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## Mild Traumatic Brain Injury: Are Emergency Department Providers Identifying Which Patients Are At Risk?

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MILD TRAUMATIC BRAIN INJURY; ARE EMERGENCY DEPARTMENT PROVIDERS  
IDENTIFYING WHICH PATIENTS ARE AT RISK?

A thesis submitted to the faculty of  
Brigham Young University  
in partial fulfillment of the requirements for the degree of  
Master of Science

College of Nursing  
Brigham Young University  
August 2010

BRIGHAM YOUNG UNIVERSITY

SIGNATURE PAGE

of a thesis submitted by

Barbara K. Stuart

The thesis/project/dissertation of Barbara K. Stuart is acceptable in its final form including (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory and ready for submission.

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## ABSTRACT

### MILD TRAUMATIC BRAIN INJURY; ARE EMERGENCY DEPARTMENT PROVIDERS IDENTIFYING WHICH PATIENTS ARE AT RISK?

Barbara K. Stuart

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Master of Science

*Objective:* Identify patients with specific emergency department (ED) discharge diagnoses who later report symptoms associated with a mild traumatic brain injury (MTBI), compare frequency and severity of MTBI symptoms by discharge diagnoses, investigate the frequency of head injury education provided to ED patients with each diagnosis, and finally, to learn what type of changes have occurred in the lives of patients as a result of their injury.

*Methods:* Fifty-two ED patients, aged 18 to 28 who were at least two weeks post injury, spoke English and were discharged with a diagnosis of concussion/closed head injury (CHI), head laceration, motor vehicle crash (MVC), whiplash/cervical strain, facial/jaw fractures or multiple injuries were invited to participate. Participants completed the Post Concussive Symptom Scale (PCSS), a demographic questionnaire and then a series of open-ended questions about the impact the injury had on their lives.

*Results:* MTBI symptoms on the PCSS were reported by 84.6% (n = 44) of respondents with a range of 1 – 23 different symptoms per participant. Headache (69.2%) and fatigue (61.5%) were the most common symptoms. Males (51% of the participants) reported on average 6.76 symptoms (S.D. = 6.53) whereas females reported an average of 12.68 symptoms (S.D. =

6.32). A large percentage (83.3%, n = 10) of participants with a MVC diagnosis reported severity scores in the moderate range (mean = 3.17; S. D. = 0.27) in all four PCSS categories (physical, thinking, sleep and emotional) representing the highest severity scores reported overall. Participants diagnosed with a concussion/CHI received the most (74%) head injury education of all discharge diagnoses, but only half (51%) received written information. The most common quality of life change was that 70.3% of survey participants became more cautious.

*Conclusion:* Participants with a discharge diagnosis not commonly associated with brain injury reported having MTBI symptoms at least two weeks post injury with females reporting twice as many symptoms as males reported. Head injury education provided in the ED was lacking for all participants and although participants involved in a MVC reported having the most severe MTBI symptoms they had the least head injury education. All health care providers, especially nurses working in the ED, need to look beyond physical complaints and recognize injuries associated with increased risk for developing MTBI symptoms. Proactive ED identification of patients with “at risk” injuries by nurses would likely promote increased MTBI education and thereby result in fewer missed MTBI diagnoses.

*Keywords:* Mild traumatic brain injury, identification, symptoms, treatments, education, outcomes, quality of life.

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## MILD TRAUMATIC BRAIN INJURY; ARE EMERGENCY DEPARTMENT PROVIDERS IDENTIFYING WHICH PATIENTS ARE AT RISK?

### *Introduction*

Mild Traumatic Brain Injury (MTBI), commonly referred to as a concussion, is defined as a blow or jolt to the head, or a penetrating head injury that disrupts brain functioning (Center for Disease Control and Prevention (CDC) 2009). However, in a comprehensive report of the World Health Organization Collaborating Centre Task Force on Mild Traumatic Brain Injury (Cassidy, Carroll & Peloso, 2004), the definition of concussion was further expanded to include acute brain injuries resulting from mechanical energy to the head from an external physical force. Criteria for clinical identification of a MTBI consists of one or more of the following: confusion or disorientation, loss of consciousness (LOC) for 30 minutes or less, post-traumatic amnesia for less than 24 hours and/or other transient neurological abnormalities such as focal signs, seizure, and a Glasgow Coma Scale score of 13 – 15 for a time frame up to thirty minutes post-injury (Cassidy, et al., 2004). In addition, clinical manifestations must not be due to drugs, alcohol, medications, other injuries or treatment for other injuries (Cassidy, et al., 2004). However, despite an expanded definition, ED clinicians may still have difficulty identifying which patients have an MTBI, since providers tend to rely heavily on a reported LOC to make the diagnosis (Powell, Ferraro, Dikmen, Temkin & Bell, 2008). Conversely, some patients suffering a MTBI may not experience LOC or the episode was so brief, they may not even know it occurred and consequently did not report it after their accident (Kashluba, Paniak & Casey, 2008; Paniak, et al., 2002; Sterr, Herron, Hayward & Montaldi, 2006).

Unfortunately, a MTBI can be anything but “mild” to the patient who suffers sequela long after the initial injury. It is true that for some patients, MTBI symptoms may resolve with little or no intervention; however, for others, MTBI can lead to significant, life-long impairment affecting the ability to function physically, cognitively, and psychologically (Rees & Bellon, 2007; Soo, & Tate, 2007). Studies have also shown MTBI symptoms are best treated early on with a multidisciplinary approach for optimal recovery, which makes timely recognition and diagnosis crucial (Schatz, Pardini, Lovell, Collins & Podell, 2006; Yang, Tu, Hua & Huang, 2007). On the other hand, if left untreated, persistent MTBI symptoms frequently become worse and have a significant impact on quality of life (Fleminger, 2008; Jakola, et al., 2007). Therefore, the purpose of this pilot project was to investigate the frequency and severity of reported MTBI symptoms related to specific ED discharge diagnoses, to identify how often head injury education is provided to those patients at the time of discharge, and what life changes participants reported over time because of their injury so more appropriate interventions can be provided.

### ***Review of the literature***

MTBI is a broad classification for traumatic brain injuries; nearly 90% of more than 2 million traumatic brain injuries that occur annually in the United States are classified as MTBI (Naunheim, Matero & Fucetola, 2008). In addition, “mild” brain injuries constitute 70% - 90% of all treated head injuries (Ponsford, 2005) and are estimated to cost \$17 billion dollars per year in the United States alone (Naunheim et al., 2008). Interestingly, the CDC refers to MTBI as a "silent epidemic" (Langlois, Marr, Mitchko, & Jonson, 2005) because the resulting problems are often not immediately apparent. In fact, many people with a MTBI are unable to return to work or function

at a lower level than they did prior to the injury (Naunheim et al., 2008). Although studies have shown symptoms and cognitive impairments caused by MTBI usually resolve within 3 months, in some cases (15% - 25%) difficulties persist, often resulting in significant ongoing disability and adjustment problems which can become chronic (CDC, 2003; Ponsford, et al., 2000). In addition, MTBI patients may be at risk for second impact syndrome – a life-threatening swelling of the brain, which occurs when a second concussion occurs shortly after the first mild injury (Mateer, Sira & O'Connell, 2005; Ponsford et al., 2000).

Estimates indicate EDs treat 100 to 300 head injuries per 100,000/population per annum. However, a large number of MTBI cases are not treated in hospital EDs, so the actual rate may be greater than 600 per 100,000 annually (Ponsford, 2005). In addition, there is limited evidence regarding whether or not patients are accurately identified as high risk for a MTBI at the time of injury or diagnosed in the weeks that follow (Powell, et al, 2008). Consequently there is a question as to the accuracy of MTBIs reported because the CDC generates epidemiological data for head injuries based on ICD.9 diagnostic codes taken directly from the provider's dictated diagnosis. If a diagnosis does not represent a head injury or it is not coded correctly, the CDC cannot accurately report the MTBI frequency. Additionally, there are no exact methods of predicting post concussive syndrome or MTBI at the time of or in relationship to the type of injury sustained (Bazarian & Atabaki, 2001; Gioia, Collins & Isquith, 2008; Paniak et al., 2002; Powell, et al., 2008). In fact, a recent real time two-year study discovered only 56% of recognized MTBI cases (meeting CDC criteria for mild brain injury) treated in the ED were actually documented in the ED record as MTBI. Furthermore, for patients who did report a LOC only 72% had MTBI documentation in their ED record. But more significantly 94% of patients

who were not diagnosed with a MTBI reported being confused immediately after the injury (Powell et al., 2008). This is problematic since both confusion and LOC are hallmark symptoms indicating a MTBI.

Even though research is beginning to provide more diagnostic information about MTBI most health care providers continue to rely on positive objective findings such as repetitive questioning or an altered LOC before considering a diagnosis of MTBI or concussion (Paniak et al., 2002). In addition, for patients reporting a LOC, a head computerized axial tomography scan (CT) is frequently performed to identify emergent traumatic conditions such as a cerebral bleed (Jagoda, et al., 2008; Ono, Wada, Takahara & Shirotani, 2007). However, it is important to note that a negative CT does not rule out a MTBI (Paniak et al., 2002).

MTBI's are commonly caused by falls (28%), motor vehicle crash (MVC) (20%), injury by collision with or against something (19%) and assaults (11%). Most head injuries involve teenage and young adult males (CDC, 2009; Cassidy et al., 2004). Interestingly, no studies have identified injury severity as a factor contributing to ongoing disability following a MTBI. Moreover patients who hit their head during a fall frequently leave the ED with a diagnosis of "head laceration" or "closed head injury" and those involved in a MVC are frequently discharged with contusions, cervical strain, or whiplash diagnoses. Based on mechanism of injury, any acceleration-deceleration injury puts patients at increased risk for developing MTBI symptoms after discharge from the ED. Therefore, ED providers should be cautious in treating injuries which superficially appear insignificant and could be viewed as a seemingly unimportant "bump on the head." It is clear that a delay in diagnosis complicates efforts crucial to early identification and provision of education about MTBI symptoms to patients whom, in fact, have

suffered a MTBI. Three decades ago the co-developers of the Glasgow Coma Scale authored an internationally recognized text on the management of head injuries, in which they wrote: "Minor head injury is the most common yet least understood of all head injuries" (Jennett & Teasdale, 1981, p. 182) with a summation suggesting brain damage caused by mild head injury is frequently underestimated.

Several factors contribute to under diagnosis of a MTBI. One factor is many ED health care providers treating mildly injured patients may be unfamiliar with recent literature concerning MTBI. ED providers are also more focused on identifying emergent conditions and not likely to give serious attention to largely subjective complaints which are the hallmarks of an unresolved MTBI. On the other end of the spectrum, ED providers accustomed to evaluating severe head injuries are apt to view mildly concussed patients as fortunate to have escaped serious brain damage and discount the significance of a milder injury (Jennett & Teasdale, 1981).

Using the term "mild" in describing any type of brain injury also predisposes both provider and patient to minimize the injury. However, there are long-term physical and psychological consequences of MTBI such as headache, balance problems, dizziness, visual changes, fatigue, sensitivity to noise, sleep disturbances, and difficulty with concentration and memory (Kashluba, et al., 2008). Emotions can also be heightened, amplifying irritability, sadness, nervousness and anxiety, all of which interfere with quality of life. MTBI symptoms can be subtle and may not be recognized until days or weeks following the injury, making an accurate diagnosis difficult. Consequently, ED patients may falsely believe their symptoms are not related to their injury because they were discharged without a brain injury diagnosis or given

education about what symptoms are associated with a MTBI (Setnik & Bazarian, 2007).

Furthermore, patients with this false sense of security may delay seeking further care for their symptoms because they were released from the ED believing they had no serious injury.

However, months later, they may still have MTBI symptoms related to a previous “at risk” injury that was not identified as causing a MTBI (Mackenzie & McMillan, 2005).

Over the past five years a number of studies have focused on the benefits of early MTBI recognition followed by appropriate interventions (Andersson, Emanuelson, Bjorklund & Stalhammar, 2007; Setnik & Bazarian, 2007; Snell, Surgenor, Hay-Smith, & Seigert, 2009).

However, not much information is found in the literature and collectively the now larger body of evidence suggests promise for educational support and intervention models when provided early following an injury (Snell, et al., 2009). More information on the incidence, cause and prevalence of MTBI is needed as well as early recognition and education provided by the ED staff (Stulemeijer, Van der Werf, Borm & Vos, 2008). Hence, there are several questions this pilot study sought to answer:

1. What is the frequency and severity of reported MTBI symptoms related to specific ED discharge diagnoses?
2. How often is head injury education provided to ED patients with each diagnosis and how was it provided?
3. What life changes have patient’s reported as a result of their injury?

#### Methodology

##### Design

This pilot study used a descriptive survey design.

### ***Procedure***

After obtaining Institutional Review Board (IRB) approval from Brigham Young University and Intermountain Healthcare Urban South Region, electronic charts of all patients seen in the ED of a 330-bed full-service tertiary facility from January 1, 2009 to December 31, 2009, were reviewed. To meet inclusion criteria, participants had to be at least two weeks post ED visit and between 18 and 28 years of age, with a discharge diagnosis of closed head injury/concussion, head laceration, facial/jaw fracture, whiplash, cervical strain, MVC or multiple injuries. However, after an ED chart review of past medical history and current medications, patients were excluded if they had previous health problems, a history of psychiatric illness, or were currently taking mood altering, pain or muscle relaxant medications. If patients did not speak English, they were excluded because the surveys used were written only in English.

Those meeting the inclusion criteria were then sent a letter inviting them to participate in the pilot study by completing a survey which was available either online using Survey Monkey or as a hard copy by mail. Participation letters were signed by the Medical Director of the Intermountain Healthcare Office of Research and were sent on hospital letterhead and envelopes, a requirement of the facility IRB (See Appendix A for a copy of the letter). Upon completion of the survey each participant received \$10 cash. Confidentiality and anonymity were assured by assigning each participant a code number.

### *Measures*

Participants completed three measures: The Post Concussion Symptom Scale (PCSS), (Schatz, Pardini, Lovell, Collins & Podell, 2006), a demographic questionnaire and a series of open-ended questions. The PCSS (See Appendix B) identifies common MTBI symptoms in four categories: physical, thinking, sleep and emotional (Schatz, Pardini, Lovell, Collins & Podell, 2006). Participants rated each symptom by using a Likert scale of 0 – 6 with 0 = none, 1 - 2 = mild, 3 - 4 = moderate, and 5 - 6 = severe. A mean severity score was calculated for each symptom and for each of the four symptom categories according to discharge diagnosis. The PCSS is a valid and reliable instrument, has been used extensively in head trauma research (Barr, & McCrea, 2001; Iverson, Lovell & Collins, 2004; McClincy, Lovell, Pardini, & Collins, 2006; McCrea, 2001; Schatz, et al., 2006) and is routinely used in assessing players in the National Football and National Hockey leagues on the sidelines to gage the severity of a concussion an athlete may have sustained during a game. The sensitivity for identifying a MTBI is 81.9%, and the specificity is 89.4% (Schatz, et al., 2006). The internal consistency reliability of the PCSS ranged from .88 - .94 in large samples of students, and was 0.93 in a clinical sample of 115 concussed athletes (McCrea, 2001).

Participants also completed a demographic questionnaire (See Appendix C) that included; age, gender, the date of the injury, how the injury occurred, the ED discharge diagnosis and the time frame medical care was sought after the injury occurred. Other questions included years of education, employment or student status, amount of time taken off from work or school, if any MTBI education or teaching was provided in the ED, and if further health care was obtained after the ED visit.

The open ended questions (Appendix D) were developed by the investigator and asked participants to provide information about care received for their injury during and after their ED visit (did they receive a CT scan or a medication prescription), the overall impact the injury has had on their life and any changes they have made as a result of the injury.

### ***Data Analysis***

#### ***Quantitative analysis***

Descriptive statistics for demographic data, individual PCSS symptoms and the four PCSS categories were calculated using SPSS, excel and Survey Monkey. Descriptive statistics were also calculated for PCSS symptoms according to discharge diagnosis, whether or not head injury information was provided in the ED, and if provided, whether it was oral, written or both.

#### ***Qualitative analysis***

The primary investigator initially reviewed responses to the open ended questions for common characteristics and themes according to qualitative methodology (Polit & Beck, 2010), that reflected the specific aspects of one's life impacted by MTBI sequelae. Responses were compared across participants and direct quotes that best reflected each category were then chosen. The faculty mentor reviewed the open ended responses, categories and quotes chosen to ensure that they were clear and representative of participant responses (Polit & Beck, 2010).

### ***Results***

A total of 45,218 charts were reviewed and letters were sent to 702 patients who met the inclusion criteria. Since participation letters were sent on Intermountain Healthcare stationery letterhead and envelopes, any undeliverable letters were returned either to the Intermountain

Healthcare Office of Research or the research facility general delivery and not all were forwarded to the investigator. Consequently, the exact number of those receiving the letter is unknown.

Fifty-four participants responded to the survey; most (n = 48) took the survey on line using Survey Monkey; six completed a hard copy which was entered into Survey Monkey by the investigator.

However, only 52 were complete and included in the data analysis.

### ***Quantitative results***

The average age of subjects was 22.75 years (S.D. = 2.68). Males (51% of participants) reported 6.76 symptoms (S.D. = 6.53) compared to females who reported 12.68 symptoms (S.D. = 6.32). Participants received their injury from 1 – 11 months prior to completing the questionnaires with a mean of 4.01 (S. D. = 2.12) months. Most participants (n = 52; 54.8%) completed more than two years of college, and 75% were currently students. Of those who were students, 65.0% took less than one week off from school after their injury. Of those employed, 73.3% were working a minimum of part-time, and the majority (70.6%) of those working took less than one week off from work after the injury. Some participants were both students and employed.

Patient descriptions of injury fell into three common categories: collision into something (45.4%) such as a cabinet door, sports equipment, or furniture; or colliding with someone such as while swimming, playing basketball or sledding; motor vehicle crash (32.8%); and falls (21.8%). The vast majority (92%) of patients sought care in the ED the same day the injury occurred.

Nine participants (17.3%) reported they did not have any symptoms after their initial ED visit. However, the remainder (n = 43; 82.7%) reported having from 1 – 23 different symptoms

with an average of 9.57 (S.D. = 6.99) symptoms per participant. The most common physical symptoms reported were headache (69.2%) and fatigue (61.5%). Difficulty remembering (57.6%) and difficulty concentrating (51.9%) were the most common thinking symptoms. The most common sleeping symptoms were trouble falling asleep (51.9%) and sleeping more than usual (40.3%). Irritability (50%) was the most common emotional symptom reported followed by feeling more emotional (42.3%). Table 1 shows frequency and mean severity score for each symptom reported on the PCSS according to the four categories.

Participants were categorized into one of the following discharge diagnoses: concussion/CHI (n = 27), head lacerations (n = 16), motor vehicle crash (n = 12), whiplash or cervical strains (n = 7), and jaw/facial fractures or multiple injuries (n = 8). (Some patients were discharged with more than one diagnosis so the total number of discharge diagnoses equals more than 52). Mean severity scores (mild = 1 – 2; moderate = 3 – 4; severe = 5 – 6) for the four categories of symptoms within each discharge diagnosis are seen in table 2 and are as follows: for those with a discharge diagnosis of concussion, the sleep category had the highest mean severity score (2.43; S.D. = 0.38). The highest mean severity score in the MVC category was in the emotional category (3.37; S.D. = 0.34). The highest mean severity score in the head laceration diagnosis category was in sleep problems (2.38; S.D. = 1.31). The highest mean severity score for the whiplash/cervical strain diagnosis category was in thinking (3.31; S.D. = 0.68).

The three most common symptoms seen in each of the four discharge diagnosis categories are as follows: headache (62.9%), difficulty remembering (55.5%), and drowsiness (51.8%) for concussion/CHI; fatigue (31.2%), sensitivity to light (31.2%) and headache (25%)

for head lacerations; headache, difficulty concentrating and irritability for 100% of participants who had a discharge diagnosis of MVC; and feeling slowed down (100%), feeling more emotional (100%), and difficulty remembering at 83.3% for the whiplash or cervical strain participants. See Table 3

Analysis of the question what education was received in the ED indicated 74% (n = 27) of all participants diagnosed with a concussion or CHI received some type of information regarding head injury, 62.9% of the information was verbal and 51.8% of the information was written (some received both). However, 81.4% (n = 22) of the participants reported having MTBI symptoms present which suggests that 7% of obviously concussed patients did not receive any head injury instructions. Unfortunately, only 25% of MVC subjects (n = 12) in this study received head injury information with only 8.3% (n = 1) receiving it in writing. However, 83% (n = 10) of MVC subjects reported current symptoms and had the highest severity scores in all PCSS categories. Education was provided to 45.4% of head laceration subjects (n = 11) with 27.2% (n = 3) receiving verbal information and 45.4% (n = 5) receiving written information. All seven of the whiplash/cervical strain patients reported symptoms and only 28.5% (n = 2) received education with 14.3% (n = 1) verbal and 14.3% (n = 1) written. All multiple injury and facial/jaw fractures (n = 8) subjects reported symptoms but only 37.5% (n = 3) received verbal head injury education with 25% (n = 2) getting something written to take home with them. See Table 4

### ***Qualitative results***

Thirteen study respondents (25%) indicated they had not made any changes in their lives since the injury. Analysis of answers to the open ended questions by those who did report

changes revealed three main themes: health and functioning, psychological, and social and economic. Many respondents with symptoms wrote multiple comments which were placed into the appropriate theme accounting for more responses than participants.

The health and functioning theme (n = 23; 30.3% of all qualitative responses) included physical (n = 12; 52%) symptoms such as headaches and fatigue or neurological and sensory difficulties (n = 5; 21.7%). However, some fell into both categories (n = 6; 26.1%). Comments related to physical symptoms are, “I am more tired than usual”; “I never used to have headaches and now I have them frequently”. Comments related to neurological/sensory difficulties include “hard to focus, concentrate and remember things”, or “I am slower in my thinking process. I have a hard time remembering things, am easily distracted and tired more often”; “I sleep more and have trouble falling asleep”; and “I have significant mood changes, poor concentration and my speech was altered for one month”.

The psychological theme (n = 37; 48.7% of all qualitative responses) was further divided into two sub themes: neuropsychological (n = 11; 30.6%) representing thought and emotional processes such as feeling nervous, irritable, anxious or fearful and neurobehavioral (n = 26; 70.3%) which represents changes in physical behaviors such as wearing a helmet or avoiding specific activities as a result of their injury . Examples of comments placed into the neuropsychological sub theme were, “I feel almost worthless”; “I feel numb now” and “My injury has ruined my confidence in my abilities”. The neurobehavioral sub theme included comments “more careful or cautious now” in 27% of all answers for the psychological category. Specific comments included: “I will always wear a helmet when riding a bike and overall I am

more cautious”, and “I stopped listening to loud music and have to lay down more often to rest and I am more aware of noises”.

The social and economic theme (n = 16; 21.1% of total qualitative responses) reflected statements about changes in participants’ role in society, relationships and/or finances. Ten of the sixteen responses (62.5%) in this theme involved a change in the ability to work or attend college and 12.5% (n = 2) made a comment about increased difficulty with finances related to changes in work status or the burden of medical bills from the accident. Relationship issues represented 25% (n = 4) with statements such as, “I broke up with my boyfriend”. Other participant comments were: “It has affected my dating life” (relationships); “I had to leave my job and withdraw from college” (role in society/finances); “It has had an impact socially because I have difficulty remembering names of people, events or commitments” (relationships); “I struggle in school and cannot work out” (role in society); “I have become a very incompetent woman/mother and my family and I are still suffering the consequences of my injury” (role in society), “ I have lost my independence and have to depend on others much more” (role in society) and “Financially it has been awful” (finances). See Table 5.

### ***Discussion***

This pilot study sought to identify patients with specific emergency department (ED) discharge diagnoses who later reported symptoms associated with a mild traumatic brain injury (MTBI), compare frequency and severity of MTBI symptoms by discharge diagnoses, investigate frequency of head injury education provided to ED patients with each diagnosis, and finally, to learn what type of changes have occurred in the lives of patients as a result of their injury.

### *Frequency of MTBI symptoms*

The most common symptoms reported by participants were headache, fatigue, difficulty remembering and concentrating, trouble falling asleep and irritability. Despite the small sample, these findings are consistent with previous research identifying similar common complaints (Kashluba, Paniak & Casey, 2008; De Kruijk, et al., 2002). In fact, the rate of headache has been reported as high as 90% after the initial injury and at 6 months was still present in 44% of MTBI patients (Bergman & Bay, 2010). These same authors reported fatigue and sleep disturbance were among the most common symptoms reported between 1- 3 months after the injury and difficulty with attention and memory were the most difficult during the first month after post injury. In a study looking at participants six months post injury (De Kruijk, et al., 2002, Kraus, et al., 2005) many complaints had diminished although some people still reported headache, dizziness and drowsiness. Of interest in the De Kruijk study, is the fact that if any of those three symptoms were present initially in the ED, there was an association of increased symptoms at the 6 month evaluation.

A majority of participants reported symptoms consistent with a MTBI between one and eleven months post injury. Because this was not a longitudinal study there was not enough data reported each month to evaluate if symptoms resolved as time increased since the injury. However, in a meta analysis using 35 studies, Petchprapai & Winkelman (2007), found participants in 29% of the studies reviewed reported post concussive symptoms (PCS) at 3 months or less post injury, 25% PCS at 3-12 months post injury; and 32% at more than a year after brain injury.

The majority of participants were employed or in school at least part time prior to their accident. However, they took less than one week off from school or work even though the CDC stresses the importance of rest along with reduced physical, thinking or concentration activities until symptoms subside (CDC, 2009). Recently, the CDC (2009) developed a care plan (Acute Concussion Evaluation (ACE), to assist healthcare providers in teaching patients when they can return to their pre-injury activities. The first key recommendation listed in the ACE care plan for optimal recovery from MTBI symptoms is rest. Current research supports early interventions which include getting additional rest and limiting physical/cognitive activities such as attending school or work will improve MTBI outcomes (Snell, et al., 2009). However, there is no evidence to suggest the ACE is routinely recommended or individually adjusted for patients not seen in a concussion clinic. This may be due to inaccurate beliefs or misconceptions by health professionals who are not experts in the field of brain injury and are similar to beliefs held by the general public. Misconceptions include how long symptoms last, the time it takes to recover, when to return to work after the injury, and believing behavioral symptoms are unrelated to the brain injury. Some providers may also view physical symptoms as having a psychological origin, misinterpret motivation problems as laziness and trivialize patient symptoms and their impact on the individual (Swift & Wilson, 2001). Another reason patients with a MTBI do not take adequate recovery time might be that patients cannot afford to miss work or school. Consequently, they push themselves to perform at the same pace they did prior to the injury without realizing how that decision may significantly delay their recovery.

***MTBI symptom frequency and severity reported by discharge diagnosis***

Discharge diagnoses used in this study were collapsed into five main categories. The first and most prevalent category was concussion and CHI. The second diagnostic category was MVC. Although MVC is a mechanism of injury, the ED providers used this as a diagnosis when other specific injuries were not found. The third diagnostic category was head laceration and the fourth category was whiplash and cervical strain combined. The last diagnostic category (other) consisted of participants with facial/jaw fractures or multiple injuries.

Symptom severity scores by discharge diagnosis were divided into physical, thinking, sleep and emotional categories (some participants reported having more than one discharge diagnosis). The concussion diagnosis resulted in all four symptom categories in the mild range with the sleep category having the highest score. The diagnoses of MVC had symptom severity scores in the moderate range and the highest severity was in the emotional category. Head lacerations reported mild symptoms in all four categories with the sleep category rated highest. Participants with a whiplash/cervical strain diagnoses surprisingly scored the thinking category higher (moderate) than reported physical symptoms (mild). Comparing data, the participants with a diagnosis of MVC or whiplash/cervical strain had higher symptom severity scores in every category when compared to subjects diagnosed with a concussion or head laceration.

The three most frequently reported symptoms by participants diagnosed with a concussion were headache, difficulty remembering, and drowsiness. The most common symptoms for head laceration diagnosis included fatigue, sensitivity to light, and headache. Interestingly, all participants involved in a MVC reported symptoms of headache, difficulty concentrating and irritability. All those in the whiplash/cervical strain category reported feeling slowed down and being more emotional with fewer participants reporting memory problems.

Data for the “other” category was not included in this analysis because the diagnoses combined were too diverse to accurately report the findings and when separated were too sparse to measure.

This study indicates that injuries caused by some type of collision into something or someone is the most frequent mechanism of injury placing patients at risk for MTBI, followed by falls and then MVC's. Listed from most to least frequent, the CDC (2009) reports the leading causes of brain injury as falls, MVC, struck by/against events and assaults. Existing literature does not definitively specify diagnoses that accompany a MTBI although clinically, practitioners could speculate the use of diagnoses such as closed head injury or concussion may suggest a higher probability of underlying brain injury. However, it is evident that ED providers are not giving ICD.9 codes that accurately reflect the diagnosis of MTBI for at least half of the patients who meet the CDC criteria (Powell, et al., 2008). One reason for the coding inconsistency could be that ED providers prefer to use more generalized diagnoses that cover a more broad spectrum of possible causes or perhaps the ICD.9 codes are chosen by non-medical billers who have to guess at which code most closely represents the discharge diagnosis.

Since the current literature does not separate MTBI symptoms into categories of cause or diagnosis, it is difficult to compare findings from this study with the literature. However, there is an abundance of literature detailing what symptoms occur in patients with a MTBI and those mentioned are consistent with the symptoms reported in these study participants (Cassidy, et al., 2004; CDC, 2003; Kashluba, et al., 2008; Langlois, et al., 2005; Mackenzie & McMillan, 2005; Petchprapai & Winkelman, 2007) . Consequently, larger studies of this type are needed to identify if there is a statistically significant relationship between diagnosis and mechanism of

injury with specific MTBI symptoms. This pilot study identifies a potentially significant gap in the MTBI literature and offers information that can be used in conducting further studies to identify the severity of MTBI symptoms related to specific diagnoses or mechanism of injury. This type of research would be especially important for staff responsible for providing discharge education to the ED patient at risk for a MTBI.

### ***Head injury education provided by diagnosis***

Head injury education provided to patients with a diagnosis of concussion or CHI occurred more frequently than in other diagnoses. However, only half of the education provided to these participants was written. This is an important omission because brain injured patients are not likely to remember instructions provided immediately after their injury (Wei & Camargo, 2008). In addition, decades of evidence supports giving written information with verbal reinforcement to patients who meet the diagnostic criteria for concussion (Kozak & Yura, 1989).

There were also more participants reporting MTBI symptoms than those who received head injury education in all diagnostic categories. This is another concern because head injury education is crucial to promote early recognition of a MTBI for prompt treatment and optimal recovery (Andersson, et al., 2007; Setnik & Bazarian, 2007; Snell, et al., 2009) and some evidence suggests better patient compliance with improved outcomes when providing written instructions to patients (Wei & Camargo, 2008). However, in a prospective study specific to minor head injuries (Bazarian & Atabaki, 2001), even with specific and consistent instructions for follow up, less than half the patients were compliant in seeking follow up. Unfortunately, of greater significance in this study is that only a quarter of participants diagnosed with a MVC received head injury education and less than 10% received it in writing. This is a significant

concern since MVC participants had the highest severity scores in every category followed closely by cervical strain and whiplash patients who received even less head injury education.

Participants who did not receive appropriate head injury education or understand the significance of following the instructions may be one of the reasons that participants took less than one week off from their routine activities despite continuing to have MTBI symptoms.

### *Life changes of participants since their injury*

Participant answers to open ended questions revealed changes not only related to the overall impact the injury had on their lives, but also changes participants made as a result of the injury. Each response was categorized into one of three themes: health/functioning, psychological and social/economic. These specific categories were used for direct comparison to the domains (health/functioning, psychological/spiritual, social/economic and family) used by Pechprapai and Winkelman (2007) in their meta-analysis of 35 studies specific to quality of life (QOL) after a MTBI. Aspects from one domain inherently could eventually impact the other domains that contribute to quality of life and makes it somewhat difficult to draw clear lines of delineation between them.

The health and functioning category in this study represents physical, sensory and neurological functions. The post concussive symptom scale was used in 80% of all studies reviewed with headache the most severe and frequently (30% - 60%) reported physical complaint in the meta-analysis but in longitudinal studies analyzed, headache, fatigue, forgetfulness and sleep disturbance were reported by 8% - 23% of participants at one year after injury (Pechprapai & Winkelman,2007). Existing research was corroborated by these participants who reported headache as the number one physical complaint (69.2%) and fatigue

(61.5%) a close second on the PCSS. A current study reports that patients having prolonged physical complaints can be directly correlated with disability scores ( $r = .60$ ,  $p < .001$ ) for those who continue to have such complaints months after their injury (Bergman & Bay, 2010).

The psychological category focuses on the ability of a person to feel or to experience changes and has two sub themes, the neuropsychological sub theme includes feelings and thoughts whereas the neurobehavioral sub theme includes changes in behaviors as a result of the injury. Petchprapai and Winkelman (2007) found in their meta analysis that 97% of studies reviewed probed for psychological symptoms and most included at least one question asking whether an individual felt depressed. They summated that depressive symptoms occurred in up to 30% of responses (compared to a control group) with an average score indicating a high level of depression in MTBI patients. Comments by participants such as, “I feel almost worthless” and “I feel numb now” could be suggestive of a depressive state. Petchprapai and Winkelman (2007) also found depressed patients reported more frequent and severe MTBI symptoms than those who were not depressed. Other studies found that for MTBI patients one year post injury the depression rate was 13% with 9% having unresolved panic disorders (Bergman & Bay, 2010).

The social and economic category focuses on the ability to maintain one’s role in society, finances and relationships with others. This domain is more directly impacted by the other categories since headache, fatigue or other physical symptoms could make it difficult for individuals with a MTBI to return to work or school. Short-term memory problems can make it hard to learn and retain new material while irritability and sadness can significantly decrease

engagement in social activities thereby altering one's expected role in society and affecting all types of relationships (Petchprapai & Winkelman, 2007). Results of the meta-analysis discovered that being able to "return to work" was inconsistent from study to study. However, 84% to 88% of participants in the meta-analysis returned to work between one week to three months post injury and almost one third (30%) of those who returned to work needed to modify their jobs. With so many variables affecting when someone with a MTBI can return to full activity, it would be helpful to have a carefully constructed study using a standardized tool such as the ACE care plan to follow MTBI patients through their recovery. Financial stress and labile emotions can affect relationships both personally and professionally. Socioeconomic and relational outcomes after MTBI are rarely reported but could logically affect recovery from any injury (Petchprapai & Winkelman, 2007).

### ***Limitations***

Even though this pilot study revealed some interesting insights into the frequency and severity of MTBI symptoms as they relate to specific injuries and discharge diagnoses, there are several important limitations that may have affected the results. First, the sample; it was small when considering the number of letters sent out to patients who met the inclusion criteria. Unfortunately, there is no way of knowing how many letters were actually received by participants who met the inclusion criteria since the undeliverable letters were not returned to the principal investigator. In addition, sending reminder post cards to participants was not possible because IRB constraints prevented collection of identifying patient data. Second, this was a cross sectional rather than a longitudinal study. It would be important to gather data over time to determine how soon after the injury the symptoms started, how long the symptoms were present,

which symptoms were the most prevalent and severe, and how much symptoms continued to interfere with the patient's life. The third limitation is that even though it was possible to connect certain diagnoses with certain symptoms, there were uneven numbers of participants within each category of discharge diagnosis making it difficult to determine if certain symptoms were more commonly seen with specific discharge diagnoses. Fourth, individuals who could not understand English were excluded. Fifth, this study was purposely limited to participants aged 18 to 28 to obtain a sample of healthy people without confounding medical conditions or treatments. Limiting the age of participants omitted patients older than 28 who may have been equally as healthy as those included. Lastly, ED staff implementation of a program to educate patients diagnosed with a concussion or closed head injury immediately before the study began undoubtedly altered responses to the question about education received in the ED.

### ***Implications and recommendations***

Despite being a small pilot study, the data collected provided a glimpse of evidence to support the belief that what may appear to be an insignificant injury to the ED staff can indeed result in MTBI symptoms and those symptoms can interfere with a patient's quality of life. Therefore, it would be important for clinicians to provide MTBI education to all patients who are injured with an acceleration-deceleration type mechanism regardless of initial injury severity, since symptoms may present days to weeks after the injury yet not be present during the ED visit. If clinicians provided patient education about MTBI symptoms to watch for and when to seek follow up care, early identification of MTBI should increase thereby reducing the long-term sequelae that may occur if misdiagnosed or inappropriately treated. All ED providers could be more diligent in documenting diagnoses with ICD.9 codes that accurately reflect an injury that

may have an underlying MTBI. This would make epidemiological tracking easier for the CDC and provide larger amounts of data to support development of a best practice model for discharge education and standardized follow up for patients meeting potential MTBI criteria. Furthermore, development of an ICD.9 code such as “MTBI, potential for” might be used more frequently by physicians since a definitive diagnosis of MTBI is difficult to identify upon initial injury. Care plans for managing the MTBI patient in returning to their regular activities, such as the ACE guidelines available through the CDC, should be utilized consistently by all health care providers.

Currently, the “mild” category of brain injury is so broad it would be helpful for the CDC to better delineate the parameters for the mild category; clearly indicating obvious and/or objective symptoms do not have to be present initially to make the diagnosis. Health care providers recognizing which simple acceleration-deceleration type injuries put a patient at risk for MTBI should increase the number of patients who receive head injury education. In addition, history taking should include specific questions that go beyond “Have you had a head injury?”, because most people will not consider a MVC, whiplash or cervical strain the type of accidents that can injure the head and/or brain. Probing specifics of any injury is especially important when treating patients with multiple or mild complaints consistent with a MTBI to determine if symptoms warrant referral to a concussion clinic for multi-disciplinary concussion care. Finally, additional research is clearly warranted as there are no similar published studies examining the severity of MTBI symptoms which accompany specific discharge diagnoses. Therefore, larger longitudinal studies specific to ED discharge diagnoses are needed to identify MTBI symptom severities for specific injury mechanisms. It would also be helpful for ED health care providers

to learn more about which symptoms initially present, how long after ED discharge they present, how long they last, if they became better or worse and/or how long it takes for them to improve with and without intervention. This area of research is still in its infancy and there remains much work to be done to promote permanent change in clinical practice.

### *Conclusions*

Mild traumatic brain injuries can easily slip undetected through the ED because patients can present with a variety of injuries and/or subjective complaints, most of which seem insignificant upon initial presentation. Most of the research being done on MTBI focuses on concussions in athletes which has brought much needed attention to the devastating effects caused by a MTBI. However, most athletes have a trainer or coach who is educated regarding care for a concussion. The general public does not have a trainer and probably could not imagine the devastating consequences which can occur from what is considered a simple injury. In this study, MVC victims had the highest symptom severity scores of all the discharge diagnosis categories. Additionally, other participants with simple appearing injuries (head laceration, whiplash and cervical strain) resulted in symptom severity scores similar to those diagnosed with a concussion, suggesting even “minor” injuries to the head may result in MTBI symptoms that affect quality of life.

Finally, we need to look beyond physical complaints to recognize there may be cognitive problems related to a physical injury. MTBI symptoms vary tremendously in severity and range of deficits; therefore, everyone should be more aware of the combination of symptoms associated with a MTBI. Increased public awareness and education exposing the truth that mild head

injuries are not always as mild as the classification would suggest, would certainly decrease the number of misdiagnosed MTBI patients. Since many accident patients initially seek care for their injury in the ED, providers have an important role in recognizing patients at risk for MTBI based on mechanism of injury and providing written MTBI information for appropriate follow up.

Increased MTBI awareness by health care providers in the ED will promote early MTBI diagnosis resulting in prompt referral to a neuropsychologist or concussion clinic and will give MTBI patients the best chance at optimal recovery.

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**Table 1***Severity Scores for Entire Sample N=52*

<b>Physical Symptoms</b>	<b>Frequency N = (%)</b>	<b>Mean</b>	<b>Standard Deviation</b>
Headache	36 (69.2%)	1.77	1.722
Fatigue	32 (61.5%)	1.79	1.775
Dizziness	23 (44.2%)	1.02	1.448
Balance problems	22 (42.3%)	.90	1.459
Pain other than headache	22 (42.3%)	1.27	1.845
Sensitivity to light	20 (38.4%)	.92	1.582
Visual Problems	20 (38.4%)	.90	1.500
Sensitivity to noise	18 (34.6%)	.83	1.451
Nausea	14 (26.9%)	.60	1.287
Numbness / Tingling	11 (21.1%)	.46	1.026
Vomiting	4 (7.6%)	.29	1.143
<b>Thinking Symptoms</b>			
Difficulty Remembering	30 (57.6%)	1.59	1.857
Difficulty Concentrating	27 (51.9%)	1.52	1.809
Feeling slowed down	26 (50.0%)	1.16	1.580
Feeling mentally foggy	25 (48.0%)	1.13	1.560
<b>Sleeping Symptoms</b>			
Trouble falling asleep	27 (51.9%)	1.38	1.659
Sleeping more than usual	21 (40.3%)	1.06	1.642
Sleeping less than usual	17 (32.6%)	.87	1.560
Drowsiness	2 (3.8%)	1.50	1.686
<b>Emotional Symptoms</b>			
Irritability	26 (50.0%)	1.42	1.944
Feeling more emotional	22 (42.3%)	1.02	1.515
Sadness	20 (38.4%)	1.08	1.725
Nervousness	18 (34.6%)	.94	1.589

**Table 2***Most common symptoms occurring by discharge diagnosis*

<b>Discharge Diagnosis</b>	<b>N</b>	<b>Male</b>	<b>Female</b>	<b>No symptoms</b>	<b>Most common symptoms</b>	<b>Severity Mean (SD)</b>
Concussion/CHI	27	15	12	6	Headache <i>n</i> = 17 (62.9%)	2.26 (1.24)
					Difficulty Remembering <i>n</i> = 15 (55.5%)	2.21 (1.18)
					Drowsiness <i>n</i> = 14 (51.8%)	2.33 (2.4)
					Fatigue <i>n</i> = 5 (31.2%)	2.60 (1.14)
Head Laceration	16	11	5	4	Sensitivity to light <i>n</i> = 5 (31.2%)	2.20 (1.30)
					Headache <i>n</i> = 4 (25.0%)	2.75 (1.25)
					Headache <i>n</i> = 12 (100%)	3.25 (1.91)
MVA	12	4	8	0	Difficulty Concentrating <i>n</i> = 12 (100%)	3.08 (1.72)
					Irritability <i>n</i> = 12 (100%)	3.83 (1.89)
					Feeling slowed down <i>n</i> = 6 (100%)	2.60 (1.96)
					Feeling more Emotional <i>n</i> = 6 (100%)	2.33 (1.86)
Whiplash & Cervical Strain	6	0	6	0	Difficulty Remembering <i>n</i> = 5 (83.3%)	3.80 (1.22)

**Table 3***Mean severity score by discharge diagnosis and symptom category*

<b>Diagnosis</b>	<b>N</b>	<b>Physical</b>	<b>Thinking</b>	<b>Sleep</b>	<b>Emotional</b>
Concussion	27	1.96 (0.39)	2.20 (0.59)	2.43 (0.38)	1.74 (0.47)
MVA	12	2.98 (0.50)	2.81 (0.77)	2.99 (0.66)	3.37 (0.34)
Head laceration	11	1.75 (0.94)	1.56 (0.63)	2.38 (1.31)	1.65 (0.47)
Whiplash	7	2.92 (0.45)	3.31 (0.68)	2.71 (0.57)	2.50 (0.49)

**Table 4***Head Injury Education*

<b>Discharge Diagnosis</b>	<b>N</b>	<b>Received Head Injury Information</b>		<b>Verbal</b>		<b>Written</b>		<b>Reported Symptoms</b>	
Concussion	27	20	74.0%	17	62.9%	14	52%	22	81.4%
MVA	12	3	25.0%	3	25.0%	1	8.3%	10	83.3%
Head laceration	11	5	45.4%	3	27.2%	5	45.4%	8	72.7%
Whiplash	7	2	28.5%	1	14.3%	1	14.3%	7	100%
Other	8	3	37.5%	3	37.5%	2	25%	8	100%

**Table 5***Qualitative data by Quality of Life framework categories*

<b>Health/Functioning</b> <u>N = 23 (30.3%)</u>	<b>Psychological</b> <u>N = 37 (48.7%)</u>	<b>Social/Economic</b> <u>N = 16 (21.1%)</u>
Physical symptoms N = 12 (52.2%)	Neuropsychological changes N = 11 (30.6%)	Role in society N = 10 (62.5%)
Sensory &/or Neuro symptoms N = 5 (21.7%)	Neurobehavioral changes N = 26 (70.3%)	Changes in Relationships N = 4 (25.0%)
Both categories N = 6 (26.1%)		Finances N = 2 (12.5%)

Appendix A  
Participation Letter



Dear Intermountain Healthcare Patient,

The Intermountain Healthcare Office of Research and the Emergency Department believes you may be interested in a research study titled, "Mild Traumatic Brain Injury, Are Emergency Department Providers Identifying which patients are at risk?"

This project was reviewed and approved by the Intermountain Healthcare Office of Research before our researchers identified you as a potential participant.

Please know that Intermountain Healthcare takes every measure to protect your health information and privacy. No information about you will be gathered for this project without your consent to participate.

The specific goal of this research is to collect information to help identify which types of injuries may cause symptoms consistent with a Mild Traumatic Brain Injury. This study is important to Intermountain Healthcare because the information we collect from you will help us identify if your specific type of injury increases the risk for a mild brain injury. Collecting this information will help Intermountain improve discharge education and instructions for patients at increased risk for a Mild Traumatic Brain Injury.

**We have included information about this study with this letter. Please read the enclosed information about the study and decide if you would like to participate. If you decide to participate, please follow the instructions on the enclosed consent..**

If you have any questions regarding the privacy of your health information, this research project or your rights as a research subject please contact the Intermountain Healthcare Office of Research at 1-800-321-2107.

Sincerely,

C. Gregory Elliott, MD

Medical Director

Intermountain Healthcare Office of Research

## Appendix B

## Post Concussive Symptom Scale

Date: \_\_\_\_\_ ID # \_\_\_\_\_

**Instructions:** For each item indicate how much the symptom has bothered you over the *past 2 days*.

	<b>Symptoms</b>	<b>none</b>	<b>mild</b>	<b>moderate</b>	<b>severe</b>		
<b>Physical</b>	Headache	0	1	2	3	4	5 6
	Nausea	0	1	2	3	4	5 6
	Vomiting	0	1	2	3	4	5 6
	Balance Problems	0	1	2	3	4	5 6
	Dizziness	0	1	2	3	4	5 6
	Visual Problems	0	1	2	3	4	5 6
	Fatigue	0	1	2	3	4	5 6
	Sensitivity to Light	0	1	2	3	4	5 6
	Sensitivity to Noise	0	1	2	3	4	5 6
	Numbness/Tingling	0	1	2	3	4	5 6
<b>Thinking</b>	Feeling Mentally Foggy	0	1	2	3	4	5 6
	Feeling Slowed Down	0	1	2	3	4	5 6
	Difficulty Concentrating	0	1	2	3	4	5 6
	Difficulty Remembering	0	1	2	3	4	5 6
	Drowsiness	0	1	2	3	4	5 6
<b>Sleep</b>	Sleeping Less than Usual	0	1	2	3	4	5 6
	Sleeping More than Usual	0	1	2	3	4	5 6
	Trouble Falling Asleep	0	1	2	3	4	5 6
<b>Emotional</b>	Irritability	0	1	2	3	4	5 6
	Sadness	0	1	2	3	4	5 6
	Nervousness	0	1	2	3	4	5 6
	Feeling more Emotional	0	1	2	3	4	5 6
Pain other than Headache		0	1	2	3	4	5 6

## Appendix C

**Demographic Questionnaire**

1. Today's Date \_\_\_\_\_
2. Age: \_\_\_\_\_
3. Gender: \_\_\_\_\_
4. Date of Injury: : \_\_\_\_\_
5. How did the injury occur? \_\_\_\_\_
6. What was your ER discharge diagnosis? Closed head injury / concussion / whiplash / cervical strain / motor vehicle accident / head laceration / facial/jaw fracture / multiple injuries / Other (please specify) \_\_\_\_\_
7. How long after the injury did you seek ER medical care? \_\_\_\_\_
8. Are you currently working? No / Yes, Part time / Full time?
9. What is your occupation? \_\_\_\_\_

10. How much time did you take off work or school after your injury? \_\_\_\_\_

11. How many years of education have you completed? <12 yrs, 13, 14, 15, 16, >16 yrs

Appendix D  
Open-ended Questions

1. Did you receive any information about a head injury during your ED visit?
2. Did you receive a head CT during your ED visit?
3. What were the results of the CT? What did the results mean to you?
4. Have you seen a medical care provider for your injury since your ED visit? If yes, please indicate when and whom you saw.
5. Why did you seek additional care?
6. If you sought treatment, what type of treatment was prescribed?  
(i.e. medications, therapies, etc)
7. Are you still taking any medications for your injury? If so what?
8. Describe in detail, the overall impact this injury has had on your life.
9. What changes have you made in your life because of the injury?
10. What else would you like me to know about the injury you sustained?