HOSPITAL-ASSOCIATED FUNCTIONAL STATUS DECLINE IN PULMONARY PATIENTS

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Chronic obstructive pulmonary disease (COPD) is a significant worldwide cause of chronic illness and mortality and one of the most common admitting diagnoses in the United States. Persons with COPD are at increased risk for deconditioning during hospitalization, which can lead to decreased functional status at discharge. Disease-related factors and elements of the hospital environment make older adults with COPD vulnerable to hospital-associated functional status decline. The purpose of this dissertation was to identify activity factors that contribute to hospital-associated functional status decline in older adults with COPD by promoting functioning during hospitalization.

This predictive correlational study is a secondary analysis of a pre-existing dataset. Patients with COPD were pulled from the larger parent study sample for comparison with patients without COPD. The convenience sample consisted of 111 patients with COPD and 190 patients without COPD. Subjects were 46.5% male, 53.5% female, and a mean age of 66 years. All subjects were patients admitted to a pulmonary unit and received an intervention protocol designed to address mobility barriers related to COPD and hospitalization.

Statistical analysis explored the number, type, and timing of activity events in relation to the selected functional status outcomes of discharge disposition, length of hospital stay, and 30-day readmission rates for hospitalized older adults with COPD. Multivariate and bivariate analyses results indicated ambulation to the bathroom,

ambulation outside the patient room, and number of days to first out-of-bed activity were significant predictors ($p \leq 0.05$) of patient discharge to home; days to first activity and ambulation were significant predictors ($p \leq 0.05$) of reduced length of stay; none of the variables were predictive of 30-day readmission. Patients with COPD experienced longer lengths of stay and more non-weight bearing activity than patients without COPD in this sample.

These findings provide a foundation for future research to explore hospital environmental factors influencing mobility, determine optimal modes of activity during hospitalization, and examine potential cost savings associated with promotion of early mobility. Findings help explain the effects of physical activity during hospitalization and may aid development of nursing interventions to prevent or alleviate functional status decline in this vulnerable population.

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ABBREVIATIONS

Abbreviation	Term
ADL	Activities of Daily Living
AHRQ	Agency for Healthcare Research and Quality
APR DRG	All Patient Refined-Diagnosis-Related Group Software
BRM	Bathroom
BSC	Bedside Commode
COPD	Chronic Obstructive Pulmonary Disease
ECF	Extended Care Facility
EMR	Electronic Medical Record
ICD	International Classification of Diseases
LOS	Length of Stay
SOI	Severity of Illness

CHAPTER ONE

INTRODUCTION AND NATURE OF THE STUDY

The following research examines the relationship between physical activity factors (weight-bearing activities) and functional status outcomes (discharge disposition to home, hospital length of stay (LOS), and 30-day readmission) of hospitalized older adults with chronic obstructive pulmonary disease (COPD). The primary objective of the study was to increase knowledge regarding predictors of hospital-associated functional status decline for this population. This research provides new information concerning the most impactful type and timing of physical activity to improve patient outcomes and preserve functional status during hospitalization. Knowledge gained from this research may lead to further development of nurse-led mobility protocol interventions that prevent hospital-associated functional status decline while employing optimal use of limited nursing resources. Table 1 shows the key terms used in this study.

Table 1

Key Terms

Key Term	Definition
Deconditioning	Loss of muscle tone and endurance because of immobility
Functional Status	Ability to perform normal daily activities to meet basic needs

Table continues

Exercise Intolerance	Decreased ability or inability to perform physical exercise at the expected level; characterized by exertional dyspnea, tachypnea, tachycardia, muscle pain, muscle weakness, and fatigue
Weight Bearing	Involving the ability to support body weight
Activities of Daily Living (ADL)	Daily self-care tasks. Six basic ADLs: walking/transferring, eating, bathing, dressing, toileting, continence
Tethers	Any device associated with the hospital environment that inhibits physical movement
Accelerometer	Any movement-monitoring device designed to capture physical activity
Spirometry	Pulmonary function testing measuring volume and flow over time
FEV_1/FVC	Ratio of forced expiratory volume in one second to forced vital capacity (maximum amount of air forcibly expired)
VO_2 max	Maximal oxygen uptake or aerobic capacity; measurement of exercise capacity

Background and Significance

The World Health Organization has predicted that COPD, a major cause of chronic illness and mortality, will become the fourth leading cause of death worldwide and rank seventh in burden of disease by the year 2030 (Bousquet & Khaltaev, 2007). In the United States, COPD is one of the most common admitting diagnoses. The economic burden to the U.S. is nearly 50 billion dollars with the majority of expense related to hospitalization (Bousquet & Khaltaev, 2007; Wier, Elixhauser, Pfutner, & Au, 2011).

Patients with COPD are at increased risk for deconditioning during hospitalization, which can lead to decreased functional status at discharge. The chronic inflammatory processes of COPD pathology result in narrowing of bronchioles, airflow limitation, and destruction of lung tissue. Impaired gas exchange and air trapping cause baseline shortness of breath, which worsens with physical activity (Global Initiative for Chronic Obstructive Lung Disease, 2017). Physical activity becomes even more challenging in the presence of acute illness and hospitalization leading to decreased mobility and deconditioning. Deconditioning is associated with prolonged bed rest, chronic disease, and aging (Gulanick & Myers, 2011). Deconditioning is characterized by weakness, exercise intolerance, exertional dyspnea, and inability to perform daily activities, thereby negatively affecting functional status (Gillis, 2008; Gulanick & Myers, 2011; Deconditioning, Tabers, 2005).

Patients admitted with COPD have shortness of breath and oxygen desaturation that make out-of-bed activity very difficult. Unfortunately, remaining in bed leads to further debilitation for these patients, which can result in extended hospitalization and functional status decline at discharge (Mador, Kufel, & Pineda, 2000). Although COPD is one of the top admitting diagnoses in the United States (Agency for Healthcare Research and Quality [AHRQ], 2011), very few studies examine the challenges of mobility in this population. The purpose of this study was to identify factors that contribute to hospital-associated functional decline in patients with COPD, specifically examining correlations between activity level and functional status at discharge.

The majority of research related to hospital-associated deconditioning and functional decline focuses on older adults in the general medical–surgical population. In these studies, functional status decline resulting from hospitalization, though multifactorial, consistently has been associated with lower levels of activity (Fisher et al., 2011; Hoenig & Rubenstein, 1991; Zisberg et al., 2011) and elements related to the hospital environment such as nurse factors, tethers, fear of falls, and physician orders (Brown, Williams, Woodby, Davis, & Allman, 2007; Buurman et al., 2012; Graf, 2013).

Much research related to hospital deconditioning and immobility focuses on adults over age 65. Patients aged 65 and older are noted to be more vulnerable to the harmful effects of prolonged bed rest, at greater risk for extended hospitalization, and experience greater functional decline at discharge (Zisberg et al., 2011). With the anticipated aging of U.S. citizens (Weiner & Tilly, 2002), and as this vulnerable population increases, problems associated with deconditioning will magnify. Patients who decline in function during hospitalization require more expensive levels of care before and after discharge and are at increased risk for falls, readmission, institutionalization, and death (Sager & Rudberg, 1998).

Of particular interest to healthcare are older adults diagnosed with COPD, which is one of the most common pulmonary-related causes of hospitalization and is among the top admitting diagnoses overall (AHRQ, 2011). This sub-group of older adults are vulnerable to hospitalized deconditioning (AHRQ, 2011), however, there are very few studies examining this population. When patients are admitted to the hospital with pulmonary disorders, they experience shortness of breath in addition to age-related risk factors including decreased muscle strength, endurance, and coordination (Miller, 2012) that make out-of-bed activity very difficult. Prolonged bed rest results in further debilitation for this patient group, which can result in extended hospitalization and further functional decline at discharge (Mador et al., 2000).

The deconditioning and subsequent functional decline that occurs in hospitalized patients potentially may be reversed (Kim, So, & Kim, 2009). Staff nurses have the most consistent and direct contact with hospitalized patients and are well situated to guide interventions aimed towards the prevention of deconditioning and preservation of function.

Statement of the Problem

Hospitalized older adults with COPD are at increased risk for deconditioning during hospitalization and decreased functional status at discharge. Little is known about hospital-associated functional decline in the population of older adults with COPD.

Theoretical Perspective

Hospital-associated functional decline among patients with COPD is a multi-factorial phenomenon (Fisher et al., 2011; Hoenig & Rubenstein, 1991; Zisberg et al., 2011). Therefore, analysis of this problem benefits from a variety of theoretical perspectives. The hospital-associated deconditioning model for COPD (see Figure 1) is the framework for this research and was derived from elements of several existing theories. Chapter Two describes the established theories that led to the development of previously published interventions and scientific knowledge aimed at improving outcomes for COPD and older adults. These theories contributed to the framework model of this research.

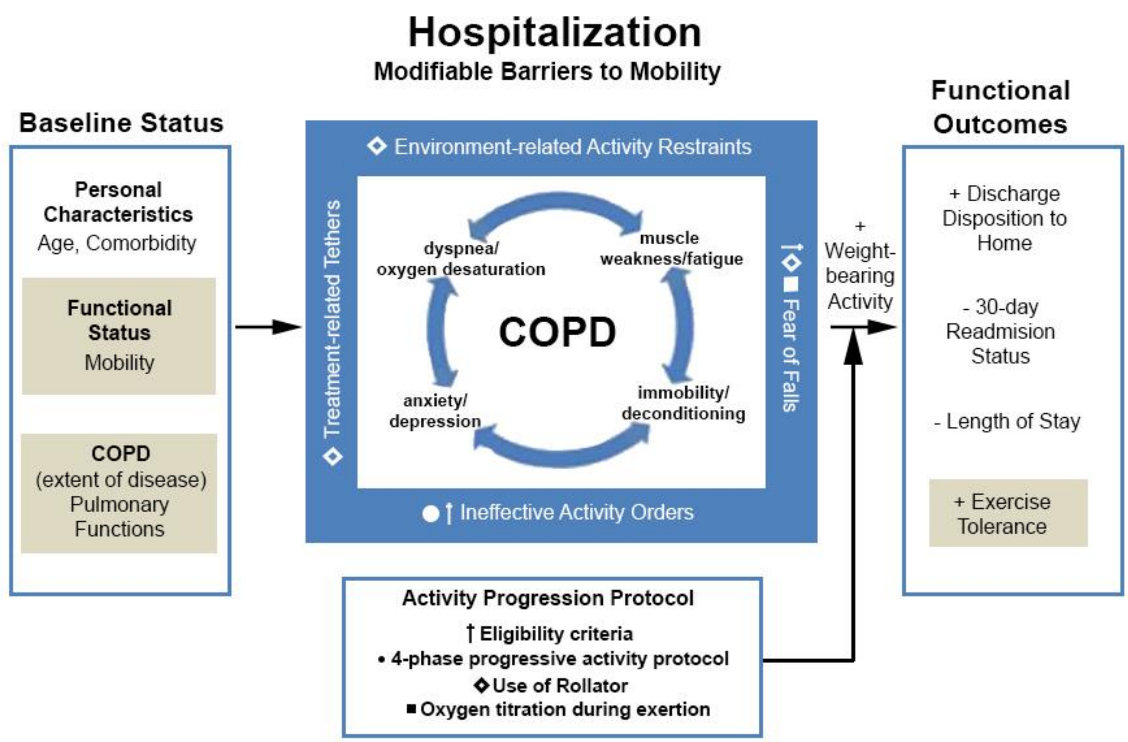

Figure 1. Hospital-associated deconditioning model for COPD (original).

The baseline status of the older adult patient with COPD entering the hospital, comprises the antecedent portion of the study model. Age, comorbidity, pre-admission functional status, and stage of pulmonary disease are non-modifiable aspects of the hospitalized patient with COPD. Only age and comorbidity aspects were addressed as co-variates in this study.

Human aging is an irreversible, comprehensive, cellular process that results in structural damage and susceptibility to illness (Touhy, Jett, Ebersole, & Hess, 2012). The normal process of aging results in functional decline. Comorbidity that accompanies aging contributes further to reduced functional status (Bondy & Maiese, 2010; Dato et al., 2013; Touhy, Jett, Boscart, & McCleary, 2014; Touhy et al., 2012). Functional decline associated with aging and disease leads to immobility. Immobility leads to deconditioning and affects all body systems (Boltz, Resnick, Capezuti, Shuluk, & Secic, 2012; Coupé et al., 2009; Joyner, 2012; Rittweger et al., 2005; Stall, 2012). Changes in cardiovascular, pulmonary, neurological, and musculoskeletal systems are linked to physical activity and are pertinent particularly to this study.

Physical activity in older adults is affected by acute illness and further limited by hospitalization (Hirsch, Sommers, Olsen, Mullen, & Winograd, 1990; Kortebein, 2009; Palleschi et al., 2011; Sager et al., 1996). Miller’s functional consequences theory (2012) aids the examination of mobility in hospitalized older adults. Miller’s functional consequences theory separates irreversible age-related changes from risk factors of disease (i.e., COPD) and environment (i.e., hospital) that increase vulnerability of older adults to functional status decline. These concepts from the functional consequences theory support the central portion of the study model (Figure 1).

The central portion of the study model (see Figure 1) depicts the pathophysiologic nature of COPD and its specific characteristics that affect mobility. Patients with COPD encounter breathing, endurance, and psychological challenges to mobility (Carrieri-Kohlman, Lindsey, & West, 2003; Dudley, Glaser, Jorgenson, & Logan, 1980). Immobility leads to deconditioning, which exacerbates each of these challenges. The bi-directional and cyclical nature of these relationships are delineated within the central portion of the model (Figure 1) and bring conceptual clarity to the problem of functional status decline of hospitalized patients with COPD. This study examines the breathing, endurance, and psychological challenges of mobility in patients with COPD within the context of the hospital environment. Aspects of the hospital environment create unique barriers to mobility (Boltz et al., 2012; Brown, Friedkin, & Inouye, 2004; Graf, Stotts, Hartford, & Deitrich, 2006).

The activity progression protocol is a proposed method to address these barriers (Shay, 2009; see Figure 2). The activity progression protocol is based, in part, upon pulmonary rehabilitation theory (Ries, Bauldoff, Carlin et al., 2007) utilizing oxygen titration during exertion. Implementation of the protocol helps address all the hospital environmental barriers delineated in the study model (Figure 1), thereby facilitating patient opportunity to engage in weight-bearing activity.

ACTIVITY PROGRESSION PROTOCOL*

Level

I. OOB to chair for 20 minutes during first 24 hours after admission
II. OOB to chair for all meals
III. OOB to chair for all meals plus ambulation $\geq$ 5 minutes one to two times per day
IV. Ambulation $\geq$ 5 minutes three times per day (Continue OOB to chair for all meals)

Patient's Perceived Rating of Dyspnea		Objective Signs	Intervention
0 0.5	No shortness of breath (SOB) Slight SOB	Patient is able to sing	Continue activity and monitor for signs of inntolerance
2 3 4	Mild SOB	Patient is able to complete a sentence without gasping	Continue activity and monitor for signs of intolerance
5 6	Strong or hard breathing	• O_2 Sat < 90% • Patient cannot complete sentence • Patient's perceived dyspnea rating is $\geq$ 5 • Diaphoresis	Stop activity Lean or sit Increase O_2 by 1–2 L to maintain O_2 Sat $\geq$ 90% Resume activity when O_2 Sat recovers and symptoms abate
7 8 9 10	Severe breathing or SOB SOB so severe you need to stop and rest	• Chest pain • Significant arrthythmias or ischemic changes • HR with sustained change of $\geq$ 20% • Decrease in SBP > 18 mmHg • Diastolic BP > 110 mmHg	Stop activity ⟶ lean or sit Increase O_2 by 1–2 L to maintain O_2 Sat $\geq$ 90% Return patient to room as soon as able

Consider PT Eval & Treat for:

- Morbidly obese patients
- Demonstrated unsteady gait requiring assistance
- Demonstrated loss of balance or lean when sitting
- Patient inability to progress to a higher level of activity

Adapted from:

Ries, A. L. (2007). Pulmonary rehabilitation: Joint ACCP/AACVPR evidence-based clinical practice guidelines. *Chest, 131*(Supp), 48–42S. doi:10.1378/chest.06-2418
Mundy, L. M., Leet, T. L., Darst, K., Schnitzier, M. A., & Dunagan, W. C. (2003). Early mobilization of patients hospitalized with community-acquired pneumonia. *Chest Journal, 124*(3), 883-889.
Bailey, P., Thomsen, G. E., Spuhler, V. J. et al. (2007). Early activity is feasible and safe in respiratory failure patients. *Crit Care Med* 2007, 35, 139–145.
Morris, P. E., Goad, A., Thompson, C. et al. (2008). Early intensive care mobility therapy in the treatment of acute respiraty failure. *Crit Care Med, 36,* 2238-22243.

* Original

Figure 2. Activity progression protocol (original).

The hospital-associated deconditioning model for COPD (see Figure 1) postulates that increased weight-bearing activity will result in improved functional status-related outcomes. Positive functional status outcomes for this study were (1) discharge disposition to home versus extended care facility (ECF), (2) no readmission to the hospital within 30 days of discharge, and (3) reduced hospital LOS. The functional status outcome measure of exercise tolerance noted in the model was not addressed in the study.

Purpose

The purpose of this study was to identify activity factors that contribute to hospital-associated functional status decline in older adults with COPD and preserving functional status during hospitalization.

Aims

1. Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and discharge disposition to home versus ECF.
2. Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and hospital LOS.
3. Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and 30-day readmission status.
4. Examine the relationship between timing of first out-of-bed activity and discharge disposition, LOS, and 30-day readmission status.
5. Determine the differences between hospitalized older adults with COPD and hospitalized patients with other diagnoses in terms of out-of-bed weight-bearing activity events and outcomes (LOS, discharge disposition, 30-day readmission rates).

Independent variables include:

1. Out-of-bed activity events (weight bearing, non-weight bearing)
2. Timing of first out-of-bed activity

Dependent variables include:

1. LOS
2. Discharge disposition (home versus ECF)
3. 30-day readmission rate

Summary

This chapter presented an introduction and a description of the nature of this study, including the theoretical perspective, purpose and aims. Chapter Two presents a review of the literature. This review includes the theory and normal process of aging, the role of physical activity in functional status decline, hospitalization-related factors, COPD pathology, and the model developed for this study.

CHAPTER TWO

REVIEW OF LITERATURE

Physical activity, age, illness, and comorbid disease have a negative effect on functional status (Wensing, Vingerhoets, & Grol, 2001). This chapter explores aging, COPD, physical activity level, and hospital environmental barriers to mobility. The purpose of this review was to evaluate current evidence examining the relationship between physical activity and functional status in hospitalized older adults with COPD.

Biological Theories of Aging

Aging is a universal, irreversible, biological process. Biological changes of aging occur at the cellular structural level affecting function and longevity (Touhy et al., 2012). As these cellular defects accumulate over time, age-related infirmity and disease develop (Fabbri, Luppi, Beghe, & Rabe, 2008). In addition to physical illness, the social and psychological spheres of aging also are affected by biological changes that occur over time (Dziechciaz & Filip, 2014). Scientists have developed many theories to explain the aging process. Although there is no single most-accepted theory of aging, existing theories fall into one of two categories: error theories and programmed theories. The sections that follow describe examples of theories in each category.

Error Theories

The general premise of error theories is that accumulated cellular damage over time leads to aging. Oxidative stress theory holds that normal aging and susceptibility to disease are the result of cumulative effects of damage from reactive oxygen species. Reactive oxygen species are by-products of oxygen metabolism (Dato et al., 2013; Lagouge & Larsson, 2013). Reactive oxygen species levels may increase during times of stress but in youth are controlled by hormones, enzymes, and antioxidants (Touhy et al., 2014; Touhy et al., 2012). Oxidative stress leads to impaired homeostasis, and the impaired stress response leads to age-related illness (Bondy & Maiese, 2010; Dato et al., 2013; Touhy et al., 2014; Touhy et al., 2012). Environmental factors such as pollution, cigarette smoke, and inflammation also may trigger oxidative stress (Dato et al., 2013; Touhy et al., 2012).

The DNA damage theory propounds that DNA mutation and dysfunction accumulate over time exceeding the body's normal repair mechanism ability (Bondy & Maiese, 2010; Lagouge & Larsson, 2013; Touhy et al., 2014; Touhy et al., 2012). The telomere is a protective structure located at the end of each chromosome that affects how human cells age. Longevity is associated with telomere length but is reduced each time the cell divides. When telomere length is reduced far enough, senescence occurs. Stress, smoking, and lack of exercise are believed to accelerate telomere shortening (Bojesen, 2013; Lin, Epel, & Blackburn, 2012; Shammas, 2011; Touhy et al., 2012).

Programmed Theories

The general premise of programmed theories is that a pre-programmed biological clock determines longevity. Endocrine theory proposes that the biological clock works through age-related hormones such as human growth hormone, estrogen, and testosterone. Aging results from diminished levels of these and other hormones associated with the aging process (Barzilai & Gabriely, 2010; Bengtson, 2009; Chahal & Drake, 2007).

Immunological theory claims that aging is the result of programmed deterioration of the immune system. Immune deficiency leads to increased vulnerability to infection, disease, and oncologic processes (Bengtson, 2009).

Normal Process of Aging and Functional Status Decline

Irrespective of theory, normal biological aging affects all cells, tissues, and organs (Dziechciaz & Filip, 2014). Age-related deterioration of cardiovascular, pulmonary, musculoskeletal, and neurological organ systems has the greatest impact upon physical function and mobility. The following sections describe the effects of normal aging upon these critical body systems.

Cardiovascular System

Physical activity improves cardiac output and oxygen utilization**.** Physical deconditioning is a risk factor for decreased cardiovascular function among healthy adults in the normal process of aging (Miller, 2012). Age-related cardiovascular system changes include left ventricular thickening, left atrial enlargement, thickening of endocardium, and thickening of atrioventricular and aortic valves. These changes reduce effectiveness of cardiac contractility, that is, reduced systolic force and diastolic filling (Cheitlin, 2003; Miller, 2012; Touhy et al., 2014).

Neuroconduction changes within the heart include reduction in pacemaker cells and increased irregularity of cell shape. In addition, fat, collagen, and elastic fiber deposits accumulate around the sinoatrial node. These changes diminish the heart's ability to adapt under physiologic stress (Miller, 2012; Seals, Monahan, Bell, Tanaka, & Jones, 2001; Touhy et al., 2014). Baroreflex changes diminish the compensatory chronotropic response to changes in blood pressure such as those occurring with change in posture. The baroreflex is blunted by a decreased response to adrenergic stimulus and decreased arterial elasticity (Miller, 2012; Touhy et al., 2014).

Vascular changes include increasingly fibrotic tunica media with subsequent lipid and calcium deposits, leading to atherosclerosis. The tunica media has increased collagen and calcification of elastin fibers contributing to greater peripheral vascular resistance and hypertension (Cheitlin, 2003; Miller, 2012; Touhy et al., 2014).

Pulmonary System

Pulmonary age-related changes are gradual in healthy adults. Respiratory compensation becomes even more difficult for older adults in the face of illness, activity restrictions such as bed rest, and history of tobacco smoke exposure such as bronchoconstriction, ciliary damage, mucosal inflammation, or alveolar collapse (Miller, 2012; Touhy et al., 2014). Age-related pulmonary changes are both structural and parenchymal. Structural changes include kyphosis resulting in a shortened thorax and increased anterior–posterior diameter. With age, the chest wall becomes less flexible and muscles of respiration are weakened resulting in increased air flow resistance and reduced efficiency of breathing. Loss of elastic recoil leads to early airway closure and decreased lung volumes (Lalley, 2013). Parenchymal changes involve thickening of the alveolar–capillary membrane negatively affecting gas diffusion and loss of alveolar surface area, which decreases the available area for gas exchange. The pulmonary capillary bed diminishes in size, and the pulmonary artery becomes thickened and wider leading to increased pulmonary artery pressure causing strain on the right ventricle. Older adults also experience a reduction in ventilatory response to hypercarbia and hypoxia because of changes in central medullary and peripheral chemoreceptors (Lalley, 2013; Miller, 2012; Touhy et al., 2014).

Musculoskeletal System

Age-related changes in the musculoskeletal system result in decreased mobility and loss of muscle strength and endurance (Touhy et al., 2014). Ligaments, tendons, and joints lose flexibility and skeletal muscle mass is lost during normal aging. At the cellular level, there is decreased protein synthesis, loss of motor neurons, degeneration of collagen and elastin cells, decreased synovial fluid viscosity, and increased bone resorption (Leveille, 2014; Miller, 2012; Touhy et al., 2014).

Neurological System

Although cognition remains largely intact with normal aging, other neurological changes contribute to altered physical activity and increased risk for falls in healthy older adults (Miller, 2012). Neurons decrease in number with deterioration of dendrites. The brain exhibits atrophy and decreases in size. There are decreased levels of neurotransmitters (i.e., choline acetylase, serotonin, and catecholamines) resulting in mildly impaired memory, slower responses, and balance problems (Camarda et al., 2015). Altered proprioception increases risk for falls (Miller, 2012; Touhy et al., 2014). Reduced serotonin may increase risk for depression and affect older adults' motivation to mobilize. Changes in the reticular formation can cause loss of ability to attain deep sleep (stages 3 and 4 of the sleep cycle) affecting daytime energy levels and ability to engage in physical activity (Touhy et al., 2014).

Biological aging and disease are separate processes that affect functional status of older adults. With aging, healthy older adults experience diminished ability to adapt to the physiological stress of exercise. Decreased muscle mass, cardiac output, and oxygen consumption result in an inability to respond to the increased cardiopulmonary, musculoskeletal, and autonomic nervous system demands of exercise (Miller, 2012). In addition to biological aging, contributing factors of functional status decline in older adults include physical inactivity, illness, and chronic disease (Miller, 2012).

Functional Status Decline and Older Adults with COPD

Among chronic diseases affecting older adults, COPD is the most prevalent. Worldwide, approximately 14% of all adults 65 years of age and older have COPD (Halbert et al., 2016). Characteristics of COPD include persistent and progressive airflow limitation from chronic inflammatory processes that lead to fibrosis, narrowing of small airways, destruction of lung parenchyma, and pulmonary vasculature changes. Pathological changes lead to progressive airflow limitation, loss of lung elastic recoil, impaired gas exchange, and air trapping. The loss of alveolar and pulmonary function leads to symptoms of dyspnea, chronic cough, and sputum production (Global Initiative for Chronic Obstructive Lung Disease, 2017).

The inter-related symptoms and pathologic elements of COPD (e.g., dyspnea/oxygen desaturation, muscle weakness/fatigue, immobility/deconditioning, anxiety/depression) become a cycle that negatively impacts physical activity. Patients with COPD exhibit this cyclic pattern as they become less active, with increasing dyspnea subsequently leading to even greater inactivity (Carrieri-Kohlman et al., 2003; Dudley et al., 1980). Reduced physical activity among patients with COPD leads to deconditioning that results in functional status decline (Carrieri-Kohlman et al., 2003; Dudley et al., 2008; Maltais, 2013). In addition, the pattern of dyspnea, decreased activity, and deconditioning contributes to progression of the disease itself (Maltais, 2013).

Hospital-associated Functional Status Decline in Older Adults

Effects of Immobility

Even in healthy older adults, immobility leads to deconditioning, which leads to functional status decline (Kim et al., 2009). The scientific theory of deconditioning originated with research related to manned space flight. Historically, the United States space program performed most of the initial research on the effects of deconditioning by examining head-down bed rest positions on earth to simulate the effects of microgravity upon the human body in space. Aerospace medicine, therefore, first defined deconditioning in terms of the effects of microgravity upon the cardiovascular system (Antonutto & di Prampero, 2003).

We now know the potential consequences of deconditioning extend beyond the cardiovascular system. Consequences of deconditioning include negative effects upon multiple body systems and decreased functional capacity (Boltz et al., 2012; Coupé et al., 2009; Joyner, 2012; Rittweger et al., 2005; Stall, 2012). Negative effects of immobility and deconditioning upon cardiovascular, pulmonary, musculoskeletal, and neurological systems particularly can significantly impact physical function.

Cardiovascular system. Immobility leads to a reduction in the amount of oxygen the body can use during exercise (VO_2 max), which reflects cardiopulmonary fitness. Immobility leads to elevated heart rate, decreased vagal tone, and decreased stroke volume and cardiac output—all of which contribute to reduced VO_2 max (Hawkins, Raven, Snell, Stray-Gundersen, & Levine, 2007). In a study of the effects of bed rest in healthy subjects, Convertino, Bloomfield, and Greenleaf (1997) found that reduction in VO_2 max is independent of age, gender, or disease state and dependent upon the duration of immobility.

Lower cardiac stroke volume following episodes of immobility is the result of decreased venous return associated with lower circulating blood volume (Convertino, 1997). The loss of plasma volume when on bed rest also contributes to orthostatic hypotension. In addition, bed rest causes an upward fluid shift stimulating baroreceptors in the aortic arch and carotid artery to have an opposite depressor effect (Convertino, 1997; Coupé et al., 2009; Rittweger et al., 2005).

Vascular hazards of immobility include the development of deep vein thrombosis. Bed rest leads to venous stasis, endothelial injury, and hypercoagulability resulting in increased incidence of deep vein thrombosis in hospitalized patients (Emed, Morrison, Des Rosiers, & Kahn, 2010).

Pulmonary system. The combination of supine position and immobility results in decreased vital capacity, residual volume, and respiratory muscle strength. In the supine position, abdominal contents increase pressure from below the diaphragm, reducing lung volumes (Brower, 2009). Lower functional reserve capacity compromises response to the increased demands of physical activity. Reduced lung volumes also can lead to collapse of alveoli. Immobility is believed to increase the risk for atelectasis even in the absence of pre-existing lung disease (Creditor, 1993; Sciaky, 1994). The mucous film lining smaller airways tends to pool leading to increased secretions and the inability to clear them. Inability to clear secretions increases risk for aspiration and aspiration pneumonitis (Convertino et al., 1997; Creditor, 1993; Sciaky, 1994).

Musculoskeletal system. Skeletal muscle atrophy begins in immobile patients within four hours of hospitalization, and muscle mass decreases after one week of bed rest. Contractures can begin forming after only eight hours of immobility. Loss of muscle strength is ongoing and progressive with an additional 20% muscle strength lost for each week of bed rest (Convertino et al., 1997; Mendez-Tellez & Needham, 2012; Sciaky, 1994). Use of weakened muscles generates an increased oxygen demand at the cellular level. Immobility also leads to decreased bone mass density resulting in high calcium clearance rates (Convertino et al., 1997; Morton, 1993; Parry & Puthucheary, 2015; Stein & Wade, 2005).

Neurological system. Prolonged immobility can lead to development of emotional and behavioral changes such as anxiety, depression, and decreased attention span. Lack of physical activity alters normal sleep patterns increasing the risk of sleep deprivation. Sleep deprivation symptoms include perceptual and coordination deficits and diminished intellectual performance (Hultman, Coakley, Annese, & Bouvier, 2012). Prolonged immobility also may lead to feelings of hopelessness and learned helplessness syndrome affecting patient motivation to mobilize (Convertino et al., 1997; Morton, 1993; Sliwa, 2000).

Immobility has long been established as detrimental to cardiovascular, pulmonary, musculoskeletal, and neurological body systems. Immobility has more recently been associated with functional status decline among hospitalized older adults (Boltz et al., 2012; Coupé et al., 2009; Joyner, 2012; Rittweger et al., 2005; Stall, 2012).

Hospital Environment and Functional Status Decline

Acute hospitalization of older adults often results in loss of functional status regardless of the causative illness or injury (Hirsch et al., 1990; Kortebein, 2009; Palleschi et al., 2011; Sager et al., 1996) even in those with stable baseline function (Zisberg et al., 2011). Hoenig and Rubenstein (1991) proposed that hospital-associated functional decline in older adults stems from the effects of deconditioning, the nature of the disease itself, and adverse effects of treatment.

Mobility occurs infrequently among the hospitalized elderly and is associated with adverse outcomes and functional decline (Brown, Redden, Flood, & Allman, 2009; Graf et al., 2006). The effects of normal aging are negatively modified by the hospital experience leading to decreased mobility and loss of function (Graf et al., 2006; Hoenig & Rubenstein, 1991; Morton, 1993). Hospital-associated risk factors for immobility among elders include hospital environmental barriers such as treatment-related tethers, environment-related activity restraints, fear of falls, and ineffective activity orders (Boltz et al., 2012; Brown et al., 2004; Graf et al., 2006).

In addition to external risk factors for immobility in the hospital environment, the hospitalization experience produces internal psychological stress related to uncertainty, pain, and loss of control (Andrade & Devlin, 2015). Symptoms of anxiety, depression, and delirium are associated with hospitalization, particularly among the elderly (Andrade & Devlin, 2015; Boltz et al., 2012; Graf et al., 2006; Graf, 2013). These internal factors may affect patient energy level and motivation to mobilize during acute illness.

Hospital-associated Functional Status Decline in Older Adults with COPD

Patients with COPD are a sub-group of older adults with increased vulnerability to hospital-associated deconditioning (Wier et al., 2011). Very few studies examined this population. When patients are admitted to the hospital with pulmonary disorders, they experience shortness of breath in addition to age-related risk factors of decreased muscle strength, endurance, and coordination (Miller, 2012) that make out-of-bed activity very difficult. Prolonged bed rest results in further debilitation for this patient group, which may result in extended hospitalization and further functional decline at discharge (Mador et al., 2000).

People with COPD have diminished capacity to participate in ADL because of exercise intolerance (Casaburi, 2006). The mechanisms contributing to exercise intolerance among those with COPD are linked to particular aspects of COPD pathology (Aliverti & Macklem, 2008; Debigare & Maltais, 2008; O'Donnell & Webb, 2008).

COPD and Acute Exacerbation Pathology

As previously described, COPD is defined as persistent and progressive airflow limitation from chronic inflammatory processes that lead to fibrosis, narrowing of small airways, destruction of lung parenchyma, and pulmonary vasculature changes. Structural pulmonary changes lead to progressive airflow limitation, loss of lung elastic recoil, impaired gas exchange, and air trapping. Loss of alveolar and pulmonary function cause shortness of breath, chronic cough, and sputum production (Global Initiative for Chronic Obstructive Lung Disease, 2017).

Acute exacerbation of COPD is caused most commonly by respiratory infection and is diagnosed via clinical presentation of dyspnea, wheeze, cough, and sputum production that is beyond normal variation and requires a change in medication administration. Acute exacerbation often requires hospitalization for increased shortness of breath, cyanosis, insufficient home support, presence of comorbidities, and failure to respond to initial treatment (Global Initiative for Chronic Obstructive Lung Disease, 2017).

Hospitalized Older Adults with COPD

While many hospitalized patients are at risk for deconditioning, patients with COPD are particularly vulnerable. The cause of exercise performance limitation in patients with COPD is complex and related to a combination of dynamic hyperinflation, lower limb muscle weakness, and energy imbalance (Aliverti & Macklem, 2008; Debigare & Maltais, 2008; O'Donnell & Webb, 2008). These elements of COPD pathology pose unique challenges to mobilization during hospitalization for acute illness.

Breathing challenges. Dynamic hyperinflation has a negative impact upon the patient's ability to meet increased ventilation demands during exercise. Dynamic hyperinflation results from reduced elastic recoil and increased airway resistance leading to increased end-expiratory lung volumes (Agusti & Soriano, 2006). The combination of low inspiratory capacity and increased end-expiratory lung volumes creates abnormal ventilatory mechanics that reduces peak oxygen uptake during exertion (O'Donnell & Webb, 2008).

Dynamic hyperinflation combined with increased oxygen demands during exertion results in an oxygenation and blood flow competition between muscles of respiration and muscles of locomotion. This is evidenced by lactic acid production in patients with COPD even at lower exercise levels (Aliverti & Macklem, 2008). Oxygen administration during exertion improves exercise performance by alleviating tissue hypoxia, thus better balancing energy supply and demand (Aliverti & Macklem, 2008).

Endurance challenges. Quadriceps strength is associated with functional capacity in patients with or without lung impairment. Patients with COPD have a reduction in type I and type II muscle fibers suggestive of contractile protein deficit manifested in reduced mid-thigh muscle mass (Debigare & Maltais, 2008). Skeletal muscle dysfunction and decreased endurance are present without evidence of muscle wasting, even in mild to moderate COPD (Bram van den et al., 2013). Exercise intolerance in patients with COPD may be connected to a combination of leg weakness, dyspnea, and fatigue (Aliverti & Macklem, 2008; Debigare & Maltais, 2008; O'Donnell & Webb, 2008).

Contributing factors of exercise intolerance in COPD are complex and intertwined. Dynamic hyperinflation can be improved temporarily using bronchodilators, the timing of which may affect exercise performance. Oxygen administration during exertion to alleviate hypoxemia and tissue hypoxia also is supported by the evidence presented and exercise aimed at increasing lower limb muscle strength is associated with better performance (Durstine & Moore, 2003; Ries, 2007).

Psychological challenges. Depression and anxiety are prevalent among older adults with COPD (al Aqqad, Ali, Md. Kassim, Sarriff, & Tangiisuran, 2014; Valenza et al., 2014). Depression among patients with COPD is as high as 45.9% and anxiety as high as 24.3% (al Aqqad et al., 2014). Anxiety among patients with COPD is often related to feelings of breathlessness or dyspnea. Dyspnea, in turn, can be reinforced and escalated by anxiety (Carrieri-Kohlman et al., 2003). Anxiety also is part of the hospitalization process for patients with COPD (Valenza et al., 2014). Hospitalization is stressful for all patients in terms of discomfort, unfamiliarity of environment, and reduced physical capability (Andrade & Devlin, 2015; Hultman et al., 2012; Tanja-Dijkstra, 2011).

Hospitalized patients with COPD exhibit increased anxiety and depression symptoms. Patients with COPD describe dyspnea and anxiety during acute illness as intertwined and related to emotional wellbeing (Bailey, 2004). Hospitalization for exacerbations are associated with worsening quality of life (Filipowski, Bozek, Kozlowska, Czyzewske, & Jarbzab, 2014; Gudmundsson et al., 2006; Maurer et al., 2008) that may contribute to depressed emotions.

Anxiety and depression related to hospitalization for COPD affects patient outcomes and has been associated with higher risk of relapse within 30 days (Gudmundsson et al., 2006). Depression is also an independent risk factor for hospital readmission within one year (Iyer et al., 2016). Anxiety and depression in patients with COPD affect physical function, functional status (Valenza et al., 2014), treatment compliance, and hospital LOS (Maurer et al., 2008).

Mobility challenges. The hospital environment routine often leads to patient loss of control of daily functions such as eating, sleeping, and freedom of movement (Andrade & Devlin, 2015; Tanja-Dijkstra, 2011). Hospital bedside technology involving wires and machines also can limit physical mobility (Graf, 2013; Tanja-Dijkstra, 2011).

Failure to ambulate hospitalized patients can result in increased LOS, muscle wasting, fatigue, and functional decline (Kalisch, Tschannen, Lee, & Friese, 2011). A review of studies of omitted or significantly delayed nursing care showed that patient ambulation was the most frequently missed (76.1% to 88.7%) component of nursing care in the hospital setting. Inadequate nurse staffing, increased time required to ambulate patients, and lack of proper equipment were among elements of the hospital environment identified as contributors to this aspect of missed nursing care (Kalisch, 2006; Kalisch, Lee, & Dabney, 2014).

Comorbidity in COPD and its Relation to Functional Status

Comorbidity is a baseline personal characteristic of this study sample, and COPD often is accompanied by comorbid conditions. Comorbidity affects functional status and physical mobility aspects of quality of life in patients with COPD (Fabbri et al., 2008; Huber, Wacker, Vogelmeier, & Reiner, 2015; Van Manen et al., 2001; Wijnhoven, Kriegsman, Hesselink, De Haan, & Schellevis, 2003; Yeo, Karimova, & Bansal, 2006).

Physical function is a key domain in measurements of health-related quality of life (Huber et al., 2015). A systematic review by Huber et al. (2015) reported specific comorbid conditions negatively affected health-related quality of life in patients with COPD: cardiovascular disease, diabetes, depression, anxiety, musculoskeletal disorders, and body mass index (Huber et al., 2015; Sundh, Ställberg, Lisspers, Montgomery, & Janson, 2011).

In addition to specific comorbid diseases, the quantity or total number of comorbid conditions is associated with worsening health-related quality of life in patients with COPD (Huber et al., 2015; Sundh et al., 2011; Van Man et al., 2001; Xiang et al., 2015; Yeo et al., 2006). The presence of three or more comorbid conditions affects health-related quality of life in all domains (Van Manen et al., 2001).

Health-related quality of life is negatively affected by decreased mobility. The muscle-wasting component of COPD is associated with fatigue and lower levels of activity and self-care (Huber et al., 2015). Physical activity is decreased in the presence of comorbidities in patients with COPD in every stage of disease (Sievi et al., 2015).

Physical Activity in Patients with COPD

Benefits of physical activity in patients with COPD include cardiovascular re-conditioning, improved muscle strength, balance, flexibility, and ability to perform daily activities (Durstine & Moore, 2003). Pulmonary rehabilitation, the recognized standard of care for patients with COPD, is based upon improving physical activity and function through exercise training. Exercise in the pulmonary rehabilitation context is defined as physical activity that is planned, structured, and repetitive for improving physical fitness (Caspersen, Powell, & Christenson, 1985).

Pulmonary rehabilitation was designed for COPD in the outpatient setting (Ries, 2008). A recent American Thoracic Society/European Respiratory Society Statement on Pulmonary Rehabilitation acknowledged the logic of pulmonary rehabilitation in the acute care setting for exacerbation of COPD (Spruit et al., 2013). The Society's statement was based, in part, on synthesized results of successful exercise interventions initiated during and/or following acute exacerbations (Puhan et al., 2011; Puhan, Scharplatz, Troosters, & Steurer, 2005).

Physical Activity and Functional Status Decline in Hospitalized Older Adults with COPD

There is limited knowledge of physical activity and functional status decline in hospitalized older adults with COPD. Decreased physical activity has been linked to deconditioning and functional status decline in hospitalized older adults. Hospitalized patients with COPD experience unique disease-related challenges to physical activity in addition to those faced by other hospitalized patients. The literature contains few studies addressing this issue with even fewer conducted in the United States.

Studies of Hospital-associated Functional Status Decline in Older Adults

Literature discussing deconditioning and functional status decline reveals a predominantly community-dwelling geriatric focus although there is emerging interest in hospital-associated functional decline among the elderly (McCusker, Kakuma, & Abrahamowicz, 2002). Studies of functional decline in hospitalized older adults are primarily descriptive and identify low pre-admission functional status as a non-modifiable risk factor associated with poorer functional outcomes at discharge (Buurman et al., 2012; Sager & Rudberg, 1998; Suesada, Martins, & Carvalho, 2007; Zisberg et al., 2011). Advanced age was another non-modifiable risk factor for adverse functional outcomes in two studies (Mehta et al., 2011; Sager et al., 1996). Though not necessarily age related, three studies identified acute illness in general (acute stroke, metastatic cancer, and COPD) as illnesses with greater risk for functional decline (Mehta et al., 2011; Pitta et al., 2006; Suesada et al., 2007).

Modifiable risk factors for functional status decline among hospitalized older adults include barriers to mobility such as tethers, fear (by staff and patients) of falls, physician orders, low staffing, time constraints, and patient refusal (Brown et al., 2007; Buurman et al., 2012; Graf, 2013).

The most frequently cited hospital environmental risk factors for functional status decline in older adults were inactivity and *tethers*. Tethers include devices that limit patient mobilization such as intravenous lines, oxygen lines, urinary catheters, restraints, and ambulatory aids. Inactivity and tethers were identified as contributing to functional decline (Brown et al., 2007; Buurman et al., 2012; Graf, 2013; Pitta et al., 2006; Zisberg et al., 2011).

Several qualitative studies considered nurse time and care processes as risk factors for patient immobility (Boltz et al., 2012; Brown et al., 2007; Graf, 2013). Graf (2013) explored nursing factors more extensively beyond nurse time constraints and the need for additional staff assistance. Although nurses could articulate the theoretical reasons for functional decline and need for patient activity to preserve function, the majority of nurses ranked patient mobility very low among priorities for care in the face of competing demands.

Fear of patient falls and self-injury created hesitation in promoting patient activity. Graf (2013) also discussed the *culture of the chair* whereby out-of-bed activity orders translated to *sitting in a chair* rather than *ambulation*. Bedside commodes (BSC) and chairs often were found placed directly next to the bed limiting the patient's opportunities to ambulate beyond one or two steps. Nurses reported continued fear of patient falls even with patients in the chair and chair alarms in place (Brown et al., 2007; Graf, 2013).

Graf (2013) discussed physician orders as a potential risk factor for hospital-associated functional status decline. Orders for *up ad lib* or *up three times per day* were the most common orders written on the Graf (2013) study unit. Nurses did not consider activity orders as having the same importance as other types of physician orders. They did not consider it necessary to report failure to carry out an activity order as they would report failure to administer an ordered medication, for instance. Physician orders written on admission were rarely re-evaluated. Nurses reported often consulting physical therapy prior to advancing patient activity beyond bed rest. Nurses reported that physical therapy was the most qualified discipline to determine patient activity ability (Graf et al., 2006).

Studies of Hospital-associated Functional Status Decline in COPD

There are numerous studies concerning deconditioning and functional status decline of patients with COPD in outpatient or rehabilitation settings but very few in the hospital setting (Reid et al., 2012). Most hospital-based studies originate from outside the United States (e.g., Belgium, New Zealand, Taiwan, and United Kingdom).

Hospitalized patients with COPD spend most of their time sitting or in other non-weight-bearing positions and do not return to baseline level of function even at 30 days post-discharge (Pitta et al., 2006). Patients with COPD face greater challenges to mobility during hospitalization secondary to acute pulmonary illness. The baseline activity level of patients with COPD prior to admission is lower when compared to much older healthy adults (Reid et al., 2012).

Pitta et al. (2006) examined 24 patients with COPD hospitalized in Belgium for acute exacerbation. The study used accelerometers to record the time patients spent in weight-bearing activity. The study measured quadriceps force on days 2 and 7 of hospitalization and performed a 6-minute walk test on day 8 and 1 month following discharge. Higher quadriceps force was correlated with improved walking performance. The study observed pronounced inactivity with marked loss of quadriceps strength during hospitalization (Pitta et al., 2006). Standard care in Belgium for COPD acute exacerbation in 2006 mandated a 10-day hospital stay. The average LOS for acute exacerbation COPD in the U.S. was approximately four days during that same time period. The study by Pitta and colleagues (2006) underscored the link between hospitalization for acute illness, lower levels of activity, and loss of lower limb muscle strength in patients with COPD. Standard LOS for acute exacerbation of COPD in Belgium is more than twice that experienced by patients in the U.S., which somewhat limits the generalizability of these findings. Other differences in hospital care between Belgium and the U.S. were not discussed in the study.

A more recent U.S. study by Khan et al. (2013) also examined the physical activity pattern of patients with COPD before, during, and after an exacerbation. In this study 17 patients with COPD were monitored continuously with accelerometer technology. Physical activity was stable during the 4-week period prior to exacerbation and significantly decreased during the first 7 days of exacerbation including the period of hospitalization. Although this study did not undertake measures of muscle strength, the participant accelerometer distances were measured and did not return to normal until 3 to 4 weeks post-discharge (Khan et al., 2013). This pattern of reduced activity during hospitalization is similar to the Belgian study and suggests patients with COPD are vulnerable to functional decline during this period, and interventions implemented during hospitalization may help mitigate loss of function.

Three randomized controlled interventional studies of hospitalized patients with COPD and functional status were identified in the literature. Eaton et al. (2009) examined 84 hospitalized patients with COPD in New Zealand and the effects of an early inpatient pulmonary rehabilitation program upon readmission risk, exercise capacity, and symptoms. There was no statistically significant difference between intervention and control groups for symptomatology and exercise capacity but clinically significant trends towards improvement in both. The readmission risk for the intervention group was 16% versus 32% for the usual care group. This was an important first study of inpatient pulmonary rehabilitation showing that ambulation and exercise interventions are safe and feasible for patients with acute exacerbation COPD (Eaton et al., 2009).

Although the Eaton and colleagues' (2009) study did not see significant improvements in symptoms, a recent randomized controlled interventional study by Liao, Chen, Chung, and Chien (2015) found significant reduction in dyspnea, cough, and sputum production. Liao and colleagues (2015) examined 61 patients hospitalized in Taiwan for COPD exacerbation who participated in an ambulation/exercise program. Exercise tolerance was measured via a 6-minute walk test at day 4 with significant improvement ($p = 0.001$) in the experimental group (Liao et al., 2015). This study provides further support of safety and feasibility of activity interventions in acutely ill patients with COPD with outcomes measured in timeframes compatible with traditional U.S. hospital care.

One recent study of exercise intervention for 389 hospitalized patients with chronic respiratory disease (82% with COPD) in the United Kingdom did not yield positive results (Greening et al., 2014). Within 48 hours of admission daily aerobic training at 85% VO_2 max, strength training, and electrical stimulation of the quadriceps began. The prescribed walking speed was 10 meters in 20 seconds. Tolerance was measured using the Borg dyspnea scale. There was no mention of oxygen titration during exertion. In-hospital sessions were supervised followed by an unsupervised home program for a total of 6 weeks. There was no significant difference between intervention and control groups for 12-month readmission rate, 12-month quality of life, LOS, or exercise tolerance. There was a statistically significant increase in 12-month mortality for the intervention group. The study authors could not explain the increased mortality and concluded that progressive exercise should not be started during acute illness. A subsequent published review of the Greening study concluded further research is needed to determine risks and benefits of early progressive exercise therapy during acute exacerbation and optimal time for delivery (Lee & Holland, 2014).

Research of early progressive mobility in the critical care arena is more developed and is now the accepted standard of care (Barr et al., 2013). In addition to the normal hazards of bed rest, critically ill patients have protein-energy malnutrition, hypermetabolic stress, decreased muscle protein synthesis, increased muscle catabolism, and loss of muscle mass and strength. In addition, these patients experience diffuse sensorimotor neuropathy, fluctuating clinical stability, and detrimental effects of prolonged mechanical ventilation (Needham, 2008; Schweickert et al., 2009).

Studies of physical activity in critically ill patients with pulmonary and hemodynamic compromise have shown positive functional status-related outcomes. Statistically significant results are demonstrated in decreased delirium, decreased ventilator days, decreased intensive care unit and hospital LOS, but no significant reduction in mortality (Adler & Malone, 2012; Kayambu, Boots, & Paratz, 2013).

Evidence to support the safety and benefits of early progressive mobility in critical care is strong enough to make this a standard of care endorsed by the Society of Critical Care Medicine (Barr et al., 2013) and the American Association of Critical-Care

Nurses (2016). Critical care literature supports safe and feasible early mobility. Interventions rely on the effects of gravitational stimulus and may use increased FiO_2 (fraction of inspired oxygen) before and during exertion. These mobility protocols consist of basic weight-bearing activity that progresses from dangle, to chair, to ambulation, for improved functional status outcomes.

Assisting patients with basic weight-bearing activity is a routine nursing function. A recent U.S. study by Nguyen et al. (2015) tracked nursing documentation of patient activity level in the 24-hour period prior to discharge for 2,910 hospitalized patients with COPD. Results showed that patients who were non-ambulatory 24 hours prior to discharge were at significantly greater risk of readmission. Study authors suggested that routine nurse documentation of activity level is a practical reflection of patients' physical functional status (Nguyen et al., 2015).

Summary of Research Findings on Hospital-associated Functional Status Decline in COPD

Research shows a recognition of hospital-associated functional decline among older adults due to lower levels of physical activity. Quantitative studies of this phenomenon are few, and fewer still examine hospital-associated functional status decline in patients with COPD or other pulmonary disorders. There is some evidence to support mobility interventions for hospitalized patients with COPD (Eaton et al., 2009; Liao et al., 2015) and evidence suggesting that much more research is needed (Greening et al., 2014).

The overall paucity of published studies addressing hospital-associated functional decline indicates that much more research is needed, particularly regarding the hospitalized patient with COPD population. Additional research should establish that functional decline does occur in hospitalized patients with COPD and also examine potential risk factors. Baseline shortness of breath and age-related changes would seem to make this population particularly vulnerable to the effects of inactivity, deconditioning, and functional status decline in the hospital environment. A comparison between the functional levels of COPD and other hospitalized older adult populations may establish if pulmonary patients are at greater risk for functional decline. See Appendix A for a summary of individual research studies exploring hospital-associated functional decline in patients admitted with COPD.

Measures of Functional Status

Deconditioning is multifaceted, and there is no single approach to measuring and analyzing deconditioning. Direct measurement of physiologic changes has been conducted primarily in animal models. Measurement of deconditioning in humans has relied on performance testing and evaluation. In clinical care, measurement of deconditioning among persons with disease has relied on indirectly determining functional status. Functional status is defined as the "ability to perform activities of daily living that require sustained aerobic metabolism" (Arena et al., 2007, p. 329). People with COPD have diminished capacity to participate in ADL because of exercise intolerance (Casaburi, 2006). The mechanisms contributing to exercise intolerance in COPD are linked to particular aspects of COPD pathology (Aliverti & Macklem, 2008; Debigare & Maltais, 2008; O'Donnell & Webb, 2008).

Commonly used measures of functional status of older adults include the tools used in the studies included in this literature review (see Table 2). The Barthel ADL index assesses 10 ADL variables that include bowel/bladder function and mobility. The scale is simple and has been used most often with in-patient rehabilitation of stroke patients. The Lawton/Brody instrumental ADL scale (IADL) examines eight domains of the more complex cognitive and/or physical functions required for independent community living, which limits its use in more acute settings. Measures of actual physical activity can be performed using technological tools such as the accelerometer, which is a sensor worn at the waist to provide an objective measure of activity. Interviewer-administered surveys, such as the Yale physical activity survey (YPAS), use patient/family reports to assess household, exercise, and recreational components of activities among older adults. Surveys rely upon participant self-report, which may limit their use to pre-admission functional status determination.

Table 2

Functional Status Measurement Tools

Tool	Functional Measurement Definition
Barthel ADL Index	10 ADL variables of basic function
Lawton/Brody IADL Scale	8 domains of complex function
Yale Physical Activity Survey (YPAS)	Survey of time/energy expenditure
Pulmonary Function Testing (PFT)	Spirometry lung volumes
Borg Dyspnea Scale	Subject rating of exertional dyspnea
St. Georges Respiratory Questionnaire	50-item survey for quality of life
Six Minute Walk Test (6MWT)	Distance walked in 6 minutes

Studies assessing functional capacity in pulmonary patients have used the Lawton-Brody Instrumental ADL Scale, pulmonary function testing (PFT) via spirometry

FEV_1/FVC ratio (ratio of forced expiratory volume in one second to forced vital capacity), exercise testing using the 6-Minute Walk Test (6-MWT), anthropomorphic measurement using body mass index (BMI), Borg dyspnea scale, and a quality of life assessment using the St. George's respiratory questionnaire (SGRQ). Pulmonary function testing uses spirometry equipment to measure lung function and can assess changes over time. The 6-MWT is a simple method to detect changes in functional capacity of pulmonary patients by measuring distance walked within 6 minutes and pre-/ post-dyspnea reports. The Borg dyspnea scale is widely used and entails subject rating of exertional dyspnea on a 0–10 scale. The SGRQ is a disease-specific instrument to measure quality of life for patients with COPD.

Theoretical Perspectives

Deconditioning and functional status decline among hospitalized older adults with COPD is a complex phenomenon. It is difficult for one single theory to explain all facets of this phenomenon—particularly within the context of acute illness. However, there are excellent established theories whose concepts could be combined to support a more focused a model for investigation of this multifaceted phenomenon. The hospital-associated deconditioning model for COPD (see Figure 1) is based upon theories described in the following section and provides the framework for this research study.

Miller's (2012) functional consequences theory and pulmonary rehabilitation theory has concepts related to functional status evaluation, hospital environmental factors, and physical activity interventions that can be combined in a coherent model for the study of the relationship of physical activity to functional status among hospitalized patients with COPD (see Figure 1).

Functional Consequences Theory

The functional consequences theory (Miller, 2012) provides a framework for exploring deconditioning in older adults with COPD. Functional consequences theory delineates age-related changes, defined as progressive and irreversible changes occurring in late adulthood, from risk factors, defined as conditions (disease or environmental) that increase the vulnerability of older adults to negative functional consequences (Miller, 2012). All older adults can be expected to experience age-related changes, albeit at different rates and to different degrees. Risk factors are related to disease and its treatment. Both age-related changes and risk factors can negatively impact functioning among older adults. Functional consequences theory proposes that nursing interventions, when aimed at modifying or alleviating these risk factors, can promote positive functional consequences and wellness. Wellness outcomes enable the older adult patient to function at the highest level despite age-related changes and risk factors (Miller, 2012).

Pulmonary Rehabilitation Theory

Pulmonary rehabilitation is founded in cardiopulmonary science and is a recognized standard of care for patients with COPD (Ries et al., 2007). Pulmonary rehabilitation is a comprehensive program whose cornerstone is exercise training but also includes education and behavior change interventions (Spruit et al., 2013). Exercise in the pulmonary rehabilitation context is defined as physical activity that is planned, structured, and repetitive to improve physical fitness (Caspersen et al., 1985). The American Thoracic Society/European Respiratory Society Statement on Pulmonary Rehabilitation acknowledges the logic of pulmonary rehabilitation interventions in the acute care setting for exacerbation of COPD (Spruit et al., 2013). The Society’s statement was based, in part, on reviews of pulmonary rehabilitation in acute exacerbation of COPD that synthesized results of exercise interventions initiated during and/or following acute exacerbations (Puhan et al., 2011; Puhan et al., 2005). Pulmonary rehabilitation principles are well suited to serve as the theoretical basis for mobility interventions in hospitalized patients with COPD (Eaton et al., 2009; Greening et al., 2015; Liao et al., 2015).

One of the goals of pulmonary rehabilitation is improved lower limb muscle strength and functional status that lead to increased quality of life in patients with COPD. Pulmonary rehabilitation has shown improved dyspnea and exercise tolerance even without corresponding improvement in lung function (Debigare & Maltais, 2008). Pulmonary rehabilitation principles of exercise interventions for patients with COPD include walking, energy conservation modalities, supplemental oxygen during exertion, and ongoing assessment for changes in clinical status (Durstine, 2003; Ries, 2007). These principles are well suited to serve as the theoretical basis for mobility interventions in hospitalized patients with COPD.

Activity Progression Protocol

The activity progression protocol (Shay, 2009; see Figure 2) is a nurse-driven protocol for early mobilization based upon principles of cardiac and pulmonary rehabilitation (Ries, 2007) and prior study of hospitalized community-acquired pneumonia patients (Mundy, Leet, Darst, Schnitzler, & Dunagan, 2003). The protocol employs screening for readiness, initiation of out-of-bed activity within 24 hours of admission, four progressive levels of activity, rollator use, and oxygen titration. Oxygen therapy during exertion has been shown to improve exercise performance in patients with

COPD (Nonoyama, Brooks, Lacasse, Guyatt, & Goldstein, 2007). Initiation of activity within 24 hours was adapted from a study of hospitalized patients with pneumonia (Mundy et al., 2003) and expanded to the COPD population for this study.

The activity progression protocol (see Figure 2) is a standardized approach to facilitate out-of-bed activity for hospitalized patients. Research shows that standardized protocols are an effective means of improving nurse-sensitive patient care outcomes. A review of nine quantitative studies examining effects of early mobilization for medical–surgical inpatients showed that a standardized protocol-based approach to early mobilization is associated with improved functional status in hospitalized older adults (Pashikanti & Von Ah, 2012).

Physical therapy and pulmonary rehabilitation define exercise interventions as planned, structured, and repetitive. Patient mobility from a nursing care perspective is often unplanned and unstructured but just as important and beneficial to the patient in terms of maintaining and restoring function. The activity progression protocol provides a defined, yet flexible, goal-oriented method for promotion of mobility in patients with pulmonary compromise.

Hospital-associated Deconditioning Model for COPD

The hospital-associated deconditioning model for COPD (see Figure 1) brings conceptual clarity to the phenomenon. The model depicts effects of disease and hospital environment upon mobility and postulates that early weight-bearing activity positively effects functional status outcomes (e.g., discharge disposition, hospital readmission, and LOS). The model uses Miller’s (2012) functional consequences theory as an overall framework. Antecedent patient characteristics of age, baseline functional status, and pre-admission comorbid disease are age-related, non-modifiable risk factors of hospital-associated functional status decline. The presence of comorbidity in COPD is associated with decreased physical activity (Sievi et al., 2015) and therefore is examined as a potential contributing factor to functional status decline in this study.

Physiologic theory of deconditioning helps explain the relationship between immobility and deconditioning and its negative effects upon multiple body systems. Pathophysiologic theory of COPD explains the cyclic and bidirectional interaction of desaturation/dyspnea, muscle weakness/fatigue, and anxiety/depression with immobility making physical activity especially challenging for these patients.

From the perspective of Miller's functional consequences theory (2012), hospitalization is the environmental context of acute illness with certain barriers to, and risks for, immobility that have been identified in the literature (i.e., treatment-related tethers, ineffective activity orders, fear of falls, and environment-related activity restraints). Pulmonary rehabilitation principles support the benefits of physical activity for patients with COPD and the use of oxygen titration during exertion to improve exercise performance. The activity progression protocol (see Figure 2) is the interventional component of the model and is based in part on pulmonary rehabilitation theory (Bailey et al., 2007; Morris et al., 2008; Mundy et al., 2003; Ries, 2007).

Assumptions of the Model

The following model assumptions are based upon the body of work reviewed for this study:

1. Age-related changes and comorbid conditions are non-modifiable contributors to hospital-associated deconditioning.

2. COPD disease-related factors increase vulnerability to deconditioning during hospitalization.
3. The hospital environment creates barriers to mobility.
4. Promoting weight-bearing mobility during hospitalization improves functional outcomes at discharge.

Based upon the scope of the problem and what is known about COPD and hospital-associated functional status decline literature, the following hypotheses emerged for study within the framework of the hospital-associated deconditioning model for COPD (see Figure 1):

Hypotheses

1. Increased frequency of out-of-bed weight-bearing activity is associated with reduced LOS and improved functional status outcomes at discharge for hospitalized older adults with COPD.
2. There is a difference between out-of-bed weight-bearing activity among hospitalized older adults with COPD and patients with other diagnoses.

Indirect measures of functional status outcomes are discharge disposition (Lee, Staffileno, & Fogg, 2010), 30-day readmission status (Medicare, 2015; Nguyen et al., 2015), and LOS (Fisher, Kuo, Graham, Ottenbacher, & Ostir, 2010). Independent variables are out-of-bed activity and time to first out-of-bed activity. Age and comorbidity are examined as confounding variables.

Summary

This chapter presented a review of the literature that explores aging, COPD, physical activity level, and hospital environmental barriers to mobility. It provided an evaluation of current evidence examining the relationship between physical activity and functional status in hospitalized older adults with COPD. While no single theoretical or conceptual framework currently possesses the ability to explain all facets of this complex issue, they provide a basis for the hospital-associated deconditioning model for COPD developed for this study. The chapter also presented the assumptions of the model and presented the hypotheses of the study. Chapter Three describes the methods used to study the relationships between the physical activity and functional status of hospitalized patients with COPD.

CHAPTER THREE

METHODS

The purpose of this chapter is to describe the methods employed to examine relationships between physical activity events and functional status during hospitalization for patients with COPD. Part 1 describes methods of the parent study from which data was obtained, and Part 2 describes methods of the current study.

Part 1: Parent Study

The parent study arose from a pulmonary patient care unit quality improvement initiative measuring LOS and readmission outcomes following implementation of an activity progression protocol. The purpose of the parent study was to examine correlations between an activity progression protocol for patients (see Figure 2) and hospital LOS, discharge disposition, falls, pressure ulcer prevalence, oxygen requirements, perceived dyspnea, and maximum activity level. Data was collected for the parent study but not analyzed because of insufficient resources at that time. The activity progression protocol (Shay, 2009) is a nurse-driven protocol for early mobilization based upon principles of cardiac and pulmonary rehabilitation (Ries, 2007) and prior study of hospitalized community-acquired pneumonia patients (Mundy et al., 2003). The protocol employs screening for readiness (Bailey et al., 2007; Morris et al., 2008), progressive levels of activity, oxygen titration, and rollator use. Development of the activity progression protocol was based upon a review of literature identifying important elements for promotion of patient mobility. The protocol was employed following the review and approval of an interdisciplinary committee at the study facility.

The parent dataset consists of data collected from the study, Clinical Outcomes of an Activity Progression Protocol for Pulmonary Patients (#SC4872, Shay PI). Part 1 of this chapter describes the design, sample criteria, recruitment, and data collection of the parent study.

Design

The parent study was a retrospective outcomes study examining correlations between a nurse-driven, four-phase, activity progression protocol and specific patient outcomes.

Sample Criteria

The convenience sample was obtained from among all patients admitted to the study unit over a 10-month period. Inclusion criteria consisted of patients aged 18 years or older, admitted to and discharged from the study unit without transfer during the hospital stay, and alive at discharge. Exclusion criteria included patients with conditions prohibiting weight-bearing activity, mechanical ventilation, do not resuscitate (DNR) status, and patients transferred to or from another hospital or other nursing unit within the study facility during the hospital stay. The parent study sample contains 358 patients meeting inclusion/exclusion criteria. There are 111 different primary and secondary diagnoses among the parent study sample. Although the study unit is designated for *pulmonary* patients, the diagnoses vary widely and include infectious, endocrinological, metabolic, neurological, auto-immune, oncologic, hematological, cardiovascular, psychological, pharmacologic imbalance, and post-operative complication-related diagnoses.

The pulmonary patient care unit is a 35-bed medical–surgical unit designated specifically for COPD and pneumonia admissions as well as patients with other respiratory-related diagnoses. Patients admitted to the study unit with pneumonia and COPD were placed on the pulmonary benchmark physician order set unless specifically ordered otherwise. Information provided by the study unit showed that COPD and pneumonia diagnoses occurred concurrently in approximately 40% of patients with COPD admitted to the study unit. The pulmonary benchmark physician order set contained standard treatment orders for admission unit placement, diet, activity (i.e., activity progression protocol), intravenous rehydration, antibiotic therapy in the presence of pneumonia, lab work (chemistry/hematology), blood/sputum cultures, imaging, bronchodilator and airway clearance treatment (i.e., respiratory care protocol), oxygen weaning, vital sign monitoring (e.g., telemetry, blood pressure, heart rate, temperature, and oxygen saturation), smoking cessation referral, and immunizations (pneumococcal/influenza). Typical nurse-to-patient ratio on the study unit was 1 to 4. Data were acquired through retrospective electronic medical record (EMR) review.

The activity progression protocol (see Figure 2) is a nurse-driven method to advance pulmonary patient mobility during hospitalization. The protocol consists of eligibility criteria, four phases of progressive mobility, use of rollators, oxygen titration during exertion to maintain minimum oxygen saturation of 90%, guidelines for assessment of exercise intolerance, and criteria for physical therapy referral (see Figure 2).

Although the activity progression protocol is nurse-driven, its implementation utilized an interdisciplinary approach. All nurses, respiratory therapists, and patient-care technicians underwent mandatory education about the protocol. Each discipline documented patient progress through the protocol activity levels on an interdisciplinary care plan. Reporting of patient activity level progress was expected at all interdisciplinary rounds. The study investigator invited physical therapy participation in the activity progression protocol but the department at the study facility declined.

Although the pulmonary benchmark physician order set contains the activity progression protocol, the activity progression protocol is also a unit-based protocol in effect for all patients admitted to the pulmonary patient care unit unless the physician specifically writes an alternative activity order. There are no data available pertaining to staff compliance with the activity progression protocol during the study period.

Recruitment

The activity progression protocol was a unit-based protocol enacted for all patients admitted to the study unit. The protocol was initiated for all patients during the first 24 hours of admission provided hemodynamic, neurological, and respiratory stability were achieved as defined within the protocol. All patients meeting inclusion criteria were potential participants. Waiver of consent was granted by the university's institutional review board (see Appendix B).

Protection of Human Subjects

The parent study was approved by the university's institutional review board (see Appendix B). The university holds a federal-wide assurance through the Office for Human Research Protections. A waiver of consent and authorization to use protected health information was granted for the parent study because there was no more than minimal risk to participant's privacy and the data management plan met review board requirements for waiver of consent.

Data Collection

Data were collected over a 10-month period on a pulmonary patient care unit in an 850-bed Level One Trauma Center facility. Data were collected from patients admitted from September 2011 through June 2012, which included the peak winter months of COPD exacerbation for the northern hemisphere (Donaldson & Wedzicha, 2014). Data were acquired through retrospective EMR review. Parent study data was stored electronically on the study hospital/university's secure research computer server.

Part 2: Dataset for Current Study

Part 2 of this chapter describes the design, sample criteria, study procedures, measures, and plan for the secondary analysis of the parent study dataset.

Design

The study employed a predictive correlational design examining the number, type, and timing of out-of-bed activity events in relation to the outcome variables of LOS, discharge disposition, and 30-day readmission status for hospitalized patients with COPD. Patients with COPD-related primary or secondary diagnoses were extracted from the parent study dataset for secondary analysis of the previously mentioned variables.

A descriptive comparative design was used to describe differences between patients with COPD-related diagnoses and patients with non-COPD-related diagnoses from among the parent study sample.

Sample Criteria

The current study sample was drawn from the same 358 patients in the parent study who met inclusion/exclusion criteria. Inclusion and exclusion criteria were unchanged from the parent study. As previously described, data were collected over a 10-month period on a pulmonary patient care unit in an 850-bed Level One Trauma Center facility.

Study Procedures

There were 137 patients with one of four possible primary or secondary COPD-related diagnoses among the parent study sample of 358 patients meeting inclusion criteria. All diagnoses were identified by International Classification of Diseases (ICD) codes. COPD-related ICD codes are 491.21 obstructive chronic bronchitis with exacerbation; 491.22 chronic obstructive asthma; 493.22 chronic obstructive asthma (unspecified); and 492.8 other emphysema. The study investigator pulled from the total parent study sample of 358 patients with these four ICD diagnosis codes for analysis. The database was kept on a secure university computer server, password protected, and accessible only from university computer networks.

Protection of Human Subjects

The current study was granted an exemption by the university institutional review board (see Appendix C) for the new protocol, hospital-associated functional status decline in pulmonary patients.

Power Analysis

The proposed study sample size estimate was based on power analyses for research Aims 1, 2, and 3. Power for logistic regression for research Aim 3 was based on the ability to predict the rarer outcome of 30-day readmission. Based on data from the AHRQ Healthcare Cost and Utilization Project (Wier et al., 2011), 30-day readmission rates for hospitalized patients with primary or secondary diagnosis of COPD is 20.2%. A minimum of five observations per parameter are required to detect significant predictors ($p < 0.05$) of the rarer outcome using logistic regression (Grimm & Yarnold, 2000). Of the COPD sample, 20.2% ($n = 28$) would be expected to be readmitted to the hospital within 30 days of discharge, which allowed for the analysis of up to five possible predictors. Therefore, the sample was deemed sufficient to support analysis of the four planned predictor variables (age, comorbidity, weight-bearing activity events, timing to first out-of-bed activity).

Power for logistic regression for research Aim 1 was based on the ability to predict the rarer outcome of discharge to ECF. Based on data from the AHRQ Healthcare Cost and Utilization Project (Wier et al., 2011), 13.2% of patients hospitalized with primary or secondary diagnosis of COPD are discharged to an ECF. A minimum of five observations per parameter are required to detect significant predictors ($p < 0.05$) of the rarer outcome using logistic regression (Grimm & Yarnold, 2000). Of the COPD sample, 13.2% ($n = 18$) would be expected to be discharged to an ECF, which allowed for the analysis of three possible predictors. This sample size was insufficient to support analysis of the four planned predictor variables (age, comorbidity, weight-bearing activity events, timing to first out-of-bed activity). Given the relative lack of variability in age among hospitalized patients with COPD (Wier et al., 2011), the study investigator determined that analysis of comorbidity, out-of-bed activity events, and timing to first out-of-bed activity would comprise the three predictor variables of study for logistic regression analysis of discharge disposition.

Aim 2 of the study used multiple regression to examine the relationship of four variables (age, comorbidity, weight-bearing activity events, and timing to first out-of-bed activity) to hospital LOS. The number of patients with COPD in the sample (*n* = 137) allowed for analysis of up to 13 variables and was deemed sufficient to support the proposed multiple regression analysis.

Measures

The following section outlines the outcomes and predictors measures for the study. A summary of measures of the independent variables, dependent variables, methods, and methods rationales with corresponding research questions is presented in Tables 3 (Methods) and 4 (Measures).

Table 3

Methods

Aims[a]	**Independent Variable**	**Dependent Variable**	**Method**
1	Out-of-bed activity events	Discharge disposition home versus ECF	Logistic regression
2	Out-of-bed activity events	LOS	Multiple regression

Table continues

3	Out-of-bed activity events	30-day readmission	Logistic regression
4	Timing of first out-of-bed activity	Discharge disposition, 30-day readmission, LOS	Logistic regression Multiple regression
5	Out-of-bed activity events Timing of first out-of- bed activity	Discharge disposition, 30-day readmission, LOS	Chi Square *t* test

[a]Potential co-variates for each aim were Age, Gender, and SOI.

Table 4

Measures

Variable	Measure	Level of Measurement	Data Source	Operational Definition
		Independent		
Out-of-bed activity	Out-of-bed activity events by type and category (weight bearing; non-weight bearing) divided by LOS in days	Ratio	EMR (ADL field)	Number of activity events per specific activity level during hospital stay, categorized as 0 (*non-weight bearing*; BSC, chair, dangle) or 1 (*weight bearing;* bathroom (BRM), ambulation outside of room) and divided by LOS

Table continues

Timing of first out-of-bed activity	Days	Ratio	EMR (nurse snapshot; ADL field)	Number of days from admission to first out-of-bed activity event regardless of type 0 (*up day of admission*)
Co-morbidity (SOI)	APR DRG[a] SOI score	Ordinal	ICD-9 Diagnosis Codes and SOI scores from hospital decision support data	Hospital-assigned SOI score using 3M™APR DRG software
Age	Years	Ratio	EMR (nurse snapshot)	Age in years

Table continues

		Dependent		
LOS	Days	Ratio	EMR (admission, discharge, transfer field)	Number of days from hospital admission to discharge
Discharge disposition	Discharge to home versus ECF	Nominal	EMR (patient discharge record)	0 (*ECF*), 1 (*Home*)
30-day readmission status	Readmitted to hospital within 30 days	Nominal	Hospital decision support data	0 (*Yes*; readmitted) 1 (*No*; not readmitted)

[a]APR DRG = All Patient Refined-Diagnosis-Related Group Software

Data acquisition. The principal investigator was the same for both the parent and current study; therefore, permission for data sharing agreements was not needed. Data for the original study were collected and remain de-identified. The objectives of the secondary analysis were compatible with the purpose of the original study. Data for the current project were transferred to the university's research file system in HIPPA-compliant de-identified form.

Data collection. De-identified data for secondary analysis were saved electronically on the university's secure server. Only the primary researcher and the chair of the dissertation committee had access to the files.

Data analysis. The study investigator performed data analysis using Statistical Package for Social Sciences, SPSS, version 22 and R software (R Core Team, 2015). Descriptive statistics (mean, range, standard deviation) for each variable were calculated and tabulated. Tables 3 and 4 describe each study variable, measurement method, level of data, and statistical test. Scatterplot matrices were plotted to assess for curvilinearity prior to correlational analysis to identify non-linear relationships. Data were examined for outliers. The level of significance was set at $p < 0.05$.

Independent variables include:

1. Out-of-bed activity events (weight-bearing, non-weight bearing)
2. Timing of first out-of-bed activity

Dependent variables include:

1. LOA
2. Discharge disposition (home versus ECF)
3. 30-day readmission rate

Logistic regression analysis was used to assess the relationship between the number and type of out-of-bed activity events and the timing of first out-of-bed activity and the dichotomous dependent variables of discharge disposition to home versus ECF and 30-day readmission status. The out-of-bed activity event data were combined by category as weight-bearing (BRM, ambulation) and non-weight bearing (BSC, dangle, chair). Multiple regression assessed the relationship between the number, type, and timing of out-of-bed activity events and hospital LOS. Chi square and *t* test analyses (see Table 3) were used to compare the COPD-related diagnoses patient group and patients with non-COPD-related diagnoses (Tabachnick & Fidell, 2001).

Methods Summary

Convenience sampling is at risk for bias and the resulting sample may not be representative of the larger hospitalized COPD population. However, convenience sampling can be more practicable to attain the necessary sample size with recruitment potentially hampered by high acuity illness (Kerlinger & Howard, 2000). In the absence of funding, convenience sampling is also more practicable in terms of time and cost (Grove, Burns, & Gray, 2013). Despite convenience sampling used in this study, exploration of relationships between the variables in this study can lay the groundwork for future interventional research using probability sampling methods for improved generalizability to the broader COPD population.

Functional status as an outcome measure was assessed indirectly through patient discharge disposition, hospital LOS, and readmission status. Indirect measure of functional status is consistent with the purpose of this predictive correlational study examining factors that contribute to functional status decline in hospitalized older adults with COPD.

Logistic regression and multiple regression analysis addressed research Aim 1 through Aim 4, examining the relationships between outcomes and activity during hospitalization of patients with COPD. Regression analysis addressed the purpose of the study by identifying potential factors that contribute to hospital-associated functional status decline while eliminating specific unrelated variables. Chi square and *t* test analyses addressed research Aim 5 to describe differences in outcomes between hospitalized patients with COPD and patients with other diagnoses.

Summary

Hospitalized older adults with COPD are at risk for deconditioning during hospitalization and decreased functional status at discharge. Few studies have examined this phenomenon in patients with COPD. This analysis examined relationships between physical activity events and functional status outcomes to help identify potential risk factors contributing to functional decline in this population. The following chapter will present detailed results of the statistical analyses for each study aim.

CHAPTER FOUR

RESULTS

The purpose of this research study was to identify activity factors that contribute to hospital-associated functional status decline and preserve functional status during hospitalization in older adults with COPD. This chapter focuses on statistical analyses related to the goals of the secondary data analysis that were to (a) examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and discharge disposition to home versus ECF, (b) examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and hospital LOS, (c) examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and 30-day readmission status, (d) examine the relationship between timing of first out-of-bed activity and discharge disposition, LOS, and 30-day readmission status, and (e) determine the differences between hospitalized older adults with COPD and hospitalized patients with other diagnoses in terms of out-of-bed weight-bearing activity events and outcomes (e.g., LOS, discharge disposition, 30-day readmission rates).

Statistical Analysis

Sample Characteristics

Characteristics of the COPD and non-COPD groups are reported in Table 5. The final COPD and non-COPD samples were reduced to n =111 and n = 190, respectively, after observations were excluded because of multiple missing values multiple predictors and frequency analysis that revealed cases with only stretcher-chair activity. Stretcher-chair activity was not included as a predictor variable in this study.

Table 5

Demographic and Characteristics of Participants

Demographics	COPD (n = 111) *M* (*SD*)	non-COPD (n = 190) *M* (*SD*)	*p*
Age (years)	67.1 (11.7)	65.2 (16.6)	0.247
SOI[a] (3M APR DRG)	2.56 (0.944)	2.70 (1.02)	0.230
Gender	% (*n*)		
Male	37.8 (42)	51.6 (98)	0.019*
Female	62.2 (69)	48.4 (92)	

[a]SOI = severity of illness.
*$p \leq 0.05$.

Demographic variables age, gender, and SOI were evaluated using descriptive statistics for COPD diagnosis and non-COPD diagnosis groups. The mean age was 67 for the COPD group and 65 for the non-COPD group. The COPD group was predominantly female (62%) while non-COPD group gender was more evenly distributed with 52% male and 48% female. Mean SOI (3M™ APR DRG) was 2.55 for COPD and 2.70 for non-COPD. This chapter's section containing results for Aim 5 further describes COPD and non-COPD groups regarding specific activities and study outcomes.

Research Aim 1

To address research Aim 1, Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and discharge disposition to home versus ECF, a logistic regression was performed. No prior assumptions were examined regarding distributions because normality, linearity, and equal variance are not factors for this type of regression (Tabachnick & Fidell, 2001). Logistic regression with backward elimination was performed. All potential variables initially were entered then deleted one at a time. Variables were deleted where variable loss was the most statistically insignificant to the model fit. Variable deletion process continued until no further variables could be deleted with significant loss of model fit (Hosmer, Lemeshow, & Sturdivant, 2013). Dichotomous dependent variable categories were coded as 0 for the reference group (*discharge to ECF*) and 1 as the response group (*discharge to home*) for the comparison.

Binary logistic regression analysis was conducted to predict discharge disposition to home for the sample of patients with COPD (n = 111) using weight-bearing activity (BRM privilege, ambulation) and non-weight-bearing activity (BSC, chair, dangle) as predictors (model 1). A test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between discharge disposition to home versus ECF while controlling for age and SOI (Chi square = 91.64, $p < 0.001$ with $df = 9$). Nagelkerke's R^2 of 0.465 indicated a moderate relationship between prediction and grouping. Prediction success overall was 91.8% with 30% for discharge to ECF and 98% for discharge to home. Weight-bearing activity ($p < 0.001$) and age ($p < 0.007$) made significant contributions to the model. Although SOI did not independently contribute to the model ($p = 0.783$), evidence showed a significant interaction of SOI and COPD ($p = 0.041$). The effect of the interaction variable SOI.COPD may be interpreted to mean the effect of SOI on discharge disposition to home differed between patients with COPD and patients without COPD in this sample. Logistic regression revealed that weight-bearing activities (ambulation, BRM) have a significant effect on discharge disposition to home when controlling for age and SOI (see Table 6).

The odds ratio for weight-bearing activity indicates that for every additional weight-bearing activity per day, the patient is 27.9 times more likely to be discharged home. Interpretation of the 95% confidence interval for the odds ratio shows we are 95% confident that the odds of discharge to home increases by a factor of between 6.8 and 113 for each additional weight-bearing activity per day on average.

Table 6

Logistic Regression to Determine Discharge Disposition Model 1

Predictor	B	*p*	*OR*	95% CI	
				Lower	Upper
Age	-0.041	0.007*	0.959	0.931	0.988
Weight bearing	3.327	0.000*	27.862	6.834	113.592

Note. OR = odds ratio; CI = confidence interval.
*$p \leq 0.05$.

Logistic regression also was conducted using single predictor models to establish probability point estimates for discharge to home for the following predictor variables: number of weight-bearing activities per day; non-weight bearing activities per day; number of chair, dangle, BSC, BRM, and ambulation activities per day (see Tables 7, 8, 9, and 10). Interpretation of confidence intervals for probability point estimates shows that two weight-bearing activities per day is associated with a 98.8% to 100% estimated probability of discharge to home. Increasing the number of chair and dangle activities per day demonstrates little improvement in estimated probability of discharge to home. Increased frequency of dangle activity is associated with greater estimated probability of discharge to home when compared to chair. Confidence intervals for chair activity show increasing frequency of chair activity beyond once per day may potentially decrease the estimated probability of discharge to home. Table 9 shows a probability estimate comparison for the toileting activities of BSC versus ambulation to the BRM. Getting up to the BRM once per day results in a 95% to 99% estimated probability of discharge to home. Comparatively, once per day BSC activity shows an 80% to 90% estimated probability of discharge to home. Increased frequency of BSC toileting activity beyond once per day shows little improvement in probability of discharge to home. Confidence intervals for ambulation (Table 10) show one ambulation activity per day results in a 99% to 100% estimated probability of discharge to home.

Table 7

Probability Estimates of Discharge to Home for Non-weight Bearing vs Weight-bearing Activity

Non-weight bearing	95% CI		Weight bearing	95% CI	
Activities per day	Lower	Upper	Activities per day	Lower	Upper
0	0.675	0.843	0	0.440	0.650
1	.0748	0.856	1	0.914	0.988
2	.0794	0.879	2	0.988	1.000
3	0.816	0.908	3	0.998	1.000
4	0.826	0.936	4	1.000	1.000
5	0.833	0.956	5	1.000	1.000

Note. CI = confidence interval.

Table 8

Probability Estimates of Discharge to Home for Chair vs Dangle

Chair	95% CI		Dangle	95% CI	
Activities per day	Lower	Upper	Activities per day	Lower	Upper
0	0.764	0.895	0	0.722	0.847
1	0.793	0.878	1	0.807	0.896
2	0.742	0.905	2	0.832	0.948
3	0.675	0.935	3	0.845	0.976
4	0.855	0.990	4		
5	0.864	0.995	5		

Note. CI = confidence interval

Table 9

Probability Estimates of Discharge to Home for BSC vs BRM

BSC	95% CI		BRM	95% CI	
Activities per day	Lower	Upper	Activities per day	Lower	Upper
0	0.768	0.870	0	0.610	0.763
1	0.801	0.906	1	0.953	0.999
2	0.781	0.905	2	0.994	0.994
3	0.751	0.975	3	0.999	1.000
4	0.716	0.988	4		
5	0.864	0.995	5		

Note. CI = confidence interval

Table 10

Probability Estimates of Discharge to Home for Ambulation

Ambulation	95% CI	
Activities per day	Lower	Upper
0	0.474	0.666
1	0.999	1.000

Note. CI = confidence interval.

Binary logistic regression was conducted to predict discharge disposition to home using individual activities (BRM privilege, ambulation, BSC, chair, dangle) as predictors (model 2). A test of the full model against a constant-only model was statistically significant, indicating that the predictors as a set reliably distinguished between discharge disposition to home versus ECF while controlling for age and SOI (Chi square = 106.76, $p < 0.001$ with $df = 6$).

Nagelkerke's R^2 of .488 indicated a moderate relationship between prediction and grouping. Prediction success overall was 91.8% with 30% for discharge to ECF and 98% for discharge to home. Ambulation ($p < 0.001$) and BRM privilege ($p = 0.008$) made significant contributions to the model (see Table 11). Logistic regression revealed that ambulation outside the room and getting the patient up to the BRM had significant effect on discharge disposition to home when controlling for age and SOI (see Table 11). The odds ratio for ambulation indicates that for every additional ambulation activity per day, the patient is 2,811 times more likely to be discharged home. The odds ratio for up to BRM indicates that for every additional BRM activity per day, the patient is 7.7 times more likely to be discharged home. Interpretation of the 95% confidence intervals for the odds ratios for ambulation and BRM shows we are 95% confident that the odds of discharge to home increases by a factor of between 1.1 and 53.8 for each additional time the patient is up to the BRM per day, on average, and we are 95% confident that the odds of discharge to home increases by a factor of between 37.9 and 208,417 for each additional ambulation activity per day, on average.

Table 11

Logistic Regression to Determine Discharge Disposition Model 2

Predictor	B	*p*	*OR*	95% CI	
				Lower	Upper
Age	-0.047	0.003*	0.968	0.938	0.999
Up to BRM	2.041	0.040*	7.697	1.102	53.754
Ambulation	0.806	0.000*	2811.929	37.938	208417.903

Note. OR = odds ratio; CI = confidence interval.
*p ≤ 0.05.

Logistic regression results are evaluated in terms of (1) multicollinearity among variables, (2) test of overall model, (3) test of individual predictors, and (4) interpretation of residuals.

Multicollinearity among variables. Collinearity diagnostics were performed by evaluating tolerance and variance inflation factor values (VIF) using linear regression statistics in SPSS (Field, 2013). Results (see Tables 12 and 13) suggest there were no issues with collinearity between outcome variables and predictor variables for model 1 and model 2 because tolerance levels were greater than 0.10 and VIF values were less than 10 (Field, 2013).

Table 12

Collinearity Statistics Model 1

Variable	Tolerance	VIF
SOI	.782	1.279
Age on Admission	.893	1.120
Gender	.916	1.091
Days to first act	.884	1.131
Weight-bearing	.826	1.211
Non-weight-bearing	.907	1.102

Table 13

Collinearity Statistics Model 2

Variable	Tolerance	VIF
SOI	.761	1.315
Age on Admission	.832	1.202
Gender	.688	1.454
Days to first activity	.857	1.167
Chair	.843	1.187
Dangle	.837	1.195

Table continues

BSC	.595	1.680
BRM	.686	1.459
Ambulation	.855	1.170

Two separate logistic regression models were performed. Model 1 categorized activity predictor variables as weight-bearing or non-weight-bearing to determine which category of activity predicted discharge disposition to home versus ECF. Model 2 included individual activities as predictors to determine which specific activities are most predictive of discharge disposition to home. The logistic regression output provided inferential tests of the overall models and goodness of fit tests of individual variables (Tabachnick & Fidell, 2001).

Test of overall model. Goodness-of-fit tests indicated the statistical models fit the set of observations (Field, 2013). Goodness-of-fit is based on how accurately the data predicted by the regression model is related to the collected data (Field, 2013). If there is no difference between a model with the slated variables and a model without the variables, then those variables entered have no influence on the dependent variable (Field, 2013). This is an important assumption of regression and must be established before further evaluation of the findings can be completed. Chi square tests of goodness-of-fit (Hosmer-Lemeshow et al., 2013) were not significant for the model examining weight-bearing activity predictors ($p = 0.366$; model 1) and not significant for the model examining individual activities as predictors ($p = 0.262$; model 2) suggesting that model prediction data did not significantly differ from the observed data (Field, 2013). Based on the goodness-of-fit, the analysis proceeded to test the significance of each independent variable.

Test of individual predictors. Significant relationships between discharge disposition and individual predictors were based on odds ratios with a 95% confidence interval outside of 1.0 and $p \leq 0.05$ (Tabachnick & Fidell, 2001). Odds ratios greater than 1 related to increased odds for discharge to home versus ECF. Results of variables entered into the logistic regression model showed significant predictors of discharge to home were specific activities of ambulation (*OR* = 2811.92) and up to the BRM (*OR* = 6.69). These same activities significantly predicted discharge to home when examined categorically as weight-bearing activity (*OR* = 27.86).

Interpretation of residuals. Residuals of the logistic regression models were examined through Studentized residuals, standardized residuals, and deviance statistics (Field, 2013; Tabachnick & Fidell, 2001). Cook's distance, DFBeta, and leverage statistics revealed no values greater than 1 for either of the models suggesting no influential cases were found that negatively impacted the regression model (Field, 2013; Tabachnick & Fidell, 2001).

In summary, results suggest weight-bearing activity (BRM privilege, ambulation) and ambulation particularly are significant predictors for discharge to home, while controlling for patient age and SOI. Significant relationships between discharge disposition to home and the individual variables were based on odds ratios with a 95% confidence interval outside of 1.0 and $p \leq 0.05$ (Tabachnick & Fidell, 2001).

Research Aim 2

To address research Aim 2, Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and hospital LOS, multiple regression was performed using three steps: (1) evaluate relationships between LOS and predictors, (2) examine multiple regression assumptions, and (3) perform multiple regression.

Step 1: Evaluate relationships between LOS and predictors. Relationships between activity events (BRM privilege, ambulation, chair, dangle, BSC) and LOS variables were evaluated using Pearson correlations. Relationships among predictors is shown in Table 14. Relationships were considered significant if the *p* value was $p \leq 0.05$. These variables were then entered into the regression model

Table 14

Test of Association among Predictors

Predictors	Severity	Days to first activity	Weight-bearing	Non-weight-bearing	Chair	Dangle	BSC	BRM	Ambulation
Days.to.first.activity	0.163*								
Weight-bearing	-0.364*	-0.243*							
Non-weight-bearing	-0.016	-0.170*	0.078						
Chair	0.081	-0.085	0.074	0.417*					
Dangle	-0.097	-0.142*	0.172*	0.809*	-0.04				
BSC	0.074	-0.086	-0.192*	0.619*	0.258*	0.173*			
BRM	-0.322*	-0.194*	0.900*	0.001	0.045	0.100	-0.225*		
Ambulation	-0.243*	-0.236*	0.675*	0.104	0.073	0.158*	-0.100	0.362*	
COPD diagnosis	-0.070	-0.035	0.078	0.211*	0.112	0.145*	0.156*	0.058	0.057

*$p \leq 0.05$, numeric values represent the Pearson correlation coefficient.

Step 2: Examine multiple regression assumptions. The assumptions of regression were evaluated before the analysis to establish that assumptions of (1) non-collinearity, (2) absence of outliers, (3) independence of errors, (4) linearity, (5) normality, and (6) homoscedasticity of residuals were not violated.

Non-collinearity. Collinearity was evaluated based on the tolerance and VIF scores. No variables approached 0 or exceeded 10, which would indicate concern of multicollinearity (Field, 2013; Tabachnick & Fidell, 2001).

Absence of outliers. Cook's distance, leverage statistics, and DFBeta revealed no values greater than 1 for either of the models suggesting no influential cases were found that negatively impacted the regression model (Field, 2013; Tabachnick & Fidell, 2001).

Linearity. Linearity was verified by examination of plotted residuals on a scatterplot diagram that was linear in shape with a positive direction.

Independence of errors. Durbin-Watson statistic was 2.34 for model 1 and 2.32 for model 2. The results were near 2.0, which is optimal to show that the errors of prediction are independent (Field, 2013; Tabachnick & Fidell, 2001).

Normality and homoscedasticity. Residuals of the logistic regression models were examined through Studentized residuals, standardized residuals, and deviance statistics (Field, 2013; Tabachnick & Fidell, 2001). Normal probability plots for model 1 and model 2 showed issues with normality and non-constant variance. Based on this examination of residuals, assumptions of normality and homoscedasticity for the multiple regression models were violated. A natural log transformation was used for both models to remediate these issues. Probability plots for the transformed models show assumptions of normality and homoscedasticity to be no longer violated.

Step 3: Perform multiple regression. Multiple regression analysis was conducted to predict hospital LOS by categorizing activities as weight-bearing (BRM privilege, ambulation) and non-weight-bearing (BSC, dangle, chair) as predictors (model 1) and again using individual activities (BRM privilege, ambulation, BSC, chair, dangle) as predictors (model 2).

The stepwise approach of multiple regression was selected for the final analysis. A process of backward elimination was used whereby the least significant variable was removed at each step. Final regression models showed significant relationships as presented in Table 15 and Table 16.

Model 1 overall fit. The model summary for the final regression model showed that the predictors in the model accounted for 33.4% of the variability in hospital LOS (R^2 = .334, adjusted R^2 = .320). The ANOVA results showed that the model statistically significantly predicted hospital LOS (F = 23.27 (6,284), $p < 0.001$). The model with the predictor variables is a better predictor of LOS than the mean model, thus establishing goodness of fit (Field, 2013).

Model 1 parameters. The model parameters evaluated the unique contribution of each predictor in the regression model. Significant predictors of LOS included days-to-first activity ($p < 0.001$), SOI (3M™ APR DRG; $p < 0.001$), and weight-bearing activity ($p < 0.001$). For model 1, the interpretation of results was based on the 95% confidence intervals of the slope coefficients (B). For each additional weight-bearing activity (BRM, ambulation) per day, it is expected that the LOS decreases by between 0.07 and 0.18 days, on average. For each additional day to first out-of-bed activity, it is expected that the LOS increases by between 0.06 and 0.13 days, on average. For each increased level of SOI, it is expected that the LOS increases by between 0.26 and 0.68 days, on average.

Table 15

Summary of Multiple Regression Model 1

Predictor	B	*SE*	*p*	95% CI	
				Upper	Lower
Days to first activity	0.0994	0.0174	0.000*	0.0654	0.1334
SOI	0.4720	0.1070	0.000*	0.2610	0.6830
Weight-bearing activity	-0.1266	0.0279	0.000*	-0.1815	0.0717

Note. CI = confidence interval.
*$p \leq 0.05$.

Model 2 overall fit. The model summary for the final regression model showed that the predictors in the model accounted for 35.1% of the variability in hospital LOS (R^2 = .3519, adjusted R^2 = .3379). The ANOVA results showed that the model statistically significantly predicted hospital LOS (F = 25.16 (6,284), $p < 0.001$). The model with the predictor variables is a better predictor of LOS than the mean model, thus establishing goodness of fit (Field, 2013).

Model 2 parameters. The model parameters evaluated the unique contribution of each predictor in the regression model. Significant predictors of LOS included days-to-first activity ($p < 0.001$), SOI (3M™ APR DRG; $p < 0.001$), and ambulation ($p < 0.001$). For model 2, the interpretation of results was based on the 95% confidence intervals of the slope coefficients (B). For each additional ambulation activity per day, it is expected that the LOS decreases by between 0.26 and 0.57 days, on average. For each additional day to first out-of-bed activity, it is expected that the LOS increases by between 0.06 and 0.129 days, on average. For each increased level of SOI, it is expected that the LOS increases by between 0.29 and 0.699 days, on average.

Table 16

Summary of Multiple Regression Model 2

Predictor	B	*SE*	*p*	95% CI	
				Upper	Lower
Days to first activity	0.0960	0.0171	0.000*	0.0624	0.1296
SOI	0.4970	0.1030	0.000*	0.2940	0.6990
Ambulation	-0.4194	0.0782	0.000*	-0.5735	0.2654

Note. CI = confidence interval.
*$p \leq 0.05$.

In summary, multiple regression models showed significant predictors of LOS included days-to-first activity ($p < 0.001$), SOI (3M™ APR DRG; $p < 0.001$), weight-bearing activity ($p < 0.001$) and ambulation ($p < 0.001$).

Research Aim 3

To address research Aim 3, Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and 30-day readmission status, a logistic regression was performed (see Table 17). No prior assumptions were examined regarding distributions because normality, linearity, and equal variance are not factors for this type of regression (Tabachnick & Fidell, 2001).

Table 17

Logistic Regression to Determine 30-day Readmission

Predictor	B	*p*	*OR*	95% CI	
				Upper	Lower
Age	.005	.810	1.005	.968	1.043
SOI	.078	.765	1.081	.650	1.796
Weight-bearing	.283	.129	1.328	.921	1.914
Non-weight-bearing	-.113	.252	.893	.736	1.084
Dangle	-.057	.646	.945	.741	1.204
Chair	-.541	.117	.582	.296	1.146
BSC	-.291	.361	.748	.401	1.395
BRM	.165	.571	1.179	.667	2.083
Ambulation	.806	.161	2.240	.725	6.922

Note. OR = odds ratio; CI = confidence interval.
$p \leq 0.05$.

Binary logistic regression analysis was conducted to predict 30-day readmission for the sample of 111 patients with COPD using weight-bearing activity (BRM privilege, ambulation) and non-weight-bearing activity (BSC, chair, dangle) as predictors. A test of the full model against a constant-only model was not statistically significant, indicating that the predictors as a set did not reliably distinguish between 30-day readmission and no-30-day readmission (Chi square = 5.2, $p < 0.517$ with $df = 6$). Nagelkerke's R^2 of .062 indicated a weak relationship between prediction and grouping. Prediction success overall was 63.6% with 87.3% for 30-day readmission and 31.9% for no-30-day readmission. None of the variables (age, LOS, SOI (3M™ APR DRG), weight-bearing activity) made significant contributions to the model.

Binary logistic regression was conducted to predict 30-day readmission using individual activities (BRM privilege, ambulation, BSC, chair, dangle) as predictors. A test of the full model against a constant-only model was not statistically significant, indicating that the predictors as a set did not reliably distinguished between 30-day readmission and no-30-day readmission (Chi square = 10.2, $p < 0.595$ with $df = 12$). Nagelkerke's R^2 of .119 indicated a weak relationship between prediction and grouping. Prediction success overall was 63.3% with 79.4% for 30-day readmission and 42.6% for no-30-day readmission. None of the variables (ambulation, BRM privilege, BSC, dangle, chair, age, LOS, SOI) made significant contributions to the model.

In summary, binary logistic regression revealed that none of the individual or categorized (weight-bearing, non-weight-bearing) activities had a significant effect on 30-day readmission.

Research Aim 4

To address research Aim 4, Examine the relationship between timing of first out-of-bed activity and discharge disposition and 30-day readmission status, logistic regression analyses were performed (see Table 18 and Table 19). Binary logistic regression analysis was conducted to predict discharge disposition to home using days to first out-of-bed activity as a predictor. A test of the model was statistically significant, indicating that the number of days to first out-of-bed activity reliably distinguished between discharge disposition to home versus ECF while controlling for age and SOI (Chi square = 3.6, $p = 0.05$ with $df = 1$). Nagelkerke's R^2 of .067 indicated a weak relationship between prediction and predictor. Prediction success overall was 90.1% with 9% for discharge to ECF and 99% for discharge to home. Days-to-first activity ($p = 0.027$) made a significant contribution to the model. Logistic regression revealed that days-to-first activity has a significant effect on discharge disposition to home while controlling for age and SOI. The odds ratio for days-to-first activity indicates that for every additional day to first out-of-bed activity, the patient is .751 times less likely to be discharged home. Interpretation of the 95% confidence interval for the odds ratio shows we are 95% confident that the odds of discharge to home decreases by a factor of between .638 and .86 or 14% and 36.2%, on average, for each additional day to first out-of-bed activity. Results suggest early initiation of out-of-bed activity increases the likelihood of discharge to home.

Table 18

Logistic Regression to Determine Discharge Disposition to Home for Days to First Activity

Predictor	B	*p*	*OR*	95% CI	
				Upper	Lower
Days to first activity	-.300	.027*	.751	.638	.8603

Note. OR = odds ratio; CI = confidence interval.
**p* = ≤ 0.05

Binary logistic regression analysis was conducted to predict 30-day readmission status using time to first out-of-bed activity as a predictor (Table 19). A test of the model was not statistically significant ($p = 0.595$). The number of days to first out-of-bed activity was not a significant predictor for 30-day readmission status ($p = 0.317$).

Table 19

Logistic Regression to Predict 30-day Readmission for Days to First Activity

Predictor	B	*p*	*OR*	95% CI	
				Upper	Lower
Days to first activity	-.139	.317*	.870	.662	1.143

Note. OR = odds ratio; CI = confidence interval.
**p* = ≤ 0.05

The relationship between timing of first out-of-bed activity and LOS was examined in results of the previous analysis for Aim 2 that showed days to first out-of-bed activity to be a significant predictor for hospital LOS ($p < 0.001$). The interpretation of results was based on the 95% confidence intervals of the slope coefficients (B). We are 95% confident that for each additional day to the first out-of-bed activity, it is expected that the LOS increases by 0.06 and 0.13 days, on average.

In summary, early first out-of-bed activity is predictive of discharge disposition to home. Time to first out-of-bed activity is not predictive of 30-day readmission status. Increased time to first out-of-bed activity is predictive of longer hospital LOS.

Research Aim 5

To address research Aim 5, Determine the differences between hospitalized patients with COPD and patients without COPD (patients with other diagnoses) for out-of-bed weight-bearing activity events, time to first activity, and outcomes (discharge disposition, 30-day readmission status, hospital LOS), independent *t* tests (continuous dependent variables) or Chi square tests (categorical dependent variables) were performed (see Tables 20 and 21). Results showed differences between groups with regard to non-weight-bearing activity. Patients with COPD had significantly more chair, dangle, and BSC activities (non-weight-bearing) per day than patients without COPD. Time to first out-of-bed activity and average weight-bearing activities per day were not significantly different between COPD and non-COPD groups). Average weight-bearing activities per day and average days to first activity for the two groups were not significantly different.

Table 20

Type and Timing of Activity Events for COPD versus non-COPD Groups

Predictor	% (*n*)		*p*
	COPD[a]	Non-COPD[b]	
Days to first activity	0.75 (1.82)	0.88 (1.77)	0.544
Weight-bearing	1.27 (1.16)	1.08 (1.22)	0.174
Non-weight-bearing	2.81 (2.35)	1.93 (1.73)	0.001*
Dangle	1.25 (1.91)	0.79 (1.21)	0.025*
Chair	0.940 (0.663)	0.799 (0.709)	0.048*
BSC	0.619 (0.882)	0.358 (0.747)	0.010*
Up to BRM	0.668 (0.854)	0.567 (0.822)	0.320
Ambulation	0.382 (0.400)	0.334 (0.412)	0.325

[a]$n = 111$. [b]$n = 189$.
*$p \leq 0.05$.

Results of group differences in outcomes show patients with COPD are less likely to be readmitted within 30 days as compared to patients without COPD ($p = 0.008$) and more likely to be discharged to home as compared to patients without COPD ($p = 0.023$) in this sample. Patients with COPD had significantly longer LOS compared to patients without COPD ($p = 0.038$). Advancing age affects patients without COPD to a greater degree than patients with COPD regarding the effect upon likelihood of discharge to home ($p = 0.001$). The probability of discharge to home decreases by 2% to 8% on average for each additional year of age for patients without COPD. Age was not significant for patients with COPD in relation to discharge disposition (*p* = 0.068).

Table 21

Patient Outcomes for COPD versus non-COPD Groups

Predictor	*M* (*SD*)		*p*
	COPD[a]	Non-COPD[b]	
Discharge Disposition			
Home	90.1 (100)	80.4 (152)	0.023*
ECF	9.9 (11)	19.6 (37)	
30-day Readmission			
Not Readmitted	57.7 (64)	41.8 (79)	0.008
Readmitted	42.3 (47)	58.2 (110)	
LOS	8.18 (6.73)	6.67 (4.57)	0.038*

[a]n = 111. [b]n = 189.
*$p \leq 0.05$.

Summary

The purpose of this chapter was to determine factors that contribute to hospital-associated functional status decline and preserve functional status during hospitalization in older adults with COPD. Five research aims were addressed and results suggest weight-bearing activity (BRM privilege, ambulation) and ambulation particularly are significant predictors for discharge to home, while controlling for patient age and SOI. Significant predictors of LOS included days-to-first activity ($p < 0.001$), SOI (3M™

APR DRG; $p < 0.001$), weight-bearing activity ($p < 0.001$), and ambulation ($p < 0.001$). Number of days to first out-of-bed activity was a significant predictor for discharge disposition to home ($p = 0.027$). None of the variables examined had a significant effect on 30-day readmission status. None of the individual or categorized (weight-bearing, non-weight-bearing) activities, nor time-to-first activity, were predictive of 30-day readmission.

Logistic regression using single predictor models to establish probability point estimates for discharge to home showed ambulation (once per day) and weight-bearing activities (twice per day) are associated with a 99% to 100% estimated probability of discharge to home. Ambulation to BRM toileting and BSC activities were compared showing once a day BRM activity results in greater estimated probability of discharge to home compared to BSC. Chair and dangle activities per day demonstrate little improvement in estimated probability of discharge to home. Dangle activity is associated with a slightly greater estimated probability of discharge to home as compared to chair.

Group comparisons between patients with and without COPD showed that patients with COPD had significantly more non-weight-bearing activities per day than patients without COPD and significantly longer LOS. Time to first out-of-bed activity and average weight-bearing activities per day were not significantly different between the two groups. Group differences in outcomes show patients with COPD are less likely to be readmitted within 30 days and more likely to be discharged to home in this sample. Increasing age has a greater negative effect upon patients without COPD regarding the likelihood of discharge to home. Age was not significant for patients with COPD in relation to discharge disposition.

The final chapter presents study findings in relation to current literature regarding weight-bearing activity and LOS, discharge disposition, and 30-day readmission rates for hospitalized older adults with COPD. Strengths and limitations are addressed as well as implications for nursing practice and recommendations for future research.

CHAPTER FIVE

DISCUSSION

The purpose of this study was to identify activity factors that contribute to hospital-associated functional status decline in older adults with COPD and preserving functional status during hospitalization. The secondary analysis of inpatient physical activity data addressed the following research aims:

1. Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and discharge disposition to home versus ECF.
2. Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and hospital LOS.
3. Examine the relationship between out-of-bed weight-bearing activity events during hospitalization of older adults with COPD and 30-day readmission status.
4. Examine the relationship between timing of first out-of-bed activity and discharge disposition, LOS, and 30-day readmission status.
5. Determine the differences between hospitalized older adults with COPD and hospitalized patients with other diagnoses in terms of out-of-bed weight-bearing activity events and outcomes (LOS, discharge disposition, 30-day readmission rates).

The purpose of this chapter is to (1) present research findings and relate findings to existing literature of hospital-associated functional decline in older adults with COPD,

(2) present strengths and limitations of the study, (3) describe implications for practice, and (4) provide recommendations for future research.

Research Findings

This section discusses findings and relates those findings to results from current literature regarding hospital-associated functional status decline in older adults with COPD. The following results are discussed: (1) sample characteristics, (2) predictors of hospital-associated functional status decline, (3) revisions of the activity progression protocol (see Figure 2), and (4) support for the hospital-associated deconditioning model (see Figure 1). Recalling gaps in the literature, the chapter discusses how this study builds upon previous findings by (a) comparing COPD versus non-COPD hospitalized patient groups, (b) examining the influence of routine patient physical activities upon functional status outcomes, (c) supporting the need for a model of hospital-associated deconditioning in older adults with COPD, and (d) supporting the need for a nurse-driven mobility protocol for patients with COPD.

Sample Characteristics

This section focuses on differences in sample characteristics including possible explanations for the findings. Differences in sample characteristics can be expected in convenience sampling. The current COPD study participants showed similar average age (67 years) compared to the U.S. population of hospitalized patients with COPD (68.7 years; Wier et al., 2011) and to the average age of participants in previous studies reviewed (average age 62 to 72 years). The current study had a greater number of female participants as is consistent with the U.S. hospitalized COPD population (Wier et al., 2011; 54% female, 46% male) and the majority of previous studies reviewed. However, the proportion of females (62.2%) to males (37.8%) was significantly greater in the current study. The explanation for the degree of this gender disparity is unknown. Although higher SOI and mortality have been noted worldwide among women with COPD, this has not been sufficiently studied to identify causative factors (Bousquet & Khaltaev, 2007). If females indeed have greater SOI, this may help explain why the higher acuity study unit had a greater proportion of female patients.

Overall Outcomes Measures for COPD and Non-COPD Groups

Differences in overall outcomes measures were found for the current study sample, among both COPD and non-COPD patient groups. The current study found the 30-day readmission rate for patients with COPD was 42.3%, which was significantly higher than the U.S. COPD population readmission rate of 20.2% and the readmission rate of 24% reported by Nguyen et al. (2015). In the current study LOS for patients with COPD was 8 days. The U.S. average LOS for patients with COPD is 4.8 days. Two of the studies reviewed reported LOS outcomes of 5 days in a United Kingdom study by Greening et al. (2014) and 6.4 to 7 days in a New Zealand study (Eaton et al., 2009). One possible explanation of the comparatively longer LOS and higher readmission rate for both patients with and without COPD in the current study may be found in the nature of the study unit. Though not a critical care unit, the study unit possessed telemetry capability for all beds with six beds equipped for mechanical ventilation and arterial pressure monitoring. The pulmonary patient care unit typically received patient admissions having a wide variety of diagnoses accompanied by compromised, sometimes unstable, respiratory status. Although none of the study patients were mechanically ventilated, the overall higher acuity population may impact direct outcomes comparisons to typical medical–surgical units.

Discharge Disposition

Discharge disposition was not an outcome measure in any of the studies reviewed. Percentage of patients with COPD with discharge disposition to home was 90% in the current study as compared to the U.S. hospitalized patient with COPD rate of 71.5%. One possible explanation may be the longer LOS on the study unit, which may increase the likelihood of discharge to home if patients are recovering longer prior to release and thus better able to care for themselves at home.

Predictors of Hospital-associated Functional Status Decline

Current literature describing hospital-associated functional status decline in older adults with COPD is limited. This study is one of the first to examine nurse documentation of physical activity during routine care as predictors of functional status outcomes. A study by Nguyen et al. (2015) established that nurse documentation of activity level in the 24-hour period before discharge was predictive of 30-day readmission status. Findings from the current study further support use of nurse documentation of activity as a significant independent predictor of functional status outcomes.

The current study examined individual activities that comprise weight-bearing (BRM privilege, ambulation) and non-weight-bearing (chair, BSC, dangle) activity and their relation to functional status outcomes. No prior studies of hospitalized patients with COPD assessed the influence of individual activities beyond ambulation upon functional status outcomes. Examination of individual activities provides additional detail regarding which activities of routine nursing care are most beneficial to promotion and preservation of functional status. Logistic regression of individual activities allowed for probability point estimates of discharge to home related to each activity (ambulation, BRM privilege, BSC, chair, dangle). This information can aid nurses' decision-making for patient mobility and best direction of resources regarding patient mobilization.

Weight-bearing Activity

A study by Khan et al. (2013) showed that patients with COPD are less active during hospitalization when compared to pre-hospital activity levels. An earlier study by Pitta et al. (2006) confirmed that patients with COPD spend the majority of time in sitting or non-weight-bearing positions while hospitalized. The current study builds upon these findings by establishing that patients with COPD spend a greater proportion of time in non-weight-bearing activities when compared to patients without COPD in the same setting with the same activity protocol. These findings allow us to begin examination of why patients with COPD differ from other patients regarding in-hospital mobility.

Ambulation

The majority of studies of functional status in hospitalized patients with COPD examine ambulation as the principal physical activity predictor variable (Eaton et al., 2009; Liao et al., 2015; Greening et al., 2014; Nguyen et al., 2015). Three of these studies were randomized controlled trials of in-hospital exercise interventions using ambulation (Eaton et al., 2009; Greening et al., 2014; Liao, 2015). Only Liao and colleagues (2015) reported significant improvement in exercise performance between groups. Greening et al. (2014) and Eaton et al. (2009) did not find significant differences in LOS or readmission rate outcomes between ambulation exercise intervention and usual care groups. The current predictive correlational study confirmed previous findings of no relationship between ambulation and readmission rate but found ambulation a significant predictor of LOS. The current study found a potential reduction in LOS up to 0.57 days on average for each additional ambulation activity per day. The current study also showed once-per-day ambulation activity is associated with a 99% to 100% probability of discharge to home. Discharge disposition was not a reported outcome in previous studies.

Study design and nature of the interventions may account for differences in findings. Measures of physiologic intensity of the structured exercise intervention strategies in the randomized controlled trials (daily aerobic training at 85% VO_2 max) was reported only by Greening et al. (2014). The current study examined ambulation as it occurred during routine nursing care rather than as part of a planned, structured intervention. Ambulation activity in the current study, therefore, may have been of lower intensity. None of the previous studies reported oxygen titration during exertion. Oxygen titration to $SpO_2 \geq 90\%$ during exertion was employed in the current study's activity progression protocol with the intent to improve arterial and muscle oxygenation and reduce lactic acid production (Nonoyama et al., 2007). These factors may help explain differences in findings related to ambulation and LOS.

Chair

Probability point estimate confidence intervals for chair activity showed increasing frequency of chair activity beyond once per day may reduce the probability of discharge to home. This finding helped inform revisions to the existing activity progression protocol regarding chair activity.

Dangle

One unexpected finding of the current study indicated that, although not statistically significant, dangle activity was more predictive of discharge to home than chair. This is unexpected because dangle activity does not involve any quadriceps muscle use and is typically of much shorter duration than chair activity. A possible explanation may be that dangle activity requires greater sustained balance and trunk strength. In addition, dangle activity has the potential to engage skeletal muscles of respiration (internal/external intercostals) and accessory muscles of respiration (pectoralis major/minor, serratus anterior/posterior, scalene anterior/posterior/middle, sternocleidomastoid, abdominal, latissimus dorsi) that holds particular importance for patients with COPD.

BRM Privileges

The current study found that ambulation to the BRM was a significant predictor of discharge to home. Once-per-day BRM privilege activity is associated with a 95% to 99% probability of discharge to home.

BSC

BSC activity was not shown as a significant predictor of discharge to home, making ambulation to the BRM the preferred method for toileting in this regard. Interpretation of probability point estimate confidence intervals for BSC activity showed increasing frequency of BSC activity beyond twice per day may in fact reduce the probability of discharge to home. This may be related to the typical placement of BSCs adjacent to the bed (Graf, 2013) thereby reducing any potential weight-bearing benefit associated with this activity. Following this logic, it may be advisable to move the BSC progressively farther from the bedside as a strategy for patients who initially are unable to ambulate fully to the BRM. Full ambulation to the BRM would remain the eventual toileting activity goal. The study investigator revised the existing activity progression protocol to reflect the findings pertaining to BSC and BRM privilege activity.

Time to First Out-of-bed Activity

Time to first out-of-bed activity was not a predictor variable in previous studies of functional status in hospitalized patients with COPD. The current study showed that decreased time to first out-of-bed activity was associated with lower LOS and greater probability of discharge to home versus ECF. Although time to first out-of-bed activity was a statistically significant predictor for LOS (B = .0994) and discharge disposition to home (B = -0.3) the clinical significance is unclear given the value of the slope coefficients for these predictors. It may be that the value of early first out-of-bed activity lies more in its role as the first step in initiation of the mobility protocol. It should be noted that chair was the first out-of-bed activity employed for nearly all patients in the current study. This was in keeping with Level I of the activity progression protocol in place during the study period. Chair is a non-weight-bearing activity that was deemed a feasible and safe way to begin out-of-bed activity in the first 24 hours following admission, provided patients met the stability criteria contained in the protocol. Mean days to first activity was less than one day for all patients in the study sample. This was likely the result of high nursing staff compliance with the activity progression protocol. Findings suggest early initiation of out-of-bed activity may play an important role in preserving functional status (LOS, discharge to home), but further study is needed given the low variability in number of days to first activity data in this sample.

Predictors of 30-day Readmission

The current study found no relationship between physical activity and hospital readmission. Previous studies of physical activity and readmission rates of hospitalized patients with COPD have had mixed results. Two randomized controlled trials outside the U.S. measured readmissions at 3 months (New Zealand; Eaton et al., 2009) and 12 months (United Kingdom; Greening et al., 2014) and found no statistically significant relationship between physical exercise interventions and readmission. One U.S. study measured readmissions at 30 days and reported nurse documentation of patient activity during the 24-hour period prior to discharge was predictive of hospital readmission within 30 days (Nguyen et al., 2015). Comparison of readmission results among previous studies is complicated by the varied timeframes of measurement (30 days, 3 months, 12 months). Measuring the readmission outcome at 30 days is particularly relevant as a financial benchmark for U.S. hospital reimbursement purposes. Measuring readmission at additional time points may add relevance to this outcome as a clinical indicator.

Studies examining predictors other than physical activity, identify numerous readmission risk factors beyond the scope of this research (Shah, Churpek, Perraillon, & Konetzka, 2015; Sharif, Parekh, Pierson, Kuo, & Sharma, 2014). The number of potential clinical, psycho-social, and socio-economic variables for study of readmission risk would require very large sample sizes. Identification and study of these numerous and varied factors would be challenging from a practicability perspective.

It may be difficult to fully explain the current study results as a result of the complexity of the phenomenon of hospital readmission in patients with COPD. The results of the U.S. study by Nguyen et al. (2015) support further investigation of patient functional status, as measured by nursing documentation of activity, and its relation to hospital readmission risk.

Revised Activity Progression Protocol

Findings of the current study suggest that some changes to the activity progression protocol are indicated. Although this study was not designed to validate the protocol, outcomes related to specific physical activities prompt the following suggested revisions.

I. OOB to chair for 20 minutes during first 24 hours after admission.

II. Ambulate for toileting:

   A. Ambulate to BRM OR

   B. Progressive ambulation distances to BSC (if unable to ambulate to BRM)

III. Ambulate to BRM for toileting plus ambulation outside the room once per day

Suggested revisions to the activity progression protocol reflect current study findings. Activity events were added, removed, and/or adjusted within the protocol according to their significance as predictors of LOS or discharge disposition (see Figure 3).

Level I

Time to first out-of-bed activity was significant for both LOS and discharge to home supporting retention of Level I of the activity progression protocol. Each additional day of delay to first out-of-bed activity negatively affected LOS and discharge to home. Chair activity was significant only as the first out-of-bed activity during the first 24 hours of hospitalization. Therefore, chair activity beyond Level I was removed from the protocol.

Level II

Getting up to the BRM was a significant predictor for discharge to home and, therefore, was added to the protocol. However, some patients are unable to ambulate to the BRM when first admitted to the hospital and must use the BSC. BSC was added to the protocol to accommodate those patients unable to initially ambulate to the BRM but for whom ambulation to the BRM should remain an activity goal. Nurses typically place the BSC adjacent to the bed regardless of the patient's changing ability to bear weight and pace during recovery. It is felt that moving the BSC progressively further from the bedside could gradually advance the patient toward full ambulation to the BRM, which has the potential to affect probability of discharge to home. Further study of this approach is needed. Ambulation to the BRM remains the first option for toileting. Ambulation to the BRM also brings the patient further toward the goal of ambulation outside the patient room.

Level III

Ambulation outside the patient's room had the greatest effect upon discharge to home and, therefore, was added to the protocol. Two or more weight-bearing activities per day (ambulation, BRM privilege) maximized the probability of discharge to home. Each additional ambulation event per day decreased hospital LOS. Therefore, ambulation outside the patient's room remains in the protocol (Level III) as the most advantageous activity with the optimal frequency adjusted to once per day.

The original activity progression protocol Level II included getting patients out of bed to the chair for all meals. Evidence from this study did not support use of the chair as a predictor of decreased hospital LOS, discharge to home, or 30-day readmission, thus prompting removal of chair activity (beyond Level I) from the original activity progression protocol. However, getting patients out of bed for all meals may have other beneficial psychosocial outcomes not examined in this study. In addition, patterns of post-meal mass peristalsis may make practical sense for nurses assisting patients to ambulate from the chair to the BRM after meals thus facilitating bowel function.

ACTIVITY PROGRESSION PROTOCOL (Revised)

Level

I. OOB to chair for 20 minutes during first 24 hours after admission

II. Ambulate for toileting:
ambulate to BRM OR progressive ambulation distances to BSC (if unable to ambulate to BRM)

III. Ambulate outside the room once per day plus ambulate to BRM for toileting

Patient's Perceived Rating of Dyspnea		Objective Signs	Intervention
0 0.5	No shortness of breath (SOB) Slight SOB	Patient is able to sing	Continue activity and monitor for signs of intolerance
2 3 4	Mild SOB	Patient is able to complete a sentence without gasping	Continue activity and monitor for signs of intolerance
5 6	Strong or hard breathing	• O_2 Sat < 90% • Patient cannot complete sentence • Patient's perceived dyspnea rating is ≥ 5 • Diaphoresis	Stop activity Lean or sit Increase O_2 by 1–2 L to maintain O_2 Sat ≥ 90% Resume activity when O_2 Sat recovers and symptoms abate
7 8 9 10	Severe breathing or SOB SOB so severe you need to stop and rest	• Chest pain • Significant arrthythmias or ischemic changes • HR with sustained change of ≥ 20% • Decrease in SBP > 18 mmHg • Diastolic BP > 110 mmHg	Stop activity ⟶ lean or sit Increase O_2 by 1–2 L to maintain O_2 Sat ≥ 90% Return patient to room as soon as able

Consider PT Eval & Treat for:

- Morbidly obese patients
- Demonstrated unsteady gait requiring assistance
- Demonstrated loss of balance or lean when sitting
- Patient inability to progress to a higher level of activity

Adapted from:

Ries, A. L. (2007). Pulmonary rehabilitation: Joint ACCP/AACVPR evidence-based clinical practice guidelines. *Chest, 131*(Supp), 48–42S. doi:10.1378/chest.06-2418

Mundy, L. M., Leet, T. L., Darst, K., Schnitzier, M. A., & Dunagan, W. C. (2003). Early mobilization of patients hospitalized with community-acquired pneumonia. *Chest Journal, 124*(3), 883-889.

Bailey, P., Thomsen, G. E., Spuhler, V. J. et al. (2007). Early activity is feasible and safe in respiratory failure patients. *Crit Care Med* 2007, 35, 139–145.

Morris, P. E., Goad, A., Thompson, C. et al. (2008). Early intensive care mobility therapy in the treatment of acute respiraty failure. *Crit Care Med, 36*, 2238-2243.

Figure 3. Activity progression protocol (revised).

Support for the Hospital-associated Deconditioning Model

This study showed that older adults hospitalized with COPD experience more non-weight-bearing physical activity and longer LOS than hospitalized older adults without COPD. This information supports the second assumption of the model that patients with COPD are more vulnerable to deconditioning (experiencing less mobility) and confirms the need for a unique model of hospital-associated deconditioning with predictors addressing the specific mobility challenges faced by patients with COPD.

Study results demonstrated that early weight-bearing activity is associated with improved functional status outcomes of reduced hospital LOS and increased probability of discharge to home. These findings support the fourth assumption of the model that promotion of weight-bearing activity results in improved function.

Study findings related to the number, type, and timing of specific activities (ambulation, chair, BSC, BRM) resulted in changes to the interventional component (e.g., activity progression protocol) of the hospital-associated deconditioning model for COPD. The model has been updated to reflect the revised intervention protocol (see Figure 4).

The relationship between weight-bearing activity and 30-day hospital readmission was not established in this study. Although not supported by findings of this study, it may be premature to remove 30-day readmission from the model as a functional status outcome measure related to physical activity. The study by Nguyen et al. (2015), with a much larger sample size (n = 2910), showed a significant relationship between ambulation and readmission, which suggests further study is needed. The model assumptions pertaining to non-modifiable antecedents (age, co-morbidity) and hospital environmental barriers were not explored in this study and therefore not changed within the model at this time.

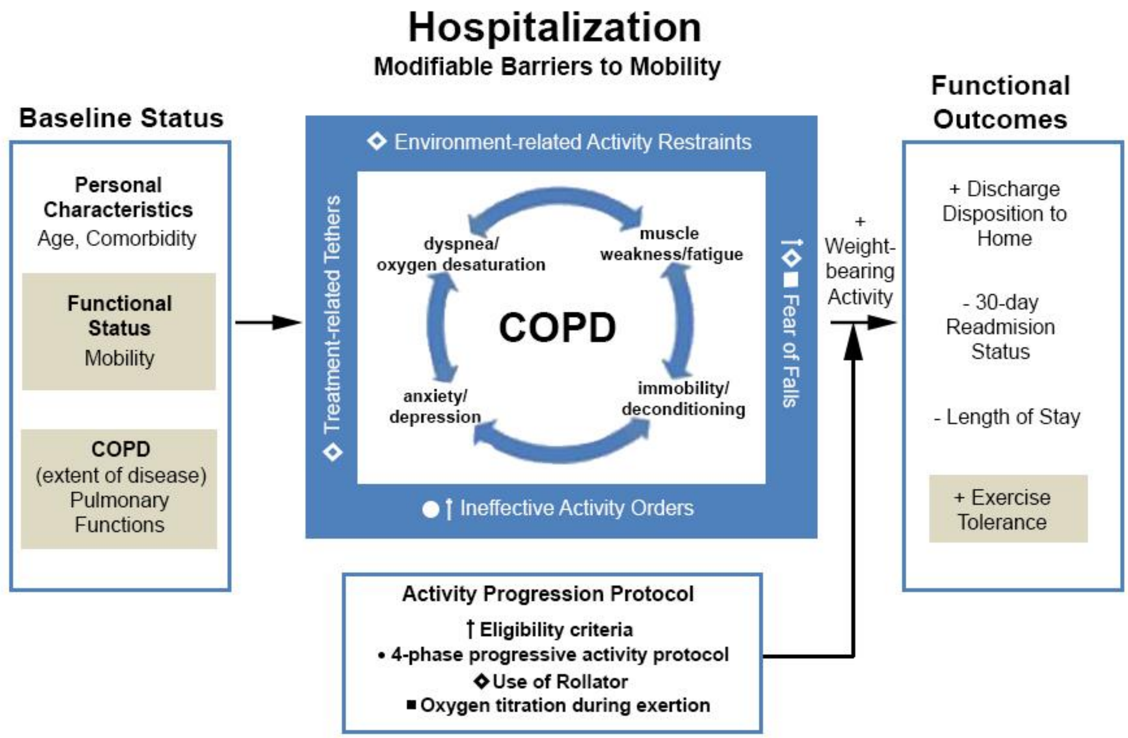

Figure 4. Hospital-associated deconditioning model for COPD (revised).

In summary, findings from this study were compared to previous research regarding physical activity and hospital-associated functional status decline in older adults with COPD. These comparisons showed similarities and differences adding new knowledge to the literature and conceptualization of hospital-associated deconditioning. Overall, the results from this study demonstrate differences in type of physical activity experienced by patients with versus without COPD while hospitalized. Results suggest that early and progressive weight-bearing activity are contributing factors for preservation and promotion of functional status during hospitalization of patients with COPD.

Strengths and Limitations

Strengths of this study included comprehensive patient activity/timing data in the parent dataset providing many specific activity variables to be evaluated. These results provided new information through exploration of nurse documentation of routine patient physical activity as predictors of functional status outcomes. Few prior studies examine functional status predictors in this manner.

Comparison between patient groups with and without COPD established existence of physical activity and outcomes differences supporting the need for a model of hospital-associated deconditioning in older adults with COPD. Finally, the current study is one of the first to examine discharge disposition as a functional status outcome, which has implications for healthcare resource utilization and patient quality of life.

There also were several limitations to this study. Limitations were related to the secondary data set and study design. Convenience sampling of the current study carries the potential for bias. A larger size COPD sub-group was desirable but unavailable from the parent study data set. The sample also contained a greater-than-expected proportion of females to males, which raises questions concerning the unknown influence of gender on study results.

The data set contained low variability of certain data points possibly due to high nursing staff compliance with the activity progression protocol. A multi-site study design or control group without a mobility protocol would increase variability of outcomes for study. Study results showed an unexplained LOS outcome variance of 35% ($R^2 = 0.35$) leaving a moderate amount of unexplained variance. Factors such as presence of tethers, patient anxiety/depression, and distance ambulated, not included in the current study, could represent missing elements needed to increase the percentage of explained variance.

The complexity of 30-day readmission for patients with COPD was not accounted for in this study. No co-variates such as socioeconomic factors or SOI indicators more specific to COPD disease stage (i.e., oral steroid use; PaO_2; FEV_1; Bahadori & Fitzgerald, 2007; Garcia-Aymerich et al., 2003; Sharif et al., 2014) were examined for 30-day readmission risk.

The nature of the secondary data set dictated the measurement of SOI and comorbidity in the current study. The study investigator was unable to use the Charlson Comorbidity Index with the current dataset. ICD codes in the original data set were not extracted for the correct time frame or payer source. Specific data extraction steps are required to correctly use and interpret the Charlson Comorbidity Index (Cenzer, Fung, Boscardin, Covinsky, & Walter, 2013). Unlike the Charlson Comorbidity Index, the current study SOI measurement (3M Health Information Systems, 2003) is amenable to domestic hospital cost/resource utilization, AHRQ quality comparisons, and Centers for Medicare and Medicaid Services COPD 30-day readmission measures but is not generalizable outside the U.S. Use of both the 3M™ APR DRG and Charlson Comorbidity Index would have been optimal.

Implications for Practice

Nurses' Role in Basic Mobility

Support of physiologic function, which includes basic mobility, is one of the seven domains of nursing care that define the profession (Knowledge-based Terminologies Defining Nursing, 2017), yet some nurses view patient ambulation as the responsibility of the physical therapist (Brown et al., 2007). Nurse workload and competing demands may contribute to nurse abdication of decision making and intervention regarding patient mobilization (Graf, 2013). Findings of the current study help quantify the contribution of physical activity provided during routine nursing care to the preservation and promotion of functional status during hospitalization.

Nurse-driven Mobility Protocol for COPD

Findings from this study established that hospitalized patients with COPD spend a significantly greater proportion of time engaged in non-weight bearing activity when compared to patients without COPD and have comparatively longer LOS. Information from this study was used to refine and guide development of nursing interventions (e.g., activity progression protocol) to maximize benefits of patient physical activity during routine nursing care. Use of the activity progression protocol designed for patients with COPD may help nurses address mobility challenges unique to patients with this disease. It should be remembered that although the activity progression protocol was designed for activities that occur during routine nursing care, it was implemented with the involvement of multiple disciplines. A team approach is an important element for success as many health professionals have some degree of responsibility for patient mobility and should be working in concert toward common goals.

Nursing-based Measures of Functional Status

The current study demonstrated the value of nursing documentation as a readily available, less cumbersome measure of functional status of hospitalized patients. The EMR has the potential to provide vast amounts of raw data that can be analyzed to further identify specific activity predictors of functional status outcomes.

Nursing Resources for Mobility

Findings of the current study can guide exploration of potential cost savings associated with reduced LOS and readmission rates. This information could be used to support nursing resource requirements for promotion of patient physical activity. In summary, nurses should emphasize and direct resources toward early and daily weight-bearing activities (ambulation, up to BRM) to improve patient outcomes and preserve functional status during hospitalization. Nurses are in a unique position to drive efforts to prevent functional decline given their continual presence at the bedside and primary responsibility for physical activity while the patient is hospitalized.

Future Research

The hospital-associated deconditioning model for COPD and findings from the current study may be used to guide future research. In terms of conceptualization of hospital-associated deconditioning, future research should focus on describing and measuring the non-modifiable antecedents of hospital-associated deconditioning (age, comorbidity, baseline functional status, pulmonary functions) to aid identification of patients at greatest risk for functional status decline.

Measurement of comorbidity should include both SOI (3M™ APR DRG) and Charlson Comorbidity Index. The 3M™ APR DRG SOI measure is widely used by hospitals in the U.S. and correlates with AHRQ quality measures and Centers for Medicare and Medicaid Services Potentially Preventable Readmissions tracking for COPD. The Charlson Comorbidity Index allows for greater generalizability of findings both within and outside the U.S.

Baseline patient characteristics of disease stage and pre-hospital functional status are elements of the Hospital Associated Deconditioning Model for COPD not addressed in the current study. Data related to these baseline characteristics could aid identification of patients at greatest risk for deconditioning. Future research could include measurement of baseline pre-hospitalization patient function using an instrument such as the St. George's Questionnaire for COPD (Table 2). Baseline stage of COPD data could be obtained from documented spirometry results of FEV_1/FVC (see Table 1 for definition).

Exercise tolerance outcomes was another element of the Hospital Associated Deconditioning Model for COPD not addressed in the current study. Future research could include the 6MWT (Table 2) to capture this outcomes data. The 6-minute walk test is a simple, low cost method to directly measure functional status which is feasible for future research but was not available for analysis in the current study's secondary data set.

Exploration of hospital environment elements of the model may help determine why patients with COPD experience a greater proportion of non-weight-bearing activity when compared to other patients. Future research should include hospital environment elements of the model that were unexplored in the current study such as the influence of anxiety and depression in hospitalized older adults with COPD and how this may impede physical activity.

Nurse and patient fear of falls is another hospital environment element of the model that bears exploration. The designation of patient falls by Centers for Medicare and Medicaid Services as a *never event* has increased nurses' fear of falls (King, Pecanac, Krupp, Liebzeit, & Mahoney, 2016). Future research should include examination of this influence on nursing judgement concerning advancing patient physical activity.

Treatment-related tethers encountered in the hospital environment have been identified in qualitative literature as potential barriers to physical activity (Graf, 2013). Presence of items such as lines, drains, and catheters should be included as variables in quantitative research to examine their influence on specific patient physical activities.

Future research should build upon findings of the current study by comparing nurse documentation of physical activity to established functional status measures such as the 6-minute walk test for COPD. Results could be used to explore refinement of outcomes measures of the model. Establishing nursing documentation of activity as a reliable reflection of functional status could identify aspects of documented physical activity most predictive of functional status outcomes and greatly expand opportunities for research of hospital-associated deconditioning in general.

Findings of the current study and the study by Nguyen et al. (2015) suggest the timing element of activity may be an important predictor of functional status outcomes. This knowledge may be used to further explore influence of physical activity on 30-day readmissions. Patients with greater than 5-day LOS have been linked to increased risk for 30-day readmission (Shah et al., 2015; Sharif et al., 2014). Given the current study finding of weight-bearing activity influence upon LOS, retrospective examination of physical activity patterns in patients with LOS greater than 5 days could provide insight into reducing risk of readmission by reducing LOS.

Future research could help further refine the activity progression protocol. Current study findings suggest the need for further study of potential benefits of BSC placement progressively farther from the bedside. Additionally, research of time to first out-of-bed activity requires a comparison group or study site that is not using the activity progression protocol to capture sufficient data points of greater variability.

Finally, future research linking specific physical activities to LOS or readmission outcomes has cost savings implications for healthcare providers. Quantifying these cost savings could provide financial justification for the necessary resources to support nursing care mobility interventions that require additional labor.

Summary

This secondary analysis evaluated data from patients with and without COPD to identify activity factors that contribute to hospital-associated functional status decline in older adults with COPD. Physical activity variables were analyzed to identify factors predictive of functional status outcomes. None of the variables examined were predictive of 30-day readmission. Predictors of discharge disposition to home were weight-bearing activity, ambulation, BRM privilege, and time to first out-of-bed activity. Predictors of hospital LOS were weight-bearing activity, ambulation, time to first out-of-bed activity, and SOI. Comparison of patients with and without COPD found that patients with COPD experienced greater proportion of non-weight bearing activity and longer hospital LOS than patients without COPD.

Findings of the current study underscore the importance of early, progressive weight-bearing activity and supports the need for a conceptual model and mobility protocol that is unique to the needs of hospitalized older adults with COPD.

APPENDIX A

HOSPITAL-ASSOCIATED FUNCTIONAL STATUS IN COPD LITERATURE

TABLE

Author/Year Origin	**Design/Setting Sample**	**Independent Variable**	**Outcome Variable**	**Results**
Pitta, F. (2006) Belgium	Quasi-experimental Hospital COPD patients *N* = 24	Weight-bearing activity during hospitalization	Quadriceps muscle Weakness	Time in weight-bearing activity positively correlated to quadriceps force. Reduction in quadriceps force significantly correlated to less improved walking time after 1 month.
Kahn, R. (2013) U.S.	Descriptive hospital/community COPD patients *N* = 17	Measurement of physical activity before, during, and after hospitalization	Level of physical activity	Level of physical activity significantly decreased during hospitalization; returns to normal 3 to 4 weeks after hospitalization

Table continues

Eaton et al. (2009) New Zealand	Prospective randomized controlled trial Hospital/outpatient COPD *N* = 84	Ambulation and exercise	Readmission (COPD related) LOS Exercise capacity HRQL	No significant difference in outcomes between intervention and control groups Clinically significant findings for lower readmission risk and fewer readmission days for intervention group
Nguyen et al. (2015) U.S.	Retrospective cohort Hospital (multi-site) COPD (acute) *N* = 2910	Ambulation within 24 hours of discharge	30-day Readmission	Patients non-ambulatory at discharge were twice as likely to be readmitted within 30 days
Liao, (2015) Taiwan	Randomized controlled trial Hospital COPD (acute) *N* = 61	Ambulation and exercise	Exercise tolerance at 4 days Symptoms (cough, dyspnea, sputum)	Intervention group demonstrated significantly greater exercise tolerance and fewer symptoms

Table continues

Greening et al. (2014) United Kingdom	Randomized controlled trial; single blind Hospitals (2) COPD (acute) *N* = 389	Aerobic & strength training within 48 hours of admission Education	Readmission rate 1 year LOS Exercise performance at 6 weeks and 1 year HRQL Mortality	No significant difference in outcomes between intervention and control groups Mortality at 1 year significantly higher in the intervention group

APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL FOR PARENT STUDY

Approval

WRIGHT STATE UNIVERSITY

Office of Research and Sponsored Programs
201J University Hall
3640 Col. Glenn Hwy.
Dayton, OH 45435-0001
(937) 775-2425
(937) 775-3781 (FAX)
e-mail: rsp@wright.edu

DATE: September 28, 2016

TO: Amy Shay, R.N., C.C.R.N., PI
Center of Nursing Excellence
Patricia O'Malley, Ph.D., Faculty Advisor

FROM: Robyn Wilks, CIM
Coordinator, WSU-IRB

SUBJECT: SC# 5921
'Clinical Outcomes of an Activity Progression Protocol for Pulmonary Patients'

This memo is to verify the receipt and acceptance of your response to the conditions placed on the above referenced human subjects protocol/amendment.

These conditions were lifted on: 09/28/2016

This study/amendment now has full approval and you are free to begin the research project. If this is a VA proposal, you must still receive a letter of approval from the Research and Development Committee prior to beginning the research project. If this is a MVH proposal, you must still receive a letter of approval from the Human Investigation and Research Committee (HIRC) prior to beginning the research project. This implies the following:

1. That this approval is for one year from the approval date shown on the Action Form and if it extends beyond this period a request for an extension is required. (Also see expiration date on the Action Form)

2. That a progress report must be submitted before an extension of the approved one-year period can be granted.

3. That any change in the protocol must be approved by the IRB; otherwise approval is terminated.

If you have any questions concerning the condition(s), please contact me at 775-4462.

Thank you!
Enclosure

RESEARCH INVOLVING HUMAN SUBJECTS

SC# 5921
Continuing Review

ACTION OF THE WRIGHT STATE UNIVERSITY
EXPEDITED REVIEW
Assurance Number: FWA00002427

Title: *'Clinical Outcomes of an Activity Progression Protocol for Pulmonary Patients'*

Principal Investigator: Amy Shay, R.N., C.C.R.N., PI
Center of Nursing Excellence
Patricia O'Malley, Ph.D., Faculty Advisor

The Institutional Review has approved the continued use of human subjects on this project, with conditions previously noted. The conditions have been removed. If the protocol and/or other documents used in the project have been amended within the past five years, you will be requested to submit a new protocol incorporating these amendments.

REMINDER: Federal regulations require prompt reporting to the IRB of any changes in research activity [changes in approved research during the approval period may not be initiated without IRB review (submission of an amendment), except where necessary to eliminate apparent immediate hazards to subjects] and prompt reporting of any serious or on-going problems, including unanticipated adverse reactions to biologicals, drugs, radioisotope labeled drugs or medical devices.

Signed _______________ Coordinator, WSU-IRB

Date: July 22, 2016

IRB Meeting Date: October 17, 2016

This approval is effective only through: July 22, 2017
To continue the activities approved under this protocol you should receive the appropriate form(s) from Research and Sponsored Programs (RSP) two to three months prior to the required due date. If you do not receive this notification, please contact RSP at 775-2425.

Continuing Approval

WRIGHT STATE
UNIVERSITY

Office of Research and Sponsored Programs
201J University Hall
3640 Col. Glenn Hwy.
Dayton, OH 45435-0001
(937) 775-2425
(937) 775-3781 (FAX)
e-mail: rsp@wright.edu

DATE: May 18, 2012

TO: Amy Shay, M.S., R.N., Asst. Professor
Clinical Nurse Specialist

FROM: B. Laurel Elder, Ph.D.
Chair, WSU-IRB

SUBJECT: SC# 4872
'Clinical Outcomes of an Activity Progression Protocol for Pulmonary Patients'

Your study/amendment/continuing review referenced above has been recommended for approval. If this is a VA proposal, you must still receive a letter of approval from the Research and Development Committee prior to beginning the research project. If this is a MVH proposal, you must still receive a letter of approval from the Human Investigation and Research Committee (HIRC) prior to beginning the research project.

If this approval is for a new or continuing protocol, please take note of the expiration date on the Action Form to see when this approval will terminate. (Approval of amendments does not affect the current approval period.) You will be reminded prior to this date of the need to submit a progress report and the procedure for requesting approval of a further continuation of this protocol. Also note that any change in the protocol must be approved by the IRB; otherwise approval is terminated.

This action will be referred to the full Institutional Review Board for ratification at its next scheduled meeting. If you have any questions or require additional information, please call me at 775-2425.

Thank you!

Enclosure

RESEARCH INVOLVING HUMAN SUBJECTS

SC# 4872

Continuing Review

ACTION OF THE WRIGHT STATE UNIVERSITY
EXPEDITED REVIEW
Assurance Number: FWA00002427

Title: *'Clinical Outcomes of an Activity Progression Protocol for Pulmonary Patients'*

Principal Investigator: Amy Shay, M.S., R.N., Asst. Professor
Clinical Nurse Specialist

The Institutional Review Board has approved the continued use of human subjects on this project. There were no problems or major concerns noted at this time. If the protocol and/or other documents used in the project have been amended within the past five years, you will be requested to submit a new protocol incorporating these amendments.

REMINDER: Federal regulations require prompt reporting to the IRB of any changes in research activity [changes in approved research during the approval period may not be initiated without IRB review (submission of an amendment), except where necessary to eliminate apparent immediate hazards to subjects] and prompt reporting of any serious or on-going problems, including unanticipated adverse reactions to biologicals, drugs, radioisotope labeled drugs or medical devices.

Signed Chair, WSU-IRB

Expedited Review Date: August 10, 2012

IRB Meeting Date: September 17, 2012

This approval is effective only through: August 10, 2013

To continue the activities approved under this protocol you should receive the appropriate form (s) from Research and Sponsored Programs (RSP) two to three months prior to the required due date. If you do not receive this notification, please contact RSP at 775-2425.

APPENDIX C

INSTITUTIONAL REVIEW BOARD APPROVAL

INDIANA UNIVERSITY
OFFICE OF THE VICE PRESIDENT FOR RESEARCH
Office of Research Compliance

To: Janet Fulton
NURSING

Amy Shay
UNIVERSITY LEVEL

From:

Chair - IRB-01
Human Subjects Office
Office of Research Compliance – Indiana University

Date: October 05, 2016

RE: **NOTICE OF EXEMPTION - NEW PROTOCOL**

Protocol Title: Hospital Associated Functional Status Decline in Pulmonary Patients

Study #: 1609484827

Funding Agency/Sponsor: None

Status: Exemption Granted | Exempt

Study Approval Date: October 05, 2016

The Indiana University Institutional Review Board (IRB) IRB00000220 | IRB-01 recently reviewed the above-referenced protocol. In compliance with (as applicable) 45 CFR 46.109 (d) and IU Standard Operating Procedures (SOPs) for Research Involving Human Subjects, this letter serves as written notification of the IRB's determination.

Under 45 CFR 46.101(b) and the SOPs, as applicable, the study is accepted as Exempt (5) Category 5: Evaluation of Public Benefit or Service Program Research and demonstration projects which are conducted by or subject to the approval of Department or Agency heads, and which are designed to study, evaluate, or otherwise examine public benefit or service programs. The following criteria must be satisfied to qualify for exemption: i) the program must deliver a public benefit (e.g. financial or medical benefits as provided under the Social Security Act) or service (e.g. social, supportive, or nutrition services as provided under the Older Americans Act); ii) project must be conducted pursuant to specific federal statutory authority; iii) there must be no statutory requirement that the project be reviewed by an IRB; iv) the project must not involve significant physical invasions or intrusions upon the privacy of participants, with the following determinations:

. Waiver of authorization under 45 CFR 164.512(i)

. The PHI to be used or disclosed is determined to be necessary

. The explanation of how this research involves no more than minimal risk of loss of privacy to the subject is sufficient

. There exists an adequate plan to protect the identifiers from improper use and disclosure

. There exists an adequate plan to destroy the identifiers at the earliest opportunity consistent with conduct of the research

. There exist adequate written assurances that the requested information will not be reused or disclosed to any other person or entity, except as required by law, for authorized oversight of the research study, or for other research for which the use or disclosure of the requested information would be permitted by the Privacy Rule

. The explanation of how this research could not be practicably conducted without waiver of authorization is adequate

. The explanation of how this research could not be practicably conducted without access to and use of the individually identifiable health information is appropriate

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Wright State University, Dayton, OH	BSN	1980

Certifications

CCRN Alumnus designation for 20 consecutive years of CCRN certification 2015
CCRN certification 1993 to 2015
Clinical Nurse Specialist, Certificate of Authority State of Ohio 1998

Academic Appointments

Assistant Clinical Professor August 2017 to present
Indiana University, Indianapolis, IN

MSN Program Director, Assistant Professor August 2015 to May 2017
Northern Kentucky University, Highland Heights, KY

Assistant Professor of Clinical September 2009 to August 2015
University of Cincinnati College of Nursing,
Cincinnati, OH

Adjunct Faculty 2002, 2003
Wright State University School of Nursing, Dayton, OH

Clinical Experience

Clinical Nurse Specialist 2011 to 2016
Center of Nursing Excellence, Miami Valley Hospital, Dayton, OH

CVSICU, Staff Nurse, Team Leader, Clinical Nurse IV January 2008 to 2011
Atrium Medical Center, Middletown, OH

Pulmonary Clinical Nurse Specialist April 2002 to November 2007
Miami Valley Hospital, Dayton, OH

Intensive Care Staff Nurse, CT/SICU September 1993 to April 2003
Miami Valley Hospital, Dayton, OH

Intensive Care Staff Nurse, MICU September 1988 to September 1993
Kettering Medical Center, Kettering, OH

Relief Nursing Supervisor September 1990 to September 1993
Kettering Medical Center, Kettering, OH

Home Health Nurse June 1983 to June 1984
Home Health Care of America, Inc., Cleveland, OH

Intensive Care Staff Nurse January 1981 to June 1983
Good Samaritan Hospital, Dayton, OH

Other Experience
Medical Advisor February 1987 to December 1988
Quality Assurance Division of Union Central Life
Insurance Company, Cincinnati, OH

Nurse Manager January 1986 to February 1987
Foster Medical Corporation, Redlands, CA

Health Analyst June 1985 to December 1985
Blue Cross/Blue Shield of Central New York,
Syracuse, NY

Courses Taught
<u>Northern Kentucky University</u>

NRP 602	Health Promotion and Disease Prevention (online)
NRP 625	Pathopharmacology and Physical Assessment for Nurse Educators (online)
COU 594	Introduction to SBIRT (online)
COU 594	SBIRT In Action (hybrid/simulation)

<u>University of Cincinnati College of Nursing</u>
Advanced Fundamentals, Capstone Complex Care of the Adult, Fundamentals, Nursing Care of the Adult, Nursing Leadership

<u>Wright State University School of Nursing</u>
Nursing 423 and 424

University Service
<u>Northern Kentucky University</u>
College of Health Professions, Research and Quality Committee
Department of Advanced Nursing Studies Curriculum Committee
Faculty Benefits Committee
Graduate Council
Online Education Strategic Planning Team
SBIRT Council of Directors
Student Affairs Committee

<u>University of Cincinnati College of Nursing</u>
BSN Admissions Committee
BSN Program Simulation: Low to Mid-range fidelity and High fidelity
Co-creator, Professional Values Program for Nursing

College of Nursing Reappointment, Promotion, and Tenure Committee
Course Coordinator for Fundamentals, Advanced Fundamentals, and Complex Care of the Adult

Professional Service
Accelerated Mobility Program for Critical Care Task Force
Advocates for Tobacco Awareness Counseling, Co-chair
Employee Flu Shot Campaign
Evidence based practice initiatives related to pulmonary and critical care
Feeding Tube Performance Improvement
Flolan Group
High Fidelity Simulation Exercise Cardiovascular Intensive Care, Co-creator
ICU Clinical Practice Committee
ICU Joint Practice
Interdisciplinary Pulmonary Benchmark Team, Chair
Mechanical Ventilation Task Force, Co-chair
Nursing research in pulmonary and critical care
Nursing Research Council
Obstructive Sleep Apnea Performance Improvement, Co-chair
Premier Health Partners Critical Care Task Force, Co-chair
Sedation Champions
Smoke Free Campus

Community Service
Medical Reserve Corps (Ohio) 2011 to present
Sponsored by the Office of the U.S. Surgeon General.

Miami Valley Hospital Nursing Research Council 2009 to 2017

Greater Dayton Area Hospital Association 2002 to 2007
Community Acquired Pneumonia Task Force

Publications

Gillespie, G. L., Brown, K., Grubb, P., Shay, A., & Montoya, K. (2015). Qualitative evaluation of a role play bullying simulation. *Journal of Nursing Education and Practice*, *5*(6), 73–80. doi:10.5430/jnep.v5n6p73

Shay, A. (2015). Evidence-based strategies to prevent ventilator-associated pneumonia. *American Nurse Today*, *10*(9), 12–13.

Shay, A. (Consultant). (2010). *Critical care made incredibly easy*. Philadelphia, PA: Lippincott Williams & Wilkins.

Shay, A. (2009). *Nurse-administered pulmonary protocol increases out-of-bed activity, shortens length of stay, and reduces readmissions,* Agency for Healthcare Research and Quality Innovations Exchange: United States Department of Health and Human Services. http://www.innovations.ahrq.gov/

Shay, A. (Consultant). (2007). *Hemodynamic monitoring made incredibly visual*. Philadelphia, PA: Lippincott Williams & Wilkins.

Shay, A. (Consultant). (2006). *Interpreting difficult EKGs*. Philadelphia, PA: Lippincott Williams & Wilkins.

Shay, A. (Consultant). (2004). *Fast facts for nurses.* Philadelphia, PA: Lippincott Williams & Wilkins.

Shay, A. (Consultant). (2003). *Nurse's 3-minute clinical reference*. Philadelphia, PA: Lippincott Williams & Wilkins.

Shay, A. (Contributor). (2003). *Nursing procedures & protocols*. Philadelphia, PA: Lippincott Williams & Wilkins.

Shay, A., & O'Malley, P. (2006). Blue Ribbon Abstract Award. Clinical outcomes of a ventilator associated pneumonia prevention program. *American Journal of Infection Control, 34*(5), E19–E20. doi:10.1016/j.ajic.2006.05.173

Research Interests

September 2016. Co-investigator, Indiana University IRB #1608964820, *Hospital Associated Functional Status Decline in Pulmonary Patients* (dissertation)

August 2011. Principal Investigator, Wright State University IRB #5921, *Clinical Outcomes of an Activity Progression Protocol for Pulmonary Patients*

August 2011. Principal Investigator, Wright State University IRB #5920, *Clinical Outcomes of a Critical Care Mobility Protocol*

August 2013. Principal Investigator, University of Cincinnati IRB. *Evaluation of an Athletics Model to Develop Values for Professional Practice in Baccalaureate Nursing Students*

February 2013. Co-investigator, Gordon Gillespie (Principal Investigator) University of Cincinnati IRB *Intervention to Mitigate Bullying and its Consequences Against Nursing Students*

Research Support

Grant#1H79TI025967-01. Wilkerson, David; Wermeling, Linda; Valandra, Rodney; Nelson, Kesha; Shay, Amy. 9/30/15–9/29/18. Department of Health and Human Services Substance Abuse and Mental Health Services Administration NKU-SBIRT Health Professions Student Training Project. Role: Co-PI $895,892 Awarded Federal.

Grant #200-2013-M-57090. Gordon Gillespie (PI) 2013 2014. CDC/National Institute for Occupational Safety and Health Workplace Violence and Bullying Training for Nursing Students. Role: Co-Investigator $67,542 Active Contract National.

Grant #200-2013-M-57090. Gillespie, Gordon; Montoya, Karen; Shay, Amy. 09/01/2013–09/30/2014 Centers for Disease Control and Prevention Intervention to Mitigate Bullying and Its Consequences Against Nursing Students. Role: Collaborator $67,542.00 Awarded Federal

Presentations

Shay, A., & Fulton, J. (2017). *Hospital associated functional status decline in older adults with chronic obstructive pulmonary disease.* Sigma Theta Tau International 28th International Nursing Research Congress. Dublin, Ireland. Podium.

Shay, A., & Montoya, K. (2015). *Evaluation of an athletics model to develop values for professional practice.* Sigma Theta Tau International Annual Conference. Las Vegas, NV. Podium.

Shay, A. (2014). *Ambulation for pulmonary patients: Overcoming the barriers*. American Nurses Credentialing Center (ANCC) Research Symposium, Magnet Exemplar Panel on Innovative Practices. Dallas, TX. Invited.

Gillespie, G. L., Grubb, P., Brown, P., Shay, A., & Montoya K. (2013). *Classroom-based nurse bullying role play simulation*. AACN Baccalaureate Conference, American Association of Colleges of Nursing. New Orleans, LA. Poster.

Shay, A., Montoya, K., & Gray, D. (2012). *Teaching professionalism: What we can learn from football*. 3T: Teaching, Techniques, & Technology Conference, University of Cincinnati, Cincinnati, OH. Local.

Shay, A. (2011). *Cardio thoracic surgery review*. Atrium Medical Center, Middletown, OH. Department Conference. Invited.

Shay, A. (2011). *Improving mobility for pulmonary patients*. William Beaumont Hospital, Detroit, MI. Regional conference. Invited.

Shay, A. (February 2010). *Progressive care certification review course*. Dayton Regional Chapter of the American Association of Critical Care Nurses. Invited lecture.

Shay, A. (April 30, 2009). *Ventilator associated pneumonia prevention program* Joint Commission Resources. http://www.jcrinc.com/2009-Archived-Audio-Conferences/Pneumonia-Prevention Invited audio conference.

Shay, A. (September 2007). *Pulmonary assessment*. Clinton Memorial Hospital, Wilmington, OH. Invited lecture.

Shay, A. (September 2007). *Ventilation and gas transport*. CATN-II course in advanced trauma nursing, Miami Valley Hospital, Dayton, OH. Lecture.

Shay, A. (August 2007). *Clinical outcomes of a ventilator associated pneumonia prevention program*. Respiratory Nursing Society Annual Conference, Charleston, SC. Poster.

Shay, A. (August 2007). *Outcomes of an activity progression protocol for pneumonia and COPD patients*. Respiratory Nursing Society Annual Conference, Charleston, SC. Poster.

Shay, A. (May 2007). *Maximizing compliance: Key to a successful VAP reduction program*. National Teaching Institute (NTI), Atlanta, GA. Concurrent session.

Shay, A. (2001–2007, quarterly). *Community acquired pneumonia and COPD*. Miami Valley Hospital, Dayton, OH. Disease Management Series, lecture.

Shay, A. (2001–2007, bimonthly). *Failure to wean*. Miami Valley Hospital, Dayton, OH. Advanced Critical Care Series, lecture.

Shay, A. (April 2007). *Chronic obstructive pulmonary disease: Current practice guidelines community acquired pneumonia*. Ohio State Society of Medical Assistants, Dayton, OH. Invited concurrent session.

Shay, A. (April 2007). *Ventilator associated pneumonia*. Association for Professionals in Infection Control and Epidemiology, Dayton, OH. Invited lecture and panel discussion.

Shay, A. (October 2006). *Chronic obstructive pulmonary disease: Current practice guidelines community acquired pneumonia*. Ohio Hospital Association Patient Safety Initiative, Columbus, OH. Invited lecture.

Shay, A. (July 2006). *Outcomes of an activity progression protocol for pneumonia and COPD patients*. Summer Institute on Evidence-Based Practice, San Antonio, TX. Poster.

Shay, A. (June 2006). *Clinical outcomes of a ventilator associated pneumonia prevention program*. Association for Professionals in Infection Control and Epidemiology, Tampa, FL. Oral. Recipient: Blue Ribbon Abstract Award.

Shay, A. (November 2005). *Care of the pulmonary patient*. Geriatric Champions Nurses. Lecture.

Shay, A. (November 2005). *Oral care in the critical care setting: A link to the prevention of VAP and HAP*. VHA, Dallas, TX. Invited presenter, live television broadcast, three-person panel. Re-broadcast December, 2005.

Shay, A. (October 2005). *Breathing easy: A guide to discharging pulmonary patients*. Case Management Staff. Lecture.

Shay, A. (October 2005). *Evidence based ventilator associated pneumonia prevention strategies*. Parkview Hospital, Ft. Wayne, IN. Invited lecture.

Shay, A. (October 2005). *Evidence-based ventilator associated pneumonia prevention strategies*. Ft. Wayne Chapter AACN, Ft. Wayne, IN. Invited lecture.

Shay, A. (October 2005). *Preventing ventilator acquired pneumonias*. Michigan Society for Respiratory Care, Frankenmouth, MI. Invited lecture.

Shay. A. (May 2005). *Ventilator associated pneumonia*. Southern Ohio Medical Center, Portsmouth, OH. Invited lecture.

Shay, A. (April 2003). *Pulmonary emergencies*. Miami Valley Hospital, Dayton, OH. Emergency Room staff, lecture.

Shay, A. (March 2003). *COPD & pneumonia*. Miami Valley Hospital, Dayton, OH. Pulmonary Care Update, lecture.

Shay, A. (2003, 2004). *Respiratory failure and mechanical ventilation*. Wright State University School of Nursing, Dayton, OH. Lecture.

Recognition

Induction as a *Nurse Leader* to Sigma Theta Tau International Honor Society of Nursing, Zeta Phi Chapter. Nurse Leaders are recognized for leadership, achievement, creativity, and commitment to the profession. — April 2014

Recognized by the American Association of Critical-Care Nurses for 20 consecutive years of critical care certification; CRN Alumnus designation — March 17, 2014

Blue Ribbon Abstract Award presented by APIC for outstanding research abstract: "Clinical Outcomes of a Ventilator Associated Pneumonia Prevention Program" — June 12, 2006

Official inquiry by the United States Government Accountability Office, at the request of the Senate Budget Committee, regarding *Outcomes of an Activity Progression Protocol for Pneumonia and COPD Patients*, as part of a report to identify best practices that improve outcomes and reduce costs and the extent to which these practices can be applied on a system wide basis in the United States. — February 2010

AHRQ (Agency for Healthcare Research and Quality) U.S. Department of Health & Human Services Innovations Exchange Innovator Steering Committee. Newly formed committee to drive new areas and means of collaboration by health care innovators, and the 2011 AHRQ Conference focus. Invitation to attend National AHRQ Health Care Innovators Event (one of 70 recognized innovators in the U.S.; invited to attend the Business Meeting) National AHRQ Annual Meeting: How Can We Deliver Better Health Care? Bethesda, MD — September 26, 2010

Professional Memberships

American Association of Critical Care Nurses (AACN)	1994 to present
National Association of Clinical Nurse Specialists (NACNS)	2015 to present
Sigma Theta Tau International (STTI), Nurse Leader, Zeta Phi Chapter	2013 to present
Society of Critical Care Medicine (SCCM)	2006
Respiratory Nursing Society (RNS)	2005, 2006