Veteran Specific Risk Factors for Delirium

Allison Perkins

University of San Diego

Follow this and additional works at: https://digital.sandiego.edu/dissertations

Part of the Critical Care Nursing Commons, Geriatric Nursing Commons, Other Nursing Commons, and the Psychiatric and Mental Health Nursing Commons

Digital USD Citation
https://digital.sandiego.edu/dissertations/171

This Dissertation: Open Access is brought to you for free and open access by the Theses and Dissertations at Digital USD. It has been accepted for inclusion in Dissertations by an authorized administrator of Digital USD. For more information, please contact digital@sandiego.edu.
Veteran Specific Risk Factors for Delirium

By

Allison K. Perkins

A dissertation presented to the

FACULTY OF THE HAHN SCHOOL OF NURSING AND HEALTH SCIENCE
UNIVERSITY OF SAN DIEGO

In partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY IN NURSING

May 2020

Dissertation Committee
Eileen Fry-Bowers, PhD, JD, CPNP, FAAN, Chairperson
Ann Mayo, DNSc, RN, FAAN
Kathleen Stacy, PhD, RN, APRN-CNS
CANDIDATE’S

NAME: Allison K. Perkins

TITLE OF

DISSERTATION: Veteran Specific Risk Factors for Delirium

DISSERTATION COMMITTEE:

____________________________________
Eileen Fry-Bowers, PhD, JD, CPNP, FAAN, Chairperson

____________________________________
Ann Mayo, DNSc, RN, FAAN
Committee Member

____________________________________
Kathleen Stacy, PhD, RN, APRN-CNS
Committee Member
ABSTRACT

Purpose/Aims: This study explored the relationships between military characteristics such as combat experience, mental health issues such as post-traumatic stress disorder (PTSD), traumatic brain injury (TBI), depression, anxiety and substance use disorder (SUD), physical comorbidities such as coronary artery disease (CAD), other risk factors, and delirium diagnosis among hospitalized veterans.

Background: Delirium is a common disorder experienced by 25% of all hospitalized adults 65 years and older. No published studies to date have examined whether combat, TBI and PTSD are associated with the incidence of delirium in the hospitalized veteran.

Methods: A retrospective cross-sectional cohort design with a sample size of 540 veterans, was used for this study. Data was collected from the electronic health record (EHR) covering a two-year period. Inclusion criteria consisted of veterans, 25 years or older, admitted to an acute or critical care unit, and length of stay greater than 48 hours.

Results: Delirium occurred in 29.6% (n=160) of veterans during hospitalization. Most cases for the delirium group were males (96.25%), white (78.8%), non-Hispanic (88.8%), served in Vietnam (61.25%), married (38.8%) and were in a medical-surgical unit (63.75%). Additionally, for the delirium group the mean age was 72.08 years (SD = 11.93) with 26.9% (n = 43) having had experienced combat. Six variables predicted the odds of having a delirium diagnosis and included older age (p<0.001), PTSD (p=0.004), depression (p=0.025), substance use disorder (p=0.009), functional impairment (p<0.001), and infection (p<0.001). The model explained 28.3% (Nagelkerke’s R²) of the variance in delirium diagnosis, and correctly classified 77.9% of the cases. Sensitivity was 44.1%, specificity was 91.6%, positive predictive value was 68.1%, and negative
predictive value was 80.2%.

**Implications:** Veteran specific risk factors such as PTSD, SUD, and depression may increase the risk of developing delirium. Veterans with these risk factors should be routinely screened for delirium throughout their hospitalization and placed in a delirium prevention program.
DEDICATION

This is dedicated to my husband, Jimmy for all of his support and encouragement over the last 3 years and for taking on many extra parenting duties without complaining so I could accomplish this dream. To my children Christopher, Aiden, Ella, and Charlotte for not expecting me to be super mom and still loving me when I couldn’t do it all; my parents for their support and the numerous hours spent proof-reading my papers. To my CNS colleagues for being an amazing example of what CNSs can accomplish when they work together and to my mentors throughout the years who have molded me into the professional I am, I thank all of you from the bottom of my heart.
ACKNOWLEDGEMENTS

I would like to take this opportunity to express my gratitude for my committee members Dr. Eileen Fry-Bowers, Dr. Ann Mayo and Dr. Kathleen Stacy without whom I would not have been able to complete this endeavor. To Dr. Fry-Bowers, for being an amazing example of what a nurse can accomplish. Thank you for taking me under your wings and allowing me to work with you throughout this process. I appreciate your compassion, understanding, encouragement and insightful feedback. Dr. Ann Mayo your guidance, encouragement, mentoring, and feedback along the way have helped me become a better writer and novice researcher. Dr. Kathleen Stacy for sharing your time and expertise throughout this dissertation process.

I would like to acknowledge all of my professors at the University of San Diego, each of you have enriched my educational experience by disseminating your knowledge and expertise. I feel grateful to have had the opportunity to learn from such an accomplished group of nurse scientist. Finally, I would like to acknowledge my PhD class cohort. I appreciate all of the support, engaging group discussion, and friendships I have made with each of you over the last three years.
# TABLE OF CONTENTS

**CHAPTER I: INTRODUCTION** ......................................................................................... 1

- Background and Significance ................................................................................................. 1
  - Incidence and Prevalence ....................................................................................................... 2
  - Risk Factors for Delirium ....................................................................................................... 2
  - Delirium Sub-types .............................................................................................................. 3
  - Recognition of Delirium ........................................................................................................ 5
  - Veterans .................................................................................................................................. 7
- Research Conceptual Framework ........................................................................................... 7
- Problem Statement ................................................................................................................ 10
- Study Purpose and Specific Aims .......................................................................................... 10
  - Purpose of Study .................................................................................................................. 10
  - Specific Aims ........................................................................................................................ 10
  - Content of this Dissertation ............................................................................................... 11

**CHAPTER II: LITERATURE REVIEW** ............................................................................ 14

- Veteran Specific Risk Factors of Delirium ............................................................................ 14
- History and Phenomenon of Delirium ................................................................................... 14
- Incidence, Prevalence and Occurrence of Delirium During Hospitalization ...................... 19
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>19</td>
</tr>
<tr>
<td>Prevalence</td>
<td>20</td>
</tr>
<tr>
<td>Occurrence</td>
<td>20</td>
</tr>
<tr>
<td>Delirium Subtypes</td>
<td>20</td>
</tr>
<tr>
<td>Hyperactive</td>
<td>21</td>
</tr>
<tr>
<td>Hypoactive</td>
<td>22</td>
</tr>
<tr>
<td>Mixed</td>
<td>23</td>
</tr>
<tr>
<td>Subsyndromal</td>
<td>23</td>
</tr>
<tr>
<td>Emergence</td>
<td>25</td>
</tr>
<tr>
<td>Risk Factors for Delirium</td>
<td>26</td>
</tr>
<tr>
<td>Predisposing Risk Factors</td>
<td>26</td>
</tr>
<tr>
<td>Age</td>
<td>27</td>
</tr>
<tr>
<td>Gender</td>
<td>27</td>
</tr>
<tr>
<td>Impaired Cognition</td>
<td>28</td>
</tr>
<tr>
<td>Comorbid Conditions</td>
<td>28</td>
</tr>
<tr>
<td>Functional Impairment</td>
<td>29</td>
</tr>
<tr>
<td>Sensory Impairment</td>
<td>29</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>29</td>
</tr>
<tr>
<td>Precipitating Risk Factors</td>
<td>30</td>
</tr>
</tbody>
</table>
Restraints .................................................................30
Medication ..............................................................30
Abnormal Laboratory Values ........................................31
Indwelling Catheters/Elimination .......................................31
Severe Illness ...........................................................32
Hospital Environment (noise, room changes, sleep disruption) ...........32
Complications and Outcomes of Delirium ..............................32
Mortality ..................................................................33
Cognitive Functioning ....................................................34
Physical Functioning ......................................................35
Institutional Placement ....................................................35
Length of Stay (LOS) ......................................................36
Delirium Prediction Models ..............................................36
Delirium Assessment Instruments ........................................40
Confusion Assessment Method (CAM) .................................40
Delirium Observation Screening Scale (DOS) .........................41
Nursing Delirium Screening Scale (Nu-DESC) ......................42
NEECHAM Confusion Scale (NEECHAM) ..........................42
Study Sample .................................................................................................................. 57

Inclusion Criteria .............................................................................................................. 58

Exclusion Criteria ............................................................................................................. 58

Sample Size .................................................................................................................... 58

Variables and Operational Definitions ............................................................................ 59

Sociodemographic Characteristics .................................................................................. 59

Age .................................................................................................................................. 59

Race .................................................................................................................................. 59

Ethnicity ............................................................................................................................ 59

Gender ............................................................................................................................... 59

Marital Status ................................................................................................................... 59

Veteran ............................................................................................................................... 59

Combat Veteran .............................................................................................................. 60

Clinical Characteristics .................................................................................................. 60

Delirium ............................................................................................................................. 60

Cognitive Impairment ....................................................................................................... 61

Functional Impairment ..................................................................................................... 61

Vision Impairment ............................................................................................................ 61

Hearing Impairment ......................................................................................................... 61

Posttraumatic Stress Disorder (PTSD) ........................................................................... 63
Traumatic Brain Injury (TBI) ................................................................. 62
Anxiety ......................................................................................... 62
Depression ................................................................................... 62
Chronic Obstructive Pulmonary Disease (COPD) ......................... 62
Coronary Artery Disease (CAD) ..................................................... 62
Alcohol Use Disorder (AUD) ......................................................... 62
Substance Use Disorder (USD) ...................................................... 62
Cerebral Vascular Accident (CVA) ............................................... 62
Infection ......................................................................................... 63
Indwelling Urinary Catheter ......................................................... 63
Length of Stay (LOS) .................................................................... 63
Disposition at Discharge .............................................................. 63
Mortality ......................................................................................... 63
Data Collection ............................................................................. 63
Data Management ......................................................................... 64
Specific Aim 1 ........................................................................ 65
Specific Aim 2 ........................................................................ 65
Specific Aim 3 ........................................................................ 66
Specific Aim 4 ........................................................................ 66
Protection of Human Subjects ..................................................... 67
CHAPTER IV: RESULTS .................................................................................................68

Specific Aim 1 ............................................................................................................68

  Sociodemographic Characteristics ......................................................................68

  Mental Health Comorbidities .............................................................................70

  Physical Comorbidities and other Risk Factors ....................................................70

  Hospital Outcomes ..............................................................................................72

  Delirium Diagnosis .............................................................................................73

Specific Aim 2 ............................................................................................................76

Specific Aim 3 ............................................................................................................78

Specific Aim 4 ............................................................................................................83

CHAPTER V: DISCUSSION OF FINDINGS .....................................................................86

Delirium Rates .........................................................................................................87

Delirium and Hospital Outcomes .............................................................................88

Delirium and Nurse Recognition ............................................................................89

Delirium Risk Factors .............................................................................................91

Age ..........................................................................................................................92

PTSD .........................................................................................................................92

Depression ...............................................................................................................94

Substance Use Disorder .........................................................................................95
LIST OF TABLES

Table 1. Demographic and Military Characteristics of Sample by Delirium Status ........ 69
Table 2. Mental and Physical Comorbidities and other Risk Factors of Sample by Delirium Status .......................................................... 71
Table 3. Hospital Outcomes of Sample by Delirium Status........................................ 73
Table 4. Mental Health Comorbidities of Study Population by Combat Status ........... 77
Table 5. Summary of Logistic Regression Analysis Predicting Delirium Diagnosis ..... 85

LIST OF FIGURES

Figure 1. Inouye’s Multifactorial Model for Delirium ............................................. 12
Figure 2. Research Conceptual Framework with Veteran Specific Factors ............... 13
Figure 3. Delirium Diagnosis and Age ...................................................................... 81
Figure 4. Delirium and Length of Stay ..................................................................... 82
Figure 5. Delirium and Hospital Admission ............................................................. 82

LIST OF APPENDICES

Appendix A: Variable Table .................................................................................... 125
Appendix B: USD IRB ............................................................................................... 127
Appendix C: VA IRB ................................................................................................. 129
CHAPTER I
INTRODUCTION

Delirium is a common cognitive disorder frequently seen in hospitalized adults that can result in detrimental outcomes. It often occurs as the result of an acute illness, surgery or hospitalization. It is estimated that around 2.6 million adults, 65 years and older, develop delirium each year. This roughly translates into one in every four hospitalized elderly adults. The financial impact of caring for and treating patients with delirium is estimated to cost between $38 and $164 billion dollars a year in health care expenditures (Leslie, Marcantonio, Zhang, Leo-Summers, Inouye, 2008; Oh, Fong, Hshieh, & Inouye, 2017).

Although 2.6 million adults each year seems overwhelming high, researchers believe this number may truly underestimate the rate of delirium, as studies have found between 30-60% of delirium goes unrecognized and untreated by healthcare providers (Ali et al., 2011; Inouye, 2001; Meagher et al., 2014; Oh, et al., 2017). Patients who develop delirium are at increased risk for prolonged hospitalization, increased mortality, decreased physical and cognitive functioning and may require long-term institutional placement upon discharge (Inouye, Westendorp, & Saczynski, 2014; McCusker, Cole, Dendukuri, Han, & Belzile, 2003; McCusker et al., 2014; Witlox et al., 2010). It is estimated that 40% of delirium cases may be preventable if patients at risk are identified upon hospital admission and preventative protocols are implemented (Inouye, 2001).

Background and Significance

The word delirium originates from the Latin origin “deliro-deliare” roughly translating to mean “to deviate from the straight line, to be crazy, to be out of one’s wit”
The phenomenon of delirium was first recorded in 500 BC by Hippocrates. Throughout the centuries, delirium continued to be of interest to medical professionals and researchers. As more was discovered about the phenomenon, a definition along with diagnostic criteria for delirium evolved. Delirium is defined “as a disturbance in attention and cognition that is an acute change from baseline, occurring over a short period of time, fluctuating in severity throughout the day, and cannot be explained by a pre-existing neurocognitive disorder. It is a direct physiological consequence of another medical condition or due to multiple etiologies” (American Psychiatric Association, 2013).

Incidence and Prevalence

The incidence rate for delirium ranges from 3-52% depending on the population being studied, with the post-operative elderly patients at highest risk for delirium (Adamis, McCarthy, O’Mahony, & Meagher, 2017; Ali et al., 2011; Collins, Blanchard, ookman & Sampson, 2009; Cull, Kent, Phillips, & Mistarz, 2013; Dosa, Intrator, McNicoll, Cang & Teno, 2007; Hosie et al., 2013; Litaker, Locala, Franco, Bronson, & Tannous, 2001; Martinez et al., 2012; O’Keeffe & Lavan, 1997; Rudolph et al., 2011; Siddiqi et al., 2006). Studies that screened all patients upon admission to the hospital found the prevalence rate ranged from 10-30% (Inouye, 1998; O’Keeffe & Lavan, 1997; Wong, Holroyd-Leduc, Simel, & Straus, 2010).

Risk Factors for Delirium

Researchers have determined the development of delirium involves an interrelationship between predisposing risk factors and precipitating risk factors. Predisposing risk factors are continuously present and reflect the person’s baseline
vulnerability. They include age (greater than 65 years), cognitive impairment, functional impairment, co-morbidity, male gender, sensory impairment and malnutrition (Ali et al., 2011; Chu et al., 2016; Inouye, 2006; Jackson et al., 2004; Juliebø et al., 2009; Litaker et al., 2001; Wakefield, 2002; Young & Inouye, 2007).

Precipitating risk factors develop during hospitalization and ultimately trigger the delirium episode. They include medications (e.g., anticholinergic, sedatives, narcotics), severe illness, infection, surgery, bedrest/immobility, fluid and electrolyte imbalances, sleep deprivation, and environmental factors (Ali et al., 2011; Chu et al., 2016; Inouye, 2006; Jackson et al., 2004; Juliebo, et al., 2009; Litaker et al., 2001; Wakefield, 2002; Young & Inouye 2007). It is generally accepted that a patient must have at least one predisposing factor and at least one precipitating factor in order for delirium to develop.

**Delirium Sub-types**

Lipowski in 1983 was the first researcher to attempt to classify delirium into different subtypes. Lipowski based the subtypes on the level of alertness and arousal of the person and labeled the subtypes according to observable patient motor behaviors (Boettger & Breitbart, 2010). Delirium is currently classified into three subtypes: hyperactive, hypoactive and mixed. However, a fourth type of delirium, emergence delirium (ED), has been found to occur immediately after anesthesia or during the post-operative acute recovery period (McGuire, 2012; Wilson, 2014).

Hyperactive delirium is often referred to as the “classic” presentation. These patients experience symptoms including hypervigilance, agitation, hyperarousal, verbal or physical aggression and restlessness (Ali et al., 2011; Liptzin & Levkoff, 1992; Yang et al.; 2009; Young & Inouye, 2007).
Hypoactive delirium is characterized by decreased alertness, lethargy, slowed movements, unawareness of surroundings and apathy. Hypoactive delirium tends to have a higher mortality rate and poorer prognosis than hyperactive or mixed (Ali et al., 2011; Liptzin & Levkoff, 1992; O'Sullivan, Inouye & Meagher, 2014; Yang, et al., 2009; Young & Inouye, 2007). Patients with hypoactive delirium are more likely to develop pressure injuries or hospital acquired infections than the other types (O’keefe & Lavan, 1997).

Mixed delirium is a combination of the two subtypes described above. Patients with mixed delirium are said to alternate between a hyperactive and hypoactive state within a single episode of delirium. Liptzin and Levkoff (1992) found this subtype to be the most common, with up to 50% of patients experiencing symptoms of both hyperactive and hypoactive.

Emergence delirium (ED) was first noted in the literature in 1960s and was originally termed post-anesthetic excitement because it occurred within the operating room (OR) and/or Post-Anesthesia Care Unit (PACU) as patients came out of anesthesia (Wilson, 2014) and was identified as typically occurring within the pediatric population. However, since September 11, 2001, military and veteran hospitals have reported an increase in the occurrence of this type of delirium. Incidence rates for ED vary between 3-27% in the military population (McGuire, 2012). Studies investigating ED occurrence amongst military personnel have found a relationship between veteran specific diagnosis (combat, PTSD, anxiety and depression) and ED during the immediate post-operative period (McGuire, 2012; Wilson, 2014). There have been no published studies to date that have specifically examined whether the factors of combat duty or experiencing traumatic
brain injury (TBI) or post-traumatic stress disorder (PTSD) are associated with the incidence of delirium among hospitalized veterans.

**Recognition of Delirium**

Despite the enormous cost of treating and caring for patients with delirium, limited research studies have addressed barriers to delirium recognition by healthcare providers. Studies focused on barriers to delirium recognition have uncovered several consistent themes that contribute to the under-recognition of delirium, including knowledge deficit, time constraints for completing assessments, fast pace of the hospital setting, increased use of technology, and lack of respect when reporting abnormal findings to providers (Hosie, Lobb, Agar, Davidson, & Phillips, 2014; Inouye, 1994; Lawlor & Bush, 2014; Nydahl, et al., 2018).

In one study, nurses were only able to identify delirium in 19% of patients while performing routine patient care. When the nurses were provided a delirium instrument known to produce valid assessment data, nurses were then able to correctly identify 31% of patients (Inouye, et al. 2001). Furthermore, this study concluded that patients who had hypoactive delirium, were 80 years and older, had a diagnosis of dementia and/or a vision impairment were seven times less likely to be recognized as having delirium by nurses (Inouye, et al., 2001). Nurses spend the most amount of time with patients and play an essential role in identifying patients with or at risk for delirium. Therefore, it is imperative bedside nurses are able to correctly identify patients with or at risk for delirium and implement evidence-based delirium prevention protocols to prevent or decrease the severity of delirium.
Another prominent theme noted as a cause for under-recognition of delirium is the lack of motivation for nurses to use screening instruments because they see limited value in using them (Nydahl et al., 2018; van de Steeg, Langelaan, Ijkema, Nugus, & Wagner, 2014; van Velthuijsen et al., 2016). Additionally, many nurses perceive delirium screening as an obligation or task to complete when providing patient care. Nurses state they often omit screening patients for delirium due to time constraints (Nydahl et al., 2018; van de Steeg et al., 2014; van Velthuijsen et al., 2016).

Nurses’ knowledge or lack thereof regarding delirium is repeatedly cited as a theme within the literature. Knowledge deficit often influences whether nurses are consistent in assessing and screening patients. Some studies report that nurses who possessed minimum knowledge regarding the risk factors, symptoms, and consequences of untreated/unrecognized delirium, were less likely to perform routine delirium screening on their patients compared to nurses who understood delirium (Hosie et al., 2013; van de Steeg et al., 2014; van Velthuijsen et al., 2016). Nydahl, et al. (2018) found only 60% of nurses are routinely screening patients for delirium with only half using a screening instrument that produces valid data. Forty-four percent (44%) of nurses admitted they only started the delirium screening process when suspicious patient behavior (e.g., agitation, yelling, pulling at lines) was observed. Even when delirium was suspected, only 38% of nurses communicated these findings to the oncoming shift (Nydahl et al., 2018). The inability of healthcare providers, specifically nurses, to accurately assess and recognize delirium appears to be a major variable in the further development of delirium within the hospitalized patient.
Veterans

There are approximately 21.8 million veterans living in the US, of which 16 million served during times of war (National Center for Veteran Analysis and Statistics, 2020). Many veterans have been diagnosed with PTSD or experienced a TBI as part of their service (National Center for Veteran Analysis and Statistics, 2020). Studies have found that PTSD, TBI, and combat have been associated with the occurrence of emergence delirium in active duty military undergoing surgery (McGuire, 2012; Wilson, 2014). Even though PTSD, TBI and combat have been found to have an association with emergence delirium, no study to date, has examined whether these same risk factors have an association or contribute to the incidence of delirium within the hospitalized veteran. It is imperative that these risk factors for delirium be studied in the hospitalized veteran population to determine if there is an association.

Research Conceptual Framework

As stated previously, delirium is a complex and complicated cognitive disorder that is associated with numerous predisposing and precipitating risk factors. Despite the development of several delirium prediction models over the last twenty-five years, predicting who will develop delirium during hospitalization remains challenging. In 1993 and 1996, Dr. Sharon Inouye and colleagues conducted research studies to investigate the relationship between predisposing and precipitating risk factors and the development of delirium. Together they created a Multifactorial Model for Delirium that describes the relationship among predisposing and precipitating risk factors and the development of delirium (see Figure 1) (Inouye, 1996; Inouye, 1993). In this model, it is hypothesized that patients admitted with few or no predisposing factors
would need to experience several precipitating factors before delirium develops. Whereas, patients with several predisposing factors present on admission may need only one precipitating factor in order to develop delirium (Figure 1).

As noted above, this was one of the first models created to guide research on delirium and assist the researcher in understanding the complex interrelationship between predisposing and precipitating risk factors and delirium. This model has since been used as a framework for numerous delirium research studies (Marcantonio, et al. 1994; Newman, O’Dwyer, & Rosenthal, 2015; Rudolph et al. 2011).

Veterans, due to their military service are at higher risk than their civilian counterparts for experiencing PTSD, TBI, anxiety, and depression. It is estimated that 20% of all military service members have experienced a TBI or have been diagnosed with PTSD as a result of their service since September 11, 2001. Furthermore, both PTSD and TBI have a strong association with anxiety, depression and substance use disorders (Hoge & Cotting, 2004; Armenta et al., 2018). However, there has been little inquiry as to whether these veteran specific risk factors are predisposing factors influencing the development or severity of delirium within this unique population.

Inouye’s 1996 Multifactorial Model for Delirium was used to inform this study and was modified to construct the research conceptual framework. This framework includes veteran specific risk factors: PTSD, TBI, anxiety, depression and combat experience (see Figure 2). It is hypothesized veterans who have one or more of these predisposing risk factors and then experience precipitating risk factors during hospitalization will be at an increased risk of developing delirium.
There is little definitive published research of the impact of these veteran specific risk factors upon delirium. Studies that have focused on these veteran specific risk factors have been in conjunction with emergence delirium (ED) only. As stated earlier, ED is a type of delirium that a person may experience during the immediate post-anesthesia period. Previous studies on ED have found a relationship between PTSD, TBI, anxiety, depression, combat and the incidence of ED (McGuire, 2012; Wilson, 2014). However, no rigorous studies have been performed to date that explore the relationship of each individual risk factor and the impact it has on the development of delirium. Hence, for the purpose of this study, it is currently unknown where each of these veteran specific risk factors would fall into the Multifactorial Model for Delirium (Figure 1) in terms of low or high vulnerability. For the purpose of this study, it is hypothesized veterans who have at least one or more of these identified risk factors will fall in the upper left quadrant on the vulnerability side of the model (Figure 2).

For example, a veteran who is diagnosed with depression but has no other risk factors may have a low baseline vulnerability for developing delirium. It may take several precipitating risk factors to occur during hospitalization for this veteran to develop delirium or this veteran may not develop delirium during hospitalization. Whereas, it is hypothesized that a veteran who has multiple veteran specific risk factors such as a PTSD, TBI, and anxiety may have a higher baseline vulnerability for developing delirium. This veteran may only need one precipitating risk factor to occur during hospitalization for delirium to develop.
Due to the limited available research findings for veteran specific risk factors and delirium, at this point in time it is impossible to determine if any veteran specific risk factor is more significant than the others.

**Problem Statement**

Delirium is a complex cognitive disorder that affects around 2.6 million adults annually. There has been limited research conducted on whether veteran specific risk factors such as PTSD, TBI, anxiety, depression or combat play a role in the development of delirium in the hospitalized veteran.

**Study Purpose and Specific Aims**

**Purpose of Study**

The purpose of this retrospective cross-sectional cohort study was to describe the relationship between veteran specific risk factors (PTSD, TBI, anxiety and/or depression) and the delirium in a southern California Veterans Administration healthcare facility.

**Specific Aims**

The specific aims of this study were to:

1. Describe the sociodemographic (i.e., age, gender, race, ethnicity, and marital status), military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., COPD, CAD, and CVA), other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling urinary catheter, and infection), hospital outcomes (i.e., length of stay, disposition at discharge, and mortality), and delirium diagnosis among hospitalized military veterans.
2. Describe the differences between mental health comorbidities (i.e., PTSD, TBI, depression, and anxiety) and delirium diagnosis among hospitalized military veterans who have experienced combat versus those who have not.

3. Describe the relationship between sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CAD, COPD, and CVA), other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling urinary catheter, and infection), and hospital outcomes (i.e., length of stay, disposition at discharge, and mortality) in terms of delirium diagnosis among hospitalized military veterans.

4. Determine whether sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CVA, CAD, COPD), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling catheter, and infection) increase the likelihood of developing delirium among hospitalized military veterans.

**Content of this Dissertation**

Chapter 1 discusses the background and significance of delirium within the hospitalized veteran and provides description of the specific aims for the conduct of this study.
Chapter 2 provides a review of the literature and conceptual framework, which guided this research.

Chapter 3 describes the methods and procedures used to quantitatively examine the relationships between veteran specific risk factors and delirium in a Veterans Administration healthcare facility located in southern California.

Chapter 4 presents the results of this research study.

Chapter 5 concludes the dissertation, discusses the study findings within the context of current evidence and policy, describes the implications for nursing practice and education, and makes recommendations for further research in the area of delirium and care of veterans.

Figure 1. Inouye’s Multifactorial Model for Delirium
Figure 2. Research Conceptual Framework with Veteran Specific Factors
CHAPTER II
LITERATURE REVIEW

Veteran Specific Risk Factors of Delirium

Delirium is a common acute neurocognitive disorder frequently experienced by hospitalized older adult patients that can have detrimental consequences. It is often the result of an acute illness, surgery or hospitalization. Patients who develop delirium are at increased risk for prolonged hospitalization, increased mortality, decreased physical and cognitive functioning and may require institutional placement upon discharge (Inouye, Westendorp, & Saczynski, 2014; McCusker, et al., 2003; McCusker et al., 2014a; Witlox et al., 2010). It is estimated 2.6 million adults 65 years and older develop delirium annually, costing between $38 and $164 billion dollars in health care expenditures (Oh, et al., 2017).

History and Phenomenon of Delirium

The etymology of the word delirium is believed to have derived from the Latin phrase “deliro-deliare” which when translated roughly means “to deviate from the straight line, to be crazy, to be out of one’s wit” (Adamis, Treloar, Martin, & Macdonald, 2007a; Ali et al., 2011). It is defined in the dictionary as “an acute mental disturbance characterized by confused thinking and disrupted attention, usually accompanied by disordered speech and hallucinations” (Merriam-Webster, 2017).

The phenomenon of delirium was first recorded in 500 BC by Hippocrates. It is documented Hippocrates used sixteen different words to describe delirium and its disease process. Most notably, he frequently used the words phrenitis and lethargus to describe the acute behavioral changes a person exhibited as a result of a fever, poisoning or head
trauma. Phrenitis was described to be what is now referred to as hyperactive delirium and lethargus was the term used to describe what is now referred to as hypoactive delirium. Hippocrates believed phrenitis could lead to the development of lethargus and vice versa. He was the first person to officially acknowledge if delirium was left untreated, it could lead to death (Adamis et al., 2007a).

In the first century AD, Celsus continued to use the term phrenitis to describe delirium, however; he believed there were illnesses other than a fever that could cause delirium. Additionally, Celsus was the first person to acknowledge that delirium may not be reversible and had lasting consequences for those who experienced it (Adamis et al., 2007a).

As the world continued to evolve, the phenomenon of delirium did as well. During the medieval period in 542 AD, a historian named Procopius was able to provide a more accurate description of delirium. He observed that some people infected with the bubonic plague either experienced a hyper-alert state, described as hallucinations, insomnia and violent aggressive behavior, while others infected suffered from a hypo-alert state which included memory loss, chronic lethargy, sleepiness, and resided in an almost comatose state (Adamis et al., 2007a). There are many descriptions of delirium throughout the medieval time period and although many different terms were used to describe delirium, there was a consensus that delirium was most likely caused by febrile illnesses. Additionally, those who experienced delirium were at greater risk for death and if they survived it, many experienced a decreased quality of life (Adamis et al., 2007a).

The first time delirium was used in English medical literature was by Cosin in 1592. He defined delirium as a “weakness of conceite and consideration and lethargie as
notable forgetfulness of all things.” The following year in 1593, Philip Barrouught proposed that even if delirium resolved, a person may still experience a permanent loss of memory or reasoning. A surgeon during this time, Ambroise Pare was the first to suggest delirium could develop as a result of a surgical complication. He observed patients who suffered from fevers, wounds, gangrene or severe bleeding as a result of surgery, often experienced delirium (Adamis et al., 2007a).

During the nineteenth century, the phenomenona of confusion and clouding of consciousness were defined along with a distinction between delirium tremens caused by alcohol and delirium caused by other illnesses (Adamis et al., 2007a). In the twentieth century, several physicians and researchers continued to explore this complex disorder and discovered associations between decreased cerebral metabolic rate and delirium.

Zbigniew J. Lipowski, a Polish psychiatrist, is regarded as the father of modern delirium research. During his lifetime (1924-1997), Lipowski wrote extensively on delirium, publishing his findings in numerous medical journals and eventually publishing a collection of his work entitled Delirium: Acute Confusional States. It is believed it was Lipowski who recommended the term delirium be used when describing hyper, hypo and mixed delirium (Lipowski, 1987).

In 1952, the American Psychiatric Association (APA) published the Diagnostic and Statistical Manual of Mental Disorders (DSM) to assist mental health professionals in using a common language when diagnosing individuals with mental disorders, including delirium. In 2013, the APA published the 5th edition of the DSM and refined the criteria/classification of delirium to incorporate new knowledge and research findings.
According to the DSM-5, delirium is defined as:

- A disturbance in attention and awareness.

- The disturbance develops over a short period of time and represents an acute change from baseline attention and awareness.

- There is an additional disturbance in cognition.

- The disturbance in attention and awareness, as well as, cognition cannot be explained by a pre-existing, established or evolving neurocognitive disorder and it does not occur in the context of a severely reduced level of arousal such as coma.

- There is evidence from the history, physical examination or laboratory findings that the disturbance is a direct physiological consequence of another medical condition, substance intoxication or withdrawal, or exposure to a toxin, or is due to multiple etiologies (American Psychiatric Association, 2013, p. 596).

Additionally, the World Health Organization (WHO) created their own medical classification system to assist with classifying diseases worldwide. The most recent International Statistical Classification of Diseases and Related Health Problems (ICD) is in its 10th edition. It defines delirium as:

- A clouding of consciousness and attention alteration.

- A disturbance of cognition (memory and orientation).

- There needs to be one psychomotor disturbance (shifts from hypo to hyperactivity, reaction time increased, speech increased/decreased, enhanced startle reaction).
• There is an alteration in the Sleep-wake cycle (includes nocturnal worsening and hypnopompic disturbances).
• It has a rapid onset and fluctuates throughout the day.
• There is underlying evidence for an etiologic cause (Sepulveda et al., 2016).

There have been several studies within the last twenty years that have compared the different classification systems to determine which system is most accurate in diagnosing delirium. In 2016, a research study conducted by Sepulveda, et al. compared the sensitivity, specificity and accuracy of the following classification systems: DSM-5, DSM-IV, DSM-III and ICD-10 when diagnosing delirium in patients with and without dementia. The study concluded the DSM-III criteria was the most accurate overall at correctly diagnosing delirium in both patients with and without dementia and was then followed by the DSM-IV criteria. However, the study found the ICD-10 criteria performed better than the DSM-5 in patients without dementia, while the DSM-5 outperformed the ICD-10 in diagnosing delirium in patients with underlying dementia. In addition, the DSM-5 was found to have the highest interrater reliability out of the four classification systems (Sepulveda et al., 2016).

Kazmierski, et al. (2010) compared the accuracy of diagnosing delirium using the DSM-IV and ICD-10 criteria in the post-operative population. Although, the DSM-IV and ICD-10 criteria are similar, the study found the ICD-10 criteria to be more restrictive than the DSM-IV because it requires the person to have symptoms in each of its five categories in order to be diagnosed with delirium (Kazmierski et al., 2010). A study by Cole, et al. found the DSM-IV criteria were more inclusive than the ICD-10 (Cole et al., 2015). Despite numerous studies comparing the DSM and the ICD classification systems,
delirium experts still disagree on which classification system is the most accurate for diagnosing delirium.

Incidence, Prevalence and Occurrence of Delirium During Hospitalization

Hundreds of research studies have examined the incidence, prevalence and occurrence rates for delirium in specific populations. For current purposes, incidence rate refers to the number of new cases of delirium that developed in a population during a hospitalization. Prevalence rate refers to the total cases of delirium in a population upon being admitted to a hospital or delirium that are diagnosed within the first 24 hours of hospitalization. Occurrence rate refers to studies where patients were not screened for delirium upon admission to the hospital but developed delirium within the first 24 hours, making it impossible for the researcher to determine if delirium was present on admission.

Incidence

Similar to prevalence rates, incidence rates are commonly reported by population. The incidence rate for patients admitted to medical units ranges between 3-29% (Collins, Blanchard, Tookman & Sampson, 2009; Cull, et al., 2013; Litaker, Locala, Franco, Bronson, & Tannous, 2001; Martinez et al., 2012; Rudolph et al., 2011; Siddiqi et al., 2006). The incidence rate for older adult patients who developed delirium during hospitalization was 24-31% (O’Keeffe & Lavan, 1997). Many studies examined the incidence rates of post-operative patients and found those rates to range from 11-52% depending on the population of surgical patients being studied (Adamis, McCarthy, O’Mahony, & Meagher, 2017; Ali et al., 2011; Goldenberg et al., 2006; Kazmierski et al., 2010; Maldonado et al., 2008). In the palliative care setting, the incidence rate was found
Prevalence

The prevalence rates of delirium vary depending on the population being studied. A systematic review of 42 studies, found the prevalence rate for patients admitted to medical units to be between 10-31% (Siddiqi, House, & Holmes, 2006). In studies that screened all patients admitted to the hospital, the prevalence rate was 10-30% (Inouye, 1998; O’Keeffe & Lavan, 1997; Wong, Holroyd-Leduc, Simel, & Straus, 2010). Studies specifically focused on the older adult population determined the prevalence rates to be between 10-43% (Adamis, Treloar, Gregson, Macdonald, & Martin, 2011; Curyto et al., 2001; Levkoff, 1992; Meagher et al., 2014; Wong et al., 2010). Lastly, in the palliative care setting, the prevalence of delirium was 13-63% (Hosie, Davidson, Agar, Sanderson, & Phillips, 2013).

Occurrence

In several studies, patients were not screened for delirium on admission or within the first 24 hours; therefore, researchers could not say with certainty whether delirium was present on admission or developed as a result of hospitalization. These studies reported delirium rates as occurrence rates. Occurrence rates have been reported to be anywhere between 5-43% (Curyto et al., 2001; Inouye, 2001; McCoy, Hart, & Perlis, 2017; D. Meagher et al., 2014).

Delirium Subtypes

Even in 500 BC, Hippocrates distinguished two main subtypes of delirium, hyperactive and hypoactive. As research advanced in the twentieth and twenty-first centuries, so did the ability to describe and classify delirium. Currently, there are five
different subtypes of delirium that are recognized within the literature, although some controversy exists with some of the newer types. They are hyperactive, hypoactive, mixed, subsyndromal and emergence delirium. Below is a brief description of each type.

**Hyperactive**

Hyperactive delirium is often referred to as the classic presentation of delirium. Patients who experience hyperactive delirium are in a hyper-alert state often characterized by hypervigilance, agitation, hyperarousal, distractibility, verbal or physical aggression and restlessness (Ali et al., 2011). It is estimated to occur in approximately 15-25% of all delirium cases (Bellelli, Speciale, Barisone, & Trabucchi, 2007; Boettger & Breitbart, 2011; Kim et al., 2015). Some studies have found a relationship between hyperactive delirium and age (younger adults more at risk), trauma (trauma experience more at risk), substance abuse (more at risk if positive for substance abuse), and mental health (more at risk for a mental health diagnosis) (Angles, et al., 2008; Meagher, O’Hanlon, O’Mahony, Casey & Trzepacz, 2000). Interestingly, one study found that hyperactive delirium was associated with a decreased length of stay and lower mortality rate when compared to hypoactive or mixed delirium (Liptzin & Levkoff, 1992).

Boettger and Breitbart’s (2011) study on patients with cancer diagnosed with delirium discovered patients with hyperactive delirium experienced more perceptual disturbances, such as hallucinations and delusions, than hypoactive or mixed delirium. These perceptual disturbances were moderate to severe in 53% of the cases, compared to only 17% in hypoactive delirium. Delusions in patients with hyperactive delirium occurred in 38% of patients compared to only 19% with hypoactive delirium. Although these finding are not abnormal compared to earlier studies conducted on hyperactive
delirium, Boettger and Breitbart (2011) also found a relationship between perceptual disturbance and delusions and hypoactive delirium. Meagher et al. (2007) also concluded hallucinations or thought disorders were more common in hyperactive delirium, but noted they also occurred in hypoactive delirium. It was the first study to report these types of issues with hypoactive delirium. In 2015, another study found 35% of patients with hyperactive delirium experienced hallucinations and 20% experienced delusions (Kim et al., 2015).

**Hypoactive**

Contrary to hyperactive delirium, hypoactive delirium is described as decreased alertness, lethargy, slowed movements, unawareness of surroundings, slow speech and apathy (Robinson, et al., 2011). Studies have estimated hypoactive delirium occurs in 19-67% of all delirium cases. However, this form of delirium is often not recognized by healthcare professionals, and as a result is associated with poor outcomes and increased mortality (Ali et al., 2011; Bellelli et al., 2007; Kim et al., 2015; Liptzin & Levkoff, 1992; O’Sullivan, Inouye, & Meagher, 2014; Robinson, 2011; Takeuchi et al., 2012; Yang, Marcantonio, Inouye, Kiely, Rudolph, Fearing & Jones, 2009; Young & Inouye, 2007).

Robinson et al. (2011) conducted a study on post-operative patients and found patients who experienced hypoactive delirium were more likely to be older, anemic and suffer from adverse events such as pressure injuries during hospitalization. In contrast, Kim et al. (2015) found an association between patient’s age and mortality. Their findings suggested younger patients who experienced hypoactive delirium had shorter survival rates than older patients. However, it should be noted this study did not define
the term “younger age” and the median age of participants was greater than 65. Yang, et al. (2009) concluded patients diagnosed with hypoactive delirium using the Modified Delirium Assessment Scale (MDAS) had increased mortality rate at 1 month, 4 months and 6 months after diagnosis compared to patients with hyperactive delirium.

**Mixed**

Mixed delirium is defined as a combination of hyperactive and hypoactive delirium. Patients who experience mixed delirium tend to alternate from a hyperactive to a hypoactive state within a single episode of delirium. Numerous studies have found this subtype to be the most common with 35-52% of patients experiencing symptoms of both hyperactive and hypoactive (Bellelli et al., 2007; Kim et al., 2015; Liptzin & Levkoff, 1992; Robinson, 2011; Takeuchi et al., 2012). Similar to hypoactive delirium, patients who suffer from mixed delirium are at an increased risk of experiencing adverse events such as pressure injuries, falls or inadvertent line removal during hospitalization (Kim et al., 2015; Robinson, 2011). In addition, increased mortality has also been associated with this subtype of delirium (Kim et al., 2015).

**Subsyndromal**

Another subtype found in the literature is subsyndromal delirium. Subsyndromal is defined as a patient having one or more symptoms of delirium (e.g., inattention, altered level of consciousness, disorientation or perceptual disturbances) but does meet the full DSM criteria for a delirium diagnosis (Cole, Ciampi, Belzile, & Dubuc-Sarrasin, 2013). Subsyndromal delirium was first noted in the literature in 1500’s but did not gain momentum until Lipowski described it as a prodromal phase of delirium in 1990. It is estimated between 34-44% of hospitalized older adult patients have one or more
symptoms of delirium, but do not meet the DSM criteria for full diagnosis (Levkoff, et al., 1992; McCusker et al., 2014). Patients with subsyndromal delirium were reported to have symptoms such as inattention (58%), disorganized thinking (48%) fluctuations (34%) and altered level of consciousness (32%) (McCusker et al., 2014a).

A systematic review in 2013 found the combined prevalence of subsyndromal delirium to be around 23% in hospitalized patients (Cole et al., 2013). In 2014, Meagher et al. conducted a point prevalence study for delirium and subsyndromal delirium in a hospital. The study found 17.6% of patients within the hospital met the DSM criteria for delirium diagnosis. However, when the Confusion Assessment Method (CAM) or Delirium Rating Scale (DRS-98) instruments was used, an additional 7-13% of patients screened positive for at least two delirium criteria. It must be noted, there was a difference in the percentage of those who screened positive for subsyndromal delirium depending on which diagnostic instrument was used (CAM vs. DRS-R98). The CAM instrument, diagnosed 41 patients with subsyndromal delirium while the DRS-R98 only classified 24 patients, and no diagnosis of subsyndromal delirium was made using the DSM-IV criteria (D. Meagher et al., 2014).

Studies have found that subsyndromal delirium is also prevalent in the nursing home population, occurring in up to 30% of all nursing home residents. It is believed that many of these patients live in a continued state of subsyndromal delirium for prolonged periods of time (Dosa, et al., 2007). Subsyndromal delirium has been found to have an association with increased mortality and decreased physical and cognitive functioning (McCusker et al., 2014a). Although the DSM-5 criteria somewhat acknowledges subsyndromal delirium, labeling it “attenuated delirium syndrome,” there is not enough
research on this type of delirium to determine if subsyndromal delirium should officially be recognized by the APA and medical professionals as a standalone subtype and if it should be included within the delirium spectrum.

**Emergence**

The last subtype to be discussed and the newest one to join the official rankings is emergence delirium (ED). ED was first noted in the 1960s and was termed post-anesthetic excitement because it occurred within the operating room or post-acute recovery care unit (PACU) as patients came out of anesthesia (Wilson, 2014). It was first noted in the literature to be a problem within the pediatric population. Since September 11, 2001, and other subsequent military interventions, military and veteran hospitals have reported an increase in this type of delirium. It was noted in one study to occur in 27% of combat veterans (McGuire & Burkard, 2010). Due to the “newness” of this type of delirium, there have not been many studies conducted; however, those published have found an association between patients who experienced combat, post-traumatic stress disorder (PTSD), anxiety and depression to be at greater risk for ED occurring during the immediate post-operative period (McGuire, 2012; Wilson, 2014). ED presents in combat veterans as a severe form of hyperactive delirium, with the veteran experiencing confusion, aggression and violent behavior such as pulling at IV lines, monitoring equipment and many times requires staff to restrain the veteran until the episode has ended (McGuire, 2012).

McGuire’s study (2012) focused on 130 military veterans who had experienced at least one combat deployment and were to undergo surgery at a military hospital. Of these veterans, 20% experienced ED when emerging from anesthesia. Those who experienced
ED were more likely to have a diagnosis of PTSD, anxiety or depression, compared to those that did not experience ED (McGuire, 2012).

Similar findings occurred in a study conducted by Wilson (2014) regarding experiences of military anesthesia providers with veterans who had experienced ED. Ninety percent (90%) of providers who responded to the survey had witnessed or cared for a veteran who had ED as they emerged from anesthesia. These providers believed disorders such as PTSD, anxiety, depression and traumatic brain injury (TBI) along with younger age (<30 years) to be risk factors for ED. Additionally, anesthesia providers believe there may be an association between type of anesthetic agent used and ED (Wilson, 2014). More research is needed regarding the association between combat veterans and whether risk factors such as PTSD, TBI, anxiety and depression increase the likelihood of delirium incidence within this population.

**Risk Factors for Delirium**

A majority of research articles published within the last 20 years have focused on identifying key risk factors for developing delirium. Researchers have determined patients at risk for delirium usually have a combination of predisposing and precipitating risk factors. Predisposing risk factors are risk factors that make a person more susceptible to the development of delirium, whereas, precipitating risk factors are when a patient experiences a specific trigger or event that contributes to the development of delirium.

**Predisposing Risk Factors**

Predisposing risk factors identified in the literature repeatedly include advanced age, gender, impaired cognition/dementia, co-morbidities such as cerebral ischemia, coronary artery disease, functional and sensory impairments and institutionalization.
Below is a brief review of the evidence that supports each of these risk factors.

**Age.** Delirium frequently occurs in people of advanced age. Among researchers, there remains some disagreement regarding when age actually becomes a risk factor for delirium. However, a majority of studies established age greater than 65 years as a cut-off point. Several studies have determined as age increases, so does the likelihood of developing delirium while hospitalized (Chu et al., 2016; Khan et al., 2012; Takeuchi et al., 2012). A meta-analysis by Ahmed et al. (2014) determined “old age” (no definition provided) increases a person’s risk for delirium by 2.74 times while a systematic review by Cull, et al. (2013) determined advanced age (defined as >80 years) was not significantly related to the development of delirium (Ahmed, Leurent, & Sampson, 2014; Cull et al., 2013).

A meta-analysis by Lin, et al. (2012) on post-operative cardiac patients revealed for every year older a person was, their odds for developing delirium increased by 8%. Similarly, a study published in 2018 concluded for every additional year of age a person experiences, there was a 15% increase in developing delirium (Solà-Miravete et al., 2018). These findings are further supported by previous research studies that have estimated as age increases, the odds ratio of developing delirium are between 3-5.1 (Goldenberg et al., 2006; Litaker et al., 2001; Marcantonio, Flacker, Michaels, & Resnick, 2000).

**Gender.** Male gender has a strong association with an increased risk of delirium development. Several studies have determined males to be at higher risk for delirium development, citing males were 2-5 times more likely to suffer from delirium during hospitalization (Chu et al., 2016; Kim et al., 2015). However, in a systematic review
completed by Cull et al. (2013) and a meta-analysis conducted by Ahmed et al. (2014), male gender was not confirmed as a risk factor, citing an odds ratio of 1.11 and 0.86 respectfully (Ahmed et al., 2014; Cull et al., 2013).

**Impaired cognition.** Impaired cognition has been cited repeatedly throughout the literature as a risk factor for delirium development in the medical population (Ahmed et al., 2014; Chu et al., 2016; Cull et al., 2013; Hare, Arendts, Wynaden, & Leslie, 2014; Inouye, 1998a; Kazmierski et al., 2010; Khan et al., 2012; Litaker et al., 2001; McCusker et al., 2014a; Oh et al., 2015; O’keeffe & Lavan, 1997). Studies have discovered underlying cognitive impairment can increase the risk of delirium development anywhere between 3-11 times (Ahmed et al., 2014; Cull et al., 2013; Hare et al., 2014; Jackson, Gordon, Hart, Hopkins & Ely, 2004; Juliebo, et al., 2009; Kazmierski et al., 2010; Morandi et al., 2012; Oh et al., 2015; Solà-Miravete et al., 2018).

Additionally, several studies have explored the relationship between impaired cognition and delirium development during the post-operative period. Three studies conducted on different post-operative populations all concluded that patients with cognitive impairment pre-operatively, had anywhere from a 2-6 times additional risk of developing delirium during the post-operative period (de Castro, et al. 2014; Goldenberg et al., 2006; Marcantonio et al., 2000).

**Comorbid conditions.** There have been numerous research studies describing different comorbid conditions and the likelihood that certain comorbidities contribute to a delirium diagnosis. While each of these studies have focused on different disease processes with varying results, several comorbidities have been determined to be risk factors. These comorbidities include stroke, underlying cardiac disease and pulmonary
disease. Studies have concluded as the number of comorbidities increases, so does the risk for developing delirium (Krzych, et al., 2013; Hare et al., 2014; Kim et al., 2015; Lin et. al. 2012; Marcantonio et al., 2000; Oh et al., 2015).

**Functional impairment.** Functional impairment is defined in many studies as the inability to perform activities of daily living. Instrumental functional impairment is often assessed by the Instrumental Activities of Daily Living (IADL) scale. A meta-analysis in 2014, found that functional impairment was an independent predictor for delirium (Ahmed et al., 2014). This finding was further supported by a systematic review conducted on medical patients that found patients who suffer from functional impairments were 1.74 times more likely to develop delirium while hospitalized (Cull et al., 2013). Additionally, several other studies have concluded that bedrest and immobility increase the chance of developing delirium anywhere from 2-2.5 times (Marcantonio et al., 2000; Solà-Miravete et al., 2018; Wakefield, 2002).

**Sensory impairment.** Sensory impairments defined in the literature as either a hearing or visual deficit have also been identified as predisposing risk factors for delirium. Numerous studies have determined that patients with sensory impairments, specifically visual impairments have a relative risk of 3.5 for developing delirium (Ahmed et al., 2014; Cull et al., 2013; Inouye, 1998a). Patients with hearing impairments are also at higher risk for developing delirium (Chu et al., 2016).

**Malnutrition.** Malnutrition or inadequate nutrition is also cited as a predisposing risk factor in the literature. In the post-operative population, patients with body mass indexes (BMI) less than 20kg/m² were 2.92 times more likely to develop delirium during the post-operative period (Juliebo, et al., 2009). This finding was confirmed by two
additional studies which found patients who suffer from malnutrition prior to surgery were 2.8 times more likely to suffer from post-operative delirium (Chu et al., 2016; Oh et al., 2015).

**Precipitating Risk Factors**

**Restraints.** Use of physical restraints as a risk factor for delirium has been noted in the literature since the 1990s. Particularly, Inouye in two separate studies concluded that physical restraint use in the older adult yielded relative risk of 4.4 for developing delirium (Inouye, 1996; Inouye, 1998a). McCusker et al. (2001) conducted a study on whether specific environmental risk factors (e.g. room location, isolation, restraints) impacted the severity of delirium using the Delirium Index instrument. When placed into the final model, the study concluded that the use of physical restraints increased the severity of the delirium by one point on the Delirium Index instrument.

**Medications.** There have been numerous research studies focused on determining if specific medication classes are associated with the development of delirium. Classes of medications such as narcotics, tranquilizers, benzodiazepines, anticholinergic and neuroleptics have been found to be associated with an increased risk for developing delirium (Ahmed et al., 2014; Kassie, et al., 2017; Kim et al., 2015).

Additionally, several studies have concluded delirium risk increases when three or more medications are added during hospitalization. In one study, patients were 33 times more likely to develop delirium, while in a second study, relative risk increased by 2.9 when multiple medications were added during hospitalization (Goldenberg et al., 2006; Inouye, 1998a).
**Abnormal laboratory values.** Numerous studies have focused on whether abnormal laboratory values, such as low albumin, low hemoglobin, hematocrit, sodium and the blood urea nitrogen (BUN)/creatinine ratio are risk factors for delirium development while hospitalized. Primarily, low albumin levels have been cited repeatedly in the literature as a strong predictor of delirium development in hospitalized patients (Ahmed et al., 2014; Goldenberg et al., 2006; Inouye, 1998a; Kim et al., 2015; Oh et al., 2015; Wakefield, 2002). Additionally, patients who experience anemia while hospitalized are at a greater risk for delirium, especially during the post-operative period, sometimes increasing risk by as much as 4-fold (Goldenberg et al., 2006; Kazmierski et al., 2010; Krzych et al. 2013; Lin et al., 2012).

Abnormal sodium levels, as well as, high fasting glucose levels in the pre-operative patient have been found to increase the odds of developing delirium (Ahmed et al., 2014; Kim et al., 2015; Krzych et al, 2013; Wakefield, 2002). Lastly, there have been several studies focused on examining patient’s BUN/creatinine ratio. When the ratio is greater than 18, patients are at an increased risk for delirium (Ahmed et al., 2014; de Castro et al., 2014; Inouye, 1998).

**Indwelling catheters/elimination.** Hospitalized patients with an indwelling urinary catheter are also at an increased risk for developing delirium. Ahmed et al. (2014) reported in their meta-analysis that catheter use increased the likelihood of delirium by 3.93. This finding was confirmed by three additional studies that determined urinary catheter use increased the likelihood of developing delirium between 2.4- 3.9 times (de Castro et al., 2014; Inouye, 1998; Solà-Miravete et al., 2018).
**Severe illness.** Illness severity is commonly measured by using the Acute Physiology and Chronic Health Evaluation (APACHE II). Ahmed, et al. (2014) reported patients with higher scores on the APACHE II were 3.91 times more likely to develop delirium while hospitalized. Another study concluded that body temperature greater than 37.5 Celsius was found to increase risk of preoperative delirium by 3.41 (Juliebø et al., 2009).

**Hospital environment (noise, room changes, sleep disruption).** Several studies have explored whether sleep deprivation or disruption impacts the development of delirium while hospitalized. In two recent studies, sleep deprivation was found to increase the likelihood of developing delirium by as much as 16.2 times (Meagher et al., 2007; Solà-Miravete et al., 2018; Todd et al., 2017). A study by Todd et al. (2017) specifically examined whether sleep disruption (either at home or during hospitalization) increased the likelihood of developing delirium. The study reported a correlation between sleep disruptions at home prior to hospitalization and an increased risk of post-operative delirium.

Lastly, McCusker, et al. (2001) concluded certain environmental risk factors such as changing rooms, absence of wall clocks, and lack of reading glasses or family members increased the severity of delirium.

**Complications and Outcomes of Delirium**

A majority of research studies regarding delirium have focused on examining outcomes for patients who have experienced delirium while hospitalized. It is noted throughout the literature the presence of delirium can contribute to poor patient outcomes such as increased length of stay, increased mortality, decreased cognitive and physical
function, as well as, an increase in institutional placements (Ali et al., 2011; Inouye, 1998a; Katz et al., 2001). Below is a brief review of some studies that support these statements.

**Mortality**

It is well documented in the literature there is a strong association between delirium and a patient’s mortality. Mortality rates one year post delirium diagnosis have been found to range between 30-60% in study participants diagnosed with delirium while hospitalized compared to 17-20% patients who did not develop delirium (McAvay et al., 2006; McCusker, Cole, Abrahamowicz, Primeau, & Belzile, 2002; McCusker et al., 2003; Witlox et al., 2010). Patients with delirium were found to be two times more likely to die within a year of diagnosis compared to those who did not develop delirium (Francis & Kapoor, 1992; McCusker et al., 2002). Furthermore, if a patient had an underlying diagnosis of dementia and developed delirium during hospitalization, their mortality risk at one year was 34.5% compared to 23% for patients with dementia who did not develop delirium (Witlox et al., 2010). Additionally, in another study, hip fracture patients who developed delirium during hospitalization were found to be three times more likely to die at one month post-discharge compared to those who did not (Marcantonio et al., 2000).

Kim et al. (2015) explored looking at different subtypes of delirium and their mortality rates. The study revealed patients suffering from hypoactive or mixed delirium had a shorter survival time compared to those with hyperactive delirium. When they specifically examined age and survival time, the study found younger patients (those less than 65 years) diagnosed with hypoactive or mixed delirium had shorter survival rates
than their older counterparts (Kim et al., 2015).

**Cognitive and Physical Functioning**

**Cognitive functioning.** A decrease or decline in cognitive functioning is a well-known adverse outcome for people experiencing delirium. A systematic review by Jackson, et al. (2004) studied cognitive functioning of patients who had experienced delirium while hospitalized from six months to three years after a delirium diagnosis. Eight of the nine studies reviewed, reported a decrease in a patient’s cognitive functioning, particularly citing an increase in new dementia diagnoses and overall lower Mini-Mental Status Exam (MMSE) scores. It was noted within the systematic review however, there was a lack of consistency on how cognitive functioning was assessed, as well as, how long-term outcomes of cognitive decline were measured/determined (Jackson et al. 2004).

Other studies have confirmed the above results by concluding patients who suffer from delirium during hospitalization are at an increased risk for developing dementia post-discharge compared to those without delirium (Katz et al., 2001; McCusker et al., 2003; Witlox et al., 2010). Of particular note, one study found patients who had dementia and developed delirium during hospitalization often still had delirium symptoms present up to 12 months post discharge (McCusker et al., 2003). A longitudinal study followed a group of older adult patients for one year and found within that year over half of the study population was hospitalized and a quarter of the study participants was diagnosed with delirium during hospitalization. The study concluded hospitalized participants diagnosed with delirium had cognitive decline and additionally showed EEG slowing at one year compared to participants who were not hospitalized (Katz et al., 2001).
**Physical functioning.** A decline or decrease in physical functioning has also been cited repeatedly in the literature as an outcome of delirium. Several studies have revealed an association between delirium and decreased physical function (Francis & Kapoor, 1992; Inouye, et al., 1998; McCusker et al., 2003; O’keeffe & Lavan, 1997). In a cohort study, delirium was noted to be a significant predictor in physical functioning decline. On average, the study saw a decline in ADLs by a mean of 1.9 in the delirious group while non-delirious patients only had a mean decline of 0.5 at three months discharge (Inouye et al., 1998).

In a study examining post-operative hip fracture patients, patients diagnosed with delirium were 2.6 times more likely to suffer from a physical functional decline one month post discharge compared to those without delirium (Marcantonio et al., 2000). Another study followed patients for two years post-delirium episode and discovered at two years 41% of patients diagnosed with delirium had suffered a decline in physical functioning compared to only 21% of the control group (Francis & Kapoor, 1992).

**Institutional Placement**

Institutional or skilled nursing placement upon hospital discharge is another adverse outcome for patients who experience delirium. Numerous studies have reported patients who are diagnosed with delirium during hospitalization are at an increased risk for institutional placement upon discharge (Inouye et al., 1998; Marcantonio et al., 2000; McAvay et al., 2006; O’keeffe & Lavan, 1997; Witlox et al., 2010). Wilcox et al. (2010) further reported patients diagnosed with delirium who also had underlying dementia had a 46% chance to be institutionalized upon discharge compared to 22.2% who had delirium but no underlying dementia.
A cohort study looking at three different groups of patients in the United States northeast, found patients diagnosed with delirium were three times more likely to be placed in long-term care upon discharge (Inouye et al., 1998). This finding was further confirmed by additional two studies which determined patients were 2.6-3 times more likely to be discharged or placed in a long term care facility one month post-discharge compared to those who did not develop delirium during hospitalization (Marcantonio et al., 2000; McAvay et al., 2006).

**Length of Stay (LOS)**

Several studies have reported patients diagnosed with delirium during hospitalization experience an increased length of stay compared to those without delirium. A study by O’Keefe and Lavan (1997) found LOS for delirious patients was almost twice as long as non-delirious patients. While studies report an increase LOS for patients with delirium, it should be noted LOS is often not found to be statistically significant compared to other risk factors (Inouye et al., 1998).

**Delirium Prediction Models**

Over the last twenty years, many researchers have developed prediction or risk stratification models for delirium with the intention of determining which risk factors have the largest impact on delirium development. A well-known researcher, Dr. Sharon Inouye, has conducted several studies to design a prediction model. In 1993, Inouye found a relationship between patient vulnerability and delirium development, concluding there were four baseline risk factors for delirium: vision impairment, severe illness, cognitive impairment and a high BUN/ creatinine ratio (Inouye, Viscoli, Horwitz, Hurst & Tinetti, 1993). Patients identified as having one of the above risk factors present upon
hospital admission received one point per each risk factor. Based on these risk factors, patients were further categorized as low risk (no risk factors present on admission), intermediate risk (1 to 2 risk factors) or high risk (3 or more risk factors). When this prediction model was applied to a patient population, it revealed patients at low risk (9%), intermediate risk (23%) and high risk (83%) developed delirium (Inouye et al., 1993).

In the 1996 study, Inouye and Charpentier explored whether certain precipitating risk factors could predict delirium development and found there were five categories of risk factors associated with predicting delirium risk: restraint usage, bladder catheter, malnutrition, multiple new medications added during hospitalization and any iatrogenic event (Inouye & Charpentier, 1996). This prediction model also allotted one point for each risk factor and again classified patients as low (no risk factors present), intermediate (1-2 risk factors) or high risk (3 or more risk factors). This model reported only 4% in the low group, 20% in the intermediate and 35% in the high-risk group developed delirium by day nine of hospitalization. This model demonstrated a nine-fold increase in delirium risk between the low and high risk groups (Inouye & Charpentier, 1996). These findings, along with the 1993 study, identified and supported the recommendation that a multifactorial model for delirium was needed since baseline vulnerabilities (predisposing) and precipitating factors equally contributed to delirium development during hospitalization.

Another prediction model designed for post-operative patients was developed in 1994. This model looked at the relationship between seven pre-operative risk factors and delirium development during the post-operative period. The risk factors identified were:
age (greater than 70), history of alcohol abuse, cognitive impairment, poor functional status, abnormal pre-op laboratory values, noncardiac thoracic surgery and aortic aneurysm (Marcantonio, Goldman, Mangione, Ludwig, Murca, et al. 1994). Similar to Inouye’s models, points were awarded for each risk factor and then patients were classified as low risk (no risk factors), medium risk (1 risk factor), medium risk (2 risk factors) or high risk (3 or more risk factors). The study found only 2%, 8%, 13% and 50% of each classification developed delirium post-operatively (Marcantonio, et al. 1994).

In 2007, Inouye expanded upon previous studies to examine which delirium risk factors are present in patients at hospital discharge that can lead to persistent delirium. Persistent delirium is defined as delirium lasting throughout hospitalization and is present at discharge. The results of the study were similar to previous ones where vision impairment, functional impairment, multiple comorbidities and use of restraints impacted the risk of a patient suffering from persistent delirium (Inouye, et al., 2007).

A study that looked specifically at predicting delirium in the veteran population was conducted by Rudolph et al. (2011). In this study, four risk factors for delirium development were used: cognitive impairment, sensory deficit, severe illness and dehydration. The author used Inouye’s prediction model (1993) as a framework for developing a chart abstraction instrument. All of the risk factors above were readily available within the patient’s medical record. Similar to previous studies, each risk factor was awarded one point. The study concluded patients with no risk factors had an 11% chance of developing delirium compared to 18% who had 1-2 risk factors and 50% for those with 3 or more risk factors (Rudolph, et al., 2011).
A study by Martinez, et al. (2012) focused on designing a prediction instrument for patients admitted to a medical unit. This study revealed only 3 risk factors (age greater than 85, functional impairment and psychotropic medications) to be of value in predicting the likelihood of a patient developing delirium. The study’s prediction instrument awarded one point for each risk factor and considered a patient to be at risk if they had at least one of the above risk factors present (Martinez et al., 2012). A limitation of this study is that it only examined variables that were readily available on admission.

In 2015, Newman et al. conducted a review on all delirium risk stratification models published up until 2013. Their review looked specifically at ten previous studies which identified delirium risk factors and had designed a prediction instrument based on the identified risk factors. A majority of the studies (8 of 10) utilized clinical data from the patient’s medical record that was available upon admission. Each study’s quality was assessed per the Newcastle-Ottawa Quality Assessment Scale for Cohort Studies. All were found to be of moderate to good quality, but each study had some type of methodological issue. The most common issues were lack of blinding in the validation phase, methods used to confirm delirium diagnosis, and inclusion of both prevalent and incident delirium rates (Newman, O’Dwyer, & Rosenthal, 2015). Additionally, the authors noted there were no published articles regarding the adoption of these prediction models making it difficult to assess generalizability of the models and if there are barriers to implementation. Newman acknowledged while certain risk factors were identified in every study, none of the prediction instruments listed the same risk factors. Due to these findings, Newman suggested that a reliable and accurate model for delirium prediction has yet to be developed and further validation studies are needed for previously
developed instruments (Newman et al., 2015).

Lastly, in a study published in 2018, authors developed an automated delirium risk assessment system to alert health care providers of a patient’s delirium risk on a daily basis. The system focused on 11 risk factors available within the patient’s electronic medical record. The risk factors identified were: age, education level, level of consciousness, pulse, activity level, medical department, BUN level, infection, total number of catheters, restraints and use of psychopharmacologic medications. After one year, this model showed a sensitivity of 0.88, specificity of 0.72, positive predictive value of 0.53, negative predictive value of 0.94 and a Youden index of 0.59 (Moon, Jin, Jin & Lee, 2018). Although this new system shows promise, it should be noted the model was developed in Korea and has only been tested in one Korean hospital. Future validation studies are needed to assess if this model produces data that has external validity.

**Delirium Assessment Instruments**

In the last thirty years, many researchers have focused on developing instruments and with the data collected validating that the instruments do indeed identify and/or assess the severity of delirium. To date, there are more than 20 instruments currently being used for delirium identification (Adamis, Sharma, Whelan, & Macdonald, 2010).

**Confusion Assessment Method (CAM)**

The most popular instrument used to measure delirium is the Confusion Assessment Method (CAM). Published in 1990, this instrument was designed to improve the recognition of delirium by non-psychiatric providers in the hospital setting. It incorporated the DSM-III criteria into the instrument to create an easy way for non-psychiatrists to identify delirium (Inouye, et al., 1990). The CAM is a useful instrument
because it has a high sensitivity (94-100%), high specificity (90-95%) and a high intrerrater reliability (Inouye, 1990). The CAM has been translated into ten different languages and has been used in over two hundred and fifty studies to identify delirium. It typically takes a clinician 5-10 minutes to administer the CAM to a patient (Inouye, et al., 1990; Wei, Fearing, Sternberg, & Inouye, 2008; Wong et al., 2010).

While the CAM instrument produces valid data and is used worldwide, it does require the clinician to be trained and educated on how to administer it correctly. It is recommended clinicians partake in a two-hour standardized training, specifically focused on instructing the clinician how to conduct a formal cognitive screening assessment using the MMSE or Short Portable Mental Status Questionnaire. If clinicians administer the CAM without proper training, the sensitivity decreases significantly (Wei et al., 2008). Over the last twenty years, the CAM has been modified and adapted for numerous populations including critical care, emergency department and nursing homes (Wei et al., 2008). Most recently, the CAM has been adapted to be administered within three minutes in the clinical setting while still maintaining a high sensitivity (95%) and specificity (94%) (Marcantonio et al., 2014).

While the CAM was originally developed for provider usage, there are three other instruments specifically developed for the bedside nurse to use when screening for delirium. They are the Delirium Observation Screening scale (DOS), Nursing Delirium Screening Scale (Nu-DESC) and NEECHAM Confusion scale (NEECHAM).

**Delirium Observation Screening Scale (DOS)**

The DOS was originally a 25-item scale but was later condensed to a 13-item scale based on the DSM-IV criteria. It uses nursing observation of the patient to identify
early symptoms of delirium. A patient can score between 0-13 on the DOS, but a score of three or more indicates delirium. It takes an average of five minutes to administer, does not require training and should be completed three times a day (every eight hours) (Wong et al., 2010). The DOS has a sensitivity ranging between 89%-100%, a specificity of 87%-97% and Cronbach’s alpha of 0.93-0.96 (Adamis et al., 2010; Scheffer, van Munster, Schuurmans, & de Rooij, 2011; van Velthuijsen et al., 2016).

**Nursing Delirium Screening Scale (Nu-DESC)**

The Nu-DESC scale is an observational assessment instrument originally adapted from the confusion rating scale (CRS), that was used previously by nurses to detect acute confusion (Adamis et al., 2010). The Nu-DESC observes for five items: orientation, behavior, communication, illusions/hallucinations and psychomotor retardation. Each item is rated between 0-2 and a score of two or more indicates delirium (van Velthuijsen et al., 2016). The instrument can be administered in less than two minutes but does require training before use (Wong et al., 2010). The instrument has been shown to have a sensitivity ranging between 32-96%, specificity between 69-92% and an interrater reliability of 94% (Adamis et al., 2010; van Velthuijsen et al., 2016). Additionally, Nu-DESC has been shown to be significantly correlated with DSM-IV and the MDAS (Adamis et al., 2010).

**NEECHAM Confusion Scale (NEECHAM)**

The last nursing specific screening instrument is the NEECHAM. It was developed originally to be used as a rapid bedside assessment for nurses with hip fracture patients. It has since been used in a variety of other settings including critical care, nursing homes, and medical units (Sörensen Duppils & Johansson, 2011). The
advantages are its ease of use and non-intrusive nature, and information for the scale can be obtained through routine nursing assessments. Its reliability is high with a Cronbach alpha of 0.90. Its sensitivity ranges between 30-100% and its specificity varies from 75-92% (Adamis et al., 2010; Sörensen Duppils & Johansson, 2011). It should be noted that this scale has been criticized by researchers, believing it assesses for acute confusion and not for delirium.

Other instruments demonstrated to produce valid data that assess for delirium or delirium severity include: Delirium Rating Scale (DRS-98), Memorial Delirium Assessment Scale (MDAS), Delirium Symptom Interview (DSI), Cognitive Test for Delirium (CTD), Simple Query for Easy Evaluation of Consciousness (SQeeC) and the 4A’s Test (4AT) (Adamis et al., 2010; Breitbart et al., 1997; Lin et al., 2015; Scheffer et al., 2011; Wei et al., 2008). Lastly, it should be noted here the mini-mental status exam (MMSE) is often used to assess cognitive functioning in patients in addition to one of the above instruments.

**Barriers to Delirium Recognition**

Numerous studies have cited between 30-60% of all delirium is not recognized by healthcare clinicians (Inouye, et al., 2001; Levkoff et al, 1992). Barriers to recognition cited in the literature include lack of knowledge regarding delirium, difficult diagnosis characteristics, fast pace of the hospital setting and increased use of technology (Inouye, 1994).

A systematic review by Lawlor and Bush (2014) concluded under-recognition of delirium was related to lack of knowledge on how to conduct a cognitive assessment, time constraints for assessing patients, an inability to detect delirium symptoms and
failure to use a screening instrument that produces valid data. Additionally, the review discovered a majority of healthcare facilities do not have policies and protocols that incorporate evidence based delirium guidelines (Lawlor & Bush, 2014). A study conducted in Britain concluded patients who presented with the following features: older, unmarried, ethnic minority, nursing home residents, multiple comorbidities and incontinence, were less likely to have their delirium recognized by a healthcare provider (Collins, et al., 2009).

Inouye et al. (2001) conducted a study to compare recognition of delirium between bedside nurses and researchers. The study discovered nurses were only able to identify delirium in 19% of patients using observations while performing routine care. When nurses used the CAM, they correctly identified only 31% of patients with delirium compared to researchers. The sensitivity of the CAM when used by nurses was extremely low, ranging from 13.7-30.5%, while the specificity remained was high (ranging from 90.8%-99.4%) indicating nurses were not over identifying delirium. The reliability, however, was low with a kappa between 5-40% (Inouye et al, 2001). Furthermore, this study identified four patient risk factors that contributed to the under-recognition of delirium by nurses. They were patient age (greater than 80 years) vision impairment and having hypoactive delirium and dementia. Patients who presented with hypoactive delirium were 7.4 times less likely to be identified by nurses. Additionally, the study concluded when all four of these risk factors were present, nurses were twenty times less likely to recognize delirium (Inouye et al, 2001).

A study by Nydahl et al. (2018) discovered only 60% of nurses are routinely screening patients for delirium and only 50% are using a reliable screening instrument
that produced valid data. When asked about barriers to recognizing delirium, nurses stated a lack of time, staffing and knowledge all contributed to the inability to recognize delirium. In this study 44% of nurses admitted they only started the screening process for delirium when they observed suspicious behavior (e.g. agitation, yelling, pulling at lines). Furthermore, only 38% of nurses reported communicating a patient’s delirium status to the oncoming shift (Nydaahl et al., 2018).

A qualitative study by Hosie et al. (2014) explored nurse barriers to recognition of delirium within the palliative care setting. The study’s findings confirm similar findings within the literature including knowledge deficit regarding delirium, perceived lack of time to complete assessments, lack of respect when reporting observations to providers and absence of delirium instruments integrated into assessments (Hosie, et al., 2014).

One of the reoccurring themes in the literature is that nurses are not motivated to use screening instruments because they see no value in using them. Nurses perceived screening as more of an obligation than helpful when providing patient care. Often times, nurses stated they omitted screening patients for delirium because it was perceived as time consuming and just another “task” to do (Nydaahl et al., 2018; van de Steeg, et al., 2014; van Velthuijsen et al., 2016).

Nurses’ knowledge or lack thereof regarding delirium also influenced whether nurses were consistent in assessing and screening patients. Research has recognized when nurses possessed only a minimum of knowledge regarding risk factors, symptoms and consequences of untreated/unrecognized delirium, nurses were less likely to perform delirium screening on their patients compared to nurses who understood the delirium risk factors (Hosie et al., 2013; van de Steeg et al., 2014; van Velthuijsen et al., 2016).
Delirium Interventions and Protocols

Over the last fifty years, hundreds of research studies have focused on developing criteria for diagnosis, identifying risk factors, conducting validation studies on screening instruments, testing interventions and managing options to treat delirium. Despite all of the research findings and evidence supporting delirium screening and protocols, there is no national standard or policy requiring healthcare facilities or clinicians to screen patients for predisposing risk factors for delirium upon admission.

Multiple professional organizations have developed guidelines and recommendations for delirium management. In 2016, there were approximately eleven different delirium guidelines published worldwide (Adamis, et al., 2007b; Lawlor & Bush, 2014). However, each of these guidelines varies in their recommendation on how often to screen patients, as well as, when to implement delirium prevention protocols. Numerous studies have focused on testing interventions to manage and treat delirium. Although many interventions have been supported and validated in the literature, there continues to be barriers to implementing delirium prevention interventions.

In 1999, the Delirium Prevention Trial was initiated to test a screening instrument in a controlled clinical setting. The screening instrument was developed and focused on six risk factors for delirium: cognitive impairment, sleep deprivation, immobilization, vision and hearing impairment and dehydration. Based on the above risk factors, researchers developed a multicomponent nonpharmacological intervention protocol for at-risk patients. The intervention group who had preventative interventions implemented upon admission had a 9.9% incidence rate of delirium compared to the control group which had a 15% incidence rate. Furthermore, the intervention group experienced fewer
delirium days, as well as, delirium episodes compared to the control group (Inouye, et al., 1999).

Selim and Ely (2017) sought to understand healthcare professional perceptions and practices regarding delirium care and management. Their findings uncovered only 27% respondents routinely screened patients for delirium. Numerous study participants admitted they did not use a standardized screening instrument to screen for delirium and did not routinely follow any recommended delirium guidelines (Selim & Wesley Ely, 2017).

However, another study investigating delirium practices within the critical care setting reported 82% of respondents used an instrument that produced valid data such as the CAM to screen patients for delirium. However, only 46% of respondents indicated their units had implemented standardized delirium protocols. Interestingly, units which routinely screened for delirium were more likely to have delirium management protocols in place (Mo, Zimmermann, & Thomas, 2017).

A study by Rudolph et al. (2014) investigated whether implementing specific preventative delirium interventions for patients at high risk would improve patient outcomes. The study concluded high risk patients who received preventative delirium interventions had a shorter length of stay, required less restraint use and had lower variable direct costs compared to those who did not receive the interventions (Rudolph, Archambault, & Kelly, 2014).
Delirium Assessment, Prevention, and Care Guidelines

Several professional organizations have created their own guidelines on the treatment and management of delirium. Below six well-known guidelines, as well as, an evidence-based program will be reviewed.

National Institute for Health and Care Excellence (NICE) Guideline

One of the best known guidelines comes from the National Institute for Health and Care Excellence (NICE) in the United Kingdom. NICE commissioned the National Clinical Guideline Centre (NCGC) group to develop an evidence-based guideline for delirium. The NICE guideline is reviewed every three years, most recently in 2016 (National Institute for Health and Care Excellence, 2016). The NICE guideline taskforce was comprised of multiple disciplines and specialties including physicians, nurses, psychiatrists, home care managers and lay persons. The guideline is specifically geared toward adults in long-term care facilities and hospitalized patients. It excludes end-of-life patients, patients withdrawing from drugs or alcohol, and those less than 18 years of age. The guideline is divided into several parts including risk factor assessment, indicators of delirium, interventions to prevent delirium, diagnosis of delirium and treatment of delirium (National Institute for Health and Care Excellence, 2016; O’Mahony, Murthy, Akunne & Young, 2017).

The NICE guideline recognizes four main risk factors for delirium: age greater than 65 years, cognitive impairment, hip fracture and severe illness. If any of these risk factors are present upon admission or occur during hospitalization, it prompts the clinician to look for changes in cognitive or physical function, hallucinations (visual or auditory) and changes in social behavior (National Institute for Health and Care
Excellence, 2016). If the clinician observes any of these changes, they are encouraged to find a clinician who is trained in administering the CAM or the CAM-ICU for patients in the critical care setting.

Although the guideline discusses risk factors for delirium and encourages preventive interventions be implemented upon admission, it does not specifically recommend using a screening instrument known to produce valid data on a daily basis. The guidelines encourage clinicians to observe the patient for changes in behavior but does not provide specific guidance on what that might entail. As stated earlier in this chapter, it is widely known that a majority of providers including nurses have a knowledge deficit when it comes to delirium. By not encouraging nurses to use a screening instrument daily, (only when they observe behavior changes) the potential of these behavioral changes being missed increases significantly. Additionally, many nurses do not work consecutive days or have the same patient assignment from shift to shift, making it difficult for nurses to pick up on subtle changes in the patient.

**Pain, Agitation and Delirium Guidelines (PAD)**

The Pain, Agitation and Delirium (PAD) guideline is another clinical practice guideline recognized worldwide. It was created by the American College of Critical Care Medicine/Society of Critical Care Medicine (ACCM/SCCM) in 2013. The guideline was created using pertinent research studies, expert opinion and a multidisciplinary approach to develop recommendations (Davidson, Winkelman, Gelinas, & Dermenchyan, 2015; Krupp & Balas, 2016).

The PAD guideline was designed specifically for patients in critical care and specifically focuses on preventative strategies, such as avoiding deep sedation, treating
pain and limiting the use of benzodiazepines (Jablonski et al., 2017). Similar to the NICE guidelines, PAD encourages the use of an instrument that produces valid data, such as the CAM-ICU to diagnose delirium, as well as the implementation of non-pharmacological interventions such as sleep promotion, noise reduction and early mobilization (Krupp & Balas, 2016). The PAD guideline recommends screening critical care patients daily and as needed.

**Delirium, Dementia and Depression in Older Adults Guideline**

Another guideline seen within the literature was designed by the Registered Nurses Association of Ontario Canada. This guideline was revised in 2016 and recommends screening patients on admission for risk factors, and if present, implementing a preventative plan for the patient. This guideline focuses on the following risk factors: age, cognitive impairment, depression, multiple medications, acute illness, restraint use, abnormal lab values, immobility, sleep deprivation and uncontrolled pain (Registered Nurses Association of Ontario Canada Guideline, 2016). It recommends patients be screened daily but does not endorse a specific screening instrument. This guideline, similar to the others, stresses the importance of implementing a preventive protocol upon admission for patients at risk for delirium.

**Hospital Elder Life Program (HELP)**

Although technically not a guideline, HELP is a widely disseminated program that focuses on using specific interventions to target delirium risk factors. HELP was one of the first evidence-based approaches that utilized a multidisciplinary team for delirium management. HELP focuses specifically on non-pharmacological interventions such as reorientation, mobilization, nutrition, sleep hygiene and sensory impairments (Hshieh et
This program has been cost-effective and successful in preventing delirium among hospitalized individuals.

**Acute Confusion/Delirium Guideline**

The University of Iowa in 1999 developed the Acute Confusion/Delirium Practice guideline, which was most recently revised in 2009. This guideline promotes early identification of delirium risk factors and implementation of preventative strategies. The guidelines encourage at risk patients be screened and monitored throughout their hospital stay. The Acute Confusion/Delirium guideline recommends patients receive a cognitive assessment upon admission and nurses use a screening instrument such as the CAM or NEECHAM (Sendelbach & Guthrie, 2009).

This guideline, like the others, promotes the importance of staff education regarding delirium, as well as, implementing preventive interventions such as correcting electrolyte imbalances, promoting nutrition, reorientation, pain management, early mobilization, correction of sensory impairments and sleep promotion (Sendelbach & Guthrie, 2009). It should be noted this guideline is only available for purchase which has limited healthcare professionals’ ability to access and utilize it.

**Reduction of Postoperative Delirium Guidelines**

In 2013, the European Society of Anesthesiology (ESA) created guidelines to reduce postoperative delirium. Similar to the above guidelines, ESA recommends patients be screened for delirium pre-operatively, before leaving the recovery room and daily until post-operative day five. If delirium is suspected at any of these times, including in the recovery room, it recommends treatment be started immediately (Aldecoa et al., 2017).

The ESA guideline recommends using a screening instrument such as the CAM...
but acknowledges the CAM has a low sensitivity when used by untrained staff. As a result, the ESA recommends nurses use the Nursing Delirium Screening Scale (NuDESC) (Aldecoa et al., 2017).

**Management of Sedation, Agitation and Delirium Guideline**

Many countries, including Germany have developed their own delirium guidelines. The Management of Sedation, Agitation and Delirium was developed in 2015 specifically for the critical care population. This guideline has been adopted by Austria, Germany, Luxembourg and Switzerland. Although this guideline has many similarities to the ones previously identified above, it recommends patients be screened three times a day for delirium using a screening instrument such as the CAM or Nu-DESC (Nydahl et al., 2018). As with the other guidelines, it recommends interventions such as early mobilization, pain management, sleep hygiene, use of glasses/hearing aids and reorientation be implemented for at risk patients. Although this guideline is the most time intensive with multiple screenings conducted daily, it should be noted hospitals that had adopted this guidelines only 20% were screening patients three times a day, and only 50% were using a recommended screening instrument known to produce valid assessment data (Nydahl et al., 2018).

**Veteran Population**

There are approximately 21.8 million veterans living in the United States, of which 16 million served during times of war (National Center for Veteran Analysis and Statistics, 2020). Many of these veterans have been diagnosed with post-traumatic stress disorder (PTSD) or experienced a traumatic brain injury (TBI) as part of their service (National Center for Veteran Analysis and Statistics, 2020). One study noted between 71-
86% of veterans returning from Iraq had engaged in a firefight during their deployment (Hoge & Cotting, 2004). Researchers are just beginning to understand the long-term effects that combat and other veteran specific risk factors such as PTSD, TBI, anxiety and depression have on a variety of other diseases and disorders such as delirium. Specifically, there has been little published in the literature on whether PTSD, TBI, anxiety, depression or combat experience contribute to the incidence of delirium.

**Post-Traumatic Stress Disorder (PTSD)**

Post-Traumatic Stress Disorder (PTSD) is a prevalent mental health diagnosis among veterans. PTSD has been estimated to affect up to 20% of the veteran population. This rate has increased nearly 200% since 2001 when the US military entered into war (Armenta, Rush, Leard, Mann, Cooper & Hoge, 2018). While the course and outcomes of PTSD vary, it has been reported that some symptoms can last a lifetime. There is a strong association between PTSD and anxiety, depression and substance use disorder (Armenta, et al., 2018; Hoge & Cotting, 2004). Studies focused on veterans have found rates of PTSD are significantly higher after a combat deployment compared to a non-combat deployment (Armenta, et al., 2018; Hoge & Cotting, 2004). The prevalence of PTSD was found to increase in veterans depending on the amount of times they were involved in firefights, citing veterans involved in five or more firefights had a 19% rate of PTSD compared to only 4% who did not experience a firefight during deployment (Hoge & Cotting, 2004).

To date, there have been few research studies examining whether there is a relationship between PTSD and delirium. The studies that have explored PTSD and delirium have focused on emergence delirium (ED) occurring during the immediate post-
operative period. These studies have found a relationship between PTSD and ED but have not looked at whether this type of delirium persists outside of the recovery room.

**Traumatic Brain Injury (TBI)**

TBI is known as the “signature injury” of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). It is estimated 20% of returning veterans from Iraq and Afghanistan have suffered a TBI as a result of their service. Of the 20% that have experienced a TBI, 60% of veterans reported suffering multiple TBIs during their deployment (Swanson et al., 2017; Wilk, Herrell, Wynn, Riviere, & Hoge, 2012). Previous studies have uncovered a relationship between veterans who experience a TBI and development of PTSD, depression and anxiety (Hoge, et al., 2008; Carlson, et al., 2010). However, researchers are still trying to determine the long-term effects TBIs have on the veteran population.

There are limited research studies that specifically focus on whether traumatic brain injuries (TBI) may have an association with development of delirium. A study by Angles, et al. (2008) looked specifically at risk factors for delirium after major trauma. The study (n=69) examined whether certain risk factors, including age, organ failure, Glasgow coma score, use of blood products, surgery and TBI, contributed to delirium development. The study found 74% (14/19) of patients who had a moderate to severe TBI developed delirium. However, during multivariate statistical analysis, TBI was shown to be non-significant. However, the authors believe this might have resulted from a type II error (Angles et al., 2008).

**Depression**

Depression as a risk factor for delirium has been studied previously; however,
results on whether it contributes to the development of delirium is mixed. Depression has been reported to be a risk factor for delirium in the cardiac surgery population. Patients with an underlying diagnosis of depression, who were undergoing cardiac surgery were found to have a threefold increase in delirium compared to those without depression (Kazmierski, et al, 2006; Kazmierski et al., 2010; Tully, et al., 2010; Lin, Chen & Wang, 2012; Smith, Attix, Weldon, Greene& Monk, 2009). A systematic review by Dasgupas and Dumbrell (2006) explored delirium risk factors for non-cardiac surgery and concluded depression was associated with delirium development (Dasgupas and Dumbrell, 2006).

Depression was noted to be a risk factor for delirium in older adults presenting to emergency departments. Patients with a diagnosis of depression were 3.4 times more likely to develop delirium than those with no depression (Hare et al., 2014). In the long-term care setting, 19% of patients diagnosed with delirium had a diagnosis of depression (McCusker et al., 2014b). However, a meta-analysis on medical patients did not find depression to be a risk factor in developing delirium while hospitalized (Cull et al., 2013).

**Anxiety**

Anxiety in the veteran population has been closely linked to PTSD and depression. However, there have been limited studies to determine if there is a relationship between anxiety and delirium development. A study conducted in 2008 examined whether a preoperative diagnosis of anxiety or depression influenced a patient developing delirium while hospitalized (Detroyer et al., 2008). The study did not find a relationship between anxiety and delirium. However, it was noted this was the first study
to look at depression and anxiety as risk factors for delirium in a cardiac population.

**Conclusion**

As described above, delirium is a complex neurocognitive disorder identified as early as 500 BC as being problematic for all those who experienced it. Delirium not only has long-lasting consequences, such as increased mortality and decreased physical and cognitive functioning but it is estimated to cost the US healthcare system $164 billion dollars annually (Oh et al. 2017). Despite this disorder being recognized by healthcare professionals and researchers, there still remains disagreement regarding the best way to prevent, screen and treat delirium.

Delirium studies have primarily focused on studying older, white adults admitted to hospitals within the public sector. There has been limited research on whether veteran specific risk factors, such as PTSD, TBI, anxiety, depression and combat service influence the incidence or severity of delirium within this population. The only studies on delirium known to examine veteran specific risk factors are studies specifically on emergence delirium. These studies have identified that veterans with these risk factors are at higher risk for developing emergence delirium than veterans without risk factors. However, these studies have been limited to the post-anesthesia care unit. It is unknown if veteran specific risk factors influence the development of delirium among the hospitalized veteran outside of the post-acute care unit. Therefore, studies are needed to determine whether veteran specific risk factors influence the incidence of delirium among this unique and important population. This study begins to close this crucial knowledge gap.
CHAPTER III

METHODS

The purpose of this retrospective, cross-sectional cohort study was to examine the relationships between delirium and select demographic characteristics of veterans and to identify whether veterans who have served in combat had a greater likelihood for developing delirium during hospitalization. Additionally, the principal investigator (PI) examined whether veterans who have a diagnosis of PTSD, TBI, anxiety, and/or depression are at increased risk of developing delirium during hospitalization compared to those veterans without these diagnoses. This chapter provides a description of the study’s research design, sample, setting, data collection procedures, data analysis, and human subject protection.

Study Design

Study Setting and Location

The setting of the study was a 296 bed Veterans Administration (VA) hospital that is classified as a Level 1a facility located in southern California. A level 1a facility is a VA hospital that receives high risk complex patients, has an established and robust teaching and research program, a large variety of medical specialists and has a level 5 intensive care unit (VHA Facility Complexity Model). In 2019, this hospital reported over 7,100 inpatient admissions. This hospital currently serves as the primary healthcare system for over 86,000 veterans (San Diego VA Annual Report 2019).

Study Sample

Cases representing veteran admissions to the facility for the period of January 1, 2017 through December 31, 2018, were examined for inclusion in this study. All case
data was extracted from the facility’s electronic health record (EHR).

**Inclusion criteria.** Cases eligible for this study were veterans who were 25 years and older, admitted to the above described facility for an inpatient admission, admitted to either the critical care, step-down or one of the medical-surgical units, and had a length of stay greater than 48 hours.

**Exclusion criteria.** A case was excluded from the study if the patient was not a veteran, was less than 25 years old, was admitted to a unit other than the ones listed above or had a length of stay less than 48 hours. In cases where veterans were admitted multiple times during the study timeframe, the first admission that met the above inclusion criteria was used.

**Sample size.** A minimum sample size of 540 veterans was needed for this study. Several approaches to determine the sample size were examined before deciding upon 540 cases. The first sample size estimate was based upon an *a priori* review of the literature (Polit and Beck, 2017). Sample size was calculated based on one of the study statistical tests, binomial logistic regression. One method to determine the sample size for a logistic regression involves having a least ten cases per each variable being tested. However, the number ten per variable is controversial, as many researchers feel that this number may not be adequate (Polit and Beck, 2017). Therefore, for this study the goal was to have twenty cases per variable. Since this study has twenty-five variables an estimated sample size of 500 was needed.

The next sample size estimate was determined using G*power. *A priori* power analysis for binomial logistic regression was conducted using G*star version 3.1 to determine sufficient sample size using an alpha of .05, a .80 power, and a medium effect
size (odd ratio = 1.551), and a two-tailed test. Based on the aforementioned assumptions, the desired sample size was \( n = 540 \).

**Variables and Operational Definitions**

**Sociodemographic Characteristics**

The following sociodemographic characteristics identified below were collected as part of this study.

**Age.** Age was recorded in years and was documented as the age the patient was at the time of their first hospital admission during study timeframe.

**Race.** Race was recorded as White, Black, Asian, and Pacific Islander, American Indian. If a veteran’s race was not documented in the EHR or if the veteran did not disclose their race, it was recorded as decline to answer, and treated as missing data in the analysis.

**Ethnicity.** Ethnicity was recorded as Hispanic or Latino and Not Hispanic or Latino. If a veteran’s ethnicity was not documented in the EHR or if the veteran did not disclose their ethnicity, it was recorded as decline to answer, and treated as missing data in the analysis.

**Gender.** Gender was recorded as male, female or transgender.

**Marital status.** Marital status was recorded as married, divorced, widow or single.

**Veteran.** A veteran, for the purpose of this study is defined according to Title 38 of the Code of Federal Regulations as “a person who served in the active military, naval, or air service and who was discharged or released under conditions other than dishonorable” (Veteran Anonymous, 2018).
Combat veteran. The official definition of a combat veteran is defined as “any military personnel who experienced any level of hostility for any duration of time resulting from offensive, defensive or friendly fire military action involving a real or perceived enemy in any pre or post-designated theater of combat (war) operations” (The American War Library, 2018). Combat Veteran, for the purpose of this study, is identified as serving in combat during one of the following wars: World War II, Korean, Vietnam, Persian Gulf War, Operation Enduring Freedom or Operation Iraqi Freedom. This information was found in the EHR in one of the following places: Combat Clinical Reminder, psychiatrist notes including: Psychiatry Progress Note or Psychiatry Consult Note, or in the social worker note: Social Worker Consult, Social Worker Psychosocial Assessment, or Social Worker Progress Note.

Clinical Characteristics

Delirium. Delirium, for the purpose of this study is defined as a neurocognitive disorder characterized by a disturbance in attention and cognition that is an acute change from a patient’s baseline upon admission to the hospital (American Psychiatric Association, 2013). It typically develops over a short period of time and fluctuates in severity throughout the day, and these changes cannot be explained by another disorder (American Psychiatric Association, 2013).

The diagnosis of delirium came from two sources. ICD-10 codes were used initially to identify delirium (F05) or a delirium-related diagnosis (R41.0). In addition, the researcher reviewed all case charts and the psychiatrist notes/provider notes to verify the diagnosis. Additionally, the brief Confusion Assessment Method (bCAM) result was noted when reviewing the EHR to see whether the veteran screened positive or negative
for delirium during hospitalization. In this facility, the bCAM tool is completed by bedside nurses daily in their shift reassessment. In cases where the provider made the diagnosis of delirium, the bCAM result performed by the bedside nurse closest to the diagnosis of delirium was used. The bCAM has a specificity of 97% and sensitivity of 78% when used by a non-physician (Han, Wilson, Vasilevskis, Shintani, et al., 2013).

**Cognitive impairment.** Cognitive impairment was recorded as present if the patient had a documented history of dementia or a neurocognitive disorder recorded on their problems list (ICD code) or if a cognitive disorder was recorded in the Physician’s Admission History and Physical Note.

**Functional impairment.** Functional Impairment was recorded as present if the veteran had a documented history of a functional impairment in the EHR. This included using any type of assistive device such as a wheelchair or walker, as well as, documented in the EHR inability to perform ADLs independently. This information was gathered from a variety of notes, including the physician’s History and Physical, the Nursing Admission Assessment Note, Nurse Reassessment Note, or Physical Therapy Progress Note.

**Vision impairment.** Vision Impairment was defined as anyone who had a documented case of impaired vision in their EHR. This may have been noted as macular degeneration, cataract that has not been removed or any other vision impairment noted by provider or nurse.

**Hearing impairment.** Hearing impairment was defined as any veteran who had a diagnosis of hearing loss in their EHR or any veteran who wore hearing aids.
**Posttraumatic stress disorder (PTSD).** PTSD was defined as a veteran who had a diagnosis of PTSD in their EHR.

**Traumatic brain injury (TBI).** TBI was defined as any veteran who had a diagnosis of TBI in their EHR.

**Anxiety.** Anxiety was defined as any veteran who had a diagnosis of anxiety in their EHR.

**Depression.** Depression was defined as any veteran who had a diagnosis of depression in their EHR.

**Chronic obstructive pulmonary disease (COPD).** COPD was defined as any veteran who had a diagnosis of COPD in their EHR.

**Coronary artery disease (CAD).** CAD was defined as any veteran who had a diagnosis of CAD in their EHR.

**Alcohol use disorder (AUD).** Alcohol use disorder was defined as any veteran who had a current diagnosis of AUD in their EHR. Veterans, who have been sober for more than 1 year, were not counted as having a current diagnosis.

**Substance use disorder (SUD).** Substance use disorder was defined as any veteran who has a diagnosis a current diagnosis of SUD in their EHR. Veterans, who have been sober/clean for more than 1 year, were not counted as having a current diagnosis.

**Cerebral vascular accident (CVA).** CVA was defined as any veteran who had a diagnosis a CVA in their EHR.
**Infection.** Any veteran admitted with an infection or developed an infection during hospitalization that was documented in the EHR by the provider was classified as positive for infection.

**Indwelling urinary catheter.** Any veteran admitted with an indwelling urinary catheter or had one placed during hospitalization that was noted on the EHR was classified as positive for indwelling urinary catheter.

**Length of stay (LOS).** Length of stay was counted from the time the veteran was admitted for an inpatient admission until discharge. LOS was measured in days.

**Disposition at discharge.** Disposition at discharge was recorded as home, skilled nursing facility, assisted living facility, homeless, mental health admission or death. This information was found on the discharge note.

**Mortality.** Mortality was measured at 3 months, 6 months, 1 year, 2 years, and greater than 2 years post discharge date.

**Data Collection**

There were 17,754 inpatient admissions to this VA facility during the timeframe from January 1, 2017 through December 31, 2018. Using the established inclusion criteria note above, a sample of 5,335 cases were identified for examination for this study. However, out of these 5,335 cases, only 2575 were admitted once during the study frame. Nine hundred and ninety-three (993) veterans were admitted to the hospital numerous times (from 1-14 distinct admissions) during the study timeframe. This number was derived by comparing the veteran name and hospital ID number. The researcher decided that the veteran’s first hospital admission that was greater than 48 hours would be the case used for this inquiry. This decision was made because every veteran in the
sample was admitted at least once during this study timeframe. This produced a final sample size of 3,604 veterans. Using a randomization function in standard office software, each case was randomly assigned a numerical value. The first 540 cases in the randomized pool were selected and a chart review and data extraction was then conducted on each of those 540 cases.

**Data Management**

After data collection was completed, the researcher assigned each case a number from 1 to 540. The principal investigator then de-identified the cases by removing the patient’s name and social security number. A list with patient’s name and corresponding number was kept by the researcher in a password protected computer in the researcher’s private office in the event that the researcher needed to verify data. The de-identified data from all 540 cases was then transferred into a SPSS statistics software program (version 26) where it was inspected per general statistical principles (Tabachnick & Fidell, 2019). All study variables were examined for normality, missing values, and outliers. The principal investigator re-reviewed all cases with missing data to determine if missing data could be obtained in the EHR.

Summary statistics were calculated including frequencies for categorical variables and means for continuous variables. Bivariate associations among categorical sociodemographic and clinical variables and delirium diagnosis were analyzed using chi-square; continuous sociodemographic and clinical variables and delirium diagnosis were analyzed using one-way analysis of variance. Variables significant at $p < .05$ in the bivariate analysis were considered for entry into a logistic regression model to identify factors that increase the likelihood of experiencing delirium during hospitalization of
veteran patients. For the logistic regression analysis, a delirium diagnosis included both, patients with delirium at admissions and those who developed it during hospitalization. Variables considered for entry in the logistic regression model were examined for linearity, multicollinearity and outliers.

Specific Aim 1. The purpose of specific aim 1 was to describe the sociodemographic (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., COPD, CAD, and CVA), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling urinary catheter, and infection), hospital outcomes (i.e., length of stay, disposition at discharge, and mortality), and delirium diagnosis among hospitalized military veterans. In order to meet this aim, the researcher conducted descriptive analyses of all variables; including frequencies and bar charts with categorical variables and measures of central tendency such as range, standard deviation, and standard error with continuous variables.

Specific Aim 2. This aim described the differences between mental health comorbidities (i.e., PTSD, TBI, depression, and anxiety) and delirium diagnosis among hospitalized military veterans who have experienced combat versus those who have not. In order to meet this aim, the principal investigator conducted bivariate analyses using Chi-square tests of association (or Fisher’s exact tests with small cell counts). The strengths of statistically significant associations were assessed via the Cramer’s V coefficient.
Specific Aim 3. The purpose of aim 3 was to describe the relationship between sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CAD, COPD, and CVA), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling urinary catheter, and infection), and hospital outcomes (i.e., length of stay, disposition at discharge, and mortality) in terms of delirium diagnosis among hospitalized military veterans. In order to meet this aim, the principal investigator conducted bivariate analyses using Chi-square tests of association (or Fisher’s exact tests with small cell counts). The strengths of statistically significant associations were assessed via Phi coefficient for two by two tables and Cramer’s V for larger tables. Furthermore, one-way analysis of variance was used to evaluate group differences in delirium diagnosis in terms of patient’s age. Test assumptions were assessed, and post-hoc analysis conducted for statistically significant results.

Specific Aim 4. Finally, specific aim 4 determined whether sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CVA, CAD, COPD), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling catheter, and infection) increased the likelihood of developing delirium among hospitalized military veterans. In order to meet this aim, a binomial logistic regression was conducted. Variables
significant at $p < .05$ in the bivariate analysis were considered for entry into the binomial logistic regression model. Test assumptions were assessed. All statistical analysis was completed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, N.Y., USA, 2016).

Protection of Human Subjects

The Institutional Review Boards (IRB) of the VA healthcare system and the University of San Diego (USD) reviewed this study for compliance with protection of human subjects. As a retrospective record review, the study was deemed exempt from review by the IRB. The USD IRB agreed to reciprocity. Participant privacy and confidentiality was maintained. All participant data was extracted from a VA Healthcare System EHR, entered into an electronic spreadsheet and de-identified. The electronic spreadsheet with extracted data was stored on a password protected computer maintained in a protected, private, locked area accessible only to the primary investigator. All collected data will be retained per IRB requirements and then will be destroyed per facility protocol for destruction of electronic data.
Chapter IV

RESULTS

The purpose of this retrospective cross-sectional cohort study was to describe the relationship between veteran specific risk factors (PTSD, TBI, anxiety, depression and combat) and delirium in a southern California Veterans Administration Healthcare Facility. The following chapter presents the results for this study. It begins with a description of the overall study sample and then reviews each specific aim’s outcome and statistical analysis used.

Specific Aim 1

The goal of specific aim 1 was to describe the sociodemographic (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., COPD, CAD, and CVA), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling urinary catheter, and infection), hospital outcomes (i.e., length of stay, disposition at discharge, and mortality), and delirium diagnosis among hospitalized military veterans.

Sociodemographic characteristics. Of the 540 cases, the majority of cases were male (93.3%, n = 504), white (80.5%, n = 430), and non-Hispanic (90.4%, n = 481). Over half of the cases (57.8%, n = 312) served during the Vietnam War. The mean age of the sample was 69.2 years with a standard deviation of 13.2 years and age ranged from 26 to 99 years old. Marital status was varied across the sample with 36.5% married (n = 197),
28.3% single \((n = 153)\), 24.8% divorced \((n = 134)\) and 10.4% widow \((n = 56)\). Only 19.3% \((n = 97)\) of the study sample was noted to have combat experience. There were 38 cases where combat status was not recorded in the EHR. Table 1 describes the sociodemographic and military characteristics of the veteran sample.

Table 1. Demographic and Military Characteristics of Sample by Delirium Status

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total Sample N=540 (%)</th>
<th>Delirium Group n=160 (%)</th>
<th>Non-Delirium Group n=380 (%)</th>
<th>(X^2) or F</th>
<th>(p--) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td>10.98^a</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Mean</td>
<td>69.2</td>
<td>72.08</td>
<td>67.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>13.2</td>
<td>11.93</td>
<td>13.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>3.24</td>
<td>.188</td>
</tr>
<tr>
<td>Male</td>
<td>504 (93.3)</td>
<td>154 (96.25)</td>
<td>350 (92.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>35 (6.5)</td>
<td>6 (3.75)</td>
<td>29 (7.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transgender</td>
<td>1 (0.2)</td>
<td>0</td>
<td>1 (0.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td>5.045</td>
<td>.279</td>
</tr>
<tr>
<td>White</td>
<td>430 (80.5)</td>
<td>126 (78.75)</td>
<td>304 (81.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>72 (13.5)</td>
<td>24 (15)</td>
<td>48 (12.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>18 (3.4)</td>
<td>3 (1.8)</td>
<td>15 (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>9 (1.7)</td>
<td>4 (2.5)</td>
<td>5 (1.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian</td>
<td>5 (0.9)</td>
<td>3 (1.8)</td>
<td>2 (0.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline to Answer</td>
<td>6 (1.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td>.131</td>
<td>.423</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>481 (89.1)</td>
<td>142 (88.75)</td>
<td>339 (91.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>51 (9.4)</td>
<td>18 (11.25)</td>
<td>33 (8.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline to Answer</td>
<td>8 (1.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Era</td>
<td></td>
<td></td>
<td></td>
<td>8.269</td>
<td>.141</td>
</tr>
<tr>
<td>World War II</td>
<td>24 (4.4)</td>
<td>11 (6.9)</td>
<td>13 (3.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korean</td>
<td>51 (9.4)</td>
<td>17 (10.6)</td>
<td>34 (8.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Korean</td>
<td>19 (3.5)</td>
<td>5 (3.1)</td>
<td>14 (3.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>312 (57.8)</td>
<td>98 (61.25)</td>
<td>214 (56.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Vietnam</td>
<td>68 (12.6)</td>
<td>16 (10)</td>
<td>52 (13.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persian Gulf</td>
<td>66 (12.2)</td>
<td>13 (8.1)</td>
<td>53 (13.9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total Sample N=540 (%)</th>
<th>Delirium Group n=160 (%)</th>
<th>Non-Delirium Group n=380 (%)</th>
<th>$\chi^2$ or F</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combat Status</td>
<td></td>
<td></td>
<td></td>
<td>13.963</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Combat</td>
<td>97 (18)</td>
<td>43 (26.9)</td>
<td>54 (14.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Combat</td>
<td>405 (75)</td>
<td>102 (63.75)</td>
<td>303 (79.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing Data</td>
<td>38 (7)</td>
<td>15 (9.35)</td>
<td>23 (6.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td>7.567</td>
<td>.055</td>
</tr>
<tr>
<td>Married</td>
<td>197 (36.5)</td>
<td>62 (38.8)</td>
<td>135 (35.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>134 (24.8)</td>
<td>48 (30)</td>
<td>86 (22.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>153 (28.3)</td>
<td>33 (20.6)</td>
<td>120 (31.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Widow</td>
<td>56 (10.4)</td>
<td>17 (10.6)</td>
<td>39 (10.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Admitted To</td>
<td></td>
<td></td>
<td></td>
<td>.023</td>
<td>1.0</td>
</tr>
<tr>
<td>Medical-Surgical</td>
<td>344 (63.7)</td>
<td>102 (63.75)</td>
<td>242 (63.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step-Down</td>
<td>103 (19.1)</td>
<td>30 (18.75)</td>
<td>73 (19.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical Care</td>
<td>93 (17.2)</td>
<td>28 (17.5)</td>
<td>65 (17.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *a* indicates that F value, $\chi^2$ = Fisher’s Exact unless otherwise specified.

### Mental health comorbidities. Close to half of the study sample had no mental health comorbidities (i.e., PTSD, TBI, depression, and anxiety). The most common one documented was depression (39.3%, $n = 212$), followed by PTSD (21.5%, $n = 116$), anxiety (16.7%, $n = 90$) and TBI (4%, $n = 22$). Alcohol use disorder (AUD) was documented in 20% of the study sample ($n = 108$) and substance use disorder was recorded in 13.7% ($n = 74$) of the cases.

### Physical comorbidities and other risk factors. Over half of the study sample (61.5%) had a documented diagnosis of CAD ($n = 332$), followed by vision impairment (55.2%, $n = 298$), infection (38.5%, $n = 208$), hearing impairment (36.1%, $n = 195$), functional impairment (33.3%, $n = 180$), COPD (26.5%, $n = 143$), indwelling urinary catheter (25%, $n = 136$), cognitive impairment (19.6%, $n = 106$), and CVA (12.4%, $n = 67$). Table 2 describes physical and mental health comorbidities for the veteran sample.
Table 2.
Mental and Physical Comorbidities & Other Risk Factors of Sample by Delirium Status

<table>
<thead>
<tr>
<th>Comorbidities and Other Risk Factors</th>
<th>Total Sample N=540 (%)</th>
<th>Delirium Group n=160 (%)</th>
<th>Non-Delirium Group n=380 (%)</th>
<th>$X^2$ or F</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTSD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>116 (21.5)</td>
<td>48 (30)</td>
<td>68 (18)</td>
<td>9.08</td>
<td>.003</td>
</tr>
<tr>
<td>No</td>
<td>424 (78.5)</td>
<td>112 (70)</td>
<td>312 (82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traumatic Brain Injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>22 (4)</td>
<td>1 (7)</td>
<td>11 (3)</td>
<td>3.60</td>
<td>.058</td>
</tr>
<tr>
<td>No</td>
<td>518 (96)</td>
<td>149 (93)</td>
<td>369 (97)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90 (16.7)</td>
<td>30 (19)</td>
<td>60 (16)</td>
<td>0.51</td>
<td>.474</td>
</tr>
<tr>
<td>No</td>
<td>450 (83.3)</td>
<td>130 (81)</td>
<td>320 (84)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>212 (39.3)</td>
<td>76 (47.5)</td>
<td>136 (35.8)</td>
<td>5.99</td>
<td>.014</td>
</tr>
<tr>
<td>No</td>
<td>328 (60.7)</td>
<td>84 (52.5)</td>
<td>244 (64.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol Use Disorder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>108 (20)</td>
<td>41 (25.6)</td>
<td>67 (17.6)</td>
<td>4.01</td>
<td>.045</td>
</tr>
<tr>
<td>No</td>
<td>432 (80)</td>
<td>119 (74.4)</td>
<td>313 (82.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>74 (13.7)</td>
<td>33 (20.6)</td>
<td>41 (10.8)</td>
<td>8.40</td>
<td>.004</td>
</tr>
<tr>
<td>No</td>
<td>466 (86.3)</td>
<td>127 (79.4)</td>
<td>339 (89.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Impairment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>106 (19.6)</td>
<td>69 (43)</td>
<td>37 (9.7)</td>
<td>77.46</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>No</td>
<td>434 (80.3)</td>
<td>91 (57)</td>
<td>343 (90.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>143 (26.5)</td>
<td>50 (31.2)</td>
<td>93 (24.5)</td>
<td>2.32</td>
<td>.128</td>
</tr>
<tr>
<td>No</td>
<td>397 (73.5)</td>
<td>110 (68.8)</td>
<td>287 (75.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>332 (61.5)</td>
<td>109 (68)</td>
<td>223 (58.7)</td>
<td>3.85</td>
<td>.050</td>
</tr>
<tr>
<td>No</td>
<td>208 (38.5)</td>
<td>51 (32)</td>
<td>157 (41.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>208 (38.5)</td>
<td>99 (61.9)</td>
<td>109 (28.7)</td>
<td>0.98</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>No</td>
<td>332 (61.5)</td>
<td>61 (38.1)</td>
<td>271 (71.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vision Impairment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>298 (55.2)</td>
<td>89 (55.6)</td>
<td>209 (55)</td>
<td>0.01</td>
<td>.960</td>
</tr>
<tr>
<td>No</td>
<td>242 (44.8)</td>
<td>71 (44.4)</td>
<td>171 (45)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>195 (36.1)</td>
<td>61 (38.1)</td>
<td>134 (35.3)</td>
<td>2.61</td>
<td>.106</td>
</tr>
<tr>
<td>No</td>
<td>345 (63.9)</td>
<td>99 (61.9)</td>
<td>246 (64.7)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hospital Outcomes. A majority of the sample was admitted to a medical-surgical unit (63.7%, \( n = 344 \)), followed by step-down (19.1%, \( n = 103 \)) and critical care (17.2%, \( n = 93 \)). The mean length of stay (LOS) was 8.9 days, with a standard deviation of 11.97 days, median of 5.5 days and mode of 3 days. LOS ranged from 3 days to 170 days. Most veterans were admitted only once during the study period (61.7%), followed by two times (24.6%) three times (9.1%), four times (2.4%) and five times (1.3%). There was one veteran in the final randomized sample admitted 11 times during the study timeframe.

A majority of the sample was discharged from the hospital to their home (66.9%, \( n = 361 \)), followed by skilled nursing facility (14.1%, \( n = 76 \)), and short-term rehab (5.7%, \( n = 31 \)). Of note, 3.9% (\( n = 21 \)) of veterans died during hospitalization. Mortality rates for the study included 14.1% of veterans died within 3 months of hospitalization, 5.6% within 6 months, and 6.9% within a year. Of interest, 31.7% (\( n = 171 \)) of the
sample died by within two years of hospitalization. Table 3 describes hospital outcomes of veteran sample.

Table 3.
Hospital Outcomes of Sample by Delirium Status

<table>
<thead>
<tr>
<th>Hospital Outcomes</th>
<th>Total Sample N=540 (%)</th>
<th>Delirium Group n=160 (%)</th>
<th>Non-Delirium Group n=380 (%)</th>
<th>X² or F</th>
<th>p--value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length of stay (days)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>8.9</td>
<td>13.4</td>
<td>7.1</td>
<td>32.955a</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>11.9</td>
<td>12.74</td>
<td>11.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of Admissions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.61</td>
<td>1.86</td>
<td>1.51</td>
<td>12.556a</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>1.046</td>
<td>1.25</td>
<td>0.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Disposition at Discharge</strong></td>
<td></td>
<td></td>
<td></td>
<td>47.112</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Home</td>
<td>361 (66.9)</td>
<td>76 (47.5)</td>
<td>285 (75)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNF</td>
<td>76 (14.1)</td>
<td>35 (21.8)</td>
<td>41 (10.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term rehab</td>
<td>31 (5.7)</td>
<td>16 (10)</td>
<td>15 (3.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assisted Living</td>
<td>7 (1.3)</td>
<td>3 (1.8)</td>
<td>4 (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homeless</td>
<td>35 (6.5)</td>
<td>11 (6.8)</td>
<td>24 (6.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental Health Admission</td>
<td>9 (1.7)</td>
<td>5 (3.1)</td>
<td>4 (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died during hospitalization</td>
<td>21 (3.9)</td>
<td>14 (8.75)</td>
<td>7 (1.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td></td>
<td></td>
<td></td>
<td>35.985</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Alive</td>
<td>357 (66.1)</td>
<td>81 (50.6)</td>
<td>276 (72.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died within 3 months</td>
<td>76 (14.1)</td>
<td>40 (25)</td>
<td>36 (9.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died within 6 months</td>
<td>30 (5.6)</td>
<td>16 (10)</td>
<td>14 (3.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died within 1 year</td>
<td>37 (6.9)</td>
<td>12 (7.5)</td>
<td>25 (6.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died within 2 years</td>
<td>28 (5.2)</td>
<td>8 (5)</td>
<td>20 (5.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died more than 2 years</td>
<td>12 (2.2)</td>
<td>3 (1.6)</td>
<td>9 (2.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. "a" indicates F value, \( \chi^2 \) = Fisher’s Exact unless otherwise specified.

**Delirium diagnosis.** There were 160 documented cases of delirium (29.6%) within the sample. This was initially recorded as delirium present upon admission (12%, \( n = 65 \)) or delirium developed during hospitalization (17.6%, \( n = 95 \)). Of the 160 delirium cases, 96 were initially identified using two ICD-10 codes for delirium (F05 and R41.0). The remaining 64 were discovered upon chart review. Demographic
characteristics for the delirium group were similar to the overall sample, with 96% males ($n = 154$), white (78.8%, $n = 126$), non-Hispanic (88.8%, $n = 142$), served in Vietnam (61%, $n = 98$), married (38.8%, $n = 62$) and admitted to a medical-surgical unit (63.75%, $n = 102$). The average age of the delirium group was 72.08 years ($SD = 11.93$), compared to 67.98 years ($SD = 13.56$) for the non-delirium group. An interesting finding was that 26.9% ($n = 43$) of veterans with delirium were combat veterans compared to 14.2% ($n=54$) of non-combat veterans with delirium. See table 1 for delirium versus non-delirium group comparison statistical significance testing.

Physical and mental health comorbidities varied slightly between the delirium and the non-delirium group, with 61.9% ($n = 99$) of the delirium group having an active infection compared to only 28.7% ($n = 109$) of the non-delirium group. Functional impairment was reported in 52.5% ($n = 84$) of the delirium group, compared to 25.3% ($n = 96$) of the non-delirium group. Depression was recorded in 47.5% ($n = 76$) of delirium cases versus only 35.8% ($n = 136$) of non-delirium. Of special note, cognitive impairment was reported in 43% ($n= 69$) of delirium group compared to 9.7% ($n= 37$) in non-delirium group. Additionally, 30% ($n = 48$) of the delirium group had a history of PTSD compared to only 18% ($n = 61$) of the non-delirium group. Substance use disorder was noted in 20.6% ($n = 33$) of delirium veterans compared to only 10.8% ($n = 41$) in the non-delirium group.

There were some distinct differences between the delirium and non-delirium group when comparing disposition at discharge, with only 47.5% ($n = 76$) of delirium veterans being discharge home, compared to 75% ($n = 285$) of non-delirious veterans. Additionally, 21.8% ($n = 35$) of delirium veterans were admitted to a skilled nursing
facility, compared to only 10.7% \((n = 41)\) of the non-delirium group. Sixteen (10%) of delirium group spent time at a short-term rehab, compared to only 3.9% \((n = 15)\) of non-delirium veterans. Lastly, 8.75% \((n = 14)\) of veterans diagnosed with delirium died during their hospital admission, compared to only 1.8% \((n = 7)\) of non-delirium veterans.

Length of stay did vary between the delirium and non-delirium group, with delirium veterans’ mean length of stay 13.42 days \((SD = 12.74)\) compared to the non-delirium group which had a mean of 7.13 days \((SD = 11.13)\). The number of admissions did not vary significantly between groups, with the delirium group averaging 1.86 admissions \((SD = 1.25)\) and the non-delirium group averaging 1.51 admissions \((SD = 0.93)\).

Mortality rates varied between the delirium and non-delirium group with 25% \((n = 40)\) of delirium veterans dying within three months of hospitalization compared to 9.4% \((n = 36)\) of non-delirium veterans. At six months post-discharge, an additional 10% \((n = 16)\) of delirium veterans died, compared to only 3.6% \((n = 14)\) of the non-delirium group. Mortality rates for one year post-delirium episode was 42.5% \((n = 68)\) for the delirium group, compared to 19.5% \((n = 75)\) for the non-delirium group.

Lastly, only 18.75% \((n = 30)\) of veterans with delirium were identified by nurses correctly using the brief Confusion Assessment Method (bCAM) instrument. Of the 65 veterans who were diagnosed with delirium upon hospital admission, only two veterans were correctly identified by the admitting nurse using the bCAM instrument. One veteran, who did not have delirium, screened positive using the bCAM instrument.
Specific Aim 2

Specific aim 2 examined the differences between mental health comorbidities (i.e., PTSD, TBI, depression, and anxiety) and delirium diagnosis among hospitalized military veterans who have experienced combat versus those who have not. A Chi-square test of difference was conducted between mental health comorbidities, delirium diagnosis, and combat status. Not all expected cell frequencies were greater than five; hence, Fisher’s exact tests were reported for variables with all expected cell frequencies less than five. Additionally, the strength of statistically significant associations was assessed via the Phi or Cramer’s V coefficient.

For veterans with PTSD, 58.3% (n=63) had experienced combat while 41.7% (n=45) had not. For veterans who did not have PTSD, 8.6% (n=34) had experienced combat, while 91.4% (n=360) had no combat experience. In addition to the differences, PTSD and combat status were found to have a statistically significant association with a $\chi^2=131.16$, $p<.001$, $Phi =.517$, and yielded a large effect size.

For veterans with a diagnosis of depression, 26.6% (n=54) of veterans had experienced combat while 73.4% (n=149) of veterans had depression but no combat experience. For veterans who did not have a diagnosis of depression, 14.4% (n=43) had experienced combat, while 85.6% (n=256) had no combat experience. Furthermore, depression and combat status were found to have a statistically significant association with a $\chi^2=10.81$, $p=.001$ and $Phi =.152$, which yielded a small effect size.

Lastly, for veterans with delirium, 26.8% (n=43) had experienced combat, while 63.75% (n=102) of veterans with delirium had no combat experience. Additionally, delirium diagnosis and combat status were found to have a statistically significant
association with a $\chi^2 = 14.44$, $p=.001$ and Cramer’s $V = .174$, that yielded a small effect size. No significant associations were found between TBI and combat status or anxiety and combat status (see table 4).

Table 4.

Mental Health Comorbidities of Study Population by Combat Status (N = 540)

<table>
<thead>
<tr>
<th>Mental Health Comorbidities</th>
<th>Total</th>
<th>Combat</th>
<th>No Combat</th>
<th>$\chi^2$</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Traumatic Stress Disorder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>116</td>
<td>21.5</td>
<td>63</td>
<td>58.3</td>
<td>45</td>
</tr>
<tr>
<td>No</td>
<td>424</td>
<td>78.5</td>
<td>34</td>
<td>8.6</td>
<td>360</td>
</tr>
<tr>
<td>Traumatic brain injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>22</td>
<td>4.1</td>
<td>7</td>
<td>36.8</td>
<td>12</td>
</tr>
<tr>
<td>No</td>
<td>518</td>
<td>95.9</td>
<td>90</td>
<td>18.6</td>
<td>393</td>
</tr>
<tr>
<td>Depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>212</td>
<td>39.3</td>
<td>54</td>
<td>26.6</td>
<td>149</td>
</tr>
<tr>
<td>No</td>
<td>328</td>
<td>60.7</td>
<td>43</td>
<td>14.4</td>
<td>256</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90</td>
<td>16.7</td>
<td>74</td>
<td>17.9</td>
<td>339</td>
</tr>
<tr>
<td>No</td>
<td>450</td>
<td>83.3</td>
<td>23</td>
<td>25.8</td>
<td>66</td>
</tr>
<tr>
<td>Delirium Diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No delirium</td>
<td>380</td>
<td>70.4</td>
<td>54</td>
<td>15.1</td>
<td>303</td>
</tr>
<tr>
<td>Delirium at admissions</td>
<td>65</td>
<td>12.0</td>
<td>20</td>
<td>33.9</td>
<td>39</td>
</tr>
<tr>
<td>Delirium during hospitalization</td>
<td>95</td>
<td>17.6</td>
<td>23</td>
<td>26.7</td>
<td>63</td>
</tr>
</tbody>
</table>

Note. $\chi^2$ = Fisher’s Exact unless otherwise specified. *Yate’s continuity correction (2-sided).
Specific Aim 3

Specific Aim 3 examined the relationships between sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CVA, CAD, and COPD), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment; indwelling catheter, and infection), and hospital outcomes (i.e., length of stay, disposition at discharge, and mortality), in terms of delirium diagnosis (present vs. absent) among hospitalized military veterans. Delirium diagnosis included those with a diagnosis at admission, as well as, those who developed delirium during their hospital stay.

A chi-square test of association was conducted between categorical sociodemographic characteristics, including military service characteristics, mental health comorbidities, physical comorbidities, other delirium risk factors, hospital outcomes, and delirium diagnosis among hospitalized military veterans. Not all expected cell frequencies were greater than five; hence, Fisher’s exact tests were reported for variables with all expected cell frequencies less than five. The strength of statistically significant associations were assessed via the Phi or Cramer’s V coefficient.

Upon analysis, twelve variables were found to have a statistically significant association with veteran’s delirium diagnosis. Military characteristics (service era and combat status) were found to be significant with military service era producing a Fisher’s $\chi^2 = 23.36$, and a $p = .006$ (Monte Carlo sig.). This yielded a Cramer’s $V = .146$, which demonstrated a small effect (Cohen, 1988). Combat status produced a Fisher’s $\chi^2 =$
14.44, and a \( p = .001 \). This yielded a Cramer’s \( V = .174 \) and also demonstrated a small effect.

There were five mental health comorbidities (PTSD, TBI, depression, alcohol use disorder, substance use disorder) found to have a statistically signification association with a veteran’s delirium diagnosis. All were found to have a Cramer’s \( V \) small effect including: PTSD, Fisher’s \( \chi^2 = 11.16, \ p = .004, \ Cramer’s \ V = .147 \); traumatic brain injury, Fisher’s \( \chi^2 = 1.40, \ p = .016, \ Cramer’s \ V = .128 \); depression, Fisher’s \( \chi^2 = 7.32, \ p = .025, \ Cramer’s \ V = .117 \); alcohol use disorder, Fisher’s \( \chi^2 = 7.52, \ p = .023, \ Cramer’s \ V = .122 \); and substance use disorder, Fisher’s \( \chi^2 = 9.15, \ p = .009, \ Cramer’s \ V = .131 \).

When mental health comorbidities were combined, it produced a Fisher’s \( \chi^2 = 48.42, \ p = .002 \) (Monte Carlo sig.). This yielded a Cramer’s \( V = .235 \) which demonstrated a medium effect.

There were five additional risk factors (cognitive impairment, functional impairment, hearing impairment, infection and indwelling urinary catheter) that were found to have a statistically significant association. Cognitive impairment produced a Fisher’s \( \chi^2 = 78.82, \ p < .001, \ Cramer’s \ V = .403 \) which demonstrated a medium effect while functional impairment produced a Fisher’s \( \chi^2 = 37.40, \ p < .001, \ Cramer’s \ V = .267 \), which demonstrated a small effect. Hearing impairment established a Fisher’s \( \chi^2 = 7.78, \ p = .020, \) and Cramer’s \( V = .122 \) which yielded a small effect; while indwelling urinary catheter established a Fisher’s \( \chi^2 = 21.62, \ p < .001, \ Cramer’s \ V = .204 \), yielding a small effect size. Lastly infection, produced a Fisher’s \( \chi^2 = 62.21, \ p < .001, \ Cramer’s \ V = .341 \) which yielded a medium effect size. It should be noted that when several impairments were combined (cognitive, functional, hearing and vision) it produced a Fisher’s \( \chi^2 = \)
Lastly two hospital outcomes (disposition at discharge and mortality) were found to have statistically significant association with delirium. The variable disposition at discharge produced a Fisher’s $\chi^2 = 53.94$, $p < .001$ (Monte Carlo sig.) and Cramer’s $V = .229$ which demonstrated a medium effect; while mortality yielded a Fisher’s $\chi^2 = 41.55$, $p < .001$ (Monte Carlo sig.), Cramer’s $V = .204$ which produced a small effect.

There were no significant associations found between veterans’ delirium diagnosis and: age, gender, race, ethnicity, marital status, anxiety, and CVA, CAD, COPD, and vision impairment.

One-way ANOVAs were also conducted with continuous variables to determine if veteran’s age, hospital LOS, and number hospital admissions during study period had a statistically significant association with delirium diagnosis. Again, veterans were classified into two groups: no delirium and delirium. Homogeneity of variances was assessed by Levene’s test of homogeneity of variances. Welch robust test for equality of means are reported for those ANOVA results that do not meet the homogeneity of variance assumption.

Age was significantly associated for veterans in terms of their delirium diagnosis, $F (1, 538) = 10.98$, $p = .001$, compared to those without a delirium diagnosis. Age significantly increased for those diagnosed with delirium, ($M = 72.08$, $SD = 11.93$) when compared to those with no delirium diagnosis ($M = 67.98$, $SD = 13.56$; see Figure 3). Hospital length of stay was also significantly associated for veterans in terms of their delirium diagnosis, Welch $F (1, 266) = 29.53$, $p < .001$. Hospital length of stay
significantly increased for those diagnosed with delirium ($M = 13.42, SD = 12.74$) when compared to those with no delirium ($M = 7.13, SD = 11.13$, see Figure 4). Finally, the number of hospital admissions during the study period was also significantly associated for patients in terms of their delirium diagnosis, Welch $F (1, 237) = 9.94, p = .002$. The number of admissions significantly increased for those diagnosed with delirium ($M = 1.86, SD = 1.29$) when compared to those with no delirium ($M = 1.51, SD = 0.93$, see Figure 5.)

*Figure 3. Delirium Diagnosis and Age*
Figure 4. Delirium and Length of Stay

Figure 5. Delirium and Hospital Admission
Specific Aim 4

Specific Aim 4 determined whether sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CVA, CAD, and COPD), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling catheter, and infection) increased the likelihood of developing delirium among hospitalized military veterans.

A binomial logistic regression was conducted to ascertain the effects of age, combat status, PTSD, depression, alcohol use disorder, substance use disorder, functional impairment and infection on the likelihood that veterans have a delirium diagnosis. Only variables significant at $p < .05$ in the bivariate analysis were considered for entry into the binomial logistic regression model. Linearity of the continuous variables with respect to the logit of the dependent variable was assessed via the Box-Tidwell (1962) test. Based on this assessment, age was found to be linearly related to the logit of the dependent variable. There were eight standardized residuals with values greater than 3 standard deviations, which were kept in the analysis.

A test of the overall model against a constant only model was statistically significant, $\chi^2(8) = 110.83, p < .001$. The model explained 28.3% (Nagelkerke’s $R^2$) of the variance in delirium diagnosis, and correctly classified 77.9% of the cases. Sensitivity was 44.1%, specificity was 91.6%, positive predictive value was 68.1%, and negative predictive value was 80.2%. Overall, this model was able to predict delirium in 44.1% of
patients with delirium, as well as, correctly predict 91.6% without delirium. Of the eight predictor variables, six were found to be statistically significant: age, PTSD, depression, substance use disorder, functional impairment, and infection (see Table 5). These six variables were found to have positive predictor values with beta weights reported as $\beta=1.40$ for infection, $\beta=1.00$ for functional impairment, $\beta=0.98$ for substance use disorder, $\beta=0.76$ for PTSD, $\beta=0.52$ for depression and $\beta=0.40$ for age.

Veterans with an infection had four times higher odds of having a delirium diagnosis when compared to those with no infection. Veterans with a documented functional impairment had almost three times higher odds; followed by veterans with a substance use disorder had two and a half times higher odds. Veterans with PTSD, were found to have two times higher odds, followed by veterans with depression, who demonstrated a little over one and a half times higher odds of having delirium when compared to those with no infection, no functional impairment, no substance use disorder, no PTSD, and no depression respectively. Finally, it should be noted that as age increases by one year, the odds of developing delirium increased about 4%.
Table 5.

Summary of Logistic Regression Analysis Predicting Delirium Diagnosis (N = 540)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>OR</th>
<th>99% CI</th>
<th>Wald statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.40</td>
<td>0.01</td>
<td>1.04</td>
<td>[1.02, 1.06]</td>
<td>13.82</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Combat status</td>
<td>0.29</td>
<td>0.32</td>
<td>1.34</td>
<td>[0.71, 2.51]</td>
<td>0.81</td>
<td>.369</td>
</tr>
<tr>
<td>PTSD</td>
<td>0.76</td>
<td>0.34</td>
<td>2.15</td>
<td>[1.11, 4.16]</td>
<td>5.15</td>
<td>.023</td>
</tr>
<tr>
<td>Depression</td>
<td>0.52</td>
<td>0.24</td>
<td>1.68</td>
<td>[1.68, 1.06]</td>
<td>4.86</td>
<td>.027</td>
</tr>
<tr>
<td>Alcohol use disorder</td>
<td>0.53</td>
<td>0.29</td>
<td>1.70</td>
<td>[0.96, 3.01]</td>
<td>3.31</td>
<td>.069</td>
</tr>
<tr>
<td>Substance use disorder</td>
<td>0.98</td>
<td>0.32</td>
<td>2.65</td>
<td>[1.41, 4.98]</td>
<td>9.24</td>
<td>.002</td>
</tr>
<tr>
<td>Functional impairment</td>
<td>1.00</td>
<td>0.24</td>
<td>2.71</td>
<td>[1.71, 4.30]</td>
<td>17.84</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Infection</td>
<td>1.40</td>
<td>0.23</td>
<td>4.05</td>
<td>[2.60, 6.33]</td>
<td>37.88</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

$\chi^2(8) = 110.83, p < .001$

$-2 \text{ Log likelihood} = 492.69. \text{Nagelkerke } R^2 = 28.3\%$

*Note. CI = Confidence interval for odds ratio (OR); PTSD = Posttraumatic stress disorder.*
Chapter V

DISCUSSION OF FINDINGS

Delirium is a complex cognitive disorder that affects around 2.6 million adults annually. There has been limited research conducted on whether veteran specific risk factors such as PTSD, TBI, anxiety, depression or combat play a role in the development of delirium in the hospitalized veteran. The purpose of this retrospective cross-sectional cohort study was to describe the relationship between the veteran specific risk factors of PTSD, TBI, anxiety, depression, and combat, and delirium in a southern California Veterans Administration Healthcare Facility. To achieve this objective, four aims were proposed and subsequently analyzed. This chapter provides a discussion of the findings, implications for nursing practice, education and research, and study limitations.

Specifically, the study addressed the following aims:

1. Describe the sociodemographic (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., COPD, CAD, and CVA), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling urinary catheter, and infection), hospital outcomes (i.e., length of stay, disposition at discharge, and mortality), and delirium diagnosis among hospitalized military veterans.

2. Describe the differences between mental health comorbidities (i.e., PTSD, TBI, depression, and anxiety) and delirium diagnosis among hospitalized military veterans who have experienced combat versus those who have not.
3. Describe the relationship between sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CAD, COPD, and CVA), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling urinary catheter, and infection), and hospital outcomes (i.e., length of stay, disposition at discharge, and mortality) in terms of delirium diagnosis among hospitalized military veterans.

4. Determine whether sociodemographic characteristics (i.e., age, gender, race, ethnicity, and marital status), including military service characteristics (i.e., service era, and combat status), mental health comorbidities (i.e., PTSD, TBI, depression, anxiety, alcohol use disorder, and substance use disorder), physical comorbidities (i.e., CVA, CAD, COPD), and other risk factors (i.e., cognitive, functional, hearing and/or vision impairment, indwelling catheter, and infection) increase the likelihood of developing delirium among hospitalized military veterans.

**Delirium Rates**

Despite the overwhelming homogeneous sample of this study, with a majority being male, Caucasian, and non-Hispanic, there were several findings in this study that were supported by previous studies, which had more diverse sample populations. Primarily, 29.6% of the study sample was diagnosed with delirium. For the purpose of this study, this was derived by summing delirium present upon hospital admission (12%)
and delirium that developed during hospitalization (17.6%). The prevalence rate of this study is in alignment with several other studies. In 2006, Siddiqi, House & Holmes conducted a systematic review of 42 studies and found the prevalence rate to range between 10-31% for medical patients. This study’s prevalence rate was further supported by studies conducted by Inouye (1998), O’Keefe & Lavan, (1997) and Wong et al. (2010) whose prevalence rates ranged from 9-27%.

The incidence rate of delirium was 17.6%, which is similar to several reported rates within the literature. In a systematic review by Cull, et al. (2013), the incidence rate of delirium was found to be 16%. Martinez, et al. (2012) reported an incidence rate of 13%, while Siddiqi, House and Holmes (2006) systematic review reported incidence rates between 3-29%.

**Delirium and Hospital Outcomes**

This study supports additional findings regarding delirium and outcomes such as mortality, disposition at discharge, and length of stay. Morality rates for this study include 8.75% (n=14) of patients with delirium died during hospitalization, 25% (n=40) of delirium patients died within 3 month post-hospitalization and 42.5% (n= 70) within a year of a delirium diagnosis. These results are not surprising and are also supported by the literature, which indicates 30-60% of patients diagnosed with delirium die within one year of hospitalization (McAvay et al., 2006; McCusker, et al., 2002; McCusker et al., 2003; Witlox et al., 2010).

This study’s results regarding disposition at discharge were also similar to rates established in other studies. When comparing the non-delirium and delirium group, 75% (n=285) of the non-delirium group was discharged home compared to only 47.5% (n=76)
of the delirium group. Over 21.8% (n=35) of the delirium group were admitted to a skilled nursing facility (SNF), while only 10.7% (n=41) of the non-delirium group were admitted to a SNF. This study concluded veterans with delirium were two times more likely to be discharged to SNF when compared to non-delirium patients. This outcome is not uncommon. Inouye, et al. (1998) reported patients diagnosed with delirium were three times more likely to be placed in a skilled nursing facility upon discharge, while Marcantonio et al. (2000) and McAvay et al. (2006) reported similar findings with delirium patients 2.6-3 times more likely to be discharged to a long term care facility than patients without delirium.

There was a significant difference for length of stay (LOS) between the delirium and non-delirium group with the delirium group averaging 13.4 days (SD 12.74) compared to the non-delirium group which averaged 7.1 days (SD 11.13). This study found that length of stay was almost double for the delirium group. In 1997, O’Keefe and Lavan reported LOS to be twice as long for the delirium group compared to the non-delirium group. Many studies have reported LOS to be increased with delirium patients; however, when placed in a model, LOS is often not found to be statistically significant (Inouye, et al. 1998). This was found to be true with the current study.

**Delirium and Nurse Recognition**

An interesting finding within this study was only 18.75% (n=30) of delirium was recognized by bedside nurses. Nurses at this facility are required to perform a brief Confusion Assessment Method (bCAM) every shift to assess patients for delirium. The bCAM is a validated instrument that was adapted from the CAM-ICU, which is a modification of the original Confusion Assessment Method (CAM) instrument developed
by Inouye in 1990. The bCAM can be performed in about two minutes and has been found to have 78% sensitivity and 97% specificity when performed by a non-physician in an older adult population (Han, et al., 2013).

Despite the fact 12% of the veterans were diagnosed with delirium upon hospital admission, bedside nurses using the bCAM were unable to detect delirium within these veterans. In fact, only two patients admitted with a diagnosis of delirium had a positive bCAM performed by a bedside nurse. Although concerning, this finding is not unusual. Delirium is typically under recognized, with 19-60% of delirium not recognized by healthcare providers, especially nurses (Inouye, et al., 2001; Levkoff, et al., 1992). Additionally, one study concluded that patients who were unmarried, were of an ethnic minority, and had multiple comorbidities were less likely to have their delirium recognized by a healthcare provider (Collins, et al., 2009).

Despite this study’s low delirium recognition results from bedside nurses, this is not a unique occurrence. Prior research findings have concluded this is due to a variety of reasons, including knowledge deficit regarding delirium, time constraints for assessing patients, fast pace of the hospital setting, increased use of technology, and failure to use a validated instrument (Hosie, et al., 2014; Inouye, 1994; Lawlor & Bush, 2014, Nydahl, et al, 2018).

Another reoccurring theme for under recognition of delirium within the literature is nurses are not motivated to use validated instruments because they see no value in using them. Nurses perceived assessing patients for delirium as more of an obligation than helpful when providing patient care. Many studies have reported, nurses omitted assessing patients for delirium because it was perceived as time consuming and just
another “task” to do (Nydahl et al., 2018; van de Steeg, et al., 2014; van Velthuijsen et al., 2016).

Nurses are the first line of defense when it comes to recognizing changes in a patient’s status; yet, in this study, they were often unable to identify acute changes in the veteran, even when the provider had documented delirium diagnosis within the EHR. Although this finding is consistent with previous studies, additional investigation is warranted as to why a majority of delirium was missed by the bedside nurse. Further research is needed to determine if it’s an instrumentation, communication or knowledge issue. When delirium is not recognized in a patient, delirium interventions and treatment are not initiated, which may impact LOS, disposition upon discharge, and mortality of these patients.

**Delirium Risk Factors**

This study originally looked at twenty six variables, a majority of which are known to be associated with the development of delirium. Through a bivariate analysis, 14 variables were found to have a statistically significant association with delirium. Eight of the 14 variables (age, combat status, PTSD, depression, alcohol use disorder, substance use disorder, functional impairment and infection) were placed into a binominal logistic regression, and six (age, PSTD, depression, substance use disorder, functional impairment and infection) were found to be statistically significant as predictor variables for delirium within the study population. Below, the importance of each variable is discussed.
Age

The overall mean age for the study was 69.2 years (SD 13.2), while the mean age for the delirium group was 72.9 years (SD 11.93) and 67.98 years (SD 13.56) for the non-delirium group. When age was placed into the model, it reported an odds ratio of 1.04, indicating that as age increases, the odds of developing delirium while hospitalized increases by 4%. Although, this is a small percentage, several research studies support the notion that as age increases, the likelihood of developing delirium increases between 1.08-5.1 times (Chu, et al., 2016; Goldenberg et al., 2006; Khan, et al., 2012; Lin, et al., 2012; Litaker, et al., 2001; Marcantonio, et al., 2000; Solà-Miravete, et al., 2018; Takeuchi, et al., 2012). However, there are several studies that have not found age to be a significant predictor variable (Cull, et al., 2013; Ahmed, et al., 2014). Of the 21.8 million veterans within the US, almost 12 million are 60 years and older (National Center for Veterans Analysis and Statistics, 2020). Therefore, since over half of the nation’s veterans are over age 60, age should be considered a risk factor for delirium development among the veteran population. In this study, age had a reported beta weight of 0.40 indicating that as a veteran’s age increased, so did the chance of the veteran developing delirium.

PTSD

There are few published studies on the relationship between delirium diagnosis and veteran specific risk factors (PTSD, TBI, depression, anxiety and combat). Studies that have been conducted to examine this relationship have only looked at these risk factors and emergence delirium within the active duty military population. Emergence delirium is a type of delirium that develops during the immediate post-anesthesia period.
McGuire (2012) found active duty military personnel with a history of combat experience and/or mental health comorbidities who underwent surgery had an incidence rate of 20% for emergence delirium. To date, this study is the first to look at whether these same veteran specific risk factors have a relationship with delirium that develops within the hospitalized veteran population.

Over 21% (n=116) of the study sample had a diagnosis of PTSD. Of these 116 veterans with PTSD, 63 had also experienced combat as part of their military time. Additionally, 30% (n=48) of veterans who developed delirium also had a diagnosis of PTSD. When PTSD was placed into the logistic regression model, it was found to have an odds ratio of 2.15 and a beta weight of 0.76. This result indicates that veterans with PTSD may have a higher likelihood of developing delirium than those without this diagnosis. This is the first known study to find that a diagnosis of PTSD may increase the risk of a veteran developing delirium while hospitalized.

While PTSD is a leading diagnosis in military personnel and veterans, the estimated prevalence varies between military service eras. Hoge (2004) estimated between 5-20% of military personnel who have served since September 11, 2001 have a diagnosis of PTSD, compared to 12% who served during the Gulf War (Hoge, et al., 2004). The largest prevalence rate for veterans with PTSD is thought to be those who served during Vietnam. It is estimated that 30% of Vietnam veterans have a diagnosis of PTSD (Friedman, Schnurr & McDonagh-Coyle, 1994). There are limited published prevalence rates for veterans that served during World War II or the Korean War. A study done by Blake et al. (1990) estimated 37% of WWII veterans and 80% of Korean veterans who served in combat had PTSD. However, it is noted that these rates may be
falsely inflated because Blake’ study did not use a sample representative of the larger veteran population.

**Depression**

Over 200 veterans or 39% of the study sample had a diagnosis of depression. When looking specifically at depression and delirium, it was discovered that 47.5% (n=76) of patients with delirium had depression compared to 35.8% (n=136) of the non-delirium group. When depression was placed into the model, veterans with depression were 1.68 times more likely to develop delirium while hospitalized than those without a depression diagnosis. In previous studies, determining whether depression contributes to delirium has produced mixed results.

Depression has been reported to be a contributing factor for delirium in certain populations, such as the older adult, patients residing in long-term care settings, and patients undergoing surgery. A study by Hare, et al. (2014) found that patients presenting to the emergency department with a diagnosis of depression were 3.4 times more likely to develop delirium than those with no depression.

In the long-term care setting, 19% of patients diagnosed with delirium had a underlying diagnosis of depression (McCusker et al., 2014b). Studies that have focused on patients undergoing cardiac surgery have reported a threafold increase in delirium compared to those without depression (Kazmierski, et al., 2006; Kazmierski et al., 2010; Tully, et al., 2010; Lin, Chen & Wang, 2012; Smith, et al., 2009).

In the non-cardiac surgery population, a systematic review concluded depression was associated with delirium development (Dasgupas & Dumbrell, 2006). However, a meta-analysis in 2013 on medical patients did not find depression to be a risk factor in
developing delirium while hospitalized (Cull et al., 2013). Lastly, prior studies by McGuire (2012), Hoge, et al. (2004), and Armenta, et al. (2018) have found a relationship between depression, PTSD, and combat status among military veterans.

**Substance Use Disorder**

A little over 13% (n=74) of the total sample had a diagnosis of substance use disorder (SUD). However, when comparing veterans with delirium and SUD, 20.6% of the delirium group had SUD compared to only 10.8% of the non-delirium group. When placed into the model, it was found that veterans with SUD were 2.65 times more likely to develop delirium compared to those without the disorder. Studies which examined whether specific medication classes such as narcotics, tranquilizers, benzodiazepines, anticholinergic and neuroleptics have a relationship with delirium, found that patients using these medications are at increased risk for developing delirium (Ahmed et al., 2014; Kassie, et al., 2017; Kim et al., 2015). However, it should be noted few, if any, studies have specifically looked at whether patients with a diagnosis of substance use disorder have an increased risk of developing delirium while hospitalized.

**Functional Impairment**

Over one third of the study sample (n=180) was diagnosed with some type of functional impairment. A veteran was positive for a functional impairment if they had a documented history of a functional impairment in the EHR. This included using any type of assistive device such as a wheelchair or walker, as well as, documented in the EHR the inability to perform ADLs such as bathing, eating, dressing or ambulating independently. Over half of the delirium group (52.5%) had a documented functional impairment, compared to just 25.3% of non-delirium group. When functional impairment was added
into the model, it found that veterans with a functional impairment were 2.71 times more likely to develop delirium while hospitalized.

Ahmed, et al. (2014) conducted a meta-analysis and reported that functional impairment was an independent predictor for delirium (Ahmed et al., 2014). This finding was further supported by a systematic review conducted on medical patients which concluded patients who suffer from functional impairments were 1.74 times more likely to develop delirium while hospitalized (Cull et al., 2013). Additionally, several other studies reported that bedrest and immobility increased the chance of developing delirium anywhere from 2-2.5 times (Marcantonio et al., 2000; Solà-Miravete et al., 2018; Wakefield, 2002).

**Infection**

Over 38.5% (n=208) of the study sample was diagnosed with an infection during hospitalization. Of those, 61.9% (n= 99) of veterans were also diagnosed with delirium. When infection was placed into the model, it was determined that patients with an active infection were four times more likely to develop delirium than those patients with no infection.

In many studies, infection is often grouped into illness severity or classified as an iatrogenic event, making it difficult to distinguish if the infection is the main variable for delirium. Inouye & Charpentier (1996) study actually distinguished different classification of iatrogenic events and found that urinary tract infection was associated with a 1.9 relative risk for delirium.

However, there have been studies that have specifically addressed infection as a standalone variable and have found it to be a statistically significant risk factor for
delirium (Chang, et al., 2008; Franco, et al., 2010; Loponen, et al., 2008; Moon, et al., 2018; Wakefield, 2002). One study determined that patients with increased temperature pre-operatively were 3.41 times more likely to develop delirium than those without a fever (Juliebo, et al, 2009). While two other studies indicated that elevated white blood cell counts greater than 10 and 12 respectfully, yielded an odds ratio of 3.0 and a relative risk of 2.3 (de Castro, et al., 2013; Marcantonio, et al., 1994).

**Implications**

**Nursing Practice**

**Delirium recognition.** There are several implications from this study that need to be addressed. In terms of nursing practice, this study demonstrated that bedside nurses are still deficient in identifying delirium within patients. Over 80% of patients with delirium in this study were not recognized by the bedside nurse. When patients are not assessed correctly or identified as having delirium, it can lead to poor patient outcomes including increased length of stay, increased mortality, decrease physical and cognitive functioning, and an increase in institutional placements upon hospital discharge (Ali et al., 2011; Inouye, 1998; Katz et al., 2001; Leslie, et al., 2008).

Delirium costs the US healthcare system between $38-164 billion dollars each year to treat and manage (Leslie, et al., 2008; Oh, et al., 2017). Several studies found up to 40% of delirium can be prevented if patients are identified at risk upon admission to the hospital and evidence based protocols are implemented (Inouye, Westendorp, & Saczynski, 2014; O'Mahony, et al., 2017). It is essential that healthcare facilities acknowledge and address the barriers to delirium assessment and recognition with its bedside nurses, so that hospitals can provide these patients with the care needed.
Nursing Education

One way to increase delirium recognition is to improve the education nurses receive on delirium. Ultimately, delirium education needs to begin when students enter nursing programs and continue throughout their nursing career. Knowledge regarding delirium and its risk factors is constantly evolving, and nurses need to updated and educated routinely to stay abreast of the latest evidence and treatment.

Prelicensure education. During prelicensure nursing education, the topic of delirium is usually covered during didactic and clinical education regarding mental health. However, many nursing students begin their introduction to clinical care in an acute care medical-surgical setting, where delirium may be prevalent amongst the population. If students are unfamiliar with the concept of delirium, they may not recognize delirium and as a result, it may go untreated. However, if nursing students receive education on delirium throughout their educational program, including attention to risk factors and settings where delirium may occur (e.g., medical-surgical, “step-down” or transitional care, intensive care units, and post-anesthesia care), their level of knowledge and ability to recognize the condition in hospitalized patients would likely increase.

Continuing education. To improve recognition in the acute care setting, health system leadership needs to recognize the financial impact of delirium. Leaders in health systems must acknowledge that when delirium goes unrecognized and untreated it costs their facilities hundreds of thousands of dollars annually. Just as hospitals are concerned with their current rates of central line blood stream infections, catheter associated urinary tract infections, pressure injuries and hospital acquired pneumonia, they should attend to
their delirium rates, as delirium costs the US billions of dollars each year to treat.

Leadership should support professional continuing education for staff regarding delirium. The costs associated with such support should not be a factor that deters hospitals from providing such essential education. Many no cost resources are available to healthcare providers. Organizations such as the Delirium Care Network, Hospital Elder Life Program, American Nurses Association and American Delirium Society, among others, offer free training, resources and education on delirium. Including such education as a component of an annual competency assessment is a practical option for health care organizations.

**Nursing Research**

Despite extensive evidence on delirium, few studies have addressed why nurses do not recognize delirium. While educational and knowledge deficits regarding delirium contribute to under-recognition of the condition, other factors have been noted in the literature. Previous studies have found that nurses do not value the instruments they are given to help them assess for delirium; instead, many nurses expressed they felt such instruments represented just another task to complete during their shift.

Reasons for nurses not valuing instruments provided to them to improve patient care needs to be explored further. Currently, nurses use a variety of instruments in their everyday practice to assess patients’ risk for things such as falls, pressure injuries, swallowing disorders, and suicidal ideation, amongst others. If nurses do not view these instruments as useful in their practice, and instead view them as a nuisance, are nurses truly identifying patients accurately for things such as falls and pressure injuries? Future nursing research needs to explore why nurses do not value these instruments in their
everyday practice and determine whether interventions can be implemented to change their perception of the value of these instruments.

With regard to the present study, future investigations should focus on replicating the above findings using a larger sample size from several Veteran Healthcare Facilities around the country to increase generalizability among the veteran population. If these risk factors are found to have an association with delirium among a larger, more diverse veteran population, action should be taken to develop a risk assessment instrument to identify these veterans upon admission to the hospital in order to prevent the occurrence of delirium while hospitalized. In addition, exploring whether PTSD, SUD, depression, functional impairment, and infection were predictive for delirium in a non-military hospitalized population would be of value, given the prevalence of these in the general population. Such investigation would also help to clarify whether such risk factors are unique to the veteran population.

**Veteran Specific Risk Factors**

To our knowledge, this was the first study to specifically look at delirium development and veteran specific risk factors in the inpatient population. Findings from this study, suggest that PTSD, delirium, and SUD increase the likelihood of veterans developing delirium while hospitalized. There are over 21.8 million veterans within the US and while many receive their healthcare through the Veterans Healthcare Administration, there are millions who do not. It is essential that healthcare facilities, specifically providers and nurses, who serve veterans, know and understand veteran risk factors for delirium may differ from the general population. While additional studies should be completed to validate these findings, it is imperative that healthcare
professionals identify veterans with these risk factors and screen them routinely for delirium while hospitalized. Future studies may focus on developing a veteran specific delirium prediction model to help identify veterans at risk for delirium upon hospital admission.

**Healthcare Policy**

Despite delirium being a serious, expensive, and often preventable disorder in older adults, there have been no regulatory mandates issued by Centers of Medicare and Medicaid Services (CMS) addressing this issue. Presently, CMS does not require healthcare facilities to assess and/or screen patients upon admission or during their hospital stay for delirium (Center for Medicare and Medicaid Service, 2020). Additionally, the Joint Commission has not published any standards for hospitals to meet in terms of delirium in order to maintain their accreditation. Furthermore, numerous professional organizations have spent millions of dollars to develop screening and management guidelines for delirium, yet none of these guidelines are required to be used nationally.

In 2015, Hshieh, et al. conducted a study and concluded that one million cases of delirium could be prevented simply by screening patients for delirium risk factors upon admission to the hospital and implementing a multi-component non-pharmacologic protocol. The study determined this would save CMS around $10 billion a year (based on an estimated cost of $10,000 per delirium case) yet five years later, there has been no movement to address this issue.

The baby boomer generation comprises 20% of the United States population. By 2029, this entire generation will be 65 years and older, placing them at risk for
developing delirium when hospitalized (US Census Website, 2020). In 2017, it was estimated 2.6 million adults, 65 years and older, experience delirium (Oh et al., 2017). This number will continue to grow unless preventative action is taken. Regulatory and accrediting agencies need to take action and require healthcare facilities to assess patients for delirium and implement evidence-based protocols.

**Study Limitations**

There are several limitations within the study that need to be recognized. Primarily, this study was a retrospective cross-sectional study that relied on information gathered within the EHR. Information entered into the EHR comes from a variety of personnel including physicians, psychiatrists, registered nurses, physical therapist, and medical support assistants. It is possible that information was entered incorrectly into the veterans’ charts.

Secondly, not every delirium case in the study had an ICD-10 code for delirium. Upon initial review of the 540 cases, only 96 cases of delirium were identified using the ICD-10 codes. It was through chart review the additional 64 cases were discovered. The study did not collect the type of delirium experienced by each veteran. This was primarily due to the fact the provider did not consistently record the type within the EHR. Although this study collected information on 26 variables, it did not collect information on all known variables associated with delirium. The following variables were not collected as part of this study: post-operative status, specific medications administered, nutritional and hydration status, laboratory values, and environmental changes. Lastly, this study was conducted in a southern California veteran healthcare facility where a majority of the
population was Caucasian, male, and non-Hispanic. This limits the generalizability of the study.

**Conclusion**

Delirium is a common and costly disorder that can have devastating effects on the patient and their family. Despite the fact thousands of research studies have investigated risk factors for delirium development; this was the first study to address veteran specific risk factors (PTSD, TBI, depression, anxiety and combat) in the hospitalized veteran. As the US life expectancy continues to increase and people live longer, it is essential healthcare providers and healthcare systems focus on preventing diseases and disorders. Research has determined 40% of delirium can be prevented if patients at risk are identified early and evidenced based interventions are implemented. Military veterans are a diverse and unique population, many of whom have experienced traumatic events that a majority of the population has not. Due to this, it is essential to understand their unique risk factors for delirium and identify veterans at risk for delirium upon hospital admission.
REFERENCES


https://doi.org/10.1111/jgs.13159


https://doi.org/10.1176/jnp.12.1.51


https://doi.org/10.1177/0897190015625396


Rudolph, J. L., Harrington, M. B., Lucatorto, M. A., Chester, J. G., Francis, J., & Shay,


Older People Nursing, 6(2), 133–142. https://doi.org/10.1111/j.1748-3743.2010.00232.x


### Appendix A. Variable Table

<table>
<thead>
<tr>
<th>Variable</th>
<th>Operational Definition</th>
<th>Instrument/ Location of Data</th>
<th>Level of measurement</th>
<th>Descriptive Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delirium Diagnosis</td>
<td>ICD-10 codes, bCAM positive during hospitalization (Yes/No)</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Combat Experience</td>
<td>Yes/No</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Diagnosis of PTSD</td>
<td>Yes/No</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>History of TBI</td>
<td>Yes/No</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Diagnosis of anxiety</td>
<td>Yes/No</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Diagnosis of depression</td>
<td>Yes/No</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Age</td>
<td>DOB, measured in years</td>
<td>NA</td>
<td>Interval</td>
<td>Mean, standard deviation</td>
</tr>
<tr>
<td>Gender</td>
<td>Male, female</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>Caucasian, African-American, Pacific Islander, Hispanic, other</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Never married, Married, Divorced, separated, widow</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Cognitive Impairment</td>
<td>Diagnosed within the EHR as having a cognitive impairment (yes/no)</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Functional Impairment</td>
<td>Diagnosed within EHR or found in provider or Physical therapy notes</td>
<td>NA</td>
<td>Ordinal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Vision Impairment</td>
<td>Yes/No</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Hearing Impairment</td>
<td>Yes/No</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Urinary catheter</td>
<td>Catheter or no catheter</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>COPD</td>
<td>Yes/No</td>
<td>NA</td>
<td>Ordinal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>CAD</td>
<td>Yes/No</td>
<td>NA</td>
<td>Ordinal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>History of Alcohol use disorder</td>
<td>Yes/No</td>
<td>NA</td>
<td>Ordinal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>History of Substance Used Disorder</td>
<td>Yes/No</td>
<td>NA</td>
<td>Ordinal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Variable</td>
<td>Operational Definition</td>
<td>Instrument/Location of Data</td>
<td>Level of measurement</td>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------</td>
<td>----------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Length of stay</td>
<td>Measured in days</td>
<td>NA</td>
<td>Interval</td>
<td>Mean, standard deviation</td>
</tr>
<tr>
<td>Infection</td>
<td>Presence of infection</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td></td>
<td>Yes/No</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of stroke</td>
<td>Positive or negative</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Disposition at discharge</td>
<td>Home, SNF, Homeless, other</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
<tr>
<td>Mortality</td>
<td>3 months, 6 months and 1 year post-delirium episode</td>
<td>NA</td>
<td>Nominal</td>
<td>Frequency distribution (percentages)</td>
</tr>
</tbody>
</table>
Dear Allison Perkins:

The Institutional Review Board has rendered the decision below for IRB-2019-525, Veteran Specific Risk Factors of Delirium.

Decision: Exempt

Selected Category: Category 4. Secondary research for which consent is not required:
Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met:

(i) The identifiable private information or identifiable biospecimens are publicly available;

(ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects;

(iii) The research involves only information collection and analysis involving the investigator’s use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of “health care operations” or “research” as those terms are defined at 45 CFR 164.501 or for “public health activities and purposes” as described under 45 CFR 164.512(b); or

(iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be
maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq.

Findings: None

Research Notes:

Internal Notes:

Note: We send IRB correspondence regarding student research to the faculty advisor, who bears the ultimate responsibility for the conduct of the research. We request that the faculty advisor share this correspondence with the student researcher.

The next deadline for submitting project proposals to the Provost’s Office for full review is N/A. You may submit a project proposal for expedited or exempt review at any time.

Sincerely,

Dr. Thomas R. Herrinton
Administrator, Institutional Review Board

Office of the Vice President and Provost

Hughes Administration Center, Room 214

5998 Alcalá Park, San Diego, CA 92110-2492
Phone (619) 260-4553 • Fax (619) 260-2210 • www.sandiego.edu
Dear Dr. Verkaaik:

1. On 08/07/2019, the RDC reviewed and approved the above referenced project. Now that this project has been reviewed and approved by all relevant sub/committees and individuals, the research may be initiated.

2. The RDC is the committee of record for this study. Any changes to the study, including, but not limited to, staffing, procedures, methods, etc., must be approved by the RDC prior to implementing the changes. RDC annual review and approval is required.

   **R&D Committee Approval Period:** 08/07/2019 – 08/06/2020

3. It is critical that you submit annual renewal applications via OnRAMP in a timely fashion to ensure that all Subcommittee approvals remain current. We recommend that you submit continuing review applications at least six weeks prior to the Subcommittee approval expiration date(s) in order to maintain continual approval. Any project without current approval will be restricted from study activity as of the date of expiration.

4. Only individuals named on this study may participate in research activities. Your VASDHS Research Service approved staff list is available in OnRAMP under the Study Management screen for the protocols linked to this project. If you find discrepancies, please contact the Research Projects Section for further guidance and direction.

5. For questions or clarification, please contact the RDC Analyst, Ben Clark, at (858) 646-2891 or Ben.Clark@va.gov.

---

Gerhard Schulteis, PhD
Associate Chief of Staff for Research