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Delirium in Long Term Care Rehabilitation Residents: A Correlational Retrospective Study

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Hahn School of Nursing and Health Science

DOCTOR OF PHILOSOPHY IN NURING

DELIRIUM IN LONG TERM CARE REHABILITATION RESIDENTS:

A CORRELATIONAL RETROSPECTIVE STUDY

by

Rebecca Lerma-Kjonegaard

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Abstract

Background: Delirium is associated with devastating outcomes, cognitive loss, decreased function and an increase risk of mortality which affects patients and places a heavy burden on family and the healthcare system. The purpose of this study was to describe the relationship between select demographics, clinical characteristics, CHART-DEL-derived delirium diagnosis and ICD-10 coded discharge delirium diagnoses among Long Term Care (LTC) rehabilitation residents.

Method: A retrospective correlational design from174 LTC rehabilitation residents age 65 years or older using EMR and hard copy charts. The setting was a Southern California community hospital-based 100-bed LTC. Abstracted data included demographic characteristics (age, gender, race), principal admitting diagnosis, admission source, discharge disposition, medication management (polypharmacy, psychotropic medications duration), presence of dementia, CHART-DEL-derived delirium diagnoses documented delirium symptoms and International Classification of Disease, 10th revision (ICD 10) coded delirium, LOS, Charlson score (comorbidities). Statistical methodology included: descriptive statistics for demographic and other variable data. Chi square for relationship between delirium and the independent variables. ANOVA described the difference between the variables. Multiple logistic regression determined the odds of having a delirium diagnosis (by either approach with separate models) based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

Results: Majority residents were female, white, average age 80.6, 99.4% acute care admissions, and 96.6% had polypharmacy. Psychotropic duration mean was 9.5 days,

LOS 14.7 days, and 64.9% discharged home with home health. More delirium identified with CHART-DEL-derived delirium diagnoses (24.9%) compared to ICD-10 code diagnosis (5.2%). The Charlson score (comorbidity) was related to delirium in both models (CHART-DEL-derived p = .044; ICD-10 code p = .002), while LOS additionally explained variance, but only in CHART-DEL-derived delirium model.

Conclusions: The daily use of a delirium-screening instrument by the healthcare team could assist with delirium identification sooner and implement appropriate interventions. This then could decrease negative outcomes of delirium, improve satisfaction among family and staff and increase resident quality of care and safety.

Dedication

Proverbs 3:5-6, (5) Trust in the LORD with all your heart; and do not rely on your own insight. (6) In all your ways acknowledge him, and he will make straight your paths. (New Revised Standard Version)

My faith in Christ Jesus has given me the strength I needed to be able to realize my dream. I give him thanks for the ability to complete this task and the amazing people who helped me to meet the challenge and succeed.

I would like to dedicate this special work to my parents, Joe and Martha Lerma. My parents not only encouraged me with their words but also by example. They made sacrifices to ensure I would be able to take advantage of life's opportunities. They repeatedly told me, "You can accomplish anything with passion, persistence and determination."

I would also like to dedicate this special work to the love of my life, my husband, Dan Kjonegaard. I am truly blessed to have such a special love, friend, confidant, and my own special cheerleader. He signed up to take this journey with me and persevered to the end. With all my heart and soul, thank you for your encouragement, hugs, and doing the extra duties so that I could focus on my studies. I celebrate with you.

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profession has contributed to the advancement of the profession and many nurse scientists, especially me.

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Chapter One

Introduction

Delirium is a rapidly growing geriatric syndrome with devastating negative

outcomes reflected in clinical and functional decline, cognitive impairment, and increased

morbidity and mortality (Bellelli, Mazzola, & Morandi, 2015; Inouye, Westendorp, &

Saczynski, 2014; Kiely et al., 2009; Voyer, Richard, Doucet, Cyr, & Carmichael, 2011).

Delirium can increase the risk of cognitive loss, long term care placement, family

burden/stress, reduce function and independence, impact the quality of life for the older

adult, and increase the use of healthcare resources resulting in costlier healthcare

(Akunne, Murthy, & Young, 2012; Bellelli et al., 2007; Fick et al., 2015; Huson, Stolee,

Pearce, Bradfield, & Heckman, 2016; McAvay et al., 2006; McCusker et al., 2011b;

Popp, 2013; Steis & Fick, 2012; Yoo, Nakagawa, & Kim, 2013). Delirium, both

incidence and prevalence, have been extensively studied in the acute care setting noting

that delirium can persist for weeks and months (Marcantonio et al., 2003). Other studies

indicated delirium is no longer just an acute care concern; 20% to 70% of 12.5 million

elderly hospitalized adults experience delirium and there was a 50% increase in patients

with delirium discharged to post-acute care (PAC) in 2010 versus 1996. In addition, one

fifth of hospitalized patients are admitted to skilled nursing facilities with delirium due to

a shortened hospital length of stay (LOS) trend, leading to a critical need to address

delirium in the post-acute care setting. Reports of delirium prevalence in the older adult

can range from 22% to 89% (Élie et al., 2000; Fick, Agostini, & Inouye, 2002;

Lemiengre et al., 2006) and 3% to 70% in long-term care (LTC) (McCusker et al.,

2011a). Some critical pieces of the delirium puzzle are that delirium is not a normal

process of aging; 30–40% of cases are preventable and the etiology of the onset of

delirium is multifactorial (Inouye et al., 1999; Marcantonio, Flacker, Wright, & Resnick,

2001). It becomes essential to assist clinicians to understand and recognize the predictors

of delirium in LTC so staff can prevent the occurrence of delirium. When it does occur,

the staff can better manage the occurrence so the risk and severity of the negative

outcomes associated with delirium may be minimized (Inouye et al., 2014).

Risk factors have been thoroughly explored in the acute care setting; however,

there is a paucity of studies investigating predictors of delirium in LTC and even fewer in

the LTC rehabilitation resident. With better awareness of what triggers delirium, the

clinician will be better able to prevent, identify, and manage delirium.

Background

Delirium has been studied for centuries and contributed to the current

understanding of the syndrome. Celus was the first author to label delirium when

describing mental disorders associated with fever or head trauma and the first to report a

non-febrile delirium (Adamis, Treloar, Martin, & Macdonald, 2007). In the 19th century,

a definition of delirium, "clouding of consciousness" (Adamis et al., 2007, p. 466) and

confusion were introduced as part of delirium and symptoms were included in the

definition. The 20th century was instrumental in the identification of the various

symptoms of delirium (psychosis, hallucinations, stupor) including the development of

the Diagnostic and Statistical Manual of Mental Disorders (DSM) and International

Classification of Diseases (ICD) (Adamis et al., 2007). The DSM was formulated to

address the need to standardize the characterization and diagnosing of mental disorders

(Kawa & Giordano, 2012). The ICD was developed by the World Health Organization to

improve classification of mental disorders internationally (ICD-10 Classification). The fact that delirium has been studied for centuries supports the concept that delirium is complex and continues to evolve as more understanding is gained.

Consequences of Delirium

Delirium is strongly associated with many iatrogenic adverse outcomes and often the older adult hospitalized patient develops an accelerated physical and cognitive decline (Fong, Jones, et al., 2009; Khan et al., 2012). Delirium is characterized by key neuropsychiatric symptoms such as acute altered mental status, inattention, disorganized thinking, and disturbICD-10

ances in consciousness. A fluctuating course for patients and residents has been observed in all healthcare settings, particularly in LTC (Fong, Tulebaev, & Inouye, 2009; Khan et al., 2012). The hospital-acquired complications may include falls, urinary tract infection, an increased LOS, and a decreased ability to manage activities of daily living resulting in high admission rate to a PAC facility (Khan et al., 2012). Patients with delirium requiring an emergency department visit post-discharge represent 8–17% of all seniors and 40% of nursing home residents.

Mortality is also linked to delirium with an estimated 11% increased risk of dying in residents with every 48 hours with delirium (Young et al., 2015). The association of delirium and mortality is seen across all settings including acute care (intensive care unit, general medical units, geriatric, stroke, and dementia units), emergency departments, and nursing homes (Inouye et al., 2014). The incidence of delirium is reported to be 29% to 64% in general medical and geriatric units, 8% to 17% in older adults in the emergency department (ED), and up to 70% in LTC residents (Inouye et al., 2014; Moyo, Huang,

Simoni-Wastila, & Harrington, 2016). The occurrence of delirium in the intensive care

unit has a 2 to 4 times increased risk of death, a 1.5 times increased risk of death in the

medical or geriatric units one year after discharge from an acute care hospitalization, and

a 70% increased risk of death 6 months following an ED visit (Inouye et al., 2014).

Patients who develop delirium may experience a longer-term impact. The

symptoms of delirium have been reported as far out as 12 months with only a gradual

recovery (Siddiqi, House, & Holmes, 2006). Another long-term impact is the onset of

dementia occurring annually in 18% of patients who develop delirium versus 6% without

delirium (Rockwood et al., 1999). Patients with a hip fracture requiring surgical

intervention have a greater risk of developing delirium, 16–62%, with recovery ranging

from a couple days to one year (Deiner & Silverstein, 2009). The post-operative delirious

patient can experience cognitive impairment as far out as one year and the physical

functional status of both the surgical and non-surgical delirious patient can be

compromised for 30 days or more (Inouye, Westendorp, et al., 2014).

Delirium has been studied for causative factors, treatment, and prevention to

reduce the incidence of delirium. Delirium, a preventable condition and not a normal part

of the aging process, is associated with health status and drug use (Alagiakrishnan, 2004;

Moyo et al., 2016; Potter & George, 2006). In a seminal study, Inouye, Schlesinger, and

Lydon (1999) reported that 50% of delirium cases could be prevented. They also

reported a 25% reduction in delirium with the implementation of key preventive

measures. According to this study, preventative measures to reduce the incidence of poor

patient outcomes are associated with an increase demand on healthcare resources and cost

(Inouye et al., 1999). As a result of the outcomes and treatment for delirium, which

include outpatient care, the financial impact to the healthcare system ranges between $38 billion and $152 billion annually (Leslie, Marcantonio, Zhang, Leo-Summers, & Inouye, 2008). The cost attributed to delirium ranges from $16,303 to $64,421 per patient with all settings considered, which includes LTC (Leslie & Inouye, 2011). In 2011, the financial impact of delirium on healthcare in the United States was $165 billion and over $182 billion in 18 European countries (Inouye, Westendorp, et al., 2014).

LTC Resident Adults

By 2030, 20% of the U. S. population will be 65 years of age or older and 30 million people will have a healthcare or social care need requiring LTC (Arinzon, Peisakh, Schrire, & Berner, 2011). The two most common cognitive disorders in the LTC resident are dementia and delirium (Arinzon, Peisakh, Schrire, & Berner, 2011). The prevalence of delirium in the LTC resident population ranges between 9.6% 89% (Arinzon et al., 2011). Kiely and colleagues (2003) found 16% of patients suffered from delirium upon admission to PAC facilities. In acutely ill residents of a nursing home, Boockvar, Signor, Ramaswamy, and Hung (2013) identified a 17.7% incidence of delirium. These residents developed delirium, on average, on the third day following the onset of an acute illness (Boockvar et al., 2013).

Older adults who reside in LTC are unable to maintain independent living and have both healthcare (physical and/or mental) and social care needs making them an extremely frail subgroup in the population of older adults (Crocker et al., 2013). Salem et al. (2014) defined frailty as "a state that affects an individual who experiences an accumulation of deficits in physical, psychological, and social domains, leading to adverse outcomes such as disability and mortality" (page 1). Residents who developed

delirium faced the risk of poor outcomes that include a 23% increased risk of falling and two-fold risk of being re-hospitalized. Length of stay (LOS) was more likely to be greater than 30 days and there was greater than six-month mortality as compared to those without delirium (Marcantonio et al., 2005).

Delirium has become a patient safety and cost focus. A driving factor for instituting preventative measures is that 30–40% of delirium cases can be prevented (Inouye, Westendorp, et al., 2014). Delirium is now an indicator for healthcare quality for this population in the Value Base Purchasing Program (VBP) for nursing homes. The political climate in healthcare has moved from pay for simply reporting the volume of healthcare outcomes to currently receiving reimbursement based on achievement and performance (Centers for Medicare and Medicaid Services, 2015). The FY 2019 Skilled Nursing Facility (SNF) Prospective Payment System (PPS) effective July 31, 2018, was part of the Protecting Access to Medicare Act of 2014 (PAMA) public law no. 113-93 and authorized the new nursing home VBP to begin in FY 2019 (Medicare Program, 2018). The outcome measure under this law is 30-day all-cause readmissions (Centers for Medicare and Medicaid Services, 2015). The Improving Medicare Post-Acute Care Transformation Act (IMPACT) 2014 focused on improving quality in SNF and LTC facilities focusing on three domains of improvement: 1) skin integrity and changes in skin integrity, 2) incidence of major falls, and 3) functional status, cognitive function, and changes in function and cognitive function. The measurement for the three domains includes new or worsened pressure ulcers, falls with major injury, and assessment and care planning for functional status. The quality measures will also be posted on the public reporting venues (Protecting Access to Medicare Act, 2014).

VBP has not only a quality improvement focus but also represents a cost impact to the LTC setting. The Congressional Budget Office anticipates a $2 billion savings to Medicare over the next 10 years. Beginning in 2018, CMS began withholding 2% of Medicare reimbursements to SNFs and would pay some or all of those funds based on the facility's performance in meeting the new requirement. (Protecting Access to Medicare Act, 2014).

Research Questions

Research questions for this study were:

1. What is the relationship between CHART-DEL-derived delirium diagnosis and documented ICD-10 coded discharge delirium diagnosis in LTC rehabilitation residents?

2. What is the relationship between delirium (CHART DEL-derived and ICD-10) and variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration in LTC rehabilitation residents?

Purpose

The purpose of this study was twofold: 1) to describe the relationship between CHART-DEL-derived delirium diagnosis and the ICD-10 coded discharge delirium diagnosis, and 2) to describe the relationship between delirium (CHART DEL-derived and ICD-10) and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration in the LTC rehabilitation residents.

Aims

The aims of this study were to:

1. Describe resident demographic characteristics of gender, race, principal admitting diagnosis, admit source, discharge disposition, polypharmacy, dementia, CHART-DEL-derived delirium diagnoses, ICD-10 coded discharge delirium diagnosis, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

2a. Describe the relationship between CHART-DEL-derived diagnoses and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

2b. Describe the relationship between ICD-10 delirium and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

3a. Determine the odds of having a diagnosis of CHART-DEL-derived delirium diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

3b. Determine odds of having an ICD-10-derived delirium diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

Study Theoretical Underpinnings

Homeostenosis

Although well described, delirium is complex, difficult to identify, and not fully understood. The homeostenosis concept is used to explore the occurrence of delirium in

the older adult and to obtain a better understanding of delirium. Homeostenosis suggests the older adult may have stable and functional independent health, but the aging process makes the older adult more vulnerable to decompensating in response to physiological disturbances such as stressors and illnesses that may not have the same impact in the health of the younger adult (Maldonado, 2013). An outcome of the aging process is that older adults succumb to illness more frequently than younger adults due to the poor physiological reserve (Maldonado, 2013). The physiological changes affected by the aging process include brain dysfunction due to a decrease in blood flow, a decline in stress-regulating neurotransmitters, neuron loss (35 % from locus coeruleus and sustantia nigra), vascular changes, and changes in the intracellular signal transductions systems (Maldonado, 2013). With this physiologic vulnerability, reserved capacity is depleted in the older adult. This may explain why the older adult brain decompensates with an exposure to a medication or illness but this same noxious stimuli does not have the same effect in the younger individual (Maldonado, 2013; Flacker & Lipsitz, 1999).

Multifactorial Model of Delirium in Older Persons

Unlike the younger adult, Inouye and Charpentier (1996) identified the older adult patient with vulnerable factors (predisposing factors) and exposed to noxious stimulus (precipitating factors) may be more vulnerable to the development of delirium. Most recently, as a concept, delirium was defined as acute fluctuating attention and cognitive changes in mental status (Inouye et al., 2014).
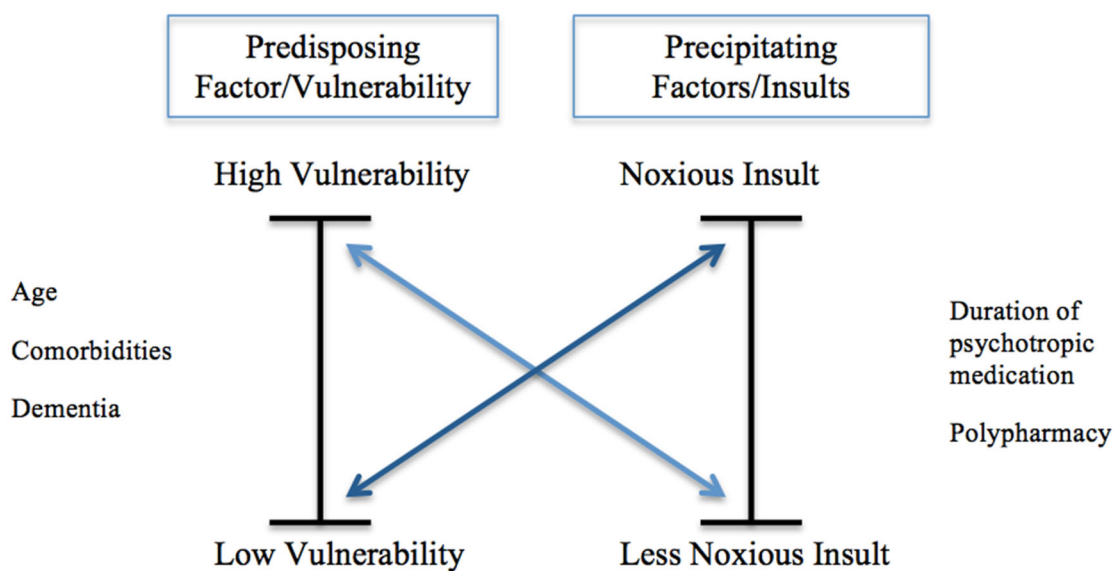
Figure 1. Multifactorial model of delirium in older persons
(Inouye et al., 2014)

Figure 1. Multifactorial Model of Delirium in Older Persons

Figure 1 graphically displays a model that was used to develop the conceptual framework for this study. "The onset of delirium involves a complex interaction between the patient's baseline vulnerability (predisposing factors) present on admission, and precipitating factors or noxious insults occurring during hospitalization" (Inouye, Westendorp, et al., 2014, p. 20).

The onset of delirium is mostly associated with multiple factors and rarely due to a single factor (Inouye, Westendorp, et al., 2014). Inouye and Charpentier (1996) found that reported studies evaluated risk factors but did not separate the baseline vulnerability and precipitating factors, thereby preventing the researchers from understanding the effects each factor contributed to the onset of delirium. They further hypothesized that delirium was a multifactorial geriatric syndrome. This highly utilized Multifactorial Model of Delirium in Older Persons has been tested and validated subsequent to their

first report. The model indicates the higher the baseline vulnerabilities upon admission, the least amount of precipitating factors (insults) will be needed to trigger the onset of delirium. The opposite is also true. If the patient has a low vulnerability on admission then many precipitating factors during hospitalization would be needed to trigger the onset of delirium (Inouye & Charpentier, 1996).

In their binomial regression model, Inouye and Charpentier (1996) included a baseline risk score, five precipitating factors, and exposure period (by 9th hospitalized day) revealing a significant independence between baseline and precipitating factors. This supported the researchers' hypothesis that there was a resistance to the onset of delirium in low-risk baseline patients and high-risk baseline patients were susceptible to the onset of delirium with any precipitating factors (Inouye & Charpentier, 1996).

The predisposing factors/vulnerability have been well studied in both acute care and LTC. The predisposing factors/vulnerability included functional impairment, dehydration, fever, hearing and visual impairment, behavioral disturbances, depression, comorbidity, pain, dehydration, malnutrition, hearing; however, advanced age and dementia were the two most significant factors in this group (Davis et al., 2012; Voyer, Richard, Doucet, & Carmichael, 2009b). The variables of age, comorbidities, and dementia were the predisposing/vulnerable factors evaluated in this study.

Precipitating factors identified in the previous studies included physical restraints, malnutrition, number of medications (greater than three), urinary catheter, and iatrogenic adverse event. The percentage of psychotropic medications found in the greater than three medications factor were at least 1 (70%), 1 (30%), 2 (20%), and 3 (13%) (Inouye & Charpentier, 1996). In this study, the precipitating factors included polypharmacy and

duration of psychotropic medications. See Figure 2 for the model created as the framework for this research.
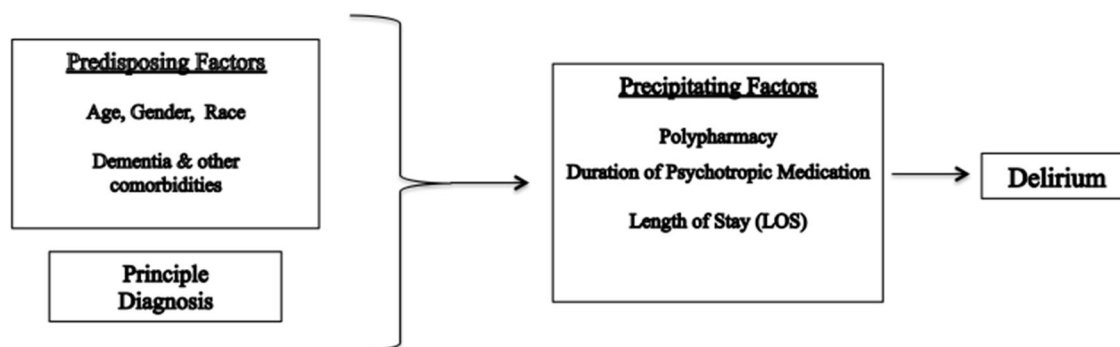
Figure 2. Study Conceptual Framework

Summary

Delirium is a devastating syndrome especially among the older adult population. As more functionally impaired older adults survive acute illnesses, there is an increase in the number of residents requiring admission to LTC for both short- and long-term care. With admission to LTC, residents are at an increased risk of poor outcomes. Most studies have addressed delirium in acute care, some have addressed delirium in the LTC setting, but few have addressed those admitted to LTC for rehabilitation and the relationship between CHART-DEL-derived delirium symptoms and ICD-10 coded delirium diagnosis delirium along with the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. This study is unique as it compares CHART-DEL-derived delirium diagnoses documented delirium symptoms and ICD-10 in the LTC rehabilitation population.

Chapter Two

Review of the Literature

This chapter will provide a review of published articles related to delirium. The researcher used the following databases and websites: CINAHL, PubMed, Ovid, Cochrane, Google, Google Scholar, CMS, HELP (Hospital Elder Life Program), and NIH. Primary articles from a reference list of systematic reviews and meta-analyses were also included in the search. The search timeframe was over the most recent 10 years. However, an exception was made regarding related models that went back to 1996 when the original model used to underpin this study was developed. The articles included a critical review of the various aspects of delirium and were organized into the following sections: overview of delirium, definition and symptomology, delirium subtypes, pathophysiology, risk factors, comorbidities, long term care, screening, length of stay, intensive care unit, post-acute care, treatment/intervention, nonpharmacological management, pharmacological interventions, medication management, psychotropic medications, polypharmacy, and post-acute care/long term care rehabilitation.

Overview of Delirium

As the population ages, the issue of delirium development among older adult patients requires urgent attention since it can increase mortality by more than 25%, accelerate the onset of dementia, decrease independence, experience adverse iatrogenic event(s), and contribute to a longer, costlier healthcare experience (Huson et al., 2016; Marcantonio et al., 2005). Delirium, a common occurring and devastating syndrome frequently underdiagnosed, is strongly associated with many iatrogenic adverse outcomes and often the older adult resident develops an accelerated physical and cognitive decline

(Khan et al., 2012; Fong, Jones et al., 2009). Marcantonio et al. (2005) conducted an observational cohort study in an LTC facility with a PAC unit. Only residents admitted to the PAC unit were included in the study. The outcomes described were delirium, subsyndromal, and no delirium. The study revealed PAC residents with delirium versus PAC residents without delirium were associated with one or more complications (73% versus 41%), re-hospitalized (30% versus 13%), placed in the community upon discharge (30% versus 73%) and all complications were significantly different between the two groups (p<.01) with delirium having more complications. A 6-month mortality was another important measured outcome that compared the resident with delirium versus no delirium, 25% and 5.7% respectively (Marcantonio et al., 2005).

The occurrence rate of delirium in the hospital and in the intensive care unit (ICU) ranged from 11% to 42% and 16% to 89% respectively (Abelha, Veiga, Norton, Santos, & Gaudreau, 2013; Siddiqi et al., 2006). Not only are there serious health and quality of life consequences due to delirium but there is also a significant cost ranging from $143 to $152 billion annually estimated based on U. S. dollars from 2005 (Fick et al., 2015). This represents twice the cost of care for older adult patients with delirium (Fick et al., 2015; Lesli, Marcantonio, Zhang, Leo-Summers, & Inouye, 2008; Steis & Fick, 2012).

Definition and Symptomology

Delirium is described as an acute, cognitive impairment evidenced by the key features of confusion and inattention that fluctuate throughout the day. The confusion may display in the form of disorientation or memory loss. The inattention symptom includes lack of focus, disorganized thinking, and altered level of consciousness or inability to shift attention. Other symptoms may be irritability, psychomotor and

visuospatial problems, hallucinations, delusions and sleep-wake cycle issues (Kukreja, Günther, & Popp, 2015). The onset of delirium is fairly rapid, occurring within a few hours to days. Diagnosis does not require all of these symptoms to present at the same time (Cavallazzi, Saad, & Marik, 2012). The fluctuation and similarity with symptoms attributed to dementia and depression contribute to the difficulty in detecting delirium (Inouye et al., 1999). Of note, delirium does decrease daily living activities and enhance symptoms of dementia (Hasegawa et al., 2013; Khurana, Gambhir, & Kishore, 2011).

The two delirium diagnostic instruments are the American Psychiatric Association (APA) Diagnostic and Statistical Manual, current version (fifth edition), (DSM-5) and the International Statistical Classification of Diseases version 10 (ICD-10) (APA, 2013; ICD-10, 2011). The DSM-5 (2013) and ICD-10 (2011) define delirium for diagnostic reference but are not easily adoptable for the bedside use (Shi, Warren, Saposnik, & MacDermid, 2013). Delirium screening instruments have been developed to be easily applied at the bedside and have utilized the DSM-5 and ICD-10 as the reference gold standards when validating the instruments. The DSM-5 defines delirium as follows:

(a). Disturbance in attention (i.e., reduced ability to direct, focus, sustain, and shift attention) and awareness (reduced orientation to the environment).

(b). The disturbance develops over a short period of time (usually hours to a few days), represents a change from baseline attention and awareness, and tends to fluctuate in severity during the course of a day.

(c). An additional disturbance in cognition (e.g., memory deficit, disorientation, language, visuospatial ability, or perception).

(d). The disturbances in criteria A and C are not explained by another preexisting, established, or evolving neurocognitive disorder and do not occur in the context of a severely reduced level of arousal, such as coma.

(e). There is evidence from the history, physical examination, or laboratory findings that the disturbance is a direct physiologic consequence of another medical condition, substance intoxication or withdrawal (i.e., because of a drug of abuse or to a medication), or exposure to a toxin or is because of multiple etiologies (p. 596).

The ICD-10 is the diagnostic instrument utilized by healthcare coders to determine diagnosis(s) when patients are discharged. The ICD-10 (2011) defined delirium as:

(a) impairment of consciousness and attention (on a continuum from clouding to coma; reduced ability to direct, focus, sustain, and shift attention);

(b) global disturbance of cognition (perceptual distortions, illusions and hallucinations - most often visual; impairment of abstract thinking and comprehension, with or without transient delusions, but typically with some degree of incoherence; impairment of immediate recall and of recent memory but with relatively intact remote memory; disorientation for time as well as, in more severe cases, for place and person);

(c) psychomotor disturbances (hypo or hyperactivity and unpredictable shifts from one to the other; increased reaction time; increased or decreased flow of speech; enhanced startle reaction);

(d) disturbance of the sleep-wake cycle (insomnia or, in severe cases, total sleep

loss or reversal of the sleep-wake cycle; daytime drowsiness; nocturnal

worsening of symptoms; disturbing dreams or nightmares, which may

continue as hallucinations after awakening);

(e) emotional disturbances, e.g. depression, anxiety or fear, irritability, euphoria,

apathy, or wondering perplexity (p. 56).

Delirium Subtypes

Persons can exhibit delirium in a wide variety of ways. There are 3 subtype

classifications of delirium. The most recognized and easiest to diagnose is the

hyperactive delirium. The hyperactive case presents itself in agitation, irritability, lack of

concentration, and perseveration (Cavallazzi et al., 2012). Hypoactive delirium, the most

common and often misdiagnosed, is present when the patient is subdued, lethargic,

comatose, with absence of or slowed speech and hypokinesia. The third subtype is a mix

of hyperactive and hypoactive delirium. Khurana and colleagues (2011) reported the

prevalence of hypoactive, hyperactive, and mixed delirium as 65%, 25%, and 10%,

respectively.

In the acute care setting, the association between delirium psychomotor activity

subtypes and mortality has been well-described but none have been reported in PAC/LTC

rehabilitation. Kiely, Jones, Bergmann, and Marcantonio, (2007) recognized the need to

assess the association between psychomotor activity delirium subtypes and 1-year

mortality in PAC/LTC rehabilitation facilities and compare the results with previous

studies. The prospective study was part of a randomized controlled trial (RCT) of a

Delirium Abatement Program (DAP) from October 2000 to June 2003 and included eight

Boston-area skilled nursing facilities with a PAC unit specifically for rehabilitation and cognitive recovery. The results of the delirium subtypes revealed 46.4% were hypoactive, 31.3% normal, 12% mixed, and 10.3% hyperactive. The 1-year mortality survival trajectory was in the hypoactive group and significant (log rank 10.9; $p = .01$). The hazard ratio (HR) compares the risk of dying within the 1-year follow up timeframe from abnormal psychomotor activity to normal psychomotor activity. The resident HR risk of dying compared to normal activity had hypoactive psychomotor activity with a significant and greatest risk of dying HR 1.60%, CI 1.11-2.37; $p <. 01$; mixed HR 1.26, CI 0.73-2.14, $P <. 40$, and hyperactive HR 1.23, CI 0.70-2.18, $p <. 47$ not significant and had the lowest risk.

The researchers' conclusion that the hypoactive delirium subtype resident was significantly at the greatest risk of dying within 1 year is important, as the hypoactive subtype is the most common type in LTC/PAC and it is the subtype most often under recognized. The study was conducted in a metropolitan area, which may make it difficult to generalize the results to previous studies conducted in rural settings, rehabilitation hospitals, or the community setting. The strength and limitations remain the same as with the previous studies within the DAP population.

Pathophysiology

The mechanism that triggers delirium is not completely understood; however, there are studies that identify neurotransmitter involvement. What is known is that delirium does accelerate the cerebral disturbance the patient may already have. The medical conditions contributing to delirium include inflammation, cerebral hypoperfusion, oxidative stress, mitochondrial dysfunction, and hypothalamic and

pituitary adrenal axis hyperresponsiveness (Kukreja et al., 2015). It is suggested the neurotransmitter system interaction with cholinergic, acetylcholine, serotonergic, dopamine, and noradrenaline glutamate activity contributed to the onset of delirium (Cavallazzi et al., 2012; Kukreja et al., 2015).

Acute illness, trauma, surgery, and drugs are known precipitating factors to the onset of delirium but what is not well understood is the molecular means by which these factors contribute to delirium (MacLullich, Ferguson, Miller, de Rooij, & Cunningham, 2008). The predisposing factors for delirium, such as ageing and central nervous system disease have an associated impact on the stress and behavior responses (MacLullich et al., 2008).

MacLullich et al. (2008) categorized the etiological factors into two groups: direct brain insults and aberrant stress. Direct brain insult includes factors that acutely impact the brain function and disrupts the neuron network (Inouye, Westendorp, et al., 2014; MacLullich et al., 2008). This brain dysfunction can be attributed to multiple factors including metabolic abnormalities, trauma, hemorrhage, or drugs that directly affect neurotransmission (MacLullich et al., 2008). Multiple areas of the brain can be affected by hypoxemia or systemic hypoglycemia. Local impact may be attributed by thrombosis, hemorrhage, or vasospasm by occluding key cholinergic pathways and basal ganglia. A common outcome associated with septic shock is delirium and may be due to impaired cerebral perfusion and blood brain permeability. Central nervous system diseases such as meningitis or encephalitis may be due to metabolic disturbance or parenchyma damage that impacts acetylcholine neurotransmitters (MacLullich et al., 2008). Pharmacological brain insult is described as affecting the neurotransmission when the dopaminergic

system is overly active and cholinergic system is underactive (MacLullich et al., 2008). Inouye et al. (2014) described contributors to delirium as mechanisms and biological factors (likely a direct impact on neurotransmission and/or cellular metabolism). Major mechanisms included "neurotransmitters, inflammation, physiological stressors, metabolic derangements, electrolyte disorders, and genetic factors" (Inouye, Westendorp, et al., 2014 p. 5). The biological factors included drugs, hypercortisolism, electrolyte disturbances, hypoxia, or impaired glucose oxidation (Inouye, Westendorp, et al., 2014).

Aberrant stress is the second category that contributes to the acute onset of delirium. Pathology, aging, neurodegeneration, negative systemic factors (stress, infection, injury, and surgery) impaired stress response, and heightened inflammatory all may interact and contribute to the onset of delirium (MacLullich et al., 2008). During the stimulation of the immune system, changed behavior may be due to the central nervous system synthesis of pro-inflammatory mediators (cytokines and prostaglandins) (Inouye et al., 2014; MacLullich et al., 2008). The systemic inflammatory routes could be the pathogen directly interacting with neurons, stimulating endothelial brain cells to secrete prostaglandins in the brain parenchyma or vagal nerve stimulating the brain by neural pathway (Inouye, Westendorp, et al., 2014; MacLullich et al., 2008). The blood brain barrier is another critical player in this process. The impact that age, diabetes, Alzheimer's, vascular dementia have on the structure and function of the blood brain barrier results in the inappropriate strength of the inflammatory signals causing a negative impact. The interaction of the neurodegenerative disease already inflamed (microglia activation), the systemic inflammatory cytokines and the degree of central nervous

system response is likely to contribute to a more severe response (Inouye, Westendorp, et al., 2014; MacLullich et al., 2008).

Risk Factors

Delirium is complex, preventable, and rarely a single factor; rather, it is commonly multifactorial (Inouye, Westendorp, et al., 2014). Each resident has a different level of susceptibility to the onset of delirium, which can be dependent on various factors (Young, Murthy, Westby, Akunne, & O'Mahony, 2010). Risk factors are categorized into predisposing or precipitating factors. Predisposing risk factors are resident baseline vulnerability factors and precipitating factors are potentially modifiable insults or environmental factors that contribute to the onset of delirium (Davis et al., 2012; Inouye & Charpentier, 1996; Voyer et al., 2009b; Voyer et al., 2011).

A state-of-the-art review of multiple aspects of delirium including etiology reviews from original published articles of validated risk prediction models between 1990 and 2012 was published by Inouye and colleagues in 2014. The review focused on primary articles including articles from a reference list of systematic reviews and meta-analysis.

The interrelationship of the validated multifactorial model was described and it reinforced the multifactorial impact in triggering the onset of the delirium syndrome (Inouye et al., 2014). The more vulnerable the patient is (multiple predisposing factors) the least amount (benign) the insult (lower degree precipitating factor/modifiable) will be needed to create the right combination that could catapult a patient into a delirious state. The opposite is also true; the non-vulnerable patient (minimal predisposing factor) will require a significant number of precipitating factors to trigger delirium.

A review of other prospective, validated predictive models identifying predisposing and precipitating factors was also conducted. The populations of the 11 studies extended from general medical, surgical (non-cardiac and cardiac), ICU. The risk factors reported included 11 predisposing factors and 10 categories of precipitating factors. The review reinforced that of the 11 predisposing factors reported, the highest risk for the onset of delirium was found in the general medical and non-cardiac surgical population and included dementia or cognitive impairment, advanced age (> 70), functional impairment, vision impairment, and alcohol abuse (Inouye, Westendorp, et al., 2014). Importantly, comorbidity burden or specific comorbidities such as stroke and depression were risk factors for triggering delirium in all populations and a 40% to 500% increased risk with reported abnormal lab values affected all populations. Precipitating factors had more variation among the populations studied. Of the 10 precipitating factors reported, there was a 4.5 times increased risk of developing delirium in the medical population who were exposed to the following precipitating factors: polypharmacy, psychoactive medication, and physical restraints.

This review did not include all diseases, especially neurological diseases that contribute to the delirium syndrome. The other critical population not included in this review is the PAC/LTC population, which is growing rapidly and at high risk for delirium. Findings from this study provided information regarding the impact of risk factors, the interrelationship between predisposing and predictors, and what to consider when developing intervention strategies for clinicians.

Comorbidities

With the advancement of technology, medication, and healthcare practice, adults

are living longer with chronic diseases and surviving intensive care and acute care

hospitalization. In LTC settings, comorbidity is associated with the duration of delirium

and mortality (Arinzon et al., 2011). Duration of delirium was associated with multiple

variables including number of comorbid diseases, specifically, congestive heart failure

(CHF), chronic renal failure (CRF), and previous cerebral vascular accident (CVA).

Multiple variables were also associated with mortality that included CHF, cardiovascular

disease (CVD), and pulmonary disease (Arinzon et al., 2011). One study reported an

association between delirium symptoms and comorbidity in the PAC setting that included

both rehabilitation hospitals and skilled nursing care facilities (Marcantonio et al., 2003).

Interestingly, another study reported medical illness was not associated with delirium in

LTC and is inconsistent with studies in acute care (McCusker et al., 2011b).

Long Term Care

Delirium has been identified in the LTC setting. However, because of the

different "homelike" environmental setting compared to the acute care hospital setting

and population, risk factors from acute care cannot be generalizable to LTC (Voyer et al.,

2011, p. 172). Voyer, Richard, Doucet, and Carmichael (2009b, 2011) investigated both

the precipitating and predisposing factors in the LTC setting in two separate studies using

the same population. Both studies were a cross-sectional design including 155 residents

with delirium and dementia, three LTC facilities, and one hospital-based LTC all located

in Quebec, Canada.

Voyer and colleagues (2011) studied precipitating factors of LTC residents. The

two aims were to identify precipitating factors associated with delirium and to assess the

number of precipitating factors that contribute to the onset of delirium. Validated and

widely used instruments used were the Confusion Assessment Method (CAM) to identify

delirium (sensitivity 94% to 100%; specificity 90% to 95%) and the Hierarchic Dementia

Scale (HDS) to measure the severity of dementia. The precipitating factors assessed in

this study included physical restraint (observed), sensory stimulation (13-item, 3-point

scale questionnaire), physical environment (11-item questionnaire), iatrogenic events

(adding number for each resident), physical activity (4-item questionnaire) and

medications (narcotics, benzodiazepines, antipsychotics, antidepressants) within a 24-

hour time period. All assessments were obtained during 7-hour observation period. The

other variables assessed were comorbidity, using the Charlson Comorbidity Index (CCI)

and functional autonomy with the Functional Autonomy Measurement System (SMAF).

The results reported for delirium occurrence and comorbidity among resident

were high: 70.3% and 84% respectively (Voyer et al., 2011). The resulted precipitating

factors significantly associated with delirium were 3 of the 10 assessed: physical

restraints (the most strongly associated) (*OR* 3.46; CI 1.65-7.22; *p* <. 05), sensory

stimulation (*OR* 0.79; CI 0.62-0.99; p<. 05), and adequacy of physical environment (*OR*

0.66; CI 0.50- 0.87; *p* < .05) (Voyer et al., 2011). Further testing of restraints and

association of delirium included multivariate analysis (*OR* 4.64; CI 2.62-8.27), indicating

a 464% odds of being delirious. A risk score to determine the number of variables that

were associated with the risk of developing delirium reported an *OR* 2.53% (CI 1.4-4.49)

or a 253% increased risk. The analysis to determine number of precipitating factors that

affect the onset of delirium was a logistic regression model controlling for physical

restraints. The analysis identified two precipitating factors will have a 6-fold greater

odds of delirium as compared to no precipitating factors. This population had 76%

residents with delirium and 2 precipitating factors.   The percentage of residents with

delirium increased to 90% with 3 precipitating factors. The residents with high

prevalence of dementia made this vulnerable population at increased risk of developing

delirium, which is consistent with the multifactorial model (Voyer et al., 2011).

Predisposing factors were explored (Voyer et al., 2009b). The same instruments

assessing for delirium and severity of dementia as mentioned in above study were used

(Voyer et al., 2009b, 2011). The predisposing factors included pain, depression,

comorbidity, behavior problems, functional autonomy, number of medications,

dehydration, fever, malnutrition, sleep problems, and visual and hearing impairment. The

total number of predisposing factors tested using a bivariate analysis were 21 and 9 (age,

severity of dementia, level of functional autonomy, number of medications, pain,

behavioral problems, dehydration, brachial perimeter, geriatric fever) and were associated

with delirium (Voyer et al., 2009b). The multivariate analysis revealed that age (*OR*

1.07; CI 1.05-1.10) and severity of dementia (*OR* 1.05%; CI 1.03-1.07; *p* < .05) were

associated with delirium. Each study provided a strong training program to provide

standard approach for the study nurse a good interrater reliability, used reliable

instruments that reported validated data, and measured the appropriate variable. Neither

study included the LTC rehabilitation patient population.

There is a difference between the two populations regarding various factors that

contribute to the risk of developing delirium in these settings. In both the acute care and

LTC populations, the onset of delirium is most often multifactorial involving both

predisposing and precipitating factors. The common predisposing factor between acute

care and LTC were dementia/cognitive impairment, advanced age, and functional

autonomy. The precipitating factor identified in both acute care and LTC was physical restraints. The LTC had nine predisposing factors but only three were congruent with acute care.

Screening

In the clinical setting, delirium frequently goes undetected by the clinical staff. One study noted that 50% of cases are undiagnosed (Volland & Fisher, 2015). To improve delirium identification, a delirium-screening instrument is essential. Elliott (2014) reported that if a delirium instrument was not employed, as much as two-thirds of delirium went undetected. Different terms are used interchangeably at times with delirium. Those can include ICU psychosis, acute mental status change, acute confusion, and postoperative psychosis. These terms may affect diagnosing delirium and contribute to a delay in appropriate care measures that need to be taken (Volland & Fisher, 2015).

The identification of delirium is complex and the presentation can be multifaceted. The challenge is determining if the cognitive change is due to dementia, psychotic disorder, neurovascular insult, or a complication of a systematic illness (Miller, 2008). To determine what is occurring, it is imperative to routinely conduct an assessment using appropriate instruments by trained staff (Kukreja et al., 2015).

National guidelines have clearly identified a systematic approach in assessing for delirium including the frequency of needed assessments (Elliott, 2014). Multiple, well-established, widely used, and reliable/valid screening instruments for delirium are currently available. Consistent compliance with the guidelines and appropriate utilization of the available instruments is still needed (Elliott, 2014; Voyer et al., 2015). One systematic review identified six validated instruments to assess for delirium including

Cognitive Test for Delirium, abbreviated Cognitive Test for Delirium, Confusion

Assessment Method for Intensive Care Unit (CAM-ICU), Intensive Care Delirium

Screening Checklist, Neelon and Champagne Confusion Scale, and Delirium Detection

Score (Cavallazzi et al., 2012).

       The CAM-ICU is the most studied and widely used instrument in the ICU to

assess for delirium. This instrument measures 4 key features: acute onset or fluctuating

course, inattention, disorganized thinking, and altered level of consciousness (Cavallazzi

et al., 2012). By using the CAM-ICU, the diagnosis of delirium was improved with a

reported 87% of ICU patients and 83% of mechanically ventilated patients experiencing

delirium (Ely, Inouye, et al., 2001; Ely, Margolin, et al., 2001). Van Velthuijsen et al.,

(2016) conducted a systematic review assessing the validity, reliability, and feasibility of

delirium identification instruments in the older adult hospitalized patient. Forty-three

studies were reviewed and 28 instruments met the criteria for inclusion. The studies were

categorized as follows: 10 observational, 6 interactive and 12 mixed. The delirium-

screening instruments population application was described as two ICU (CAM-ICU,

Intensive Care Delirium Screening Checklist (ICDSC) and one emergency department

(modified CAM for the Emergency Department; mCAMed). The instruments can be

divided into two categories to screen for delirium: trained professionals and

family/informal caregiver (Delirium scale (I-AGeD); Family-CAM (FAM-CAM); Simple

Question in Delirium (SQiD).

       Delirium Observation Screening Scale (DOS) is a highly valid and reliable

instrument utilized by nurses and has a reported sensitivity of 89% to 100%, with

specificity at 87% and 97%, interrater reliability (Spearman r-0.54) and internal

consistency (Cronbach's α=0.93 to 0.96) (van Velthuijsen et al., 2016). The Nursing

Delirium Screening Scale (Nu-DESC) as the name of the instrument implies, is

implemented by nurses and has a sensitivity ranging 32% to 96%; specificity ranging

69% to 92%, an interrater reliability a-0.94 (van Velthuijsen et al., 2016). CAM, the

most validated and used delirium screening instrument, has sensitivity ranging 46% to

94%, specificity ranging 63% to 100%, interrater reliability kappa 0.65 to 1.00 and

implemented by nurses (van Velthuijsen et al., 2016). CAM-ICU, a highly validated and

reliable delirium screening instrument specifically for the ICU patient population, has a

sensitivity ranging 28% to 92%, specificity ranging 89% to 99%, interrater reliability

kappa ranging 0.81 to 0.94 and implemented by nurses (van Velthuijsen et al., 2016).

The Delirium Rating Scale Revised-98 (DRS-R-98) instrument was designed to screen

for delirium and determine symptom severity (van Velthuijsen et al., 2016). The

instrument DRS-R-98 is implemented by clinicians (not nurses) and has a reported

sensitivity ranging 56% to 93%, specificity ranging 82% to 98%, interrater reliability

ranging 0.92 to 1.00, and internal consistency a=0.91 to 0.94 (van Velthuijsen et al.,

2016). The family/informal caregiver instruments also have been validated. FAM-CAM

has a reported sensitivity 75% and specificity 91%. Single Question in Validity (SQiD)

has a reported sensitivity of 77% and specificity 51% (van Velthuijsen et al., 2016). The

researchers measured many other instruments but only had one validation study so no in-

depth reporting was provided.

In summary, the review of instruments used in the management of delirium

provided information about what instruments are available, what they are used for, and

offered a guide to researchers on the most appropriate setting in which the instrument can

be implemented to identify delirium. The instruments were reported to have a sensitivity and specificity of ≥ 80% and all could be completed within a short timeframe. It is not only essential to have a reliable and sensitive instrument but to have one that will be utilized by the staff. The CAM is the most widely used, with high reliability and validity, for delirium-screening in both medical and surgical patients, used in various settings including ED and ICU, and implemented by nurses. The FAM-CAM instrument obtains the family/informal caregivers' participation is assessing for delirium to assist with early recognition. The most widely used instrument for identifying delirium-severity is the DRS-98. The combination of observational and interactive items in delirium-screening instruments is most useful for diagnostic means for physicians (van Velthuijsen et al., 2016).

Length of Stay

Increased LOS has been reported in patients with delirium as compared to patients without delirium. There are several studies indicating that delirium in the acute care setting has a deleterious impact by extending LOS (Marcantonio, Flacker, Michaels, & Resnick, 2000; Marcantonio et al., 2003; McCusker, Cole, Dendukuri, & Belzile, 2003). One study reported a significant increased LOS in prevalent subsyndromal delirium cases in the acute care setting (Cole, McCusker, Dendukuri, & Han, 2003). Inouye et al. (1999) conducted an intervention study evaluating the effectiveness of the multicomponent program that implemented strategies to address delirium risk factors to prevent delirium. The LOS was measured by days resulting in a similar mean for both intervention 7 days and usual care 6.5 days (Inouye et al., 1999).

McCusker et al. (2003) investigated the impact delirium has on LOS over a 12-month timeframe identifying patients via a two-step process: screening interview and chart review of documented delirium symptoms in nurses' notes. They evaluated 359 patients (age ≥ 65 years) resulting in 241 with delirium admitted to a Canadian university acute care hospital during the first week (excluding ICU, oncology or stroke patients). For patients with prevalent delirium (adjusting for a diagnosis of dementia), results indicated there was no significance in LOS between prevalent and non-delirium matched control groups. The median and interquartile ranges (13.0, 7.0-21.0; 8.0, 5.0-7.0, respectively) identified patients with prevalent delirium. Their population had a large portion with dementia from a skilled nursing facility. The incident cases did have significance in LOS, 8 days longer, between the incident delirium and matched control group reporting median and interquartile (16.5, 11.0-23.0; 7.5, 4.0-15.0, respectively) with and without adjustments (McCusker et al., 2003). It was the interaction between delirium and dementia that contributed to increased LOS (McCusker et al., 2003). The researcher did identify that one instrument, IQCODE, used to detect dementia, had not been validated with delirium population. A strength of the study is the large sample size that provided the researcher a 99% power to detect LOS between incident delirium and matched controls (McCusker et al., 2003).

Stroke patients can also present with delirium; however, there is a paucity of information on the outcomes in this group. A systematic review and meta-analysis reviewed relevant articles through 2011 to evaluate outcomes of stroke patients with delirium in an acute hospital, inpatient mortality, 12-month mortality, institutionalization, and LOS (Shi, Quiyun et al., 2012). Ten studies met the criteria for inclusion and a total

of 2,004 patients were included in the review. The LOS was reported to be greater in the six studies (n=1,290 patients). The researchers calculated the LOS from two studies by computing both study results. The LOS was higher, 9 days longer (mean difference 9.39 days, 95% CI 6.67-12.11), when patients developed delirium as compared to patients without delirium (Shi, Presutti, Selchen, & Saposnik, 2012).

Intensive Care Unit

The delirious patient is at greater risk of experiencing a sequelae. One study reported a 3.2 increase in 6-month mortality and a twofold increase in the length of hospitalization (Cavallazzi et al., 2012). The ICU patient with delirium has potentially both short-term and long-term sequelae. The short-term outcomes include confusion, agitation, sleep-wake cycle disturbance, and disorientation. The delirious patient has a longer ICU stay, increased and heavier use of sedation, physical restraints, increased mortality, and increased falls (Kukreja et al., 2015). At 6 months, post-operative SICU patients with delirium had 3.2 times higher mortality, increased personal activity of daily living (ADL) dependency (p<0.001), and negatively impacted quality of life (Abelha et al., 2013).

The long-term consequences have been reported as far out as 12 months following the older adult patient's hospitalization. The patient with delirium may experience both physical and cognitive decline, institutionalization, and higher mortality (Kukreja et al., 2015). One study reported of the 55 patients studied, 78% of the critical care survivors developed impairment in memory, attention, concentration and/or mental processing speed 1 year after mechanical ventilation. Also there is evidence of dementia-like symptoms following ICU stay (Girard et al, 2010). Rothenhäusler, Ehrentraut, Stoll,

Schelling, & Kapfhammer (2001) studied patients who survived acute respiratory distress

syndrome over 10 years and identified 24% had cognitive impairment that affected their

ability to return to work and poor health. Another study evaluated patients who had heavy

sedation and after 1 year; 34% had cognitive scores at the level of brain injury and 24%

had scores similar to Alzheimer's patients (Pandharipande et al., 2013).

Post-Acute Care

Marcantonio et al. (2003) conducted a study to identify the prevalence of delirium

upon admission, delirium persistence, and functional recovery associated with delirium

upon admission to PAC settings (85 PAC: 55 rehabilitation and 30 skilled nursing

facilities) in 29 states that included 551 residents age $\geq$ 65 years. The study was a field

validation study testing the Minimum Data Set for Post-Acute Care (MDS-PAC) from

December 1998 to February 1999. The bedside staff was trained to use the MDS-PAC

and implemented the screening within 4 days of admission followed by a random patient

selection to conduct another MDS-PAC assessment on the 11th or 18th day from

admission. The total number of symptoms was assessed within one week from admission

and measured as more, less, or none compared to admission assessment. Functional status

was also reported on both admission and 1-week utilizing the ADL and instrumental

activity of daily living (IADL) MDS-PAC. Delirium assessment reported results included

23% overall prevalence; 1 week follow-up assessment, 14% resolved, 22% decreased

symptoms, 52% no change, 12% increased symptoms and 4% incidence (new

occurrence). The delirium occurrence is strongly associated with dementia ($p <. 01$) and

comorbidity ($p.01$). Functional recovery was worse, ADL change 3.6, CI 2.2-5.0; IADL

change 2.6, CI 1.4-3.6, with the same or increased delirium symptoms compared to

decreased or resolved symptoms.

Treatment/Intervention

Delirium is more often attributed to a multifactorial verses single factor cause and 30% to 40% of the cases are considered preventable (Inouye et al., 1999). In each program attempting to effectively decrease the risk, occurrence, and negative outcomes of delirium, it is important to enlist both preventative and treatment protocols (Huson et al., 2016). Treatment should be focused on the underlying causes and risk factors contributing to the onset of delirium and may include acute medical illness, adverse event, or drug intoxication (Huson et al., 2016). By knowing what precipitating factors contribute to the delirium onset, clinicians can initiate the appropriate management of the risk factor. The treatment strategies can be broken into two segments: non-pharmacological and pharmacological. Preferably, initiating non-pharmacological intervention should be done, making it the first-line treatment strategy (Fong, Tulebaev, et al., 2009). Pharmacological intervention should be implemented when non-pharmacological interventions have failed or when there is an urgent need to prevent harm to the patient, either medically or psychologically (Cavallazzi et al., 2012).

Nonpharmacological Management

Nonpharmacological management has been effective in preventing and reducing the symptoms of delirium. One study showed a 40% decrease in the odds of developing delirium (Kukreja et al., 2015). Strategies to address risk factors include management of dehydration, immobility, sleep disturbance, and visual and hearing impairment. Environmental factors are critical to address to prevent or reduce the onset of delirium. The environmental aspects to modify include appropriate light exposure during the day,

minimize light during the night, and temperature control and noise level, especially at night, which can contribute to the disruption of sleep (Kukreja et al., 2015).

A pioneer intervention study assessed the effectiveness of a multicomponent program, Elder Life program, determined adherence to the program and the impact on the risk factors determined in the acute care setting (Inouye et al., 1999). The prospective individual-matching studied population were patients admitted to a non-critical care urban teaching hospital located in Connecticut (Inouye et al., 1999). The study implemented standard intervention protocol to address 6 risk factors (cognitive impairment, sleep deprivation, immobility, visual impairment, hearing impairment and dehydration) with the ultimate goal to reduce the incidence of delirium. Overall, the intervention group had a significant decrease in delirium than the usual care group (9.9%) verses usual care (15%) and match odds ratio 0.60 (95% CI 0.39 to 0.92), p=0.02 (Inouye et al., 1999). Overall compliance with the intervention protocols was 87% and reasons for non-adherence was multifactorial: patient refusal, patient not available, intervention staff not available, and medical contraindications resulting in less risk factors in the intervention group (Inouye et al., 1999). This study was instrumental in identifying prevention as the primary effective strategy to reduce risk of delirium (Inouye et al., 1999). This study did not include PAC or LTC.

Post-Acute Care

There have been many studies to address delirium in the acute care setting and development of intervention/prevention delirium programs but few have been explored in LTC/PAC. Due to the specialty environment of the LTC and PAC settings, the adoption of the models developed for acute care may not be effective in the PAC setting.

Bergmann, Murphy, Kiely, Jones, & Marcantonio (2005) described the Delirium

Abatement Program (DAP) developed in 2000 that addresses persistent delirium

specifically in the PAC setting. The primary goal of the DAP is to reduce the duration of

delirium and improve functional recovery. The DAP was implemented in eight skilled

nursing facilities with separate dedicated units for skilled nursing care and rehabilitation

care. The patient population consisted of patients admitted directly from acute care

following a medical or surgical hospitalization. Screening for delirium took place within

five days of admission and previous prevalence for delirium and dementia was reported

16% in skilled nursing care and 33% in rehabilitation care. An experienced research

nurse provided consultation in the implementation of DAP in the PAC units of each of

the skilled nursing care facilities. The benefit in implementing DAP is the standardization

in the PAC unit in the following areas: delirium screening, assessment and treatment of

possible causes, prevention and management, and restoration of patient cognitive and

self-care function (Bergmann et al., 2005).

A mixed methods with a repeated measure study by Huson et al. (2016) evaluated

the impact of implementing a multicomponent intervention program aimed at preventing

delirium and functional decline in the older adult patient ($\geq$ 70 years) in a PAC

rehabilitation hospital. The Hospital Elder Life Program (HELP) has provided positive

results in the acute care hospital setting (medical unit, geriatric unit, surgical unit) but this

was the first PAC setting. The qualitative method of this study utilized a purposeful

sampling for a total of 6 patients that participated in the study. Caregivers (of the patients

in the program), volunteers, and staff participated in a focus group interview.

The reduction of delirium was greater in the intervention group (10.9%

admission/ 2.5% at discharge) compared to the usual care group (2.5% admission / 2.5% at discharge), LOS was lower in HELP group (52.3 versus 59.2; p = .244), significant improvement in short-term memory and recall in the intervention group mean 0.8 –0.1 usual group; p = .006); FIM 25.9% improvement intervention group and 20.9% improvement; p = .188) and rehabilitation efficiency 0.5 intervention group and 0.4 usual care group; p =. 381.

Inouye, Marcantonio, and Metzger (2014) conducted a thorough review of delirium in the elderly. Prevention and treatment were reviewed and reinforced the positive impact HELP, the most widely adopted multicomponent intervention strategy, has had on the reduction of delirium and functional impairment. With the wide implementation of the program in greater than 200 hospitals, the studies have revealed a cost-effective method in preventing delirium. Although this program has been adopted in various healthcare settings none has been reported as being adopted in the LTC rehabilitation setting.

Although HELP has been well disseminated in over 200 hospitals globally, there are other nonpharmacological interventions. A proactive geriatric consultation to address management of surgical patients pre- and post-op had a positive result in an RCT. Additional interventions that have shown to be effective included geriatric units multifactorial intervention, interdisciplinary consults, family conducted intervention, education of staff, and rehabilitation intervention. (Inouye, Westendorp, et al., 2014). Other nonpharmacological interventions are earplugs at night (enhance sleep factor) and the Delirium room, which are promising but lacked rigor in the studies at this time. The scientific criteria used to critique the published articles included: "≥ 25 patients in each

intervention and control group, prospective sampling framework, validated delirium assessment and achieved a modified Jadad score" (Inouye, Westerndorp, et al., 2014, p. 8).

Pharmacological Interventions

The pharmacological prevention and treatment publications were evaluated using the same methods as stated for non-pharmacological strategies. The concern is that the antipsychotics and sedations will only modify the level of agitation or behavioral symptoms resulting in moving from hyperactive to hypoactive delirium (Inouye, Westendorp, et al., 2014). Hypoactive syndrome is associated with worse outcomes. Due to the lack of rigor or reproducible evidence, the researchers could not make recommendations for the pharmacological use in delirium prevention or treatment. The researchers do recommend the best approach is a "multipronged nonpharmacological approach, such as cognitive rehabilitation, drug reduction or drug sparing approaches (i.e., substituting less toxic neuroprotection, sleep enhancement (e.g. melatonin), and reduction of pain and stress including complementary and alternative medicine" (Inouye, Westendorp, et al., 2014 p. 11).

Review of the patient's medications is critical. Reducing, eliminating, or substituting the current medication regime may decrease the symptoms of delirium. The implementation of medication such as antipsychotics on a short-term basis and at the lowest dose has been shown to reduce the duration of delirium (Kukreja et al., 2015). To manage behavioral changes low doses of haloperidol is the drug of choice.

Medication Management

Medications, especially psychotropic and polypharmacy, have been associated

with the onset of delirium and adverse outcomes. Baby boomers 65 and older have become the largest population in the healthcare system and will contribute to the alarming incidence of medication adverse events and delirium. Medications may contribute to the onset of delirium in12%-39% delirium cases, and are considered the most preventable trigger in the development of delirium (Hein et al., 2014). Between 1997 and 2008, one study reported a 96% increase in drug-related admission in the 65 to 84 year old adult population (Morandi et al., 2013). They also indicated approximately 50% of the hospital admissions related to adverse drug events occurred in the 80 or older adult population.

As the older adult develops the onset of diseases related to aging, there is also an increased use of medications to treat chronic diseases. The challenge is for physicians to be cognizant of medications that are necessary to treat the patient and understand the drug-to-drug interactions. The medications prescribed may be the right medication for the clinical event; however, with improved clinical condition, the medication may no longer be needed. Morandi et al. (2013) indicated 50% of the hospitalized older adults would be discharged home with at least one potentially inappropriate medication (PIM) and one actual inappropriate medication (AIM). Interestingly, 50% of PIMs and 59% AIMs were first prescribed while in the ICU.

Treating the older adult ICU patient is complex and often requires multiple medications to help them survive their critical illness. During their critical health crisis, the clinical benefit of the medications prescribed outweigh the risk of delirium. However, once the patient improves, it is important for clinicians to assess the patients' medications and determine the need for those medications, the risk, and the drug-to-drug interaction.

This will reduce the risk of developing delirium and ensure the most appropriate medications are prescribed for the patient including at the time of discharge. (Morandi et al., 2013).

The American Geriatrics Society Beers Criteria Update Expert Panel (2015) reviewed the medications that are used for the older adult and developed criteria to help drive safe medication practice in this population. The objective was to update the PIMs to ensure safe prescribing practices for the older adult. There have been adverse events associated with PIM that include confusion, falls, and mortality. To reduce the risk of poor patient outcomes related to medications, the update included medication dose adjustment related to kidney function and drug-to-drug interaction. The criteria will not only provide safe medication practice patterns for practitioners working with the older adult but will also be a multipronged resource to educate clinicians, patients, and families in the appropriate selection of medications, provide a means to track cost, medication usage in the older adult population, and drive quality of care. The criteria will help guide care for the older adult ($\geq$ 65 years) in all settings (acute care, outpatient, institutionalized care) excluding hospice and palliative care (The American Geriatrics Society Beers Criteria Update Expert Panel, 2015).

Psychotropic Medications

There is controversy surrounding the use of antipsychotic medications in the prevention or treatment of delirium (Inouye, Westendorp, et al., 2014).   For every recommended treatment it is essential to have well-supported evidence demonstrating the benefits outweigh the risk of harm and currently there is no reproducible evidence that clearly demonstrates antipsychotic effectiveness in prevention or treatment of delirium

(Inouye, Marcantonio, et al., 2014; Inouye, Westendorp, et al., 2014).   The American

Geriatrics Society Beers Criteria Update Expert Panel (2015) identified antipsychotic

medications as a PIM due to the lack of consistent scientific evidence of effectiveness

and risk of drug-related adverse events. This panel has recommended that if an

antipsychotic medication is used in the treatment of delirium, it should not be the first

line of treatment and used only if nonpharmacological methods have proven ineffective

or cannot be implemented. In the LTC population, there have been safety concerns with

the high use of antipsychotic use (Chen, 2010). The Food and Drug Administration

issued a black box warning on antipsychotic use in 2005 for older adult patients with

dementia and another warning in 2007 for all antipsychotic use due to the high

association of antipsychotic medications and mortality (Chen, 2010; Jung, Meucci,

Unruh, Mor, & Dosa, 2013). To evaluate the antipsychotic use in the Medicare

beneficiaries in LTC, the Office of Inspector General investigated LTC facilities in 2011,

revealing 14% of residents were on atypical antipsychotic, 83% were off-label

indications, and 88% had dementia even following the black box warning placed in 2005

and 2007 (Urick, Kaskie, & Carnahan, 2016).

A systematic review conducted by Flaherty, Gonzales, and Dong in 2011

examined 13 studies, six on a single-agent (drug) and seven comparing two agents (drug)

with varying number of participants in the treatment arms; 62% (8 studies) had < 25 and

15% (2) had > 70. The antipsychotic medications included haloperiodol, quetiapine,

risperidone, olanzapine, mianserin (not available in U.S.), perospirone (not available in

U.S.), and amisulpride (an antidepressant-different than atypical or conventional

antipsychotic). The instruments used to diagnosis delirium were the Diagnostic and

Statistical Manual of Mental Disorders Fourth Edition (DSM-IV) (12 studies) and DSM-III-R (1 study). Both instruments are widely used and well-validated.

The ability to draw conclusions regarding the effectiveness of the studies was compromised and the lack of a control group is challenging with the wide variation and lack of key description of the methods used for each of the studies. The sample size was generally small and from a variety of countries. No LTC rehabilitation or PAC populations were included in this study.

Anderson, Greer, MacDonald, Rutks, & Tacklind, (2011) also conducted a systematic review with similar results. The pharmacological studies were unable to determine if the drug was effective in preventing delirium. The small sample sizes, select population, and inconsistency or incompleteness of recording outcomes were all reported (Anderson et al., 2011). Again, there were no LTC rehabilitation or PAC settings in this study.

Transition from acute care to LTC and skilled rehabilitation facilities has an increased risk of residents being admitted with delirium. The delirium may have a negative impact on the resident's functional recovery and care (Syed & Messinger-Rapport, 2013). The management of delirium and/or dementia has a pharmacological approach to treat the hyperactive behavioral disturbances of the LTC resident who has delirium and or dementia (Hopewell et al., 2016; Pasina et al., 2016; Syed & Messinger-Rapport, 2013). A major concern was the reported high use of psychotropic medication in the LTC and the mixed reports of its impact on the resident outcomes (U. S. Government Accountability Office, 2015).

A retrospective, longitudinal cohort study described how the dose and duration of

antipsychotics impacts mortality risk in nursing home residents with a stay greater

than100 consecutive days (Simoni-Wastila et al., 2016). All residents received

psychotropic medications for three different health conditions: severe mental illness

(SMI; *n*= 5,621), dementia with behavioral symptoms but without SMI (*n*= 1,090), or

delirium with behavioral symptoms only without SMI or dementia (*n*=2,100). The data

were retrieved from 2006 to 2009, merged data sources and a 5% random sample of

Medicare claims data and Minimum Data Set (MDS) vs 2.0 (Simoni-Wastila et al.,

2016). The International Classification of Diseases, Ninth Revision, Clinical

Modification (ICD-9-CM) codes were used to obtain the Medicare part A (10 diagnoses)

and Medicare part B (9 diagnoses). All three cohorts used antipsychotic agents and 90%

of them used atypical agents; quetiapine and risperidone were used by one third of this

group. Typical antipsychotic agents were used for in 5 residents and haloperidol was the

most common. Duration of the antipsychotic was lower in the delirium cohort compared

to SMI cohort and dementia+behavior that had the same longer duration. Mortality risk is

highest within the 30 days of initiating the antipsychotic agent for the SMI cohort and

less than 7 days for the delirium cohort. The mortality risk was lower in SMI cohort and

delirium cohort both with a longer duration of 91-184 days. Interestingly, the relationship

between mortality risk and antipsychotic duration did not have a significant relationship

in the dementia+behavior cohort (Simoni-Wastila et al., 2016).

Polypharmacy. Polypharmacy is a precipitating factor to the onset of delirium.

There is no official standard definition but an accepted general definition "concurrent use

of several prescription medications" (Hein et al., 2014, p. 850.e12) and there is no clear

agreement on the number of medications. Some researchers have used 3 to 5 medications

while others report using 9 or more (Hein et al., 2014). The researchers conducted a prospective cohort study in an acute care geriatric ward of a university hospital with 410 patients over a 9-month period in order to ascertain the association of delirium with polypharmacy. The investigation included an assessment of delirium using the highly sensitivity, specificity, validated and widely used CAM instrument within 72 hours of admission. Patients taking more than five medications were included in the study and compared to the control group that were taking less than six medications. Compared with the control group, delirium was significantly identified more often in patients receiving polypharmacy medications versus not receiving polypharmacy, 69% and 30% respectively and a relative risk of 2.33, (CI 1.23-4.41; *p* < .010). Delirium was significantly associated with age and dementia in patients admitted from an acute care hospital (*OR* 2.15; CI 0.15-3.99; *p* <. 016 and *OR* 3.6; CI 1.74-5.72; *p*< .001) respectively.

The study successfully identified polypharmacy's association with delirium independent of type of medication. Interestingly, there was no relationship between comorbidity and polypharmacy, which varied from previous studies (Hein et al., 2014). This study population did not include other elderly populations such as those in PAC/LTC facilities and there was no separation of prevalence and incidence of delirium that is important in determining intervention/preventative care. The significant relationship of age and dementia in the development of delirium was reported and consistent with other studies.

The number of medications a resident is prescribed is a predictor of the occurrence of delirium for the resident during their LTC visit (Voyer et al., 2009b).

Inouye and Charpentier (1996) identified the increased risk of developing delirium when three or more medications were added to the patients' care.

Post-Acute Care/Long Term Care Rehabilitation

There is a paucity of research studies that focus on delirium in LTC and even fewer in the LTC rehabilitation population. The patient population is changing; the trend primarily is an increasing number of patients requiring recovery in LTC or PAC and shorter LOS in the acute care setting (Marcantonio et al., 2005). Upon admission, the LTC/PAC patient has an increased prevalence of delirium. Knowing the negative patient outcomes once a patient has delirium, there is an increased risk of sequelae events occurring in the LTC and post-acute facilities.

The following studies were conducted in LTC facilities with both skilled nursing care and PAC units and evaluated different aspects of delirium in the same population.

The residents in these studies were exclusively from the PAC unit. The prevalence of delirium, delirium symptoms, and delirium severity was assessed in residents recruited for a RCT Delirium Abatement Program by Kiely et al. (2003) from October 2000 to June 2003. The 2,158 recruited patients aged 65 and older were admitted to an LTC/PAC facility from an acute care hospital. Instruments utilized include CAM, the Mini-Mental State Examination (MMSE) to assess for cognition (memory, concentration, attention); Memorial Delirium Assessment Scale (MDAS) to quantify delirium severity; and the Delirium Symptom Interview (DSI) to identify specific symptoms of delirium. Delirium categories were divided into four groups based on the CAM algorithm: full delirium, two or more symptoms, one symptom, and no delirium. There was a 16% delirium prevalence but the facility reported 9% to 26% delirium upon

admission. Of the residents, 12% has two or more symptoms and 40% had one symptom. Interestingly, full delirium had the highest hypoactive or normal psychomotor activity (37% and 37% respectively). Noted limitations included delirium assessment conducted within five days and there could be a potential risk of not capturing symptoms on admission, no outcome data were obtained, and the method section did not state the type of study. The researchers concluded 16% of this population admitted to PAC from acute care setting had delirium. The concern raised was whether the PAC staff was prepared to identify and manage delirium patients in this setting.

Marcantonio et al. (2005) conducted a cohort study in residents with delirium, subsyndromal delirium, or no delirium and compared outcomes among these groups. A total of 545 residents, aged 65 and older, admitted to a PAC unit were screened for delirium and subsyndromal delirium within five days of admission (prevalence 15%) utilizing the CAM instrument. Other instruments used were the Mini-Mental State Examination (MMSE) to assess for cognition (memory, concentration, and attention), Digit Span, and Delirium Symptom Interview (DSI) to identify specific symptoms of delirium. Residents with delirium were found to be 75% more likely to have one or more complications than residents without delirium. The complications identified and compared to residents with and without delirium included a higher 30-day acute care readmission (30% versus 13%), decreased placement in community within 30 days (30% versus 70%) and an increased 6-month mortality (25% versus 5.7%) with all complication results reaching significance ($p <. 01$). There was a significant ($p. <001$) number of residents with preexisting dementia upon admission from acute care but no difference in comorbidity. Noted study limitations included the delirium assessment

conducted within five days and review of medical records may not have captured all the issues if clinicians did not document them; no medications were assessed in the study. The study strengths included trained research interviewers and chart reviewers.

The impact of delirium resolution on functional recovery was investigated in a prospective longitudinal study conducted by Kiely et al. (2006). The association between delirium resolution and functional recovery was studied among 393 PAC residents aged 65 and older and admitted with delirium to a skilled nursing/PAC facility. The instruments used in this study (CAM, DSI, MDAS, and Charlson Comorbidity) have already been discussed as they have been used in prior studies. The two exceptions were the Katz scale (testing functional status) and the Blessed Dementia Rating Scale (BDRS) (identifying cognitive status prior to hospitalization). The confounding characteristics that were significantly different with delirium resolution status include > high school education (p. <02), dementia (p <. 0004), age (p. <04), prehospital cognitive ability (p. <0001), and delirium severity (p. <0001). The prehospital functional assessment score resulted in a significant difference compared with delirium resolution status (p < .0001), and PAC admission had a slightly different result, p < .0007. The functional recovery compared to delirium resolution status had a significant result of p <. 0001.

There are many delirium instruments utilized in the various healthcare settings. The most common delirium screening instrument is the CAM (Inouye, Westendorp, et al., 2014). In LTC, the standard instrument is the minimum data set (MDS), which contains the CAM (Inouye, Westendorp, et al., 2014). Limited studies conducted in the LTC setting have utilized various methods to assess and/or screen for delirium in the LTC population. This variation has made it difficult to compare incidence and prevalence

of delirium in the LTC population (Culp et al., 1997).

Summary

Delirium has been well studied for the causative factors, treatment, and prevention to reduce its onset in the acute care setting. There was an opportunity to study delirium and gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration in the older adult LTC rehabilitation resident. Another relationship to study was between CHART-DEL-derived delirium diagnoses, documented delirium symptoms, and the documented ICD-10 coded discharge delirium diagnosis. The value of this study to science will augment previous studies evaluating the association with delirium. The multifactorial model of delirium in older persons model served as the framework for this study and guided the evaluation the predisposing factors age, comorbidities and dementia. The model also guided the evaluation of the precipitating factors polypharmacy and duration of psychotropic medications.

Chapter Three

Methodology

This chapter describes the research design and procedures enlisted to investigate the research aims. The data needed to address this quantitative study were obtained by a retrospective review of the electronic medical record (EMR) utilizing both a manual review and an electronic extraction of the data.

Purpose

The purpose of this study was twofold: 1) to describe the relationship between CHART-DEL-derived delirium diagnosis and the ICD-10 coded discharge delirium diagnosis; 2) to describe the relationship between delirium (CHART DEL-derived and ICD-10); and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration in the LTC rehabilitation residents.

Research Questions

Research questions for this study were:

1. What is the relationship between CHART-DEL-derived delirium diagnosis and documented ICD-10 coded discharge delirium diagnosis in LTC rehabilitation residents?

2. What is the relationship between delirium (CHART-DEL-derived and ICD-10) and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration in LTC rehabilitation residents?

Aims

The aims of this study were to:

1. Describe resident demographic characteristics of gender, race, principal admitting diagnosis, admit source, discharge disposition, polypharmacy, dementia, CHART-DEL-derived delirium diagnoses, ICD-10 coded discharge delirium diagnosis, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

2a. Describe the relationship between CHART-DEL-derived delirium diagnoses and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

2b. Describe the relationship between ICD-10 delirium and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

3a. Determine the odds of having a CHART-DEL-derived delirium diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

3b. Determine odds of having an ICD-10-derived delirium diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

Research Design

A retrospective, descriptive correlational design was selected for this study. This method was selected for the study because it addresses the purpose of the study, which is to describe the relationships of the variables instead of identifying the causes of the problem being studied (Polit & Beck, 2012, p. 226). The sample consisted of randomized

LTC rehabilitation residents who were admitted from January 1, 2016 to December 31, 2016. Study variables were abstracted from the EMR and paper chart. In this study, the researcher is an objective observer, using a deductive research process that determined the existence of relationships (Terrell, 2016, p. 136).

Setting / Sample

The site for this study was a hospital-based 100-bed LTC facility with two resident care units, one 50-bed skilled nursing care (custodial) unit, and one 50-bed rehabilitation unit, located in Southern California. It admits residents from the acute setting and is connected to an acute care facility with an adjoining enclosed walkway. In each specialty unit, skilled nursing, or rehabilitation, the residents were admitted for medical or surgical care. The 50-bed rehabilitation unit was the setting for this LTC rehabilitation population.

Inclusion Criteria

The following inclusion criteria were established for this study. Residents were included if they were:

1. admitted from the hospital to the LTC rehabilitation unit between January 1, 2016 and December 31, 2016

2. at least 65 years of age

3. a minimum of 48-hour LOS

4. chart review capped at 30-days

Exclusion Criteria

Residents were excluded from the study if they were:

1. admitted to the LTC for skilled nursing care

2. less than 65 years of age

3. at an LOS of less than 48 hours

4. experiencing eminent terminal illness i.e. 24-hour expired

5. undergoing alcohol withdrawal

Variables and Operational Definitions

Dependent Variable: Delirium diagnosis

The delirium diagnosis was abstracted by full-chart review including notes documented by all disciplines in both the patient's paper chart and electronic chart. Previous hospitalization provided history and physical notes where cognitive baseline was often identified.

ICD-10. For this study, F05 is the ICD-10 code identifying delirium. ICD-10-coded delirium was identified and entered into the resident's chart following discharge from the LTC rehabilitation facility. The coders were certified in their role and maintained annual competencies. The coders abstracted the diagnosis, which assigns the code and interfaces with billing system. The coders utilized ICD-10 delirium and included physician documentation such as encephalopathy and confusion codes as applicable.

CHART-DEL-derived delirium diagnoses. For this study, mental status change, disorientation, hallucinations, agitation, acute confusion, reversibility of symptoms were abstracted from the review of all documented notes and utilized the CHART-DEL-derived delirium diagnoses. The delirium diagnosis was entered as yes/no once the chart review was completed.

a. "All Confusion Assessment Method (CAM) features are present in the notes (i.e.,

all four of these features are present: (1) acute onset/fluctuation; (2) inattention;

(3) disorganized thinking or (4) altered level of consciousness" (Xu, Fong, Yee, &

Inouye, 2011, p. 9).

b. "Acute onset of disorientation or hallucinations, especially with evidence of

reversibility or evidence of attribution to medications "in someone with no history

of preexisting cognitive impairment" (Xu et al., 2011, p. 9).

Independent Variables

Demographics were gender, race, principal admitting diagnosis, admit source,

discharge disposition, polypharmacy, dementia, CHART-DEL-derived delirium

diagnoses, and ICD-10-coded discharge delirium diagnosis, age, LOS, Charlson score

(comorbidities), psychotropic medications duration.

Gender. Defined as the "the sex of assignment by oneself or those who raise the

individual" (Hensyl & Cady, 1990, p. 639). The gender will be female or male.

Race. Defined as "a group of animals or individuals within a species which has

common somatic inherited characteristics" (Hensyl & Cady, 1990, p. 1306). The resident

provides this information at time of registration.

Admitting diagnosis. Defined as the "determination of the nature of a disease"

(Hensyl & Cady, 1990, p. 428) by the physician upon being admitted to the LTC

rehabilitation unit.

Admission source. Defined as resident pre-existing living accommodations prior

to being admitted to the hospital.

Discharge Disposition. Defined as placement of resident following discharge.

Polypharmacy. There is no official standard definition but an accepted general

definition is "concurrent use of several prescription medications" (Hein et al 2014, p. 850.e12) The reported range was 5-10 medications (Roffman, Buchanan, & Allison, 2016) For the purposes of this study, six or more drugs served as the definition of polypharmacy.

Age. Defined as the "period that has elapsed since birth" (Hensyl & Cady, 1990, p. 34) ending with the date the chart was reviewed.

LOS. Defined as resident hospital stay from time of admission to discharge. "The total number of days a participant stays in hospital" (Young et al., 2010, p. 20).

Comorbidities. Defined as "a concomitant but unrelated pathologic or disease process; usually used in epidemiology to indicate the coexistence of two or more disease processes" (Hensyl & Cady, 1990, p. 334) defined as the total burden of illnesses unrelated to the patient's principal diagnosis.

Charlson score is a valid scoring method to determine risk of mortality and disease burden. Charlson score has weighted comorbidities ranging from 1 to 6 and the sum of each weighted comorbidity category provides a score. The score of zero indicates no comorbidities. The higher the score the greater the risk of mortality and severity of disease (Roffman et al., 2016)

Psychotropic medication. Defined as "a drug that affects brain activities associated with mental processes and behavior: categories include anti-psychotics; antidepressants; antianxiety drugs or anxiolytics; hypnotics" (psychotropic drug, 2002).

Data Sources

Data were obtained from two sources: the EMR and paper chart forms that are not part of the EMR. Data extracted from the EMR included age, gender, race, Charlson

score (comorbidities), LOS, disposition, admission source, presence of dementia (ICD-10 code), and International Classification of Disease, 10th revision Clinical Modification (ICD-10) coded delirium. The data from the paper chart included CHART-DEL-derived delirium diagnoses, polypharmacy, duration of psychotropic medications, nurse's notes, progress notes, emergency department notes, medication administration record, and neurology or psychiatric consultant notes. In addition, physical therapy, occupational therapist, speech therapist, and social service notes were reviewed for mentions of delirium symptomology the electronic chart. Any data where it was noted in the chart as the resident declined to answer or unknown were labeled as missing.

A data analyst assisted the researcher with EMR data extraction. An initial test run to pull the data elements was conducted to verify appropriate data procedure. The researcher worked with the data analyst to address any issues that may arise with the data pull during the test run.

Data Extraction

The EMR data abstraction was conducted by the data analyst who was instructed by the researcher to replace patient identifiers with an ID. Encrypted, coded data were exported to the researcher's password-protected computer. The data were critically reviewed by the researcher for any errors or missing data before proceeding to export the data into analyzing software. A research code ID was placed on the data abstraction instrument and recorded in a coded logbook. The coded logbook was stored in secured cabinet in the investigator's home. The cleaned-up data encrypted coded Microsoft Excel file was exported into the Statistical Package for the Social Sciences (SPSS) software version 24.

The paper chart data were collected onto the chart abstraction instrument for delirium during hospitalization (see appendix A). Key documented elements abstracted included acute confusion, source and time of acute confusion, duration of confusion, agitation, evidence of reversibility or improvement of acute confusion during hospitalization, and if delirium was present upon admission and during hospitalization.

Data Collection Instruments/Measures

CHART-DEL- derived Delirium Diagnosis Method

This Chart-based Delirium Identification (CHART-DEL) method is designed to identify delirium (definitive or probable) using clinical chart documentation and no delirium (possible, uncertain, none) calculating an individual score (Inouye et al., 2005). It is known that other methods to assess for delirium require more time and resources, thus increasing cost and time (Xu et al., 2011). The CHART-DEL method can improve identifying delirium on a broader scale, making it a useful method in many forums including clinical and both quality improvement and research programs (Xu et al., 2011).

Xu and colleagues (2011) recommended criteria to identify delirium based on "the level of probability that delirium is truly present" (p. 9) and definite and probable were used in this study. Voyer et al. (2009a) suggested that using definite and probable categories are the most appropriate for LTC. The definite criterion is confirmed diagnosis, unequivocally, determined by an expert rater (Xu et al., 2011). The probable criterion is that all CAM measures met the acute onset of disorientation or hallucinations (person without history of impaired cognition) (Xu et al., 2011). The delirium is yes or no and is an individual score.

The CHART-DEL has a reported sensitivity of 74%, specificity 83%, likelihood

ratio for a positive result 4.4 and interrater of 82% agreement comparing chart and interviewer results (Inouye et al., 2005).

Process for this study. The CHART-DEL process was used in this study to identify delirium using documented symptoms of delirium. For delirium identification, the EMR was reviewed for documentation of delirium or trigger (words, phrases, signs, or symptoms) associated with delirium. To address interpreting difficult handwriting, the researcher rarely consulted the medical record staff to aid in identifying letters or words and the vast majority of the time the handwriting remained legible. Delirium identification was confirmed based on the definite or probable criteria. Adjudication was conducted by the researcher of this study and did not consult with other delirium experts or utilize consensus to reach agreement (expert panel). Also, no additional screening or diagnostic instruments were used to identify delirium or other cognitive impairment.

Table 1

Variable and Data Source

Variable	Data Source
Age	EMR
Gender	EMR
Race/Ethnicity	EMR
Length of Stay	EMR
Admit Source	EMR
Discharge Disposition	EMR
Primary Diagnosis Description Code	EMR
Charlson Total Score	EMR
ICD-10 Dementia	EMR
CHART-DEL-Derived Delirium	Paper Chart Review
ICD-10 Delirium	EMR
Polypharmacy	Paper Chart Review
Psychotropic Medications Duration (days)	Paper Chart Review

Sample Size

The G*Power version 3.1.9 was used to obtain A priori power analysis. Logistic regression was used to measure potential predictors, independent variables (LOS, Charlson score [comorbidities], polypharmacy, and duration of psychotropic medications) of the binary dependent variable (delirium). To measure significance, the following was used: two-tail; odds ratio 1.8; null 0.15; alpha 0.05; power .80, resulting in a minimum sample size of 204 residents (Polit, & Beck, 2004, p. 495-496; 537-538). One-way ANOVA two-tailed statistical model measured the second aim with degrees of freedom 2, alpha 0.05, power .80, and effect size 0.25 required a minimum sample size of 64. Two-tailed Chi-Square statistical model measured the second aim with degrees of freedom 1, 3, or 5, alpha 0.05, power .80, and effect size 0.30, and required a minimum sample size ranging from 87 (2x2 table) to 143 (2x6 table) (Waltz, Strickland, & Lenz, 2017, p. 187 & 196).

Data Analysis

Data were analyzed by entering the data into the SPSS data analysis software, version 24.

Aim 1. Describe resident demographic characteristics of gender, race, principal admitting diagnosis, admit source, discharge disposition, polypharmacy, dementia, CHART-DEL-derived delirium diagnoses, ICD-10 coded discharge delirium diagnosis, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. Descriptive statistics were used to analyze these variables.

Aim 2a. Describe the relationship between CHART-DEL-derived delirium diagnoses and the variables of gender, race, principle admitting diagnosis, polypharmacy,

dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. Chi-square (2x2, 2x4, 2x6) and one-way ANOVA were the statistical methods used.

Aim 2b. Describe the relationship between ICD-10 delirium and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. Chi-square (2x2, 2x4, 2x6) and one-way ANOVA were the statistical methods used.

Aim 3a. Determine the odds of having a CHART-DEL-derived delirium diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. Multiple logistic regression was the statistical method used.

Aim 3b. Determine odds of having an ICD-10 derived delirium diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. Multiple logistic regression was the statistical method used.

Descriptive statistics were used to clearly describe each variable and summarize the data in a meaningful way (Knapp, 2013). Categorical variables were described using number and percent (Knapp, 2013). Continuous variables were described using the number, mean and standard deviation (Knapp, 2013).

Human subjects

The study was approved by the hospital and the university Institutional Review Boards. To maintain confidentiality, no patient identifiers were recorded and all data were coded. A research code ID was placed on the data abstraction instrument and

recorded in a coded logbook. The coded logbook was stored in secured cabinet in the investigators home. All data will be destroyed 7 years following the study.

Summary

The purpose of this study was to understand the relationship between CHART-DEL-derived delirium diagnosis and the ICD-10 coded delirium and factors associated with delirium identified from previous studies. Data were obtained from a review of both the patients' electronic and paper charts. The patients were hospitalized in an LTC rehabilitation unit located in southern California. This chapter described the study method, timeframe of the study, dependent and independent variables, the method of data analysis and efforts to protect the human subjects' confidentiality.

Chapter Four

STUDY REULTS

This chapter begins with a description of the sample followed by findings and results for each aim along with a corresponding table(s). Several tables display the findings and highlight levels of significance.

Description of the Sample

The sample consisted of 174 patients discharged between January 1, 2016 and December 31, 2016, who were at least 65 years old, who had a minimum of 48-hour LOS, and a chart review cap of 30-days. The review of the residents' charts included gender, race, principal admitting diagnosis, admit source, discharge disposition, polypharmacy, dementia, symptoms to generate CHART-DEL-derived delirium diagnoses, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. An ICD-10-coded discharge delirium diagnosis was obtained from the EMR entered by coders. Cases excluded from the study were residents who had been admitted for skilled nursing care, were less than 65 years of age, had an LOS of less than 48-hours, had eminent (24 hour) terminal illness, or were undergoing alcohol withdrawal.

Specific Aims and Results

Aim One

Describe resident demographic characteristics of gender, race, principal admitting diagnosis, admit source, discharge disposition, polypharmacy, dementia, CHART-DEL-derived delirium diagnoses, ICD-10 coded discharge delirium diagnosis, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

The study sample consisted of 174 patients with a mean age of 80.8 ($SD = 8.49$),

ranging from 65 to 101.

Table 2

Sample Description *(N = 174)*

Characteristics	Frequency	%
Gender		
Female	108	62.1
Race		
White	79	46.2
Hispanic/Latino	53	31.0
Asian	19	11.1
Other	20	11.7
Principal Admitting Diagnosis		
Infection	36	20.7
Major system disorder	28	16.1
Neurological	21	12.1
Cancer	8	4.6
Post-surgical	46	26.4
Musculoskeletal	35	20.1
Admit Source		
Acute care	173	99.4
SNF discharge/Readmit	1	0.6
Discharge Disposition		
Home health	113	64.9
Home/Self care	16	9.2
Skilled nursing	10	5.8
ED short-term acute	23	13.2
Other	12	6.9
Polypharmacy		
Yes	168	96.6
ICD-10 Dementia		
Yes	54	31.0
No	120	69.0

CHART-DEL-Derived Delirium		
Yes	45	25.9
No	129	74.1
ICD-10 Delirium (F05)		
Yes	9	5.2
No	165	94.8
	Mean	*SD*
Age	80.81	8.49
Length of Stay	14.72	6.65
Charlson Score	2.13	1.83
Psychotropic Medications Duration (days)	9.54	8.34

Note. F05 is the ICD-10 code identifying delirium. *CI* = confidence interval for mean.

The majority of cases were female (62.1%) with average age of 80.8 years. White race accounted for 46.2%, with Hispanic/Latino ethnicity accounting for 31% of the sample. Almost all were admitted from acute care (99.4%) with the top three admitting diagnoses of post-surgery (26.4%), infection (20.7%), and musculoskeletal diagnosis (20.1%). Almost all had polypharmacy (96.6%) and 25.8% received psychotropic medications for 9.5 days. The mean LOS was 14.72 days and discharges to home with home health accounted for 64.9%. The CHART-DEL-derived delirium diagnosis identified 25.9% of the time with the ICD-10 code at 5.2%. ICD coding captured 31% dementia in this sample (see Table 2)

Aim Two

Aim 2a. Describe the relationship between CHART-DEL-derived delirium diagnoses and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications

duration.

Table 3 organizes the Chi-square test statistics, describing the relationship between CHART-DEL-derived delirium diagnosis (no/yes), observed frequencies, and the variables of gender, race, principle admitting diagnosis, polypharmacy, and ICD-10 dementia. The percentage of residents that were identified with CHART-DEL-derived delirium diagnoses did not differ significantly by gender, race, principle admitting diagnosis, or dementia. It should be noted that polypharmacy did not meet the minimum expected count assumption, and therefore, was not used in the logistic regression analysis for the third study aim.

Table 3

CHART-DEL-Derived Delirium Diagnoses by Resident Characteristics Chi-square Results

Characteristics	No		Yes		X^2	P
	n	%	n	%		
Gender ($N = 174$)						
Male	45	34.9	21	46.7		
Female	84	65.1	24	53.3	1.967	.161
Race/Ethnicity ($N = 171$)						
White	58	45.3	21	48.8		
Hispanic/Latino	38	29.7	15	34.9		
Asian	14	10.9	5	11.6		
Other	18	14.1	2	4.7	2.818	.420
Polypharmacy ($N = 174$)						
Yes	123	95.3	45	100.0		
No	6	4.7	0	0.0	2.168	.141[1]
Primary Diagnosis Description Code ($N = 174$)						
Infection	24	18.6	12	26.7		
Major system disorder	26	20.2	2	4.4		

Neurological	13	10.1	8	17.8		
Cancer	4	3.1	4	8.9		
Post-surgical	34	26.4	12	26.7		
Musculoskeletal	28	21.7	7	15.6	10.864	.054
ICD-10 Dementia (*N* = 174)						
Yes	37	28.7	17	37.8		
No	92	71.3	28	62.2	1.290	.256

Note. [1]Violated the minimum expected count assumption of the model.

One-way ANOVA was used to describe the difference between CHART-DEL-derived delirium diagnoses (no/yes) by age, length of stay, Charlson score (comorbidities), and psychotropic medications duration (Table 4). The LOS differed significantly between CHART-DEL-derived delirium diagnoses (*M* = 16.69) and not having CHART-DEL-derived delirium diagnoses (*M* = 14.04), $F (1, 172) = 5.44$, $p = .021$. Charlson score violated homogeneity of variance and a Kruskal-Wallis test was used instead, resulting in a significant difference between CHART-DEL-derived delirium diagnoses (*M* = 2.71) and not having CHART-DEL-derived delirium diagnoses (*M* = 1.92), $H(1) = 4.045$, $p = .044$. The residents with CHART-DEL-derived delirium diagnosis had a significantly higher Charlson score (comorbidities) than those without CHART-DEL-derived delirium diagnosis. There was no significant difference in CHART-DEL-derived delirium diagnosis in age or psychotropic medications duration between the two groups.

Table 4

CHART-DEL-Derived Delirium Diagnoses by Resident Variables One-way ANOVA
Results

| | No | | Yes | | | |
Characteristics	*M*	*SD*	*M*	*SD*	*F*	*P*
Age	80.16	8.70	82.67	7.66	2.932	.089
Length of Stay	14.04	6.64	16.69	6.34	5.440	.021
Charlson Score	1.92	1.64	2.71	2.21	6.390	.012[1]
Psychotropic Medications						
Duration (days)	8.82	8.08	11.60	8.80	3.762	.054
Nonparametric Kruskal-Wallis					*H*	*P*
Charlson Score					4.045	.044

Note. [1]Charlson Total Score violated the homogeneity of variance assumption, $F(1) = 5.294$, $p = .023$. Therefore, the Kruskal-Wallis test was used instead.

Aims 2b. Describe the relationship between ICD-10 delirium and the variables of gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

In Table 5, all Chi-square tests run for ICD-10 Delirium violated the minimum expected count assumption of the model and were not used in additional logistic regression analysis for the third study aim.

Table 5

ICD-10 Delirium by Resident Characteristics Chi-square Results

	No		Yes			
Characteristics	n	%	n	%	X^2	P
Gender ($N = 174$)						
Female	103	62.4	5	55.6	.171	.679[1]
Male	62	37.6	4	44.4		
Race/Ethnicity ($N = 171$)						
White	74	45.4	5	62.5		
Hispanic/Latino	51	31.3	2	25.0		
Asian	18	11.0	1	12.5		
Other	20	12.3	0	0.0	1.576	.665[1]
Polypharmacy ($N = 174$)						
Yes	159	96.4	9	100.0		
No	6	3.6	0	0.0	.339	.560[1]
Principle Admitting Diagnoses ($N = 174$)						
Infection	34	20.6	2	22.2		
Major system disorder	27	16.4	1	11.1		
Neurological	20	12.1	1	11.1		
Cancer	7	4.2	1	11.1		
Post-surgical	44	26.7	2	22.2		
Musculoskeletal	33	20.0	2	22.2	1.125	.952[1]
ICD-10 Dementia ($N = 174$)						
Yes	46	27.9	8	88.9		
No	119	72.1	1	11.1	14.842	<.001[1]

Note. [1]Violated the minimum expected count assumption of the model.

One-way ANOVA was used to describe the difference between ICD-10 Delirium (no/yes) by age, length of stay, Charlson score (comorbidities), and psychotropic medications duration (Table 6). Charlson score (comorbidities) violated homogeneity of variance and a Kruskal-Wallis test was used instead. The Charlson score differed

significantly between diagnosed delirium ($M = 4.67$) and those who were not diagnosed

with delirium ($M = 1.99$), $H(1) = 9.935$, $p = .002$. The residents diagnosed with delirium

had significantly higher Charlson scores (comorbidities) than those who were not

diagnosed with delirium. There was no significant difference in ICD-10 delirium in age,

length of stay or psychotropic medications duration between the two delirium groups.

Table 6

ICD-10 Delirium by Resident Characteristics One-way ANOVA Results

Characteristics	No		Yes			
	M	*SD*	*M*	*SD*	*F*	*P*
Age	80.58	8.52	85.00	7.23	2.327	.129
Length of Stay	14.80	6.62	13.33	7.37	.414	.521
Charlson Score	1.99	1.66	4.67	2.83	20.336	<.001[1]
Psychotropic Medications Duration (days)	9.46	8.38	11.00	7.86	.290	.591
Nonparametric Kruskal-Wallis					*H*	*P*
Charlson Score					9.935	.002

Note. [1]Charlson Total Score violated the homogeneity of variance assumption, $F(1) = 6.416$, $p = .012$. Therefore, the Kruskal-Wallis test was used instead.

Both aim 2a and 2b results revealed significantly higher Charlson Scores

(comorbidities) for cases diagnosed with either CHART-DEL-derived delirium diagnoses

or ICD-10 delirium ($p = .044$ and $p = .002$ respectively). In contrast, only aim 2a results

revealed a significantly longer LOS for cases diagnosed with CHART-DEL-derived

delirium ($p = .021$).

Aim Three

Aim 3a. Determine the odds of having a CHART-DEL-derived delirium

diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

Logistic regression was conducted to describe the effect factors may have had on the likelihood the resident would have CHART-DEL-derived delirium diagnoses (Table 7). Both polypharmacy and race did not meet assumptions for logistic regression and were not used. There were 174 cases with no outliers or multicollinearity. The model contained 7 independent (factors) variables: gender, principle admitting diagnosis, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration. The overall model of 7 factors was a fairly good fit (-2 Log likelihood = 170.854) and was statistically significant, $\chi^2(11) = 28.066$, $p = .003$, indicating the variable groupings, as a whole, correctly distinguishing which cases had CHART-DEL-derived delirium diagnoses from those that did not. The model explained 21.9% (Nagelkerke R^2) of the variance, indicating a good model fit and correctly predicted 74.1% of the cases (No = 92.2%, Yes = 22.2%). The independent variable Charlson score significantly contributed to the model ($p = 0.027$). The odds ratio of 1.3 for this variable indicated that for every one unit the Charlson score (comorbidities) increased, the odds of having delirium determined by CHART-DEL-derived delirium diagnoses method went up 1.3 times. Since the constant, CHART-DEL-derived delirium diagnoses, was predicting whether or not a Yes was recorded and the coefficient was negative, then the cases were less likely to have CHART-DEL-derived delirium diagnoses when the independent variables were zero.

Table 7

Logistic Regression Predicting CHART-DEL-Derived Delirium Diagnoses.

Predictor	*B*	*SE*	Wald	*P*	*OR*	*CI* (95%)
Age	0.05	0.03	3.64	.056	1.05	1.0, 1.10
Gender	-0.34	0.41	0.68	.409	0.72	0.32, 1.59
Charlson Score	0.26	0.12	4.90	.027	1.30	1.03, 1.63
Length of Stay	0.05	0.04	1.56	.212	1.05	0.98, 1.12
Psychotropic Medications Duration (days)	0.03	0.03	0.99	.319	1.03	0.97, 1.09
Dementia	-0.07	0.46	0.02	.883	0.94	0.38, 2.29
Primary Diagnosis Descript Code			8.04	.154		
Infection (1)	0.68	0.61	1.24	.265	1.98	0.60, 6.53
Major system disorder (2)	-1.33	0.88	2.26	.133	0.27	0.05, 1.50
Neurological (3)	0.92	0.67	1.89	.169	2.51	0.68, 9.31
Cancer (4)	0.66	1.00	0.43	.510	1.93	0.27, 13.63
Post-surgical (5)	0.16	0.59	0.07	.787	1.17	0.37, 3.72
Musculoskeletal (6)						
Constant	-6.45	2.22	8.42	.004	.002	

*Note.*CI = confidence interval for odds ratio (OR)

Aim 3b. Determine odds of having an ICD-10 derived delirium diagnosis based upon gender, race, principle admitting diagnosis, polypharmacy, dementia, age, LOS, Charlson score (comorbidities), and psychotropic medications duration.

Logistic regression was conducted to evaluate the effect of factors may have on the likelihood the resident would have ICD-10 delirium (Table 8). The variables of gender, race, principle admitting diagnosis, polypharmacy, and dementia did not meet the assumptions for logistic regression. There were 174 cases with no outliers or multicollinearity. The model contained 4 independent (factors) variables: age, LOS, Charlson score (comorbidities), and psychotropic medications duration. The overall model of 4 factors was a good fit (-2 Log likelihood = 54.082) and was statistically

significant, $\chi^2(4) = 16.758$, $p = .002$, indicating the variable groupings as a whole,

correctly distinguished which cases had ICD-10 delirium from those that did not. The

model as a whole explained 27.5% (Nagelkerke R^2) indicating a good model fit and

correctly predicted 94.8% of the cases (No = 89.4%, Yes = 11.1%). The independent

variable, Charlson score (comorbidities), significantly contributed to the model ($p =$

.001). The odds ratio of 1.63 for this variable indicated that for every one unit the

Charlson score (comorbidities) increased, the odds of having delirium determined by

ICD-10 delirium method went up 1.63 times. Since the constant, ICD-10 delirium, was

predicting whether or not a Yes was recorded and the coefficient was negative, then the

cases were less likely to have ICD-10 delirium when the independent variables were zero.

Table 8

Logistic Regression Predicting ICD-10 Delirium

Predictor	B	SE	Wald	*P*	*OR*	*CI* (95%)
Age	0.08	0.06	2.08	.150	1.08	0.97, 1.21
Charlson Score	0.49	0.15	10.49	.001	1.63	1.21, 2.19
Length of Stay	-0.11	0.11	1.05	.305	0.90	0.73, 1.10
Psychotropic Medications Duration (days)	0.11	0.09	1.45	.229	1.12	0.93, 1.33
Constant	-10.57	4.92	4.61	.032	.00	

Note. CI = confidence interval for odds ratio (OR)

When comparing Aim 3a and 3b results, both described a statistically significant

difference in the Charlson score (comorbidities) result ($p = .027$ and $p = .001$

respectively), indicating higher Charlson scores (comorbidities) may be a factor in the

onset of either CHART-DEL-derived delirium diagnoses or ICD-10 delirium in the LTC

rehabilitation resident. In contrast, aim 3a results described a marginally significant difference in age for CHART-DEL-derived delirium diagnoses (p = .056), whereas aim 3b age difference for ICD-10 delirium did not.

Summary

The information provided in this chapter were the results of the analysis of the data. Only the Charlson score (comorbidities) variable was statistically significant in determining the odds of having a) the symptoms of delirium determined by the CHART-DEL-derived delirium diagnoses method or b) by having an ICD-10 diagnosis of delirium being in the medical record.

Chapter 5

Discussion

The discussion of this study is organized into the following sections: study findings, comparisons and contrasts to other studies, research strengths and limitations, implications and recommendations for future practice, education, and nursing research.

Study Findings

Prior studies have identified that older adult patients were at high risk of developing delirium when hospitalized in various healthcare settings. The relationship of predisposing factors and precipitating factors influenced the development of the onset of delirium. This study described the relationship of key delirium predisposing and precipitating factors in both the CHART-DEL-derived delirium diagnosis and the ICD-10 code delirium diagnosis in the LTC rehabilitation resident.

A higher percentage of cases were White, older females, without dementia but with polypharmacy, admitted from acute care, and discharged with home health. The researcher identified a greater number of CHART-DEL-derived delirium diagnoses cases (25.9%) than the ICD-10 delirium diagnosis method (5.2%). When reviewing the cases that failed to meet the ICD-10 delirium criteria, an additional 34 cases (21.8%) met the diagnosis criteria for CHART-DEL-derived delirium diagnoses. This may highlight not only possible cases of unidentified delirium, but also missed opportunities for delirium-specific treatment. The significantly longer LOS for cases diagnosed with CHART-DEL-derived delirium diagnoses ($M = 16.69$) than those without ($M = 14.04$) also lends evidence to suggest that possible cases of delirium went both unidentified and untreated. Additionally, Charlson scores were also significantly higher for identified CHART-DEL-

derived delirium diagnoses cases (Yes; $M = 2.71$, No: $M = 1.92$) and both longer

psychotropic medications duration days (Yes: $M = 11.60$, No: $M = 8.82$) and older

residents (Yes: $M = 82.67$, No: $M = 80.16$) were marginally significant. Although the

residents, in general, were less likely to have CHART-DEL-derived delirium diagnoses,

their significant Charlson score ($OR = 1.30$) and marginally significant age ($OR = 1.05$)

helped to predict a potential diagnosis.

In comparison, the only significant factor contributing to a diagnosis of ICD-10

delirium was the Charlson score (comorbidities). Residents diagnosed with ICD-10

delirium had higher Charlson scores (comorbidities) on average ($M = 4.67$) than those

who were not diagnosed ($M = 1.99$). Likewise, although the residents, in general, were

less likely to have ICD-10 delirium, their Charlson scores (comorbidities) ($OR = 1.63$)

helped to predict a potential diagnosis.

The analysis results suggested a disturbing outcome regarding potential

undiagnosed and untreated delirium, which may result in longer LTC rehabilitation stays,

longer recovery times, and lower patient satisfaction, as well as increased risk of medical

complications, mortality, medical costs, and readmission rates (Huson et al., 2016;

Inouye, Westendorp, et al., 2014; Marcantonio et al., 2005). Therefore, healthcare

providers should remain attentive to potential risk factors for CHART-DEL-derived

delirium diagnoses, because timely and effective treatment could result in reduced

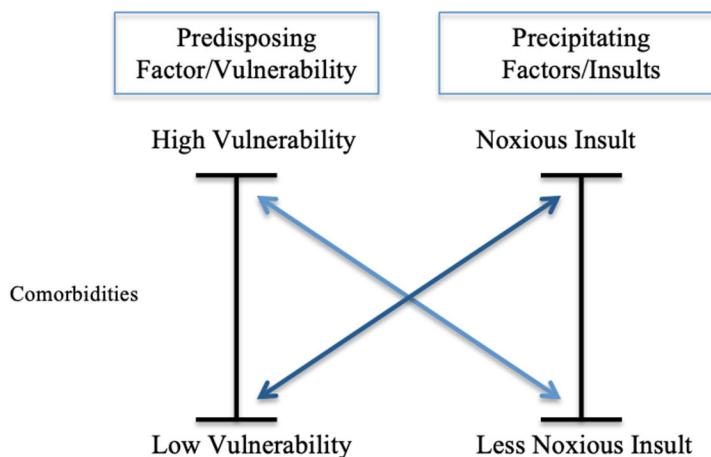adverse effects and better patient outcome.

Figure 1. Multifactorial model of delirium in older persons
(Inouye et al., 2014)

Figure 3. Inouye Multifactorial Model of Delirium in Older Persons (2014)

The variable of Charlson score (comorbidities), one predisposing factor out of a total of five predisposing factors, was statistically significant in determining (using separate models) the odds of having either a) delirium present as determined by the CHART-DEL-derived delirium diagnoses, or b) having an ICD-10 diagnosis of delirium in the medical record. All other predisposing and precipitating factors were not significant study variables.

Findings Compared and Contrasted to Other Studies

Description of population

The residents in this study were older and the majority of them did not have dementia. Age and dementia did not reach statistical significance in the current study but had been reported as a significant risk factor for delirium in other studies. (de Lange, Verhaak, & van der Meer, 2013; Kiely et al., 2004; Kolanowski et al., 2015; Voyer, Richard, Doucet, & Carmichael, 2009b; Voyer et al., 2011) . One study evaluated 11

predisposing factors finding residents over 70 with dementia were high risk factors for

the onset of delirium (Inouye, Westendorp, et al., 2014). Also, the non-cardiac surgical

population, evaluated by Inouye, Westendorp et al. (2014), were at high-risk of delirium;

however, in this study, the post-op resident did not reach statistical significance.

Dementia, age (greater than 80 years), and functional impairment were identified as

predisposing factors for delirium with dementia being the most critical factor (Voyer et

al., 2011). Another study reported that cognitive impaired participants had a higher

likelihood of developing delirium (Flanagan & Spencer, 2015).

CHART DEL-derived delirium diagnoses

In this study, the CHART-DEL instrument was used to identify delirium in the

residents of the LTC rehabilitation unit. All charts were reviewed from admission to

discharge, which included both prevalence and incidence of delirium. The overall

percentage of CHART-DEL-derived delirium diagnoses was 25.9% in this population

and not only differs from the ICD-10 coded delirium of 5.2% but also is higher than

reported in other studies. In the previous CHART-DEL validation study, the delirium

incidence was reported to be 12.5%; however, this excluded prevalence so this

percentage was not reported (Inouye et al., 2005). Another study evaluated two methods

in identifying the incidence of delirium in elective surgery hospitalized patients. The

researchers reported occurrences of delirium in both the interview-based (23%) and

CHART-DEL-derived delirium diagnoses (12%). They again excluded prevalence so

this percentage was not reported (Saczynski et al., 2014). One study evaluated the

prevalence of delirium in PAC patients using the CHART-DEL-derived delirium

diagnoses method with 9% prevalence but excluded delirium incidents (Morandi et al.,

2009). In this study, Morandi 2009, searched keywords from "primary nurse, other nurse, primary physician and other physician" (p. 331).

Another study utilized the Minimum Data Set (MDS) to assess prevalence of delirium in the PAC and reported 23% delirium on admission (Marcantonio et al., 2003). The difference between this study and some of the other previous studies may be attributed to the fact that almost all residents in this study were admitted from acute care at the same organization so baseline cognitive and behavioral status were obtained, which is critical in assessing the resident for delirium. The other studies may not have access to obtain detail knowledge of the resident's prior healthcare visit. Another difference is the researcher in this study included both prevalence and incidence of delirium. In other studies the focus was to evaluate either incidence or prevalence. In this study, dementia diagnosis was included, which could increase the risk of misclassification.

ICD-10 delirium diagnosis versus CHART-DEL-derived delirium diagnoses

Another item interest in this current study was the physician documentation of delirium diagnosis. This was identified in 11 CHART-DEL-derived delirium cases and 9 ICD-10 cases. In the CHART-DEL instrument validation study conducted by Inouye et al., (2005), the CHART-DEL-derived delirium diagnoses outperformed the ICD-9 coding method with 74% and 3% respectively. The CHART-DEL instrument, which had a 3% sensitivity, 99% specificity and 88% negative predictive accuracy (kappa = 0.03) indicating CHART-DEL-derived delirium diagnoses, was better at excluding delirium (Inouye et al., 2005). Another study compared the use of CAM and ICD-10 administrative databases (delirium codes entered by coder) to identify delirium incidence in cardiac surgical patients (Katznelson et al., 2010). The study reported the hospital

administrative database underestimated delirium incidence (Katznelson et al., 2010) which may also reflect the difference identified between CHART-DEL-derived delirium diagnoses and ICD-10 delirium method in this current study. Another contributing factor was the difficulty in interpreting the handwriting. In this study, the researcher was in the LTC rehabilitation setting when reviewing the charts and rarely consulted with the medical record staff to help clarify a letter or word in the written documentation. However, this may not have been the case for the coders. Other studies also reported that the best method to identify delirium is when an interview method such as CAM is utilized in conjunction with the CHART-DEL-derived delirium diagnoses instrument (Inouye et al., 2005; Morandi et al., 2009; Saczynski et al., 2014).

The precipitating factors of polypharmacy and psychotropic medications duration in this study were not factors in developing delirium as compared to previous studies. Both polypharmacy and psychoactive medications duration were identified as precipitating factors in the development of delirium in the medical population (Inouye, Westendorp, et al., 2014). However, in this current study the psychotropic medications duration did not meet significance in both the CHART-DEL-derived delirium diagnoses and the ICD-10 delirium method. Polypharmacy in both the CHART-DEL-derived delirium diagnoses and the ICD-10 delirium method did not meet assumptions of the test; therefore, it was not used. In another study of an LTC population where 10 precipitating factors evaluated the association between the development of delirium and the use of antipsychotics was included but was not a factor (Voyer et al., 2011).

Charlson score significance - Logistic regression

In this study, the Charlson score, indicative of comorbidity, had a significant

association when delirium was identified in both the CHART-DEL-derived delirium diagnoses and the ICD-10 delirium method. This is consistent with previous studies indicating that comorbidity is a high-risk predisposing factor in developing delirium. One study stated that when there was an increase in comorbidities there was also an increase in delirium severity (Kolanowski et al., 2014). Higher comorbidity was associated with the development of delirium in the PAC patient population (Marcantonio et al., 2003). A study evaluating patients recovering from a hip fracture in a rehabilitation ward reported no significant difference in comorbidities for those patients who developed or did not develop delirium (Heyman, Nili, Shahory, Seleznev, & Ben Natan, 2015)

LOS significance - ANOVA

In this study, length of stay (LOS) in the CHART-DEL-derived delirium diagnoses was statistically significant versus the ICD-10 delirium method. Previous studies supported the association of delirium and an increased LOS. Another study found the delirious resident stayed longer in the PAC versus the resident without delirium (Marcantonio et al., 2005). The study comparing the CAM method and the CHART-DEL-derived delirium diagnoses method to identify delirium reported a longer LOS in both instances; 17% utilizing the CAM method and 27% utilizing the CHART-DEL-derived delirium diagnoses method (Saczynski et al., 2014). Another study evaluated patients recovering from a hip fracture in a rehabilitation ward and reported no significant difference in LOS for those patients who developed or did not develop delirium (Heyman et al., 2015).

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Strengths and Limitations

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There were several strengths of this study that are worthy of being mentioned.

The instrument, CHART-DEL, was used to identify delirium from the CHART-DEL-derived delirium diagnoses method review. It is a reliable and valid instrument, (sensitivity 74%, specificity 83%, likelihood ratio 4.4, overall agreement 82% kappa = 0.41) (Inouye et al., 2005). The retrospective chart review was rigorous, extending over the 24-hour period throughout the patients' hospital stays and included all disciplines' documentation: physician, nursing, physical rehabilitation therapist, occupational rehabilitation therapist, social work, speech therapist, certified nursing assistant, admission, discharge notes, and previous acute care discharge summary, which is consistent with other studies. Almost all patients were from the same organization, allowing the researcher to obtain the residents' cognitive and behavioral baseline from the charts and be able to evaluate changes during the entire health care encounter, information also obtained from the charts. Lastly, review of the charts was conducted in the facility that on rare occasion, allowed the researcher to obtain clarification of an illegible letter or word in the documentation.

The study did have limitations that need to be acknowledged. Adjudication was conducted by the researcher of this study and did not utilize a delirium expert panel to reach consensus agreement. At times, illegible handwriting in the paper chart created difficulty in interpreting the documentation and could have led to misclassification. The CHART-DEL validation study did identify risk factors that could contribute to misidentification of delirium including patient factors such as dementia, severity of illness, and high baseline risk for delirium (Inouye et al., 2005). This sample included residents with dementia that added to the complexity in identifying delirium due to the overlapping symptoms noted between delirium and dementia (Inouye et al., 2005). The

CHART-DEL-derived delirium diagnoses instrument does not provide the opportunity to measure severity or type (hyperactive, hypoactive, mix) of delirium. This study was conducted in an LTC-SNF rehabilitation unit connected to a community-based hospital, limiting the generalizability to other PAC and stand-alone LTC rehab facilities.

Implications Practice

Identification of delirium in the LTC-SNF rehabilitation patient is critical in reducing the risk of poor outcomes and potential sequelae (Flanagan & Spencer, 2015). Although nurses are the primary healthcare professional on the team assessing the patient's mental alertness status, other disciplines may provide further assessment to help identify delirium. Other key professionals, such as the physical therapist and occupational therapist, assess the patient's behavior, attention, and alertness frequently (every other day, daily, or event twice a day) depending on the therapy order. It is essential to ensure communication among all members of the healthcare team that may provide early identification in the development of delirium. With early identification of delirium, treatment can be implemented, reducing the extent of negative outcomes related to delirium. Previous studies have reported early identification of delirium and implementation of interventions reduced poor outcomes such as LOS and improved cognitive and functional outcomes (Huson et al., 2016). It is important to develop the system and structures to improve communication among all disciplines, ensuring the physician is updated with the changes early on.

Ideally, a comprehensive delirium management program may provide a reduction in delirium and poor outcomes associated with delirium. To develop this program would require healthcare professionals with advanced practice skills in the geriatric population.

Advance Practice Nurses (APNs) are masters or doctorally prepared nurses and include

Nurse Practitioner (NP) and Clinical Nurse Specialist (CNS). Both the CNS and NP can

also specialize in the care of the older adult. The CNS can provide leadership, patient

care and family education, ensure evidence-based research is the basis for clinical

practice, improve staff knowledge, and engage multidisciplinary support (Mayo et al.,

2010). The NP can provide evidence-based care, prescribing medication and treatments

(Mayo et al., 2010). Both the CNS and the NP can provide added support for the older

adult, the resident family/caregivers, and all staff caring for this population, which can

improve the resident healthcare outcomes.

This study identified that almost all patients were admitted to the LTC

rehabilitation unit from the acute care setting. Previous studies reported patients admitted

to LTC rehabilitation tended to have more acute illnesses and prevalent delirium. This

requires different clinical management than those admitted to LTC-SNF for custodial

care as these residents tend to be more frail (Marcantonio et al., 2003). Screening for

delirium is a critical practice for nurses and all disciplines. These older residents were

reported to have dementia or other cognitive impairment, which made it difficult to

identify if the patient had delirium. The use of a screening method and a reliable

instrument that generates valid data would aid in the early recognition of delirium and the

need for intervention. Additionally, the family and/or caregivers have seen their loved

one in all settings: home, acute care, long term care. This makes them a critical member

of the team, especially identifying change in cognitive status. The family member is

likely to alert the healthcare team of subtle cognitive changes indicative of early onset of

delirium that the healthcare team may not be aware of.

The LTC rehabilitation setting does not require daily physician visits, which leads to a decreased interaction between physicians and other members of the healthcare team in most LTC rehabilitation settings. However, the LTC rehabilitation unit where this study was conducted has some gerontologists who partnered with nurse practitioners to provide care management and ongoing support to the staff. The outcome is that the resident and staff have more interaction with the physician and/or the nurse practitioner. This LTC rehabilitation also has a PhD-prepared nurse who provides guidance in developing the staff and improving the LTC rehabilitation program.

The facility also has a quality control committee with members that include bedside nurses, the medical director (gerontologist), the PhD nurse (CNS, researcher), management, a physical therapist, a social worker, and a dietician. This team is charged with addressing issues and making improvements in resident care and staff education. Adding delirium as a quality measure and routinely monitoring the resident may assist in identifying and managing delirium early on. This type of committee may be helpful in other organizations for adaption into their particular setting.

Education

Even though the majority of residents in this study did not have dementia, one third of the residents had dementia. The resident admitted with dementia is a challenge for the staff as the symptoms of dementia are similar to symptoms of delirium and the staff may not recognize the acute cognitive change. The other issue is that, in previous studies, residents admitted from the acute care indicated a 9% or 12% prevalence of delirium. It is essential for the staff to be knowledgeable of the two syndromes, their symptomology, and their differences. The staff, nursing in particular, will need to be

educated on both syndromes, the use of a screening instrument for delirium, and immediately communicate acute changes to other members of the team. Once delirium is identified, treatment can be implemented. Ongoing education regarding updated and evidence-based standards and competencies for all disciplines need to be integrated into all practice updates.

The aging population in America is growing and as a result, placing demands on the healthcare workforce. In 2008, the Institute of Medicine (renamed the National Academy of Medicine) not only identified the lack of geriatric content in nursing education programs, but provided recommendations to increase formal geriatric training to better prepare the baccalaureate and APN in ambulatory care, hospitals, and institutional long-term care settings. The American Association of Colleges of Nursing (AACN), National Council of State Boards of Nursing (NCSBN), and National Council Licensure Examination (NCLEX) have worked together to ensure geriatric education, competencies, and testing are in place to address the healthcare-related issues with the geriatric population (IOM, 2008).

Nursing Research

Further research is needed to add to the paucity of research studies in the LTC rehabilitation/PAC setting to address delirium. Polypharmacy and race were variables that did not meet the assumptions of the logistic regression test for CHART-DEL-derived delirium diagnoses. Thus, the researcher was not able to complete the evaluation of these factors associated with onset of delirium. The categorical variables of gender, race, principle admitting diagnosis, and dementia also did not meet the assumptions of the logistic regression test for the ICD-10 delirium and so the researcher was not able to

complete the evaluation of these factors associated with onset of delirium. It is important to test these factors in future studies, which may require a larger sample to adequately test the factors. Replication of this study with the addition of other providers will reduce the risk of misclassification and possibly confirm the results of this study. The ICD-10 administrative data edition was introduced in late 2015, so at the time of this study, the method was relatively new to the coders. With time and experience, the coders are likely to become more familiar with the ICD-10 codes and may identify delirium more often (Quan et al., 2008). A study could be designed to determine if differences exist in identifying delirium with the adoption of this edition. The LTC rehabilitation unit where this study was conducted does have an MDS nurse who uses the CAM instrument to identify delirium. The nurse performs the assessment within five days of admission and again in 14 days or whenever the MDS nurse is notified of changes. A study to compare the MDS-documented nurse delirium method with the CHART-DEL-derived delirium diagnoses method could be done concurrently, daily in real time, conducted by the bedside nurse. The ICD-10 method can then be conducted post-discharge, thus capturing any changes during those timeframes. Lastly, it would be interesting to evaluate assessment for delirium by all disciplines and the family and caregivers of the LTC rehabilitation resident to determine if there might be earlier recognition of the onset of delirium.

Conclusion

This study measured the factors associated with two different sources of the occurrence of delirium in LTC rehabilitation unit residents, CHART-DEL-derived delirium diagnoses and ICD-10 delirium diagnosis. Charlson score (comorbidities) was

identified as a significant factor in the resident with delirium. In both the CHART-DEL-derived delirium diagnoses and ICD-10 method, the residents with higher Charlson score (comorbidities) were 1.3 and 1.6 times, respectively, more likely to identify delirium. The odds ratio of 1.3 (CHART-DEL-derived delirium diagnoses) and 1.63 (ICD-10 delirium diagnosis) for these variables. This means that for every one unit the Charlson score (comorbidities) increased, the odds of having delirium determined by CHART-DEL-derived delirium diagnoses method went up 1.3 times and by ICD-10 delirium method by 1.63 times

The research reported in this study provided additional and unique information to the body of knowledge in understanding delirium in the LTC rehabilitation resident. In this study, there was an increased number of cases identified using the CHART-DEL-derived delirium diagnoses method as compared to the ICD-10 method.

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Appendix A: USD IRB

University of San Diego®   **Rebecca Lerma-Kjonegaard <rkjonegaard@sandiego.edu>**

IRB-2018-47 - Initial: Initial - Expedited
3 messages

irb@sandiego.edu <irb@sandiego.edu>   Fri, Oct 6, 2017 at 1:11 PM
To: rkjonegaard@sandiego.edu, urden@sandiego.edu

Oct 6, 2017 1:11 PM PDT

Rebecca Lerma-Kjonegaard
Hahn School of Nursing & Health Science

Re: Expedited - Initial - IRB-2018-47, Delirium in long-term care rehabilitation residents: A correlational retrospective
study

Dear Rebecca Lerma-Kjonegaard:

The Institutional Review Board has rendered the decision below for IRB-2018-47, Delirium in long-term care
rehabilitation residents: A correlational retrospective study.

Decision: Exempt

Selected Category: Category 4. Research involving the collection or study of existing data, documents, records,
pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is
recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to
the subjects.

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