-.545</td>
<td>.586</td>
</tr>
<tr>
<td>Patient Age4 (55)</td>
<td>.319</td>
<td>.336</td>
<td>.059</td>
<td>.950</td>
<td>.343</td>
</tr>
<tr>
<td>Patient Age5 (65)</td>
<td>.264</td>
<td>.328</td>
<td>.050</td>
<td>.806</td>
<td>.421</td>
</tr>
<tr>
<td>Patient Age6 (75)</td>
<td>.138</td>
<td>.336</td>
<td>.026</td>
<td>.409</td>
<td>.683</td>
</tr>
<tr>
<td>Gender2 (female)</td>
<td>.202</td>
<td>.178</td>
<td>.054</td>
<td>1.133</td>
<td>.258</td>
</tr>
<tr>
<td>MVA (Mech. Injury2)</td>
<td>.632</td>
<td>.264</td>
<td>.143</td>
<td>2.393</td>
<td>.017</td>
</tr>
<tr>
<td>Struck (Mech.Injury3)</td>
<td>.389</td>
<td>.261</td>
<td>.090</td>
<td>1.494</td>
<td>.136</td>
</tr>
<tr>
<td>Assault (Mech. Injury4)</td>
<td>.235</td>
<td>.252</td>
<td>.057</td>
<td>.932</td>
<td>.352</td>
</tr>
<tr>
<td>Days (Shift1)</td>
<td>.444</td>
<td>.213</td>
<td>.111</td>
<td>.2086</td>
<td>.038</td>
</tr>
<tr>
<td>Nights (Shift3)</td>
<td>.229</td>
<td>.218</td>
<td>.056</td>
<td>1.049</td>
<td>.295</td>
</tr>
</tbody>
</table>
Physiological variables and risk. Based on the regression in model 1A, physiological variables significant in predicting nurse judgments about likelihood of secondary brain injury were three levels of O2sat (B=1.024, 1.302, 1.233; p=.000), one level of ICP (B=.952; p=.001), and three levels of CPP (B=.907, p=.022; B=1.284, p=.001; B=1.843, p=.000). The remaining physiological variables of BP and temperature were not significant. A one way ANOVA was performed with each variable that was significant in the regression model. The results of these analyses will first be presented for O2sat, followed by ICP and CPP.

The variable of O2sat had 4 levels. Level 1 (O2sat= 90-95%) was used as the base category in regression model 1. When the remaining 3 levels of O2sat were compared to Level 1, all were significant (p=.000) and increased nurse judgments about risk for secondary brain injury (Table 12), supporting hypothesis 1A. One way ANOVA was performed to explore the impact of O2sat on risk for secondary brain injury. All 4 levels of O2sat were used in the analysis. There was a statistically significant difference in judgments about risk for secondary brain injury for the 4 different levels of O2sat (Table 13). Hypothesis 1A states that nurses would increase their judgment scores about risk for secondary brain injury as O2at levels deteriorated from level 1 (O2sat=90-95%) to level 4 (O2sat <80%). In table 11, the mean judgment scores about risk for secondary brain injury increase as levels of O2sat increase from 1 (O2sat 90-95%) to 4 (O2sat <80%), supporting hypothesis 1A. Post hoc analyses using LSD for O2sat indicate that there were significant differences between the mean scores for all levels of O2sat, except when comparing levels 2,3 and levels 3,4. Thus, nurses judged O2sat values of 85-89% (level 2
value) and 80-84% (level 3 value) to be similar, and O2sat values 80-84% (level 3) and <80% to similar in terms of their influence on judgments.

Table 13

**Results of One Way ANOVA for O2sat and Risk of Secondary Brain Injury**

<table>
<thead>
<tr>
<th>O2sat Level</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (O2sat 90-95%)</td>
<td>81</td>
<td>7.49</td>
<td>2.383</td>
</tr>
<tr>
<td>Level 2 (O2sat 85-89%)</td>
<td>93</td>
<td>8.34</td>
<td>1.891</td>
</tr>
<tr>
<td>Level 3 (O2sat 80-84%)</td>
<td>88</td>
<td>8.74</td>
<td>1.450</td>
</tr>
<tr>
<td>Level 4 (O2sat &lt;80%)</td>
<td>73</td>
<td>8.99</td>
<td>1.253</td>
</tr>
</tbody>
</table>

\[F (3,331)=10.416; \ p=.000\]

The physiological variable of ICP had 4 levels. Level 1 (ICP 15-20 mmHg) was used as the base category for this variable. When the remaining 3 levels were compared with the base category, ICP levels greater than 30 mmHg (i.e. level 4 value) significantly increased nurse judgments about patient risk for secondary brain injury (B=.952; \(p=.001\)) (Table 12). One way ANOVA was performed to determine if increasing levels or values of ICP resulted in increased nurse judgments about risk for secondary brain injury. Table 14 displays the results of this analysis. As presented in Table 14, there were significant differences among the mean judgment scores for risk of secondary brain injury for the different levels of ICP. Judgment scores for risk of secondary brain injury increased as ICP levels moved from level 1 (ICP 15-20 mmHg) to level 4 (ICP>30 mmHg). Post hoc
analyses for the various levels of ICP indicate that all pairs of comparisons were significant except for ICP levels 1,2 and 3,4. This suggests that nurses judged patients with ICP levels at 1 or 2 (i.e. ICP 15-20mmHg or 21-25 mmHg) to be at similar risk for secondary brain injury, and patients with ICP levels at 3 or 4 (i.e. ICP 26-30mmHg or >30mmHg) to also be at equal risk for injury. Based on these analyses, hypothesis 1A was supported for ICP.

Table 14

*Results of One Way ANOVA for ICP and Risk of Secondary Brain Injury*

<table>
<thead>
<tr>
<th>ICP Level</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (ICP 15-20mmHg)</td>
<td>102</td>
<td>7.76</td>
<td>2.126</td>
</tr>
<tr>
<td>Level 2 (ICP 21-25mmHg)</td>
<td>107</td>
<td>7.95</td>
<td>2.062</td>
</tr>
<tr>
<td>Level 3 (ICP 26-30 mmHg)</td>
<td>64</td>
<td>9.06</td>
<td>1.097</td>
</tr>
<tr>
<td>Level 4 (ICP &gt;30 mmHg)</td>
<td>62</td>
<td>9.44</td>
<td>.822</td>
</tr>
</tbody>
</table>

$F(3,331)=16.912, p=.000$)

The physiological variable of CPP had 4 levels. Level 1 (CPP 60-65 mmHg) was used as the base category in regression model 1A. CPP values between 55-59 mmHg (level 2 value), 50-54 mmHg (level 3 value), and less than 50 mmHg (level 4 value) were all significant in predicting nurse judgments about risk for secondary brain injury. One way ANOVA to determine differences among mean judgment scores for the various levels of CPP is presented in Table 15. An examination of this analysis indicates that
there were significant differences among the mean judgment scores for the different CPP levels. The mean judgment scores about risk for secondary brain injury increase as levels of CPP deteriorate from level 1 (CPP 60-65 mmHg) to level 4 (CPP <50 mmHg). Post hoc analyses indicate that all pairs of comparisons for CPP were significant except for levels 2, 3, indicating that patients with CPP at 2, 3 (i.e. CPP values 55-59 mmHg and 50-54 mmHg) were judged to be at similar risk for secondary brain injury. Based on the regression and ANOVA analyses, ICU nurses are more likely to judge a patient at risk for secondary brain injury as CPP values worsen, thus supporting hypothesis 1A for CPP.

Table 15

Results of One Way ANOVA for CPP and Risk for Secondary Brain Injury

<table>
<thead>
<tr>
<th>CPP Level</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>35</td>
<td>6.40</td>
<td>2.452</td>
</tr>
<tr>
<td>(CPP 60-65 mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>33</td>
<td>7.33</td>
<td>2.630</td>
</tr>
<tr>
<td>(CPP 55-59 mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>42</td>
<td>7.79</td>
<td>1.945</td>
</tr>
<tr>
<td>(CPP 50-54 mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td>225</td>
<td>8.96</td>
<td>1.228</td>
</tr>
<tr>
<td>(CPP&lt;50 mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(F(3,331)=31.565, p=.000\)

Overall, hypothesis 1A was only partially supported for physiological variables. Hypothesis 1A was supported for three of the five physiological variables: O2sat, ICP, and CPP. An ICU nurse judged a patient to be at increased risk for secondary brain injury if the patient had worsening values of O2sat, ICP, and CPP. Deteriorating values
for patient BP and temperature were not shown to increase nurse judgments about risk for secondary brain injury in the critically ill TBI patient. Thus, hypothesis 1A was not supported for BP and temperature.

Situational variables and risk. In addition to physiological variables, regression model 1A also provides information on how situational variables in the vignettes influenced ICU nurse judgments about patient risk for secondary brain injury. The situational variables that were significant in regression model 1A will first be presented, followed by the results of the ANOVAs for each significant situational variable.

An examination of the individual regression slopes provided in Table 12 indicates that situational variables influencing judgments were patient diagnosis ($B=.482, p=.047$; $B=.511, p=.045$), mechanism of injury ($B=.632, p=.017$), and nursing shift ($B=.444, p=.038$).

Patient diagnosis had 4 levels (epidural hematoma (EDH) subdural hematoma (SDH), intracerebral hemorrhage (ICH), and diffuse axonal injury (DAI). In regression model 1A, patient diagnosis level 2 (SDH) was used as the base category. In Table 12, patient diagnosis of ICH ($B=.482, p=.047$) or DAI ($B=.511, p=.045$) were significant in predicting nurse judgments about patient risk for secondary brain injury. Therefore, hypothesis 1A is supported for patient diagnosis. One way ANOVA for patient diagnosis indicated that there were not significant differences among the mean judgment scores for risk of secondary brain injury among the different types of patient diagnosis. Thus, although the variable was significant in the regression model predicting judgments about
risk for secondary brain injury, the differences among the mean judgment scores across the different levels or values of this variable were not significant.

Patient mechanism of injury had 4 levels (fall, motor vehicle accident (MVA), struck by object, assault). Level 1 (fall) was used as the base category in regression model 1A. When the remaining levels were compared with level 1, patients who had sustained head injuries from an MVA (level 2) significantly increased nurses’ judgments about risk for secondary brain injury ($B=.632, p=.017$). One way ANOVA comparing mean judgment scores about patient risk for secondary brain injury across different levels of mechanism of injury indicate no significant differences among mean judgment scores.

The situational variable of nursing shift was shown in regression model 1A to be significant at predicting nurse judgments about risk for secondary brain injury. Nursing shift had 3 levels (days, evenings, nights). Level 2 (evening shift) was used as the base category in regression model 1A. When the remaining 2 levels were compared with the base level, the level 1 value (day shift) was significant in predicting judgments about risk of secondary brain injury ($B=0.444, p=.038$). One way ANOVA investigating judgment scores across different types of nursing shift indicate that there were no significant differences in the mean judgment scores for the various shifts.

*Summary of regression model 1A: Hypothesis 1A.* Hypothesis 1A was partially supported. It was expected that worsening physiological values would result in increased nurse judgments about risk for secondary brain injury. This pattern was present for three of the five physiological variables: O2at, ICP, and CPP. Further, it was hypothesized that judgments about risk for secondary brain injury would be higher for older patients with a
primary diagnosis of ICH, DAI, and who also had extracranial injuries, hypertension, or DM. While nurse judgments about risk were higher for patients with ICH and DAI, supporting hypothesis 1A, the remaining situational variables hypothesized to influence judgments (i.e. increased patient age, secondary diagnosis of extracranial injuries, hypertension, or DM) were not significant. Instead, nurses caring for patients who had been in an MVA (mechanism of injury) on the day shift (shift) were more likely to judge their patient at increased risk for secondary brain injury.

Regression Model 1B: Vignette Variables and Nurse Interventions (H 1B)

As stated in hypothesis 1B, it was expected that worsening physiological variables (i.e. level 3 or 4 values, or values farthest from normal ranges), and the situational variable of nursing shift (day shift) would decrease nurse judgments to manage a situation solely with nursing interventions. Regression model 1B presents the results of the multiple regression analyses performed using all physiological and situational variables with the dependent variable of management solely with nursing interventions. The overall significance of this model will first be presented, followed by an explanation of the physiological variables in the model as they relate to hypothesis 1B. Finally, the situational variables of regression model 1B will be described in relation to hypothesis 1B.

Significance of regression model 1B. The multiple regression conducted on model 1B using all physiological and situational variables revealed that this model was significant in predicting nurse judgments about managing a situation solely with nursing interventions ($R = .557, R^2 = .310, R^2_{adj} = .235, F (33, 301) = 4.103, p = .000$). The coefficients
output displays the individual regression slopes (Table 16), and six variables were significant.

Table 16

*Regression Coefficients Predicting Likelihood of Nursing Interventions*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>SE</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
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<td>.745</td>
<td>-.1299</td>
<td>.195</td>
<td></td>
</tr>
<tr>
<td>BP2</td>
<td>.007</td>
<td>.400</td>
<td>.001</td>
<td>.018</td>
<td>.985</td>
</tr>
<tr>
<td>BP3</td>
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<td>.482</td>
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<td>-.049</td>
<td>.961</td>
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<tr>
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<td>.405</td>
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<td>-.037</td>
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<td>.550</td>
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<td>-.028</td>
<td>-.555</td>
<td>.579</td>
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<td>-.100</td>
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<td>Nights (Shift3)</td>
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<td>.109</td>
<td>1.865</td>
<td>.063</td>
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</table>
Physiological variables and nurse interventions. Based on the regression in model 1B, three of the five physiological variables significantly predicted nurse judgments about management solely with nursing interventions: O2sat (B=-1.200, \(p=.001\), B=-1.974, B=-1.604, \(p=.000\)), ICP (B=-1.257, \(p=.003\)), and CPP (B=-1.756, \(p=.001\)). The remaining physiological variables of BP and temperature were not significant.

O2sat had 4 levels, and level 1 (O2 sat 90-95%) was used as the base category in regression model 1B. When the remaining levels for O2sat were compared to level 1, levels 2 (O2sat 85-89%), 3 (O2sat 80-84%), and 4 (O2sat <80%) were significant in predicting judgments about nursing interventions. The negative beta weight associated with these levels in the displayed regression coefficients indicates that nurses were least likely to manage a situation solely with nursing interventions if O2sat levels were at all below normal levels (i.e. if O2sat levels were at level 2, level 3, or level 4, which are all below the normal levels of 90-95%). A one way ANOVA was performed to determine if mean judgment scores about nursing interventions decreased as values for O2sat deteriorated (moved to a level 3 or 4 value, or farther from normal ranges). Table 17 reveals that there were significant differences among the mean judgment scores to manage with nursing interventions across the various levels of O2sat. Judgment scores decreased as values for O2sat worsened, thus supporting hypothesis 1B.

Post hoc analysis using LSD indicated that all pairs of comparisons for the various levels of O2sat were significant, except for level 3 (O2sat 80-84%) and 4 (O2sat<80%). Thus, nurses determined O2sat values at either of these levels (i.e. O2sat 84% or less) to be equally detrimental.
Table 17

Results of One Way ANOVA for O2sat and Nurse Interventions

<table>
<thead>
<tr>
<th>Shift</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>81</td>
<td>3.54</td>
<td>3.091</td>
</tr>
<tr>
<td>(O2sat 90-95%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>93</td>
<td>2.52</td>
<td>2.873</td>
</tr>
<tr>
<td>(O2sat 85-89%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>88</td>
<td>1.69</td>
<td>1.865</td>
</tr>
<tr>
<td>(O2sat 80-84%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td>73</td>
<td>1.68</td>
<td>2.027</td>
</tr>
<tr>
<td>(O2sat &lt;80%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$F(3,331)=9.778, p=.000$

The physiological variable of ICP had 4 levels. Level 1 (ICP=15-25 mmHg) was used as the base category in regression model 1B. When the remaining levels of ICP were compared to level 1, ICP level 4 (ICP >30 mmHg) (B=-1.257, p=.003) was significant in predicting judgments about nursing interventions. Nurses were least likely to use nursing interventions if a patient’s ICP was greater than 30 mmHg (i.e. if a patient’s ICP was farthest outside normal values).

One way ANOVA of the mean judgment scores for nursing interventions across the different levels of ICP was performed (Table 18). There were significant differences among mean judgment scores for ICP. Nurses’ judgments to use only nursing interventions were highest when ICP values were at level 1 (ICP=15-20mmHg, normal values). As values for ICP deteriorated (moved from level 1 to level 4), nurses were less likely to manage the situation solely with nursing interventions, as evidenced by the
decrease in mean judgment scores. Thus, hypothesis 1B was supported for ICP. Post hoc analyses for ICP indicated that all pairs of comparisons were significant, except for level 1 and 2, and for level 3 and 4. Based on this information, nurses judged ICP levels 1 (ICP 15-20 mmHg) and 2 (ICP 21-25 mmHg) to be comparable in terms of their severity and their influence on judgments about nursing interventions. Similarly, nurses also judged ICP values at level 3 (ICP 26-30 mmHg) and 4 (ICP >30 mmHg) to be equally detrimental to a patient’s condition, which influenced their judgments.

Table 18

Results of One Way ANOVA for ICP and Nurse Interventions

<table>
<thead>
<tr>
<th>Shift</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>102</td>
<td>3.10</td>
<td>2.933</td>
</tr>
<tr>
<td>(ICP 15-20 mmHg)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>107</td>
<td>2.92</td>
<td>2.632</td>
</tr>
<tr>
<td>(ICP 21-25 mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>64</td>
<td>1.67</td>
<td>2.190</td>
</tr>
<tr>
<td>(ICP 26-30 mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 4</td>
<td>62</td>
<td>.94</td>
<td>1.618</td>
</tr>
<tr>
<td>(ICP &gt;30 mmHg)</td>
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</tr>
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</table>

\(F(3,331)=13.075, p=.000\)

The physiological variable of CPP had 4 levels, and level 1 (CPP 60-65 mmHg) was used as the base category in regression model 1B. When the remaining levels were compared to level 1, level 4 (CPP <50 mmHg, abnormal value) values significantly predicted nurse judgments about nursing interventions. Nurses were least likely to
manage a situation solely with nursing interventions if CPP values were below 50 mmHg (i.e. if CPP values farthest outside normal limits).

One way ANOVA was performed to determine if there were differences among judgment scores across the various levels of CPP. Table 19 provides results of this analysis. There were significant differences in mean judgment scores about using solely nursing interventions across the different values of CPP. As illustrated in Table 19, nurse judgment scores about using only nursing interventions decreased as CPP values deteriorated (moved to level 3 (CPP 50-54 mmHg) and level 4 (CPP <50 mmHg) values). Thus, hypothesis 1B is supported for CPP. Post hoc analysis using LSD indicated that there were significant differences among the different pairs of comparisons for CPP except for levels 1 and 2 and levels 2 and 3. This suggests that CPP values of 1, 2 (i.e. CPP values of 60-65 mmHg and 55-60 mmHg) and 2, 4 (i.e. CPP values 55-60mmHg and <50 mmHg) were similar in terms of their influence on judgment scores about management solely with nursing interventions.
Table 19

Results of One Way ANOVA for CPP and Nursing Interventions

<table>
<thead>
<tr>
<th>Shift</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (CPP 60-65 mmHg)</td>
<td>35</td>
<td>4.29</td>
<td>3.286</td>
</tr>
<tr>
<td>Level 2 (CPP 55-59 mmHg)</td>
<td>33</td>
<td>4.12</td>
<td>3.029</td>
</tr>
<tr>
<td>Level 3 (CPP 50-54 mmHg)</td>
<td>42</td>
<td>3.17</td>
<td>2.784</td>
</tr>
<tr>
<td>Level 4 (CPP &lt;50 mmHg)</td>
<td>225</td>
<td>1.66</td>
<td>2.073</td>
</tr>
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</table>

$F(3,331)=20.978, p=.000$)

Situational variables and nurse interventions. Hypothesis 1B predicted that the only situational variable influencing judgments to manage a situation solely with nursing interventions would be nursing shift. It was hypothesized that nurses working the day shift would be less likely to manage a situation solely with nursing interventions. The regression in model 1B illustrates that shift was significant in predicting judgments ($B=.636, p=.043$) about nursing interventions. However, nurses were most likely to manage a situation solely with nursing interventions on the day shift. This is contrary to hypothesis 1B, which predicted that day shift would result in a decrease in judgments to manage with nursing interventions. Thus hypothesis 1B was not supported for this variable.

Nursing shift had 3 levels (days, evenings, nights). Evening shift (level 2) was used as the base category in regression model 1B. When the remaining levels were
compared to level 2, only level 1 (day shift) was significant in predicting judgments to manage a situation solely with nursing interventions. One way ANOVA was performed to determine if judgment scores differed across the various levels of shift. There were no significant differences among the mean judgment scores for management solely with nursing interventions across the different levels of nursing shift.

**Summary of regression model 1B: H1B.** Hypothesis 1B predicted that worsening physiological values and the situational variable of shift (day shift) would result in decreased judgments to manage a situation solely with nursing interventions. This hypothesis was only partially supported. Worsening O2sat, ICP, and CPP values were significant in decreasing judgments to manage with nursing interventions. However, the remaining physiological variables of BP and temperature did not influence judgments. Further it was predicted that vignettes that took place during the day shift would result in decreased judgments to manage with nursing interventions. However, regression model 1B did not support this part of hypothesis 1B. While shift was shown to significantly influence judgments to manage with nursing interventions, the variable of day shift was associated with increased judgment scores to manage with nursing interventions. In summary, hypothesis 1B was supported for the physiological variables of O2sat, ICP, and CPP, but was not supported in its predictions about the situational variable of nursing shift.

**Regression Model 1C: Vignette Variables and Consulting (H1C)**

As stated in hypothesis 1C, it was expected that worsening physiological variables (i.e. level 3 or 4 values), and the situational variable of nursing shift (day shift) would
increase the likelihood that the nurse would choose to manage a situation by consulting another member of the healthcare team. Regression model 1C presents the results of the multiple regression analyses performed using all physiological and situational variables with the dependent variable of management by consulting. The overall significance of this model will first be presented, followed by an explanation of the physiological variables in the model as they relate to hypothesis 1C. Finally, the situational variables of regression model 1C will be described in relation to hypothesis 1C.

**Significance of regression model 1C.** The multiple regression conducted on model 1C using all physiological and situational variables revealed that this model was significant in predicting nurse judgments about consulting ($R = .500; R^2 = .250; R^2_{adj} = .168, F(33, 301) = 3.037; p = .000$). When comparing the variance explained in this model to the previous two regression models (i.e. the regression models predicting risk for secondary brain injury and management solely with nursing interventions), it is noted that a smaller proportion of the variance is explained in this current model predicting judgments to consult. For this model, the separate regression slopes are presented in Table 20, and of these, four were significant.
Table 20

*Regression Coefficients Predicting Consulting*

<table>
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<tr>
<th>Variable</th>
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Table 20, cont.

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<th>$t$</th>
<th>$p$</th>
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<td>-.796</td>
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<td>.648</td>
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<td>.224</td>
<td>.823</td>
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<td>.273</td>
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</tr>
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<td>Days (Shift1)</td>
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<td>-.015</td>
<td>-.258</td>
<td>.797</td>
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<tr>
<td>Nights</td>
<td>.133</td>
<td>.341</td>
<td>.024</td>
<td>.390</td>
<td>.697</td>
</tr>
</tbody>
</table>

*Physiological variables and consulting.* In this regression model, the only physiological variables significantly influencing judgments about consulting other healthcare team members were all three levels of $O_2$sat ($B=1.626, 1.776, 2.048; p=.000$),
and one level of CPP (B=1.459 p=.010). The remaining physiological variables were not significant.

O2sat had 4 levels: O2sat=90-95% (level 1), O2sat=85-89% (level 2), O2sat=80-84% (level 3), O2sat<80% (level 4). In regression model 1C, level 1 (O2sat 90-95%, normal value) was used as the base category for analysis. The remaining 3 levels for O2sat were all significant in predicting judgments to manage a situation by consulting another member of the healthcare team. Nurses were most likely to consult if O2sat was at level 4 (O2sat=<80%). One way ANOVA was conducted to determine if there were significant differences among mean judgment scores to consult for the different levels of O2sat (Table 21). An examination of Table 21 indicates that there are significant differences across the levels for O2sat. Specifically, as values for O2sat deteriorate (move from level 1 to level 4), the mean judgment scores to consult increase, supporting hypothesis 1C. Post hoc analysis with LSD reveal that all pairs of comparisons were significant, except for levels 2, 3, and 3, 4. Thus, O2sat values of 85-89% and 80-84% were similar in terms of their influence on judgments to consult. Similarly, there were not significant differences between mean judgments to consult when O2sat was between 80-84% and <80%.
Table 21

Results of One Way ANOVA for O2sat and Consulting

<table>
<thead>
<tr>
<th>O2sat</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (O2sat 90-95%)</td>
<td>81</td>
<td>6.94</td>
<td>3.350</td>
</tr>
<tr>
<td>Level 2 (O2sat 85-89%)</td>
<td>93</td>
<td>8.36</td>
<td>2.505</td>
</tr>
<tr>
<td>Level 3 (O2sat 80-84%)</td>
<td>88</td>
<td>8.59</td>
<td>2.317</td>
</tr>
<tr>
<td>Level 4 (O2sat &lt;80%)</td>
<td>73</td>
<td>9.19</td>
<td>1.036</td>
</tr>
</tbody>
</table>

\[ F(3,331) = 11.702, p = .000 \]

CPP had 4 levels: CPP 60-65mmHg (level 1), CPP 55-59mmHg (level 2), CPP 50-54mmHg (level 3), CPP<50mmHg (level 4). Level 1 was used as the base category in regression model 1C. When comparing the remaining levels for CPP to level 1, only CPP values at level 4 (CPP<50mmHg) were significant in predicting judgments to consult (B=1.459, p=.010). Nurses were most likely to consult another member of the healthcare team when CPP values were extremely poor (CPP<50 mmHg).

One way ANOVA for CPP was performed and is displayed in Table 22. There were significant differences among the mean judgment scores across the various levels of CPP. Hypothesis 1C predicted that judgment scores to consult would increase as values for CPP worsened (moved to level 3, 4). This pattern is present in Table 22, supporting hypothesis 1C. Post hoc analysis using LSD revealed that all pairs of comparisons were significant except for CPP levels 1,2, and 1,3, and 2,3. All pairs that contained level 4
values were significant. Thus, there were no significant differences among mean judgment scores to consult for CPP except between extremely poor CPP values (CPP<50mmHg, level 4 value) and the remaining levels. Thus, nurses deemed CPP values between 50-65mmHg (levels 1, 2, 3) to be similar in terms of their influence on judgments to consult.

Table 22

Results of One Way ANOVA for CPP and Consulting

<table>
<thead>
<tr>
<th>CPP</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (CPP 60-65 mmHg)</td>
<td>35</td>
<td>6.71</td>
<td>3.426</td>
</tr>
<tr>
<td>Level 2 (CPP 55-59 mmHg)</td>
<td>33</td>
<td>6.64</td>
<td>3.154</td>
</tr>
<tr>
<td>Level 3 (CPP 50-54 mmHg)</td>
<td>42</td>
<td>7.61</td>
<td>3.027</td>
</tr>
<tr>
<td>Level 4 (CPP &lt;50 mmHg)</td>
<td>225</td>
<td>8.86</td>
<td>1.973</td>
</tr>
</tbody>
</table>

\( F(3,331)=15.042, p=.000 \)

Situational variables and consulting. No situational variables were found to be significant in regression model 1C investigating judgments about consulting.

Summary of regression model 1C: Hypothesis 1C. Hypothesis 1C predicted that worsening physiological values (level 3 and level 4) and the situational variable of nursing shift (day shift) would increase nurse judgments to consult another member of the healthcare team to manage the situation presented in the vignette. This hypothesis was only partially supported. The physiological variables of O2sat and CPP were significant
in predicting judgments to consult, and worsening values for these variables increased the likelihood that a nurse would consult. However, the remaining physiological variables of BP, ICP, and temperature were not shown to be significant in predicting judgments. It was also predicted that when the shift (situational variable) presented in the vignette was day shift, nurses would be more likely to consult another member of the healthcare team. However, in regression model 1C, no situational variables were predictive of judgments to consult. Therefore, hypothesis 1C was partially supported.

**Summary of Hypothesis 1A-1C**

Regression models 1A-1C addressed research question 1 and how vignette variables (physiological and situational variables) influenced nurse judgments about risk for secondary brain injury, management solely with nursing interventions, and consulting. Hypothesis 1A predicted that worsening physiological values, patient diagnosis of ICH or DAI, secondary diagnosis of extracranial injuries, hypertension, or DM, and increased patient age would cause nurses to judge a patient at increased risk for secondary brain injury. The results from regression model 1A indicate that this hypothesis was partially supported. Worsening physiological values of O2sat, ICP, and CPP and patient diagnosis of ICH or DAI resulted in higher judgment scores about risk for secondary brain injury. However, the patient’s secondary diagnosis and age were not significant in predicting judgments. Instead, the patient’s mechanism of injury and nursing shift predicted judgments about risk. Patients who had sustained a TBI from an MVA and were cared for on the evening shift were deemed at increased risk for secondary brain injury by nurses.
Hypothesis 1B predicted that worsening physiological values, and shift (day shift) would decrease judgments to manage a situation solely with nursing interventions. Regression model 1B indicates that this hypothesis was partially supported. Worsening values of O2sat, ICP, and CPP did decrease judgments to manage a situation solely with nursing interventions, supporting hypothesis 1B. While shift was shown to significantly predict judgments in regression model 1B, the day shift actually resulted in increased judgments to use nursing interventions. Therefore, hypothesis 1B was not supported in the direction predicted for nursing shift.

Finally, hypothesis 1C predicted that worsening physiological values, and shift (day shift) would increase judgments to consult another member of the healthcare team to manage the situation. Results of regression model 1C illustrate this hypothesis was partially supported. Worsening values for O2sat and CPP caused an increase in nurse judgments to consult. However, no situational variables were significant in predicting judgments to consult.

Additional analyses were performed to determine if interaction effects were present among any of the vignette variables, which might have had an additive effect on nurse judgments. Results of these analyses indicate that there were no significant interaction effects.
Hypothesis 2A-2C: Nurse Variables and Judgments

Regression models 2A-2C pertain to the second research question investigating how nurse variables influence judgments about risk for secondary brain injury, nursing interventions, and consulting. It was hypothesized that nurses with increased experience would have higher judgments about risk for secondary brain injury (H2A). It was further hypothesized that experienced nurses who worked the night shift would be more likely to use nursing interventions (H2B), while experienced nurses working the day shift would be more likely to consult (H2C). The remaining nurse variables of age, gender, and ethnicity were not predicted to influence judgments about secondary brain injury.

Regression Model 2A: Nurse Variables and Risk for Secondary Brain Injury (H2A)

Regression model 2A was significant in predicting the effects of nurse characteristics on judgments about risk for secondary brain injury ($R=.256; R^2=.066; R^2_{adj}=.046; F(7, 327)=3.276; p=.002$). Nurse variables explained a small percent of the variance in judgments about risk for secondary brain injury. The regression coefficients displayed in Table 23 indicate that nursing shift was the only variable shown to be significant in predicting judgments ($B=.306, p=.000$). The age, years as an RN, experience level (i.e. years in ICU, years in current ICU, years with TBI), and education of the nurse were not significant in this model. Therefore, hypothesis 2A was not supported.
Table 23

*Regression Coefficients Predicting Risk from Nurse Variables*

<table>
<thead>
<tr>
<th>Nurse Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>7.982</td>
<td>.326</td>
<td>-24.498</td>
<td>24.498</td>
<td>.000</td>
</tr>
<tr>
<td>Age</td>
<td>-.101</td>
<td>.111</td>
<td>-.099</td>
<td>-.913</td>
<td>.362</td>
</tr>
<tr>
<td>Years RN</td>
<td>.012</td>
<td>.189</td>
<td>.009</td>
<td>.065</td>
<td>.948</td>
</tr>
<tr>
<td>Years ICU</td>
<td>.245</td>
<td>.281</td>
<td>.172</td>
<td>.872</td>
<td>.384</td>
</tr>
<tr>
<td>Years Current ICU</td>
<td>-.081</td>
<td>.275</td>
<td>-.053</td>
<td>-.294</td>
<td>.769</td>
</tr>
<tr>
<td>Years TBI</td>
<td>-.081</td>
<td>.287</td>
<td>-.055</td>
<td>-.282</td>
<td>.778</td>
</tr>
<tr>
<td>Education</td>
<td>-.040</td>
<td>.140</td>
<td>-.018</td>
<td>-.286</td>
<td>.775</td>
</tr>
<tr>
<td>Shift</td>
<td>.306</td>
<td>.065</td>
<td>.264</td>
<td>4.744</td>
<td>.000</td>
</tr>
</tbody>
</table>

A one way ANOVA was conducted to explore the differences among mean judgments of risk for secondary brain injury based on the significant nurse characteristic of shift. Table 24 displays the results of this analysis. There were significant differences among the mean scores of nurses working different shifts (p=.000). Nurses who worked the day/evening or night shift had higher mean judgment scores about secondary brain injury than nurses working other shifts. Nurses working primarily day shift were less likely to judge a patient at risk for secondary brain injury when compared to nurses working other shifts.
Table 24

*Results of One Way ANOVA for Shift and Risk for Secondary Brain Injury*

<table>
<thead>
<tr>
<th>Shift</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days</td>
<td>85</td>
<td>7.58</td>
<td>2.078</td>
</tr>
<tr>
<td>Day/Night</td>
<td>100</td>
<td>8.25</td>
<td>1.946</td>
</tr>
<tr>
<td>Day/Evening</td>
<td>35</td>
<td>9.26</td>
<td>1.482</td>
</tr>
<tr>
<td>Evenings</td>
<td>5</td>
<td>8.40</td>
<td>2.608</td>
</tr>
<tr>
<td>Nights</td>
<td>110</td>
<td>8.85</td>
<td>1.466</td>
</tr>
</tbody>
</table>

$F(4,330)=8.247, p=.000$)

*Regression Model 2B: Nurse Variables and Nurse Interventions (H2B)*

Hypothesis 2B predicted that experienced nurses (i.e. nurses with higher number of years working in ICU, working in current ICU, and working with TBI patients) who worked the night shift would be more likely to use solely nursing interventions to manage a patient situation. The remaining nurse variables were not predicted to influence judgments. Regression model 1C was significant in predicting judgments about management solely with nursing interventions ($R=.232; R^2=.054; R^2_{adj}=.033; F(7,327)=2.645; p=.011$). Nurse variables explained a small amount of the variance in judgments about nursing interventions. The regression coefficients in Table 25 indicate that the number of years a nurse had worked in the ICU ($B=.895, p=.024$) and shift ($B=.273, p=.003$) were significant in predicting judgments. Thus, hypothesis 2B was only partially supported.
Table 25

Regression Coefficients Predicting Nurse Interventions from Nurse Variables

<table>
<thead>
<tr>
<th>Nurse Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.667</td>
<td>.459</td>
<td></td>
<td>5.816</td>
<td>.000</td>
</tr>
<tr>
<td>Age</td>
<td>.058</td>
<td>.156</td>
<td>.040</td>
<td>.370</td>
<td>.712</td>
</tr>
<tr>
<td>Years RN</td>
<td>-.076</td>
<td>.266</td>
<td>-.040</td>
<td>-.285</td>
<td>.776</td>
</tr>
<tr>
<td>Years ICU</td>
<td>.895</td>
<td>.395</td>
<td>.451</td>
<td>2.267</td>
<td>.024</td>
</tr>
<tr>
<td>Years Current ICU</td>
<td>-.658</td>
<td>.388</td>
<td>-.306</td>
<td>-.1.697</td>
<td>.091</td>
</tr>
<tr>
<td>Years TBI</td>
<td>-.286</td>
<td>.404</td>
<td>-.139</td>
<td>-.709</td>
<td>.479</td>
</tr>
<tr>
<td>Education</td>
<td>.042</td>
<td>.197</td>
<td>.013</td>
<td>.212</td>
<td>.832</td>
</tr>
<tr>
<td>Shift</td>
<td>-.273</td>
<td>.091</td>
<td>-.168</td>
<td>-3.003</td>
<td>.003</td>
</tr>
</tbody>
</table>

A one way ANOVA was performed to determine if there were significant differences among mean judgment scores based on the number of years the nurse worked in the ICU and by nursing shift. There were no significant differences among mean judgment scores based on the number of years the nurse had worked in the ICU ($p=.135$).

In contrast, the results of the ANOVA for nursing shift (Table 26) reveal significant differences among mean judgment scores ($p=.001$). It was hypothesized that nurses who worked the night shift would be most likely to manage a situation solely with nursing interventions. However, an examination of the mean judgment scores in Table 26 indicate that night shift nurses were among the least likely to use only nursing
interventions. Nurses who worked the day shift actually had the highest mean judgment scores for nursing interventions. Therefore, hypothesis 2B was only partially supported.

Table 26

Results of One Way ANOVA for Shift and Nurse Interventions

<table>
<thead>
<tr>
<th>Shift</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days</td>
<td>85</td>
<td>3.41</td>
<td>2.900</td>
</tr>
<tr>
<td>Day/Night</td>
<td>100</td>
<td>2.21</td>
<td>2.479</td>
</tr>
<tr>
<td>Day/Evening</td>
<td>35</td>
<td>1.66</td>
<td>2.141</td>
</tr>
<tr>
<td>Evenings</td>
<td>5</td>
<td>2.00</td>
<td>4.472</td>
</tr>
<tr>
<td>Nights</td>
<td>110</td>
<td>1.95</td>
<td>2.396</td>
</tr>
</tbody>
</table>

\[F(4,330)=5.045, p=.001]\]

Regression Model 2C: Nurse Variables and Consulting (H2C)

Hypothesis 2C predicted that experienced nurses (i.e. nurses with increased years in the ICU, years in current ICU, and years with TBI patients) who worked the day shift would be more likely to consult another member of the healthcare team to manage a situation. Regression model 1C testing this hypothesis was not significant in predicting judgments about consulting from nurse variables \(R=.196; R^2=.039; R^2_{\text{adj}}=.018; F(7, 327)=1.871; p=.074\). The regression coefficients displayed in Table 27 indicate that nursing shift was the only variable predicting nurse judgments to consult \(B=.226, p=.013\).
Table 27

Regression Coefficients Predicting Consulting from Nurse Variables

<table>
<thead>
<tr>
<th>Nurse Variable</th>
<th>$B$</th>
<th>$SE$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>7.839</td>
<td>.455</td>
<td></td>
<td>17.245</td>
<td>.000</td>
</tr>
<tr>
<td>Age</td>
<td>-.105</td>
<td>.155</td>
<td>-.075</td>
<td>-.679</td>
<td>.498</td>
</tr>
<tr>
<td>Years RN</td>
<td>.166</td>
<td>.263</td>
<td>.089</td>
<td>.631</td>
<td>.528</td>
</tr>
<tr>
<td>Years ICU</td>
<td>-.416</td>
<td>.391</td>
<td>-.213</td>
<td>-1.063</td>
<td>.289</td>
</tr>
<tr>
<td>Years Current ICU</td>
<td>-.109</td>
<td>.384</td>
<td>-.052</td>
<td>-.284</td>
<td>.776</td>
</tr>
<tr>
<td>Years TBI</td>
<td>.632</td>
<td>.401</td>
<td>.312</td>
<td>1.578</td>
<td>.116</td>
</tr>
<tr>
<td>Education</td>
<td>-.032</td>
<td>.196</td>
<td>-.010</td>
<td>-.163</td>
<td>.870</td>
</tr>
<tr>
<td>Shift</td>
<td>.226</td>
<td>.090</td>
<td>.142</td>
<td>2.510</td>
<td>.013</td>
</tr>
</tbody>
</table>

One way ANOVA for nursing shift indicate that there were significant differences among the mean judgment scores to consult by nursing shift ($p=.003$). An examination of Table 28 reveals that nurses who worked the day shift were least likely to consult another member of the healthcare team to manage a situation. Instead, nurses working day/ evening or night shift had the highest judgment scores for consulting. Hypothesis 2C predicted that experienced nurses who worked the day shift would be most likely to consult. Based on the results of regression model 2C and the ANOVA in Table 28, hypothesis 2C was not supported.
Table 28

Results of One Way ANOVA for Shift and Consulting

<table>
<thead>
<tr>
<th>Shift</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days</td>
<td>85</td>
<td>7.50</td>
<td>2.719</td>
</tr>
<tr>
<td>Day/Night</td>
<td>100</td>
<td>8.13</td>
<td>2.802</td>
</tr>
<tr>
<td>Day/Evening</td>
<td>35</td>
<td>9.35</td>
<td>1.583</td>
</tr>
<tr>
<td>Evenings</td>
<td>5</td>
<td>8.00</td>
<td>4.472</td>
</tr>
<tr>
<td>Nights</td>
<td>110</td>
<td>8.63</td>
<td>2.273</td>
</tr>
</tbody>
</table>

\(F(4,330)=4.158, p=.003\)

Summary of Hypothesis 2A-2C

Regression models 2A, 2B, and 2C focused on research question 2 and how nurse variables influenced judgments about secondary brain injury, nursing interventions, and consulting. Hypothesis 2A predicted that more experienced nurses (increased years in ICU, increased years in current ICU, increased years with TBI) would have higher judgment scores about patient likelihood of secondary brain injury. This hypothesis was not supported by regression model 2A, as nursing shift was the only variable shown to predict judgments about risk for secondary brain injury. Hypothesis 2B stated that more experienced nurses (increased years in ICU, increased years in current ICU, increased years with TBI) working the night shift would have higher judgment scores to manage a situation solely with nursing interventions. Regression model 2B revealed that this hypothesis was only partially supported. While the number of years the nurse had worked in the ICU was significant in predicting judgments about nursing interventions, other
variables pertaining to nurse experience were not significant. Further, it was expected that nurses on the night shift would have higher judgment scores; however these nurses in fact had lower judgment scores to manage with nursing interventions. Finally, hypothesis 2C predicted that more experienced nurses working the day shift would have the highest scores to consult another member of the healthcare team to manage a situation. This hypothesis was not supported. Regression model 2C was not significant, and while shift was shown to predict judgments to consult, nurses working the day shift actually had lowest judgment scores to consult.

*Two Step Regressions with Nurse Variables*

Additional regression analyses (regression models 3, 4, 5) were conducted with nurse variables to determine how these variables influenced judgments above and beyond physiological and situational variables. To accomplish this, “two step” regression analyses were performed. In these analyses, the different groups of variables were entered into the regression equation in blocks for each dependent variable. Physiological and situational variables were entered into the first block of the regression, and nurse variables were entered into the second block of the regression for each dependent variable. The resulting regression model was then examined to determine if addition of nurse variables increased the variance explained in the model for each dependent variable. Each model will be described separately in the following sections.

*Regression Model 3: Risk for Secondary Brain Injury*

In regression model 3, physiological and situational variables from the vignettes were entered into block 1. As expected, the results of this regression equation are
identical to regression model 1A ($R=.613; R^2=.376; R^2_{adj}=.308; F (33, 301)=5.500; p=.000$) (Model 1, Table 29). Physiological and situational variables together explained over 30% of the variance in judgments about patient risk for secondary brain injury.

When nurse variables were added to this model in block 2, the correlation ($R$) increased to .649, and the $R^2$ increased significantly by 3.2% on the dependent variable ($R=.649; R^2=.412; R^2_{adj}=.343; F(33, 7)=3.277; p=.002$) (Table 29). Thus, nurse characteristics significantly increased the explained variance in predicting judgments about risk for secondary brain injury.

Table 29

*Multiple Regression with Nurse Variables Added for Risk of Secondary Brain Injury*

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>$R^2$ Change</th>
<th>$F$ Change</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.613</td>
<td>.376</td>
<td>.308</td>
<td>.376</td>
<td>5.500</td>
<td>.000</td>
</tr>
<tr>
<td>2</td>
<td>.649</td>
<td>.421</td>
<td>.343</td>
<td>.045</td>
<td>3.277</td>
<td>.002</td>
</tr>
</tbody>
</table>

(Model 1: $F(33, 301)=5.500; p=.000$; Model 2: $F(40, 294)=5.351; p=.000$)

Regression Model 4: Nursing Interventions

In a manner similar to model 3, physiological and situational variables were entered into block 1 of regression model 4. This regression was identical to model 1B as expected ($R=.557; R^2=.310; R^2_{adj}=.235; F (33, 7)=4.103; p=.000$). When nurse variables were added to this model in block 2, the correlation increased to .596, and the $R^2$ increased significantly by 4.5%. (Table 30). Thus, the characteristics of the nurse
significantly increased the variance explained in predicting judgments to manage a situation with nursing interventions.

Table 30

*Multiple Regression with Nurse Variables Added for Nurse Interventions*

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>$R^2$ Change</th>
<th>$F$ Change</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.557</td>
<td>.310</td>
<td>.235</td>
<td>.310</td>
<td>4.103</td>
<td>.000</td>
</tr>
<tr>
<td>2</td>
<td>.596</td>
<td>.356</td>
<td>.268</td>
<td>.045</td>
<td>2.958</td>
<td>.005</td>
</tr>
</tbody>
</table>

(Model 1: $F(33, 301)=4.103; p=.000$; Model 2: $F(40, 294)=4.057; p=.000$)

*Regression Model 5: Consulting*

The first block of regression model 5 again contained physiological and situational variables from the vignettes, and was identical to regression model 1C ($R=.500; R^2=.250; R^2_{adj}=.168; F(33, 7)=3.037; p=.000$). When nurse variables were added to this model in block 2, the correlation increased to .532, and the $R^2$ increased by 3.3% (Table 31). While addition of nurse variables to this model increased the variance explained in predicting judgments to consult, this increase did not reach statistical significance ($p=.064$).
Table 31

Multiple Regression with Nurse Variables Added for Consulting

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>R² Change</th>
<th>F Change</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.500</td>
<td>.250</td>
<td>.168</td>
<td>.250</td>
<td>3.037</td>
<td>.000</td>
</tr>
<tr>
<td>2</td>
<td>.532</td>
<td>.283</td>
<td>.185</td>
<td>.033</td>
<td>1.935</td>
<td>.064</td>
</tr>
</tbody>
</table>

(Model 1: F(33, 301)=3.037; p=.000; Model 2: F(40, 294)=2.898; p=.000)

Summary of Regression Models 3-5

Regression models 3, 4, and 5 were composed of “two step” multiple regression analyses in which physiological and situational variables were entered into block 1 and nurse variables were entered into block 2. This was done to investigate if the addition of nurse variables to each regression model increased the variance explained in predicting judgments about patient risk for secondary brain injury, nursing interventions, and consulting. Regression models 3, 4, and 5 indicated that nurse variables significantly increased variance explained in judgments about risk for secondary brain injury and nursing interventions. The addition of nurse variables to the regression model for consulting increased the variance explained, but it did not reach statistical significance.

Summary of Hypothesis Testing

Regression models 1A, 1B, 1C, and 2A, 2B, and 2C addressed the two main research questions guiding this study. Research question 1 (regression models 1A-1C) centered on how physiological and situational (i.e. vignette variables) influenced judgments about risk for secondary brain injury, management solely with nursing interventions, and consulting. Table 32 and 33 provide a summary of the findings from
these analyses. As evidenced in Table 32, hypotheses 1A-1C were partially supported. Hypothesis 1A-1C, which predicted that worsening physiological values would result in increased judgments about risk for secondary brain injury, decreased judgments to manage with nursing interventions, and increased judgments to consult, were supported for the variables of O2sat and CPP, and to a lesser degree with ICP. The situational variables predicted to influence judgments about risk were partially supported (i.e. patient primary diagnosis and shift were significant as predicted). However, patient secondary diagnosis and age were not significant (Table 33). Finally the only situational variable hypothesized to influence judgments to use nursing interventions and to consult was shift. These hypotheses were not supported, as shift was not significant in the direction predicted (i.e. day shift was predicted to decrease judgments for nursing interventions, but was shown to increase judgments to use nursing interventions), and shift was not significant in judgments to consult.
Table 32

*Summary of Hypotheses 1A-1C*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Supported (Yes, No, Partial)</th>
<th>Predicted Variables</th>
<th>Significant Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1A: Vignette</td>
<td>P</td>
<td>BP, O2sat, Temp, ICP, CPP</td>
<td>O2sat, ICP, CPP</td>
</tr>
<tr>
<td>Variables and Risk</td>
<td>Patient primary and secondary diagnosis, age</td>
<td>Primary diagnosis, Mechanism Injury, Nursing shift</td>
<td></td>
</tr>
<tr>
<td>Nurse Intervention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1B: Vignette</td>
<td>P</td>
<td>BP, O2sat, Temp, ICP, CPP, O2sat, ICP, CPP</td>
<td>Shift*</td>
</tr>
<tr>
<td>Nurse Intervention</td>
<td>Nursing Shift</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1C: Vignette</td>
<td>P</td>
<td>BP, O2sat, Temp, ICP, CPP</td>
<td>O2at, CPP</td>
</tr>
<tr>
<td>Consulting</td>
<td>Nursing Shift</td>
<td>Shift*</td>
<td></td>
</tr>
</tbody>
</table>

*Variable significant, but not in predicted direction*
Table 33

**Summary of Hypothesis Tests for each Vignette Variable and Judgments**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Consult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>Nurse Intervention</td>
<td>Consult</td>
</tr>
<tr>
<td>BP</td>
<td>N*</td>
<td>N*</td>
</tr>
<tr>
<td>O2sat</td>
<td>$p=.000$</td>
<td>$p=.000$</td>
</tr>
<tr>
<td>Temp</td>
<td>N*</td>
<td>N*</td>
</tr>
<tr>
<td>ICP</td>
<td>$p=.001$</td>
<td>$p=.003$</td>
</tr>
<tr>
<td>CPP</td>
<td>$p=.000$</td>
<td>$p=.001$</td>
</tr>
<tr>
<td>Primary Diagnosis</td>
<td>$p=.045$</td>
<td>N</td>
</tr>
<tr>
<td>Secondary Diagnosis</td>
<td>N*</td>
<td>N</td>
</tr>
<tr>
<td>Patient Age</td>
<td>N*</td>
<td>N</td>
</tr>
<tr>
<td>Patient Gender</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Mechanism of Injury</td>
<td>$p=.017^*$</td>
<td>N</td>
</tr>
<tr>
<td>Nursing Shift</td>
<td>$p=.038$</td>
<td>$p=.043^*$</td>
</tr>
</tbody>
</table>

N=Not significant,
*=Hypothesis not supported

Hypotheses 2A-2C addressed research question 2 and focused on how characteristics of nurse respondents influenced the same three judgments about risk for secondary brain injury, using only nursing interventions, and consulting. These hypotheses were only partially supported, as depicted in Table 34. The experience level of the nurse (i.e. years in ICU, years in current ICU, years TBI) was predicted to
influence all three judgments (H2A-H2C). However, only the number of years the nurse had worked in the ICU was significant in predicting nursing interventions. Experience was not significant in predicting any other judgments (Table 35). The only other variable predicted to influence nursing interventions and consulting was shift. This variable proved to be significant in all three judgments, including risk for secondary brain injury (which was not expected). However, it was hypothesized that nurses working the day shift would be less likely to use nursing interventions and more likely to consult. While shift was significant in predicting these judgments, it was not significant in the predicted directions. Nurses working the day shift were more likely to use nursing interventions and less likely to consult, which is contrary to hypotheses 2B-2C.

Regression models 3-5 were additional two step regression analyses performed to determine if the addition of nurse variables increased the explained variance in judgments about risk for secondary brain injury, management solely with nursing interventions, and consulting. Results of these analyses indicate that nurse variables significantly increased the variance explained in judgments about risk for secondary brain injury and management solely with nursing interventions. The explained variance in judgments about consulting also increased with the addition of these nurse variables; however, it did not reach statistical significance.
Table 34

Summary of Hypotheses 2A-2C

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Supported (Yes, No, Partial)</th>
<th>Predicted Variables</th>
<th>Significant Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2A: Nurse Variables and Risk</td>
<td>N</td>
<td>Years ICU</td>
<td>Shift</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years Current ICU</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years TBI Patients</td>
<td></td>
</tr>
<tr>
<td>H2B: Nurse Variables and Nurse Intervention</td>
<td>P</td>
<td>Years ICU</td>
<td>Years ICU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years Current ICU</td>
<td>Shift*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years TBI Patients</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shift</td>
<td></td>
</tr>
<tr>
<td>H2C: Nurse Variables and Consulting</td>
<td>P**</td>
<td>Years ICU</td>
<td>Shift*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years Current ICU</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years TBI Patients</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shift</td>
<td></td>
</tr>
</tbody>
</table>

* Variable significant, but not in the predicted direction
** Regression model not significant
Table 35

Summary of Hypothesis Tests for each Nurse Variable and Judgments

<table>
<thead>
<tr>
<th>Nurse Variables</th>
<th>Dependent Variables</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk</td>
<td>Nursing Interventions</td>
<td>Consult</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Years RN</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Years ICU</td>
<td>N*</td>
<td>p=.024</td>
<td>N*</td>
<td></td>
</tr>
<tr>
<td>Years Current ICU</td>
<td>N*</td>
<td>N*</td>
<td>N*</td>
<td></td>
</tr>
<tr>
<td>Years TBI</td>
<td>N*</td>
<td>N*</td>
<td>N*</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Primary Shift</td>
<td>p=.000*</td>
<td>p=.003*</td>
<td>p=.013*</td>
<td></td>
</tr>
</tbody>
</table>

N=Not significant
*=Hypothesis not supported

Supplemental Methodological Analyses

This study was significant for its methodological approach, specifically as it pertained to use of a multiple segment factorial vignette (MSFV) design (Ganong & Coleman, 2006). The MSFV design uses two segments for each vignette, which allows an examination of causal effects of changes over time on judgments. (Ganong & Coleman, 2006). The first segment, or initial vignette in the study survey were randomly created using the independent physiological and situational variables of the study. The second segment, or follow-up vignette to each initial vignette contained a different set of randomly generated physiological variables. The situational variables in the follow up
vignette remained essentially unchanged. The only situational variable that was included in the follow up vignette was the type/time of assessment. Inclusion of this situational variable reflected the time that has passed since the first assessment in the initial vignette.

Each nurse was asked to read and respond to five of these two segment vignettes. Nurses indicated their judgments about patient risk for secondary brain injury, using only nursing interventions, and consulting on a likert scale after reading each initial vignette (i.e. judgments at time 1), and after reading each follow up vignette (i.e. judgments at time 2). The preceding sections of this chapter have addressed what variables influenced judgments at time 1. Additional analyses were performed to determine what influenced the same three nurse judgments at time 2 after reading each follow up vignette. This section will describe these analyses and results. A series of correlational analyses were first performed to identify relationships between variables in the first and second segments of each vignette. A series of regression analyses were then used to identify variables influencing judgments at time 2 in the second segment, or follow-up vignettes.

Correlational Analyses

Correlations Among Independent Variables

Correlational analyses were first performed to determine the relationship between physiological variables in the first and second segments of vignettes (Table 36). Because the two segment vignettes were created to reflect real life clinical contexts, it was expected that the correlation for each physiological variable at time 1 (initial vignette segment) and time 2 (follow-up vignette segment) would be high (i.e. BP at time 1 would be highly correlated with BP at time 2). This was expected because the program used for
generation of the vignettes included linear transformations between each type of physiological variable at time 1 and time 2 to ensure that changes in that variable made clinical sense. Therefore, it was expected that correlations within each type of physiological variable would be high at time 1 and time 2 (i.e. BP highly correlated with BP), but correlations between different physiological variables would be low at time 1 and time 2 (i.e. BP not correlated with ICP). These predictions were supported in the correlational analyses. Most importantly, no strong or significant correlations were found among different physiological variables, providing evidence of the orthogonal nature of vignette variables at time 1 and time 2.

Table 36

Correlation Matrix for Physiological Variables at Time 1 and Time 2

<table>
<thead>
<tr>
<th>Physiological Variables At Time 2</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correlation Matrix for Physiological Variables at Time 1 and Time 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiological Variables At Time 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. BP</td>
<td>.905**</td>
<td>-.107</td>
<td>-.072</td>
<td>.147</td>
<td>.464**</td>
</tr>
<tr>
<td>2. O2sat</td>
<td>-.062</td>
<td>.899**</td>
<td>-.076</td>
<td>-.062</td>
<td>-.022</td>
</tr>
<tr>
<td>3. Temperature</td>
<td>-.034</td>
<td>-.085</td>
<td>.900**</td>
<td>-.047</td>
<td>-.043</td>
</tr>
<tr>
<td>4. ICP</td>
<td>.178**</td>
<td>-.083</td>
<td>-.060</td>
<td>.897**</td>
<td>.335**</td>
</tr>
<tr>
<td>5. CPP</td>
<td>.392**</td>
<td>-.116**</td>
<td>-.125*</td>
<td>.232**</td>
<td>.880**</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (two tailed)
* Correlation is significant at the 0.05 level (two tailed)
Correlations Among Dependent Variables

A correlation matrix was then created to investigate the relationship between nurse judgments (dependent variable) at time 1 and time 2 (Table 37). No strong or significant correlations were found between judgments made after the initial vignette and those judgments made after the follow up vignette.

Table 37
Correlation Matrix for Time 1 and Time 2 Judgments

<table>
<thead>
<tr>
<th>Dependent Variables At Time 1</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Risk Secondary Brain Injury</td>
<td>.696**</td>
<td>-.400**</td>
<td>.377**</td>
</tr>
<tr>
<td>2. Nurse Interventions</td>
<td>-.523**</td>
<td>.692</td>
<td>-.354**</td>
</tr>
<tr>
<td>3. Consulting</td>
<td>.455**</td>
<td>-.365**</td>
<td>.643**</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level

Regression Analyses

A series of regression analyses were performed to determine: (1) which variables at time 2 (i.e. patient BP, O2sat, temperature, ICP, CPP, type/time assessment) predicted judgments at time 2; (2) if situational variables (i.e. patient primary and secondary diagnosis, age, gender, mechanism of injury, nursing shift) presented at time 1 and physiological variables at time 2 (BP, O2sat, temperature, ICP, CPP) influenced judgments at time 2; (3) how physiological variables at time 1 and time 2, dependent variables at time 1 (i.e. nurse judgments to initial vignette segments), and nurse variables
all influenced judgments at time 2. The results of these regression analyses will be presented for each dependent variable.

**Dependent Variable 1: Risk for Secondary Brain Injury**

A regression model was first created to determine how the vignette variables at time 2 (type of assessment, BP, O2at, ICP, CPP, temperature) influenced judgments about likelihood of secondary brain injury at time 2. This analysis showed a strong and significant prediction, with vignette variables accounting for over 20% of the variance in judgments about likelihood of secondary brain injury ($R^2=.281$; $R^2_{adj}=.245$; $F(16, 318 )=7.766; \ p=.000$).

Separate regression slopes were calculated for each follow up vignette variable, and the following physiological variables were significant at predicting judgments: BP ($B=.455, \ p=.035$; $B=.560, \ p=.048$; $B=.708, \ p=.009$), O2sat ($B=.825, \ p=.000$; $B=1.151, \ p=.000$; $B=1.13, \ p=.000$), ICP ($B=.670, \ p=.002$; $B=.823, \ p=.002$), and CPP ($B=1.045, \ p=.007$; $B=1.582, \ p=.000$). These variables were similar to those that predicted judgments at time 1, with the exception of BP.

A second regression equation was then calculated to determine how situational variables from time 1 and vignette variables from time 2 influenced judgments about likelihood of secondary brain injury. This model was also significant ($R^2=.341$; $R^2_{adj}=.267$; $F(34, 300)=4.569; \ p=.000$). Similar to the regression equation predicting judgments about likelihood of secondary brain injury at time 1, the situational variables influencing judgments at time 2 were patient diagnosis ($B=.482, \ p=.034$), mechanism of injury ($B=.581, \ p=.013$), and shift ($B=.460, \ p=.022$).
To determine how physiological variables at time 1, vignette variables at time 2, judgments at time 1, and nurse variables influenced judgments about secondary brain injury at time 2, a series of regression equations were performed where each group of variables were entered in blocks. The output from this analysis is displayed in Table 38.

Physiological variables at time 1 were entered into the first block of the regression equation (Model 1, Table 38). These variables were significant and accounted for 12% of the variance in judgments. Vignette variables from time 2 were then entered into the 2\textsuperscript{nd} block of the regression equation (Model 2, Table 38). These variables increased the variance explained in the model to 24% \((p=.000)\). Block 3 contained the judgment scores about likelihood of secondary brain injury from time 1 (i.e. judgments by nurses after reading the first segment of the vignette). Addition of these variables to the regression equation increased the variance explained to 67% \((p=.000)\) (Model 3, Table 38). Finally, nurse variables were entered into the 4\textsuperscript{th} block of the regression equation, and contributed little to the explained variance \((R=.841, R^2=.707; p=.000)\) (Model 4, Table 38). Overall, judgment scores from time 1 explained the majority of the variance in judgments about likelihood of secondary brain injury at time 2. The ANOVA summary in Table 39 indicates that all models were significant.
Table 38

*Multiple Regressions with T1 Physiological, T2 Vignette, T1 Dependent, and Nurse Variables on T2 Judgments about Likelihood of Secondary Brain Injury*

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.404</td>
<td>.164</td>
<td>.124</td>
</tr>
<tr>
<td>2</td>
<td>.553</td>
<td>.305</td>
<td>.244</td>
</tr>
<tr>
<td>3</td>
<td>.834</td>
<td>.695</td>
<td>.667</td>
</tr>
<tr>
<td>4</td>
<td>.841</td>
<td>.707</td>
<td>.673</td>
</tr>
</tbody>
</table>

Table 39

*Summary of ANOVA for Regression with T1 Physiological, T2 Vignette, T1 Dependent, and Nurse Variables on T2 Judgments About Risk of Secondary Brain Injury*

<table>
<thead>
<tr>
<th>Model</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression 158.732</td>
<td>15</td>
<td>10.582</td>
<td>4.160</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Residual 811.548</td>
<td>319</td>
<td>2.544</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Regression 296.249</td>
<td>27</td>
<td>10.972</td>
<td>4.997</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Residual 674.032</td>
<td>307</td>
<td>2.196</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Regression 674.334</td>
<td>28</td>
<td>24.083</td>
<td>24.902</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Residual 295.946</td>
<td>306</td>
<td>.967</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Regression 686.458</td>
<td>35</td>
<td>19.613</td>
<td>20.662</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Residual 283.823</td>
<td>299</td>
<td>.949</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Dependent Variable 2: Nursing Interventions**

To investigate what influenced judgments about likelihood of using only nursing interventions at time 2, a regression model was first created between vignette variables at time 2 and judgments at time 2. The regression model was significant, with the vignette variables accounting for 15% of the variance in judgments ($R=0.435$, $R^2=0.189$, $R^2_{adj}=0.148$, $F(16, 318)=4.640; p=.000$). The separate regression slopes for each vignette variable identified that BP ($B=0.863$, $p=0.037$), O2at ($B=1.666$, $p=0.000$), and CPP ($B=1.774$, $p=0.002$; $B=1.242$, $p=0.009$) were all significant in predicting judgments at time 2 about using nursing interventions.

A second regression equation was created using situational variables from time 1 and vignette variables from time 2. These variables had a .519 correlation with judgments, and accounted for 19% of the variance ($R=0.519$; $R^2=0.269$; $R^2_{adj}=0.186$; $F(34, 300)=3.246$, $p=.000$). The separate regression slopes for each variable revealed that the only situational variable that was significant in judgments at time 2 was shift ($B=0.902$, $p=0.003$; $B=1.286$, $p=0.000$).

Finally, regression analyses were performed where the following groups of variables were entered in blocks: physiological variables at time 1 (block 1), vignette variables at time 2 (block 2), judgments about nursing interventions at time 1 (block 3), and nurse variables (block 4) (Table 40). Each block of variables produced a significant regression equation, with judgments at time 1 again accounting for the majority of the variance in judgments at time 2 (model 3: $R=0.801$; $R^2=0.642$; $R^2_{adj}=0.609$; $p=.000$). The
ANOVA summary for each regression model presented in Table 41 indicates that each model was significant.

Table 40

Regression Equation Predicting Nursing Interventions From T1 Physiological Variables, T2 Vignette Variables, T1 Judgments, and Nurse Variables

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.309</td>
<td>.096</td>
<td>.053</td>
</tr>
<tr>
<td>2</td>
<td>.482</td>
<td>.232</td>
<td>.232</td>
</tr>
<tr>
<td>3</td>
<td>.801</td>
<td>.642</td>
<td>.642</td>
</tr>
<tr>
<td>4</td>
<td>.819</td>
<td>.671</td>
<td>.671</td>
</tr>
</tbody>
</table>
Table 41

Summary of ANOVA for Regression Equation Predicting Nursing Interventions from T1 Physiological Variables, T2 Vignette Variables, T1 Judgments, and Nurse Variables

<table>
<thead>
<tr>
<th>Model</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>192.785</td>
<td>15</td>
<td>12.852</td>
<td>2.246</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1825.197</td>
<td>319</td>
<td>5.722</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Regression</td>
<td>468.365</td>
<td>27</td>
<td>17.347</td>
<td>3.437</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1549.617</td>
<td>307</td>
<td>5.048</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Regression</td>
<td>1295.519</td>
<td>28</td>
<td>46.269</td>
<td>19.597</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>722.463</td>
<td>306</td>
<td>2.361</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Regression</td>
<td>1353.828</td>
<td>35</td>
<td>38.681</td>
<td>17.414</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>664.154</td>
<td>299</td>
<td>2.221</td>
<td></td>
</tr>
</tbody>
</table>

Dependent Variable 3: Consulting

A final set of regression analyses were performed to determine how different groups of variables influenced judgments to consult another member of the healthcare team at time 2. First, a regression equation was created between vignette variables at time 2 and judgments to consult at time 2. This model was significant ($R=0.435$, $R^2=0.189$, $R^2_{adj}=0.148$, $F(16, 318)=4.636, p=0.000$) and explained 15% of the variance in judgments to consult at time 2. Similar to the regression model predicting judgments about consulting at time 1, variables found to be significant in the current model (i.e. time 2
judgments) were O2 sat (B=1.296, \( p=.000 \); B=1.503, \( p=.000 \); B=1.818, \( p=.000 \)), and CPP (B=1.635, \( p=.003 \)).

A second regression equation predicting judgments about consulting at time 2 from situational variables at time 1 and physiological variables at time 2 was created. This model was significant, explaining 16% of the variance in judgments (\( R=.492, R^2=.242, R^2\text{adj}=.156, F(34, 300)=2.820, p=.000 \)). The separate regression slopes for each variable showed that the situational variables of patient diagnosis (B=.649, \( p=.050 \)), and mechanism of injury (B=.984, \( p=.004 \)) were found to be significant in predicting judgments to consult at time 2.

A final series of regressions were performed to determine how groups of variables influenced judgments to consult at time 2 (Table 42). Physiological variables at time 1 were entered into block 1 of the equation; vignette variables at time 2 were entered into block 2; judgments at time 1 were entered into block 3, and nurse variables were entered into block 4. Each regression model was significant, with judgments at time 1 again accounting for most of the variance in judgments at time 2 (Model 3, Table 42) (\( R=.754, R^2=.569, p=.000 \)). Table 43 presents the ANOVA summary for each regression model. An examination of this table indicates that each regression model was significant.
Table 42

*Regression Equation Predicting Consulting at T2 from Physiological Variables at T1, Vignette Variables at T2, Judgments at T1, and Nurse Variables*

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.281</td>
<td>.079</td>
<td>.036</td>
</tr>
<tr>
<td>2</td>
<td>.482</td>
<td>.232</td>
<td>.167</td>
</tr>
<tr>
<td>3</td>
<td>.754</td>
<td>.569</td>
<td>.531</td>
</tr>
<tr>
<td>4</td>
<td>.770</td>
<td>.593</td>
<td>.547</td>
</tr>
</tbody>
</table>

Table 43

*Summary of ANOVA for Regression Equation Predicting consulting at T2 from Physiological Variables at T1, Vignette Variables at T2, Judgments at T1, and Nurse Variables*

<table>
<thead>
<tr>
<th>Model</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>140.463</td>
<td>15</td>
<td>9.364</td>
<td>1.825</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1636.551</td>
<td>319</td>
<td>5.130</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Regression</td>
<td>412.269</td>
<td>26</td>
<td>15.856</td>
<td>3.579</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1364.746</td>
<td>308</td>
<td>4.431</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Regression</td>
<td>1010.358</td>
<td>27</td>
<td>37.421</td>
<td>14.985</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>766.657</td>
<td>307</td>
<td>2.497</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Regression</td>
<td>1053.877</td>
<td>34</td>
<td>30.996</td>
<td>12.859</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>723.138</td>
<td>300</td>
<td>2.410</td>
<td></td>
</tr>
</tbody>
</table>
Summary of Supplemental Methodological Analyses

The regression analyses and results presented in this section indicate that nurse judgments about likelihood of secondary brain injury, management solely with nursing interventions, and consulting at time 2 were influenced by many of the same variables that influenced initial (time 1) judgments. Variables influencing follow up judgments (i.e. judgments at time 2) about risk for secondary brain injury were BP, O2sat, ICP, CPP, patient diagnosis, mechanism of injury, and nursing shift. Judgments about managing a situation solely with nursing interventions were influenced by BP, O2sat, CPP, and nursing shift. Finally, variables influencing judgments to manage a situation by consulting another member of the healthcare team were O2 sat, CPP, patient mechanism of injury, and nursing shift. While these vignette variables significantly influenced follow up judgments of nurses (i.e. judgments at time 2), the most significant predictor of judgments at time 2 were the initial judgments at time 1. Judgments at time 1 nearly doubled the explained variance in judgments at time 2; addition of these judgments increased the variance to approximately 60% for all three follow up judgments. The type/time of assessment variable that was presented in the follow up vignettes (i.e. follow up assessment 15 minutes later, routine shift reassessment 4 hours later) reflected the amount of time that had passed since the initial vignette scenario and judgment and the follow up scenario and judgment. This variable was not significant in influencing any of the follow up judgments. The significance of these findings will be discussed in the following chapter.
CHAPTER V
DISCUSSION

The purpose of this study was to examine how physiological, situational, and nurse variables influenced ICU nurse judgments about secondary brain injury. The study was guided by social judgment theory, and findings contribute information about cues influencing ICU nurse judgments when managing secondary brain injury in critically ill TBI patients. In this chapter, the significance of the study findings is examined in relation to current knowledge about secondary brain injury management and social judgment theory. This chapter is organized in the following manner: factorial survey and hypothesis testing, additional findings, significance, limitations, and implications.

Factorial Survey and Hypothesis Testing

This study incorporated a factorial survey design to examine factors influencing ICU nurse judgments when managing secondary brain injury in the critically ill TBI patient. Two hypotheses were generated that predicted the effect of physiological, situational, and nurse variables on ICU nurse judgments about (a) patient risk for secondary brain injury, (b) using nursing interventions, and (c) consulting. Hypothesis I predicted the effects of physiological and situational variables (i.e. vignette variables) on nurse judgments, while hypothesis II predicted the effects of nurse variables on these same judgments. The major findings of each hypothesis and their relationship to the literature and social judgment theory will be discussed separately.
Hypothesis I: Physiological and Situational Variables

Physiological Variables

Hypothesis 1A-1C predicted that worsening physiological values for O2sat, BP, temperature, ICP, and CPP would result in increased nurse judgments about risk for secondary brain injury, decreased judgments to use only nursing interventions, and increased judgments to consult. These hypotheses were only partially supported. Worsening values of O2sat, ICP, and CPP significantly predicted nurse judgments about patient risk for secondary brain injury and using nursing interventions; however, only O2sat and CPP predicted judgments about consulting. Deteriorating values for BP and temperature were not predictive of any of the three judgments about secondary brain injury.

ICU nurses are educated to ensure adequate airway protection and oxygenation as a priority when resuscitating and caring for all critically ill patients (AACN, 2007a; AHA, 2005). Ensuring adequate O2sat values are therefore an expected standard of care for all critically ill patients, and particularly for brain injured patients as hypoxia decreases cerebral oxygenation, leading to secondary brain injury (Bardt et al., 1998; Chesnut, et al., 1993b; Robertson, 1993). The fact that O2sat was significant in predicting all judgments in the current study is therefore consistent with the expectation that all ICU nurses must ensure adequate oxygenation as a priority when caring for patients. It is not surprising that patient O2sat levels in this study significantly influenced all judgments, as this is consistent with required ICU nurse education and certification (AACN, 2007a; AHA, 2005).
ICU nurses also are taught to consider the “whole picture” when interpreting physiological parameters in TBI patients. Because a patient’s BP, ICP, and CPP values are dependent on one another (i.e. MAP-ICP=CPP), nurses are often instructed that fluctuations in BP values can usually be tolerated, provided that the patient’s ICP remains within normal limits (<25mmHg), and more importantly that CPP values remain above 60mmHg (Hickey, 2003; March et al., 2004). Thus, the fact that O2sat and CPP were significant in predicting all three judgments about secondary brain injury, (while ICP was only significant in predicting two judgments, and BP was not significant) is consistent with the literature on management of secondary brain injury in the critically ill TBI patient (BTF & AANS, 2000; Chamberlain, 1998; Hickey, 2003; March et al., 2004; Nolan, 2005).

Worsening values for temperature were not significant in predicting judgments in this study. It has been documented that nationally, nurses vary in how they define elevated temperature (fever) and determine appropriate interventions (Thompson et al., 2007). There are currently no evidence based standards of care for temperature management, particularly for TBI patients. While fever in TBI patients has been associated with poor outcomes (Diringer et al., 2004; Geffroy et al., 2004; Jiang et al., 2002), it is not clear to what extent nurses are aware of this information when determining risk for secondary brain injury. The fact that elevated temperature in the current study did not significantly influence judgments about secondary brain injury suggests that nurses do not routinely associate this physiological parameter with secondary brain injury. This finding is consistent with the literature that nurses vary in
how they define and respond to elevated temperature when caring for TBI patients (Thompson et al., 2007).

The findings pertaining to the physiological variables of this study provide information about cues influencing ICU nurse judgments about secondary brain injury. Social judgment theory posits that certain cues will exert more influence on judgments than other cues (Cooksey, 1996). This assertion was supported in this study, as O2sat, ICP, and CPP emerged as cues that significantly predicted judgments, while the remaining physiological variables (BP and temperature) were not significant.

Situational Variables

Hypothesis 1A-1C predicted that situational variables of patient primary and secondary diagnosis and patient age would influence judgments about risk for secondary brain injury, while nursing shift would be the only situational variable influencing judgments about nursing interventions and consulting. These hypotheses were only partially supported. In this study, patients with a primary diagnosis of ICH or DAI were judged to be at increased risk for secondary brain injury, which supported hypothesis 1A. These two types of TBI account for the highest percentage of TBI related deaths and injuries necessitating critical care monitoring (Hickey, 2003; March et al., 2004). Therefore, ICU nurses likely have cared for a number of patients with these diagnoses and have witnessed poor outcomes among these patients. While any of the diagnoses included in vignettes (i.e. EDH, SDH, ICH, DAI) are associated with secondary brain injury, ICU nurses may have judged patients with ICH and DAI to be at higher risk for secondary brain injury due to the severe nature of these two diagnoses.
Patient mechanism of injury was also significant in predicting judgments about risk for secondary brain injury. This variable was not expected to influence judgments about risk for secondary brain injury as TBI patients with any mechanism of injury are at comparable risk for secondary brain injury. However, in this study, nurses judged patients who had sustained a TBI from an MVA to be at increased risk for secondary brain injury. MVAs are responsible for the highest number of TBI requiring hospitalizations (59,000/year) and result in the most deaths (16,800 deaths/year) among TBI patients (Langlois et al., 2006). The last case data supplied by nurses indicate that most nurses recently cared for a patient who had sustained a TBI from an MVA. Thus, it is likely that nurses in this study have recent experience caring for a number of patients who have sustained a TBI from an MVA, which may account for why this variable was significant in predicting judgments.

The final situational variable that was significant in predicting judgments about risk and nursing interventions in this study was shift. Nursing shift has been shown in the literature to influence nurse decisions (Bucknall, 2000). It was predicted that vignettes that took place during the day shift would result in decreased nurse judgments to manage with nursing interventions and increased judgments to consult. However, these hypotheses were not supported. Instead, results from this study indicate that nurses were more likely to use nursing interventions and less likely to consult during the day shift. While this finding was not expected, it could be explained by the fact that nurses working day shift are more comfortable managing a situation solely with nursing interventions because additional staff is readily available if nursing interventions prove ineffective and
a patient begins to quickly deteriorate. Conversely, the night shift may not always have immediate access to support staff should nursing interventions prove ineffective.

The situational variables of this study provided the context for the judgments made by nurses and thus composed the ecological or environmental aspect of the lens model of social judgment theory. Through this theory, it is assumed that the interactions between these different situational variables influence cues and subsequent judgments (Cooksey, 1996). In this study, situational variables that were significant in predicting judgments about secondary brain injury were patient primary diagnosis, mechanism of injury, and nursing shift.

Hypothesis II: Nurse Variables

Hypothesis 2A-2C predicted that all three judgments about secondary brain injury would be influenced by the experience level of the nurse, and that judgments about level of intervention (i.e. nurse interventions vs. consulting) would also be influenced by nursing shift. The literature is not consistent in its conclusions about how the experience level of the ICU nurse influences judgments and decisions (Bakalis et al., 2003; Baumann & Bourbonnais, 1982; Benner et al., 1999; Bucknall, 2000; Currey et al., 2006; Henry, 1991; Lauri et al., 1998). While several studies indicate that experience does influence judgments and decisions (Bakalis et al., 2003; Baumann & Bourbonnais, 1982; Benner et al., 1999; Bucknall, 2000; Currey et al., 2006), others have concluded that this variable is not significant (Henry, 1991; Lauri et al., 1998). In this study, the number of years the nurse had worked in the ICU was only significant in predicting judgments to use nursing interventions. The remaining variables that measured level of experience (i.e. years in the
current ICU, years with TBI patient) were not significant in predicting judgments and no experience variables were significant in predicting judgments about risk for secondary brain injury or consulting. Thus, these findings are consistent with the mixed results in previous studies on nurse experience and judgments (Bakalis et al., 2003; Bucknall, 2000; Currey et al., 2006; Henry, 1991; Lauri et al., 1998).

The primary shift worked by the nurse also significantly influenced judgments in this study. It was predicted that nurses working the day shift would be less likely to use nursing interventions, and more likely to consult. This hypothesis was not supported, as nurses working day shift actually were more likely to use nursing interventions and less likely to consult. This is consistent with the way in which shift predicted judgments when used as a vignette variable. While this finding is not supported by the literature (Bucknall, 2000), it can be explained by the fact that additional support staff is available during the day shift, which could influence judgments about nursing interventions vs. consulting.

Additional Findings

This study incorporated a multiple segment factorial survey design. This method proved to be a valuable technique, as many ICU nurses incorporate previous experiences or the sense of “knowing the patient” when making judgments (Ashcraft, 2001; Currey et al., 2006; Peden-McAlpine & Clark, 2002; Pyles & Stern, 1983). This method closely resembles real-life scenarios encountered in the ICU, where patient status quickly changes and nurses often make judgments based on previous situations or responses associated with that patient (Benner et al., 1999). In this study, regression analyses performed with the second segment of the vignettes (i.e. judgment scores at time 2)
indicated that the single best predictor of follow up judgments were the initial judgments made by the nurse. Judgments at time 1 nearly doubled the explained variance in judgments at time 2. The resulting variance explained for all three judgments at time 2 was approximately 60%.

Follow up vignettes were programmed to include patient scenarios that were either the same (i.e. levels for physiological values remained the same as in the initial vignette), better (i.e. levels increased 1-2 values), or worse (i.e. levels decreased 1-2 values). The three types of follow up vignettes were then randomly added to each initial vignette. A descriptive analysis that included the frequencies for how often each type of follow up vignette were used indicates that 80% of follow up vignettes were the same as initial vignettes. This may explain why time 1 judgments so strongly influenced time 2 judgments (i.e. because the patient scenario at time 1 was identical to the scenario in time 2). Future work using physiological variables in a multiple segment factorial survey design should focus on ensuring that follow up vignettes are randomly created and distributed, while still providing accurate clinical scenarios.

The fact that time 2 judgments were influenced by time 1 judgments is consistent with reports in the literature that ICU nurses rely on previous decisions and “knowing the patient” when making new judgments (Bakalis et al., 2003; Baumann & Bourbonnais, 1982; Benner et al., 1999; Currey et al., 2000). Benner et al. (1999) in particular cite several examples where ICU nurses develop an intuitive sense about a patient situation. This is also referred to as “knowing the patient”, and involves nurses gaining a sense about what should be done for a patient based on previous experiences with similar
patients or repeated experiences with the same patient. In this study, use of the multiple segment vignettes may have aided in nurses feeling that they were getting to “know” the patient. This fact, coupled with nurses reflecting on their initial judgments at time 1, may also explain why judgments at time 2 were so heavily influenced by judgments at time 1.

**Significance**

This study was significant for its contribution to nursing knowledge and education, and for its methodological approach. The discussion of the significance of the study findings is therefore organized in this manner.

**Significance for Nursing Knowledge**

ICU nurses have an integral role in preventing secondary brain injury in TBI patients through continuous monitoring and maintenance of physiological parameters. No studies have assessed nurses’ knowledge about secondary brain injury or what cues influence how a nurse determines risk of secondary brain injury. In this study, physiological, situational, and nurse variables accounted for over 30% of the variance in ICU nurse judgments about risk for secondary brain injury and in determining appropriate levels of intervention (i.e. only nursing interventions vs. consulting). Physiological variables were the strongest predictors of judgments, but only O2sat, ICP, and CPP values proved to influence judgments. BP and temperature were not shown to influence ICU nurse judgments when managing secondary brain injury. Situational and nurse variables influenced judgments, but to a lesser degree than physiological variables. This information provides the foundation for future educational initiatives for nurses responsible for managing secondary brain injury in TBI patients.
Significance for Nursing Education

This study contributes to knowledge about nurse management of secondary brain injury and provides information to guide educational initiatives for nurses. ICU nurses are not routinely provided with structured educational materials about secondary brain injury in TBI patients. Orientation to care of the TBI patient varies by nursing unit, and often does not include specialized content about risks and consequences of secondary brain injury. Nurses are typically instructed on ICP monitoring and maintenance of physiological parameters, including ICP, O2sat, BP, and CPP. However, it is not known to what extent nurses associate fluctuations in these parameters with secondary brain injury, or make judgments about how to best manage patients when these fluctuations occur.

Findings from this study provide preliminary information about how nurses associate different physiological and situational variables with patient risk of secondary brain injury. A patient’s O2sat, ICP, CPP, diagnosis, and mechanism of injury influence nurses’ judgments about risk of secondary brain injury. Nurses associate increasing values of O2sat, ICP, and CPP to progressively place a patient at higher risk for secondary brain injury. These findings are consistent with other reports in the literature citing that neuroscience nurse judgments are influenced by patient variables (Villaneuva, 1993), and that maintaining hemodynamic stability is a priority (Fonteyn & Fisher, 1994). As physiological values rise and the patient becomes less hemodynamically stable, nurses become less likely to use only nursing interventions, and more likely to consult other members of the healthcare team. BP and temperature were not shown to influence judgments, despite the fact that the research literature links these variables to secondary
brain injury and poor patient outcomes. This finding is consistent with the conclusions by Thompson (2007) which indicate that neuroscience nurses do not routinely rely on research evidence when making judgments. Educational efforts for nurses about secondary brain injury therefore must include evidence based content about the adverse consequences of all physiological variables.

Evidence-based guidelines for care of the TBI patient include recommendations for physiological parameters to reduce risk of secondary brain injury (BTF & AANS, 2000, 2003). However, nurses are not routinely educated about these guidelines, and there is no evidence that nurses incorporate these guidelines into their practice. In this study, nurses were asked if they were aware of any evidence-based guidelines for care of the TBI patient. Over 70% of nurses indicated that they were not aware of any such guidelines. Of the 27% who responded they were aware of guidelines, not one respondent cited the guidelines by the BTF and AANS when asked to report the name of the guidelines for care of the TBI patient. This finding is particularly interesting, considering that two of the ICUs in the study had recently implemented the BTF guidelines as part of standard practice in their units. It is not clear therefore if these nurses were not educated about the guidelines, or if they are incorporating guidelines as part of their practice, but simply were not able to state the specific name of the guidelines. In either case, this study highlights the fact that ICU nurses need to be educated about the specific guidelines recommended by the BTF. This coincides with the recommendation of the BTF (2002) that these guidelines must be disseminated to all members of the healthcare team.
Significance for Methodological Approach

Finally, this study was significant for its methodological approach. Few studies in nursing research have used factorial survey to investigate factors influencing nurse judgments. No studies have used this method when examining judgments of ICU or neuroscience nurses. Because care of these patients can be extremely complex and variables influencing judgments are often highly intercorrelated, use of factorial survey methodology proved beneficial in identifying factors influencing nurse judgments. Identification of variables influencing judgments about secondary brain injury highlighted areas for future educational initiatives for nurses, which could further prevent secondary brain injury and improve patient outcomes.

The use of the multiple segment factorial survey design has not been used in nursing research, but provided valuable information on the degree to which nurses rely on previous judgments when caring for critically ill patients. Use of this design more closely resembled the real life clinical context of the ICU, where patient situations often change rapidly and nurses must make numerous, frequent decisions.

Limitations

Limitations of this study center on the validity and generalizability of the study findings. First, while the vignettes were created to reflect real-life scenarios, they were in fact hypothetical situations that nurses were asked to read and indicate judgments. Situations presented in vignettes contained a limited amount of patient information, and judgments supplied by nurses in this study may differ from those made in the actual clinical setting. However, data that nurses provided on the last TBI patient they cared for
in their unit proved to be consistent with information presented in vignettes, thus strengthening the validity of the vignettes. Further, the study variables accounted for over 30% of the variance in nurse judgments. Therefore, although the amount of information supplied in vignettes was limited, this information was able to capture a significant portion of the variance explaining judgments.

A second limitation is the generalizability of the study findings. Although the study sample was composed of nurses from three ICUs at two different trauma centers, the sample size is not large enough to conclude that the judgments in this study reflect judgments made by all ICU nurses. Characteristics of respondents when compared to non-respondents were similar, indicating that the study sample reflected nurses working in the three units. However, because the sample was limited to nurses working in one geographical location, and because educational efforts about secondary brain injury vary by nursing unit and hospital, it is difficult to infer that ICU nurses working in all trauma centers would respond similarly to the vignettes.

Implications for Future Research

The findings from this study highlight areas for future research investigating how nurses manage secondary brain injury in critically ill TBI patients. This study provides baseline information about key factors influencing nurse judgments about secondary brain injury. Expanding the study using a larger, stratified random sample of nurses from trauma centers across the United States would provide a better representation of nursing knowledge and judgments about secondary brain injury, and may indicate additional areas for future educational initiatives.
Future research should focus on implementing and evaluating structured educational materials for nurses about secondary brain injury. Specifically, nurses need to be informed about the evidence-based guidelines by the BTF and the risks and consequences of secondary brain injury. Further, nurses must be educated about evidence-based interventions for preventing and minimizing secondary brain injury in TBI patients. Research evaluating the effectiveness of these educational interventions would not only highlight the role of the ICU nurse in secondary injury prevention, but has the potential to improve patient outcomes.

Additional research is needed about the effectiveness of nursing interventions on reducing secondary brain injury. Few studies have explored the relationship between nursing interventions and physiological values associated with secondary brain injury, such as O2at, BP, ICP, and CPP. These studies are limited by small sample sizes and the fact that they reported how nursing interventions negatively influence physiological values. Research on nursing interventions to prevent secondary brain injury, particularly with temperature management is needed.

Finally, future research using multiple segment factorial design in nursing science is needed. This study was the first in nursing research using this method to investigate nurse judgments. Because this methodology facilitates an examination as to how changes in context influence judgments, it could prove to be a valuable methodology for research on nurse judgments and decision making.
Conclusion

This study examined how physiological, situational, and nurse variables influenced ICU nurse judgments about secondary brain injury when caring for TBI patients. Physiological, situational, and nurse variables were shown to influence judgments about patient risk for secondary brain injury, nursing interventions, and consulting. Information from this study is valuable for nurse researchers, clinicians, and educators, as there is limited knowledge about how ICU nurses manage secondary brain injury among TBI patients. This information can be used to guide future educational initiatives for nurses about preventing secondary brain injury, which has the potential to improve patient outcomes.
REFERENCES


NOTIFICATION OF EXEMPTION

Date: May 30, 2007

From: David Kuentz, D.O.

To: Molly McNeely

Co-Investigators:

Date Coordinator:
Molly McNeely

Department Chair:
Jane Fuslero
Lorraine Mon

Re: Study # IRB07-00478
Title: Judgments of Intensive Care Unit Nurses When Managing Secondary Injury in Traumatic Brain Injury Patients

I am pleased to inform you that your study application has been reviewed by the MetroHealth Institutional Review Board (IRB) and it has been determined that it is Exempt from IRB review. Additionally, it has been determined that this activity meets the Ethical Standards of The MetroHealth System.

If you plan to make any alterations to this research project you must consult with the IRB first. The IRB will then review all proposed alterations to determine if they impact your study's Exempt status. Thank you for consulting the IRB regarding your proposal. Please contact the IRB Office at 216-778-2077 if you have any questions or concerns regarding your research study.

Sincerely,

David Kuentz, D.O.

MetroHealth Institutional Review Board, Chairperson
Appendix B: Summa Akron City Hospital IRB Approval

June 29, 2007

Molly McNett, RN, MSH, Ph.D.
Nursing Research
IFC 2nd Floor
ACH

SUBJECT: RP #07078
Judgments of Intensive Care Unit Nurses when Managing Secondary Injury in Traumatic Brain Injury Patients

Dear Ms. McNett:

The IRB Office has reviewed and approved your project effective June 29, 2007. This approval was processed through the exempt/expedited review process according to SOP RR 401 and in accordance with the federally defined categories of expedited review per 45 CFR 46.110(b) and 21 CFR 56.110(b)(2). Your project has been approved for a twelve-month period, expiring June 28, 2008. At that time an update regarding the project (renewal application) must be submitted and reviewed by the IRB Office.

Your project must be renewed by the MRC Chairperson and/or the full committee no later than June 27, 2008. Federal regulations do not allow for ANY grace period for renewal. As a courtesy, the IRB office will mail you a reminder notice requesting a renewal application/progress report. If the renewal application/progress report is submitted too late for MRC review prior to the expiration date stated above, your project will be inactivated and your department notified. This inactivation would mean that you can not accrue patients and/or review charts until proper renewal is obtained.

We wish you success with your project.

Sincerely,

Thomas Alexander, Ph.D.
Chair
Medical Research Committee
Appendix C: Kent State University IRB Approval

KENT STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD
APPLICATION FOR APPROVAL TO USE HUMAN RESEARCH PARTICIPANTS
Send completed forms to one of the reviewers designated for your Department or Katherine Light, Research and Graduate
Studies, 113 University Auditorium

LOG NUMBER C-7-500

Form can be downloaded from http://www.kent.edu/rope-alpha/forms/

Please type all information. HANDWRITTEN FORMS WILL NOT BE ACCEPTED. Move through the document
using TAB or Mouse. Do not use the enter Key. To mark a box, click with the mouse.

Name: Molly McNett
Telephone: 440-352-4286 Address: 1545 Lakeview Ave., Rocky River, OH 44116 Email: mmcnett@kent.edu

Department: Nursing Faculty Rank/Student Status: PhD Candidate

Project Title: Judgments of Intensive Care Unit Nurses Managing Secondary Brain Injury in Traumatic Brain Injury Patients

Type of Project: ☐ FACULTY RESEARCH ☐ External Funded (Agency: ) Include copy of proposal
☐ STUDENT DIRECTED RESEARCH (Advisor: Peggy Doherty, Carol Sedlak)
☐ Thesis ☐ Dissertation ☐ Course Requirement (Course #: )
☐ Other (Specify: )

Duration of Project: Starting Date: 7/1/2007 (But not before approval is obtained) Ending Date: 12/31/2007

I certify that the research procedures for this project and the method of obtaining consent (if any), as approved by the Kent State
University Institutional Review Board, will be followed during the period covered by this research project. Any future changes
will be submitted for Board review and approval prior to implementation.

If this project involves approval/permission from other institutions, the principal investigator (and the faculty advisor if the PI is
a student) must sign below to certify the following statement: "We will not begin research at other institutions before having
obtained their permission to do so."

Principal Investigator Date Faculty Advisor (If PI is a student) Date

Action Taken:
By REVIEWER:

☑ Level I, Category ☐ Level II, Category ☐ Level III, Category ☐
☐ Deception ☐ Waiver of Consent ☐ Identifiable medical information

Primary Reviewer Date Administrator, IRB Date

Co-Reviewer (Level II) Date

IRB Level III Action:
☐ Approved ☐ Disapproved ☐ Contingent Approval (Comments or Contingencies):

Chairperson, IRB Date
Appendix D: Introductory Letter

Hello,

My name is Molly McNett and I am a registered nurse at MetroHealth Medical Center. I am a doctoral student in the College of Nursing at Kent State University. I am conducting a research project examining factors that influence ICU nurses’ judgments when managing secondary brain injury in critically ill traumatic brain injury (TBI) patients. To gather this information, I am surveying ICU nurses who routinely take care of trauma patients with head injuries and would like you to participate in this study.

If you agree to participate in this study, you will be asked to complete an anonymous survey. The survey has three sections. The first section asks you questions about the last head-injured trauma patient you took care of in your unit. The second section is composed of seven fictional case scenarios you are asked to read and indicate how you would respond if you were caring for that patient. The third part of the survey is a set of questions that asks about your age, your educational preparation, and your work experience.

It will take approximately 5-10 minutes for you to complete the survey. To compensate you for your time if you choose to participate in this research, I am offering a raffle for a $25 gift card to Starbucks. If you are interested in participating in the study and having a chance to win this gift card, you may phone/email me with your first name and a way to contact you if you should win. My phone number and email are at the bottom of this letter. The contact information that you supply for this raffle will not be linked to the study records and I will notify the winner of the raffle privately in order to ensure your anonymity.

With any research study there are risks involved with participating in the research. Potential risks to you if you choose to participate in this study are that someone might find out if you participated and/or how you answered the questions on the study surveys. In order to minimize this risk, I am asking that you do not place your name anywhere on the study survey. Also, you may choose to return the completed survey directly to me today or I will give you a self-addressed, stamped envelope and you can mail your completed survey back to me directly via U.S. mail within 2 weeks.

There are no direct benefits to you if you choose to participate in this study. However, the information that you provide on the survey will be used to guide future educational programs for nurses about caring for critically ill TBI patients. Thus, information from this study has the potential to influence how future nurses care for TBI patients, which may impact patient outcomes.

You do not have to participate in this study. Your choice to participate or not will have no bearing on your employment in your unit or in your hospital organization. Your unit manager, co-workers, and supervisors will not be informed of your choice to participate (or not) in the study, nor will they be informed of your answers to the survey questions. If you choose to participate in this study, you may withdraw yourself from the study at any time.

If you do choose to participate in this study, please fill out the enclosed survey and return it directly to me today or via U.S. mail using the supplied envelope within 2 weeks. By completing and returning the survey, you are providing your consent to participate in this study. If you do not wish to participate in this study, simply do not complete the survey.

Thank you so much for your time today and for your consideration of this research project. If you have any questions about the study, please feel free to ask me today or you may call me at 216-778-2119. This proposal has been reviewed by the institutional review boards at MetroHealth Medical Center, Summa Health System, and Kent State University. If you have questions about your rights as a research participant, you may contact the Institutional Review Board at MetroHealth Medical Center at 216-778-3884, or at Summa Health System at 330-375-4045. If you have questions about Kent State University’s rules for research, you may contact my advisors, Dr. Peggy Doheny (330-672-8804), or Dr. Carol Sedlak (330-672-8836), or Dr. Peter Tandy, Acting Vice President and Dean, Division of Research and Graduate Studies (330-672-2851).

Sincerely,

Molly McNett, RN, MSN
mmcnett@metrohealth.org
216-778-2119
Appendix E: Follow-Up Letter

[KSU LETTERHEAD]

Hello,

My name is Molly McNett and I am a registered nurse at MetroHealth Medical Center. I am a doctoral student in the College of Nursing at Kent State University. I am conducting a research project examining factors that influence ICU nurses’ judgments when they are managing secondary brain injury in critically ill traumatic brain injury (TBI) patients. To gather this information, I am surveying ICU nurses who routinely take care of trauma patients with head injuries and would like you to participate in this study.

If I have already talked with you about this project and/or if you have already completed the survey, thank you so much and please disregard this letter and the enclosed survey. However, if you have not yet heard about this study or completed the study survey, please read the following information and consider participating in this important project.

If you agree to participate in this study, you will be asked to complete an anonymous survey. The survey has three sections. The first section asks you questions about the last head-injured trauma patient you took care of in your unit. The second section is composed of seven fictional case scenarios you are asked to read and indicate how you would respond if you were caring for that patient. The third part of the survey is a set of questions that asks about your age, your educational preparation, and your work experience.

It will take approximately 5-10 minutes for you to complete the survey. To compensate you for your time if you choose to participate in this research, I am offering a raffle for a $25 gift card to Starbucks. If you are interested in participating in the study and having a chance to win this gift card, you may phone/email me with your first name and a way to contact you if you should win. My phone number and email are at the bottom of this letter. The contact information that you supply for this raffle will not be linked to the study records and I will notify the winner of the raffle privately in order to ensure your anonymity.

With any research study there are risks involved with participating in the research. Potential risks to you if you choose to participate in this study are that someone might find out if you participated and/or how you answered the questions on the study survey. In order to minimize this risk, we are asking that you do not place your name anywhere on the study survey. Also, you may choose to return the completed survey directly to me today or I will give you a self-addressed, stamped envelope and you can mail your completed survey back to me directly via U.S. mail within 2 weeks.

There are no direct benefits to you if you choose to participate in this study. However, the information that you provide on the survey will be used to guide future educational programs for nurses about caring for critically ill TBI patients. Thus, information from this study has the potential to influence how future nurses care for TBI patients, which may impact patient outcomes. You do not have to participate in this study. Your choice to participate or not will have no bearing on your employment in your unit or in your hospital organization. Your nurse manager, co-workers, and supervisors will not be informed of your choice (or not) to participate in the study, or of the answers you provided in the study survey. If you choose to participate in this study, you may withdraw yourself from the study at any time.

If you do choose to participate in this study, please fill out the enclosed survey and return it to me via U.S. mail using the enclosed envelope within 2 weeks. By completing and returning this survey, you are providing your consent to participate in this study. If you do not wish to participate in this study, simply do not complete the survey.

Thank you so much for your time today and for your consideration of this research project. If you have any questions about the study, please feel free to ask me today or you may call me at 216-778-2119. This proposal has been reviewed by the institutional review boards at MetroHealth Medical Center, Summa Health System, and Kent State University. If you have questions about your rights as a research participant, you may contact the Institutional Review Board at MetroHealth Medical Center at 216-778-3884, or at Summa Health System at 330-375-4045. If you have questions about Kent State University’s rules for research, you may contact my advisors, Dr. Peggy Doheny (330-672-8804), or Dr. Carol Sedlak (330-672-8836), or Dr. Peter Tandy, Acting Vice President and Dean, Division of Research and Graduate Studies (330-672-2851).

Sincerely,
Molly McNett, RN, MSN
mmcnett@metrohealth.org
Appendix F: Study Survey

ICU NURSE SURVEY

Primary Investigator:
Molly McNett
MetroHealth Medical Center
216-778-2119
Directions: This survey is composed of 3 sections. In the first section (SECTION A) you will be asked to answer some questions about the last trauma patient that you took care of who had a head injury. Please read the questions and circle the answer that best represents the situation surrounding your last head-injured trauma patient.

In the second section of this survey (SECTION B) you will be presented with a series of different case scenarios about a trauma patient who has sustained a head injury and is admitted to your SICU. Please read each scenario and indicate how you would respond if caring for that patient in your unit.

The final section of this survey (SECTION C) is a series of demographic questions to gather information about you and your work experience as a registered nurse. Please read each question and circle the appropriate answer.

There are no right or wrong answers to any of the questions in this survey. Information from the answers you provide on these surveys will help me better understand how ICU nurses take care of head-injured trauma patients.

When you have completed your survey, please hand it directly to me (Molly McNett). If you would prefer to take the survey home with you and mail it back me, please just let me know and I will provide a pre-addressed, stamped envelope for your convenience. If you choose to take your survey home to complete, please mail it to me within 2 weeks.

***REMEMBER, DO NOT PLACE YOUR NAME ANYWHERE ON THIS STUDY SURVEY***

Thank you for taking the time to complete this survey!
SECTION A

Instructions: This section contains a series of questions about the last head-injured trauma patient you took care of in your SICU. Please think back to the last head-injured trauma patient that you cared for in your unit and circle the answer that best represents that patient.

1) Approximately how long ago was it that you last took care of a trauma patient with a head injury? (circle one):
   A.) Within the last week
   B.) Within the last month
   C.) Within the last year
   D.) I can’t remember the last time I took care of this type of patient in my unit
   E.) I have never taken care of this type of patient in my unit

2) Please indicate which of the physiological parameters listed below you were responsible for monitoring and managing when you were taking care of this patient (circle all that apply):
   A.) Blood pressure (BP)
   B.) Oxygen levels (O2sat)
   C.) Temperature
   D.) Intracranial pressure (ICP)
   E.) Cerebral perfusion pressure (CPP)
   F.) Other (please specify):
3) What was the mechanism of injury of that patient (i.e. how did he/she get hurt)? (circle one):

A.) Motor vehicle accident (MVA)
B.) Fall
C.) Assault
D.) Other (please specify):

4) Was the patient male or female? (circle one):

A.) Male
B.) Female

5) What was the approximate age range of the patient? (circle one):

A.) 18-35 years old
B.) 36-65 years old
C.) 66-85 years old
D.) Over 86 years old

6) Did the patient have any of the following co-morbidities or secondary diagnoses? (circle all that apply):

A.) Injuries to areas other than the head (extracranial injuries)
B.) Hypertension
C.) Diabetes
D.) Other (please specify):

7) What were some of the interventions that you did while caring for that patient?
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
SECTION B

Instructions: In this section, you will be presented with a series of case scenarios and asked a few questions after each scenario. There are no right or wrong answers. Please just read each case scenario and indicate how you would respond if caring for that patient in your SICU.

The first two scenarios only have one part. Read each scenario and answer the questions that immediately follow that part. The last 5 scenarios each have two parts. After reading each part please again answer the questions that immediately follow.

For each question, please circle the number that best represents what you would be most likely to do immediately for that patient, using the following scale where:

0=not very likely and 10=very likely

For the purposes of this study, the phrase “nursing interventions” refers to activities such as:

- Repositioning the patient
- Suctioning the patient
- Talking to the patient
- Limiting environmental stimuli
- Administering prn pain medication
- Administering prn anti-anxiety medication
- Administering prn agents for blood pressure management (i.e. labetolol, albumin)
- Titrating vasoactive medications within prescribed parameters
Case Scenario #1:
You are performing your initial assessment at the beginning of your shift when caring for a 85 year old male patient in your SICU on the night shift. The patient has sustained an diffuse axonal injury from an assault and also has diabetes mellitus. In performing your assessment, you record the following values:

<table>
<thead>
<tr>
<th>SBP</th>
<th>&lt;70mmHg</th>
</tr>
</thead>
<tbody>
<tr>
<td>O2 sat</td>
<td>&lt;80%</td>
</tr>
<tr>
<td>Temperature</td>
<td>&gt;39.6 degrees C</td>
</tr>
<tr>
<td>ICP</td>
<td>&gt;30mmHg</td>
</tr>
<tr>
<td>CPP</td>
<td>&lt;50mmHg</td>
</tr>
</tbody>
</table>

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                     (very likely)
   0  1  2  3  4  5  6  7  8  9  10

2. What is the likelihood that you would manage this situation solely with nursing interventions:
   (not very likely)                     (very likely)
   0  1  2  3  4  5  6  7  8  9  10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                     (very likely)
   0  1  2  3  4  5  6  7  8  9  10
   Who would you consult? (check all that apply)
   ___ I would not consult anyone at this time
   ___ A more senior nurse
   ___ A respiratory therapist
   ___ A physician

Case Scenario #2:
You are performing your initial assessment at the beginning of your shift when caring for a 35 year old male patient in your SICU on the day shift. The patient has sustained an epidural hematoma from a fall and also has extracranial injuries. In performing your assessment, you record the following values:

<table>
<thead>
<tr>
<th>SBP</th>
<th>90-100mmHg</th>
</tr>
</thead>
<tbody>
<tr>
<td>O2 sat</td>
<td>90-95 %</td>
</tr>
<tr>
<td>Temperature</td>
<td>38.0-38.5 degrees C</td>
</tr>
<tr>
<td>ICP</td>
<td>15-20mmHg</td>
</tr>
<tr>
<td>CPP</td>
<td>60-65mmHg</td>
</tr>
</tbody>
</table>

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                     (very likely)
   0  1  2  3  4  5  6  7  8  9  10

2. What is the likelihood that you would manage this situation solely with nursing interventions:
   (not very likely)                     (very likely)
   0  1  2  3  4  5  6  7  8  9  10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                     (very likely)
   0  1  2  3  4  5  6  7  8  9  10
   Who would you consult? (check all that apply)
   ___ I would not consult anyone at this time
   ___ A more senior nurse
   ___ A respiratory therapist
   ___ A physician
Case Scenario #3:
You are performing your initial assessment at the beginning of your shift when caring for a 75 year old female patient in your SICU on the day shift. The patient has sustained an diffuse axonal injury from a fall and also has extracranial injuries. In performing your assessment, you record the following values:
- SBP <70mmHg
- O2sat 80-84%
- Temperature >39.6 degrees Celsius
- ICP 26-30 mmHg
- CPP <50mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                              (very likely)
   0  1  2  3  4  5  6  7  8  9  10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely)                              (very likely)
   0  1  2  3  4  5  6  7  8  9  10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                               (very likely)
   0  1  2  3  4  5  6  7  8  9  10

Who would you consult? (check all that apply)
___I would not consult anyone at this time     ___A more senior nurse
___A respiratory therapist         ___A physician

Case Scenario #3a:
You are now performing your follow up assessment 15 minutes later on this same patient. You record the following values:
- SBP 90-100mmHg
- O2sat 90-95%
- Temperature >39.6 degrees Celsius
- ICP 15-20mmHg
- CPP 55-59mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                              (very likely)
   0  1  2  3  4  5  6  7  8  9  10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely)                              (very likely)
   0  1  2  3  4  5  6  7  8  9  10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                               (very likely)
   0  1  2  3  4  5  6  7  8  9  10

Who would you consult? (check all that apply)
___I would not consult anyone at this time     ___A more senior nurse
___A respiratory therapist         ___A physician
**Case Scenario #4:**
You are performing your initial assessment at the beginning of your shift when caring for a 35 year old female patient in your SICU on the night shift. The patient has sustained a subdural hematoma from a motor vehicle accident and also has diabetes mellitus. In performing your assessment, you record the following values:

- SBP 70-79mmHg
- O2sat 90-95%
- Temperature 39.1-39.5 degrees Celsius
- ICP >30 mmHg
- CPP <50mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                             (very likely)
   0 1 2 3 4 5 6 7 8 9 10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely)                             (very likely)
   0 1 2 3 4 5 6 7 8 9 10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                             (very likely)
   0 1 2 3 4 5 6 7 8 9 10

   Who would you consult? (check all that apply)
   ___I would not consult anyone at this time
   ___A more senior nurse
   ___A respiratory therapist
   ___A physician

**Case Scenario #4a:**
You are now performing your routine shift re-assessment 4 hours later on this same patient. You record the following values:

- SBP 80-89mmHg
- O2sat 85-89%
- Temperature >39.6 degrees Celsius
- ICP 15-20mmHg
- CPP 50-54mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                             (very likely)
   0 1 2 3 4 5 6 7 8 9 10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely)                             (very likely)
   0 1 2 3 4 5 6 7 8 9 10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                             (very likely)
   0 1 2 3 4 5 6 7 8 9 10

   Who would you consult? (check all that apply)
   ___I would not consult anyone at this time
   ___A more senior nurse
   ___A respiratory therapist
   ___A physician
**Case Scenario #5:**
You are performing your initial assessment at the beginning of your shift when caring for a 45 year old male patient in your SICU on the evening shift. The patient has sustained an intracerebral hemorrhage from a fall and also has hypertension. In performing your assessment, you record the following values:

- SBP 70-79mmHg
- O2sat <80%
- Temperature 39.1-39.5 degrees Celsius
- ICP 21-25 mmHg
- CPP <50mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                             (very likely)
   0  1  2  3  4  5  6  7  8  9  10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely)                             (very likely)
   0  1  2  3  4  5  6  7  8  9  10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                             (very likely)
   0  1  2  3  4  5  6  7  8  9  10
   Who would you consult? (check all that apply)
   ___ I would not consult anyone at this time   ___ A more senior nurse
   ___ A respiratory therapist           ___ A physician

**Case Scenario #5a:**
You are now performing your routine shift re-assessment 4 hours later on this same patient. You record the following values:

- SBP 80-89mmHg
- O2sat 85-89%
- Temperature >39.6 degrees Celsius
- ICP 15-20mmHg
- CPP 50-54mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely)                             (very likely)
   0  1  2  3  4  5  6  7  8  9  10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely)                             (very likely)
   0  1  2  3  4  5  6  7  8  9  10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely)                             (very likely)
   0  1  2  3  4  5  6  7  8  9  10
   Who would you consult? (check all that apply)
   ___ I would not consult anyone at this time   ___ A more senior nurse
   ___ A respiratory therapist           ___ A physician
**Case Scenario #6:**
You are performing your initial assessment at the beginning of your shift when caring for a 85 year old female patient in your SICU on the day shift. The patient has sustained an epidural hematoma from an assault and also has diabetes mellitus. In performing your assessment, you record the following values:
- SBP 70-79mmHg
- O2sat 90-95%
- Temperature >39.6 degrees Celsius
- ICP 26-30mmHg
- CPP <50mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely) (very likely)
   
   0 1 2 3 4 5 6 7 8 9 10

2. What is the likelihood that you would manage this situation solely with nursing interventions:
   (not very likely) (very likely)
   
   0 1 2 3 4 5 6 7 8 9 10

Who would you consult? (check all that apply)
- I would not consult anyone at this time
- A more senior nurse
- A respiratory therapist
- A physician

**Case Scenario #6a:**
You are now performing your evaluative/follow up assessment 15 minutes later on this same patient. You record the following values:
- SBP 80-89mmHg
- O2sat 85-89%
- Temperature >39.6 degrees Celsius
- ICP 15-20mmHg
- CPP 50-54mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely) (very likely)
   
   0 1 2 3 4 5 6 7 8 9 10

2. What is the likelihood that you would manage this situation solely with nursing interventions:
   (not very likely) (very likely)
   
   0 1 2 3 4 5 6 7 8 9 10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely) (very likely)
   
   0 1 2 3 4 5 6 7 8 9 10

Who would you consult? (check all that apply)
- I would not consult anyone at this time
- A more senior nurse
- A respiratory therapist
- A physician
Case Scenario #7:
You are performing your initial assessment at the beginning of your shift when caring for a 25 year old female patient in your SICU on the night shift. The patient has sustained a diffuse axonal injury from a motor vehicle accident and also has hypertension. In performing your assessment, you record the following values:
- SBP 90-100mmHg
- O2sat <80%
- Temperature <39.6 degrees Celsius
- ICP >30 mmHg
- CPP <50mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely) (very likely)
   0 1 2 3 4 5 6 7 8 9 10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely) (very likely)
   0 1 2 3 4 5 6 7 8 9 10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely) (very likely)
   0 1 2 3 4 5 6 7 8 9 10
   Who would you consult? (check all that apply)
   ___I would not consult anyone at this time
   ___A more senior nurse
   ___A respiratory therapist
   ___A physician

Case Scenario #7a:
You are now performing your routine shift re-assessment 4 hours later on this same patient. You record the following values:
- SBP 80-89mmHg
- O2sat 85-89%
- Temperature >39.6 degrees Celsius
- ICP 15-20mmHg
- CPP 50-54mmHg

1. What is the likelihood that this situation places your patient at increased risk for additional injury to the brain:
   (not very likely) (very likely)
   0 1 2 3 4 5 6 7 8 9 10

2. What is the likelihood that you would manage this situation **solely** with nursing interventions:
   (not very likely) (very likely)
   0 1 2 3 4 5 6 7 8 9 10

3. What is the likelihood that you would consult another member of the healthcare team to assist in managing this situation:
   (not very likely) (very likely)
   0 1 2 3 4 5 6 7 8 9 10
   Who would you consult? (check all that apply)
   ___I would not consult anyone at this time
   ___A more senior nurse
   ___A respiratory therapist
   ___A physician
Instructions: Please answer the following questions about yourself and your work in your current SICU. This information will help me to interpret the information you provide in the study survey about taking care of brain-injured patients.

Please answer the following questions about yourself:

1. What is your age range?
   A.) 20-25 years
   B.) 26-30 years
   C.) 31-35 years
   D.) 36-40 years
   E.) 41-45 years
   F.) 46-50 years
   G.) 51-55 years
   H.) 56-60 years
   I.) Greater than 60 years

2. What is your gender? (circle one):
   A.) Male
   B.) Female

3. What is your primary racial/ethnic background?(circle one):
   A.) Caucasian/White
   B.) African American
   C.) Hispanic
   D.) Asian
   E.) Other (please specify): ______________
4. How many years have you worked as a registered nurse? (circle one):
   A.) 0-5 years
   B.) 6-10 years
   C.) 11-15 years
   D.) 16-20 years
   E.) 21 years or greater

5. How many years have you worked in critical care? (circle one):
   A.) 0-5 years
   B.) 6-10 years
   C.) 11-15 years
   D.) 16-20 years
   E.) 21 years or greater

6. How many years have you worked in your current ICU? (circle one):
   A.) 0-5 years
   B.) 6-10 years
   C.) 11-15 years
   D.) 16-20 years
   E.) 21 years or greater

7. How many years have you been taking care of patients with traumatic brain injuries? (circle one):
   A.) 0-5 years
   B.) 6-10 years
   C.) 11-15 years
   D.) 16-20 years
   E.) 21 years or greater
8. What is the highest NURSING degree that you have completed? (circle one):
   A.) Associates degree (AD)
   B.) Nursing Diploma
   C.) Bachelors Degree (BSN)
   D.) Masters Degree (MSN)
   E.) Doctoral Degree (PhD)

9. What is your primary shift assignment (i.e. what shift do you work most often?) (circle one):
   A.) Days
   B.) Days/Nights
   C.) Days/Evenings
   D.) Evenings
   E.) Nights
   F.) Other (please specify): _____________________

10. Are you currently aware of any evidence based guidelines that would assist you in taking care of trauma patients that have sustained head injuries?
    A.) No
    B.) Yes  (If yes, please indicate what guidelines):

11. Do you currently belong to any specialty nursing organizations?
    A.) No
    B.) Yes (If yes, please indicate which ones):

12. Do you currently hold any specialty nursing certifications?
    A.) No
    B.) Yes (If yes, please indicate which ones):
Thank you so much for taking the time to complete these surveys. Please hand your completed surveys to directly to me today or you may send them via U.S. Mail to me within two weeks using the pre-addressed, stamped envelope.

If you would like to be entered into the raffle to win a $25 gift to Starbucks, please call/email me with your first name and a contact phone number or email address (my contact information is on the introductory letter you received). Raffle winners will be notified privately in 3-4 weeks.